APPENDIX A: EXISTING INFORMATION

Appendix A

Existing Information

CONTENTS

- Plans for Burnside Bridge (Hedrick & Kremers Consulting Engineers, 1924)
  - Sheet No. T2
  - Sheet No. 7
  - Sheet No. T8
  - Sheet No. T10
  - Sheet No. T16
  - Sheet No. 18
  - Sheet No. 48
- Plans for Completing Approaches to Burnside Bridge (Hedrick & Kremers Consulting Engineers, 1925)
  - Sheet No. L-75
- Burnside Bridge Foundation Piling Summary
- Burnside Bridge Sketch Showing Harbor Wall West of Pier 1 (Gustav Lindenthal Consulting Engineers, 1925)
- Burnside Bridge Record of Borings (Hedrick & Kremers Consulting Engineers, 1924)
  - Includes boring 1 (pier), 2 (pier), 3 (pier), 4 (pier), 4b (pier), 4c (pier), 4d (pier), 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, and 17
- Banfield Access Ramp Foundation Data (Oregon Department of Transportation, 1991)
  - Includes boring TB-521, TB-522, TB-523, TB-527, TB-528, TB-530, TB-531, and TB-538
- Ankeny Pump Station (Fujitani Hilts & Associates, 2000-2001)
  - Plan of Explorations
  - Log of Boring A-1
  - Log of Boring A-1a
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  - Plasticity Chart
  - Grain Size Distribution Plots

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APPENDIX A: EXISTING INFORMATION

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  - Borehole Location Plan
  - Boring Log PB-305A
  - Boring Log PB-306R
  - Boring Log PB-401A
  - Boring Log PB-401B
    West Side CSO Project (Parsons Brinckerhoff, 2000-2001)
  - Boring Log PB-402A
  - Boring Log PB-900
  - Grain Size Analysis Test Results
  - Atterberg Limits Test Results
  - Corrosivity Data
- Portland Development Commission (GeoEngineers, 2004)
  - Site Plan
  - Geologic Cross Section A-A'
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  - Geologic Cross Section C-C'
  - Log of Boring GEI-2
  - Log of Boring GEI-3
  - Log of Boring GEI-4
  - Log of Boring GEI-5
  - Log of Boring GEI-6
  - Log of Boring GEI-7
  - Log of Boring GEI-8
  - Log of Boring GEI-9
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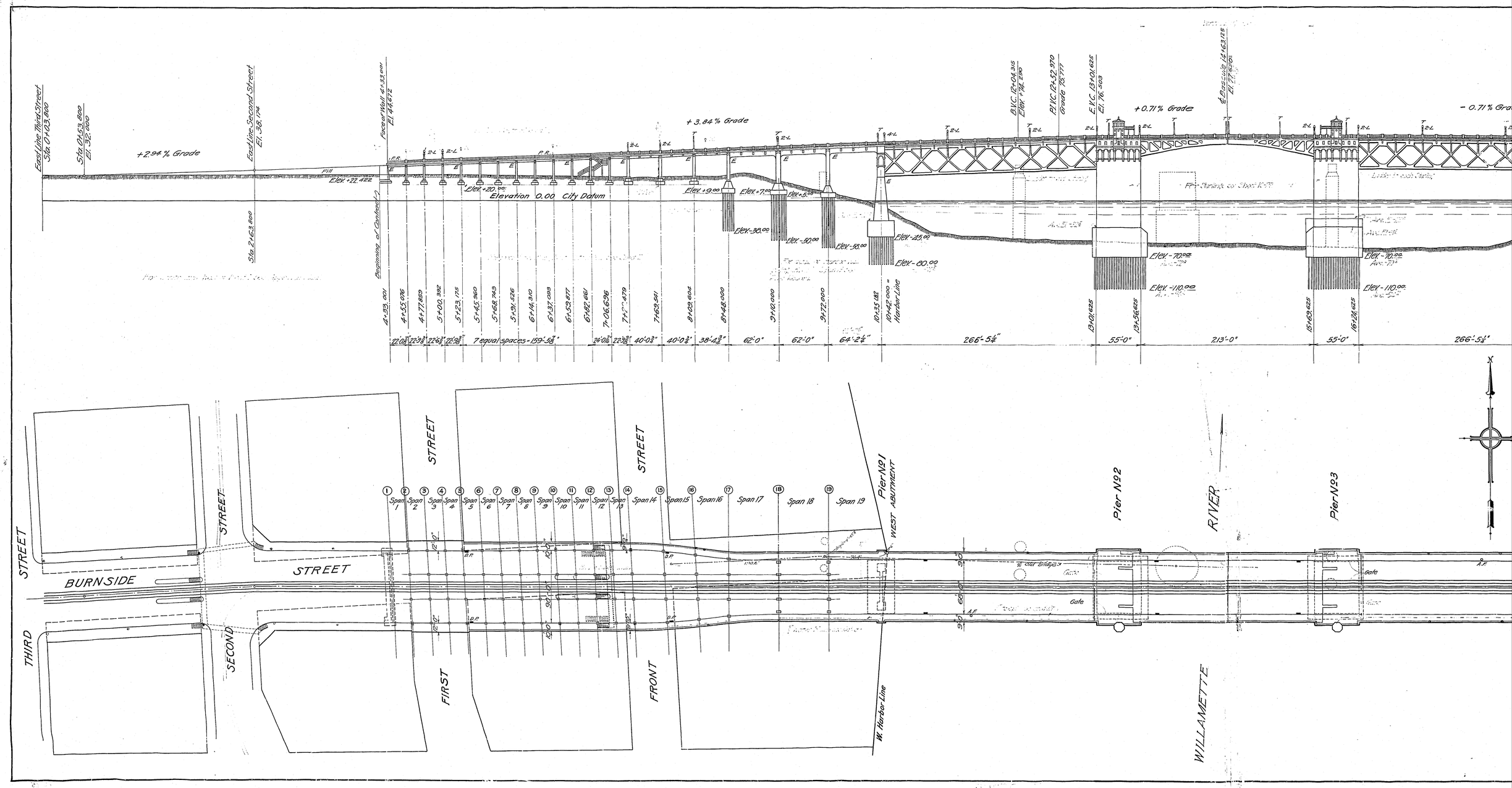
  - Borehole Location Plan (Figure 2-L)
  - Boring Log ES-2003A
  - Boring Log ES-2005C
  - Boring Log ES-2006C
  - Boring Log ES-2007A



E D C B A B C D E

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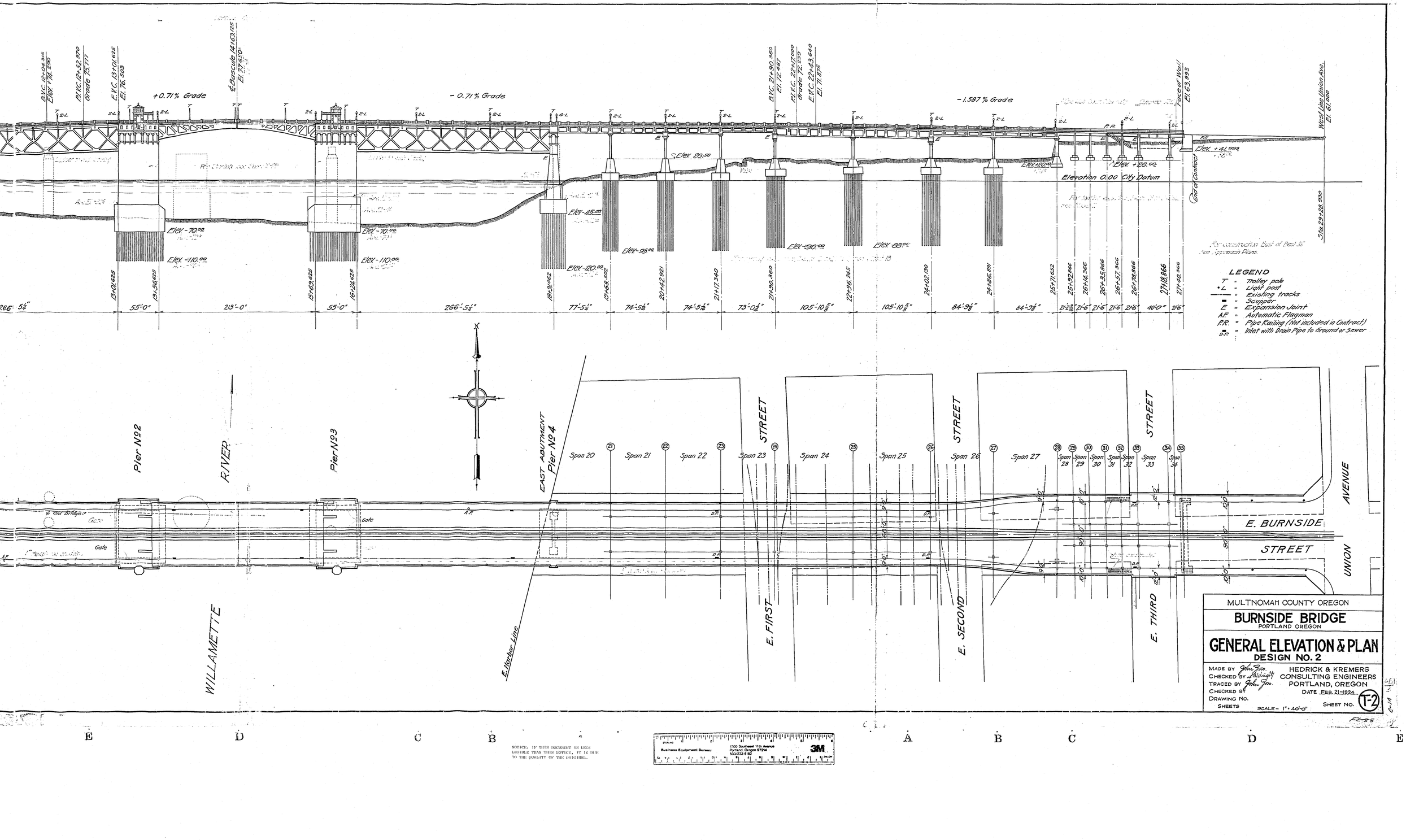
503/233 8182
3M



MULTNOMAH COUNTY OREGON

BURNSIDE BRIDGE

PORTLAND OREGON

GENERAL ELEVATION & PLAN

DESIGN NO. 2

MADE BY John Joo.
CHECKED BY J.A. Wright
TRACED BY John Joo.
CHECKED BY
DRAWING NO.
SHEETS

HEDRICK & KREMERS
CONSULTING ENGINEERS
PORTLAND, OREGON

DATE FEB. 21-1924

SCALE - 1" = 40'-0"

SHEET NO. T-2

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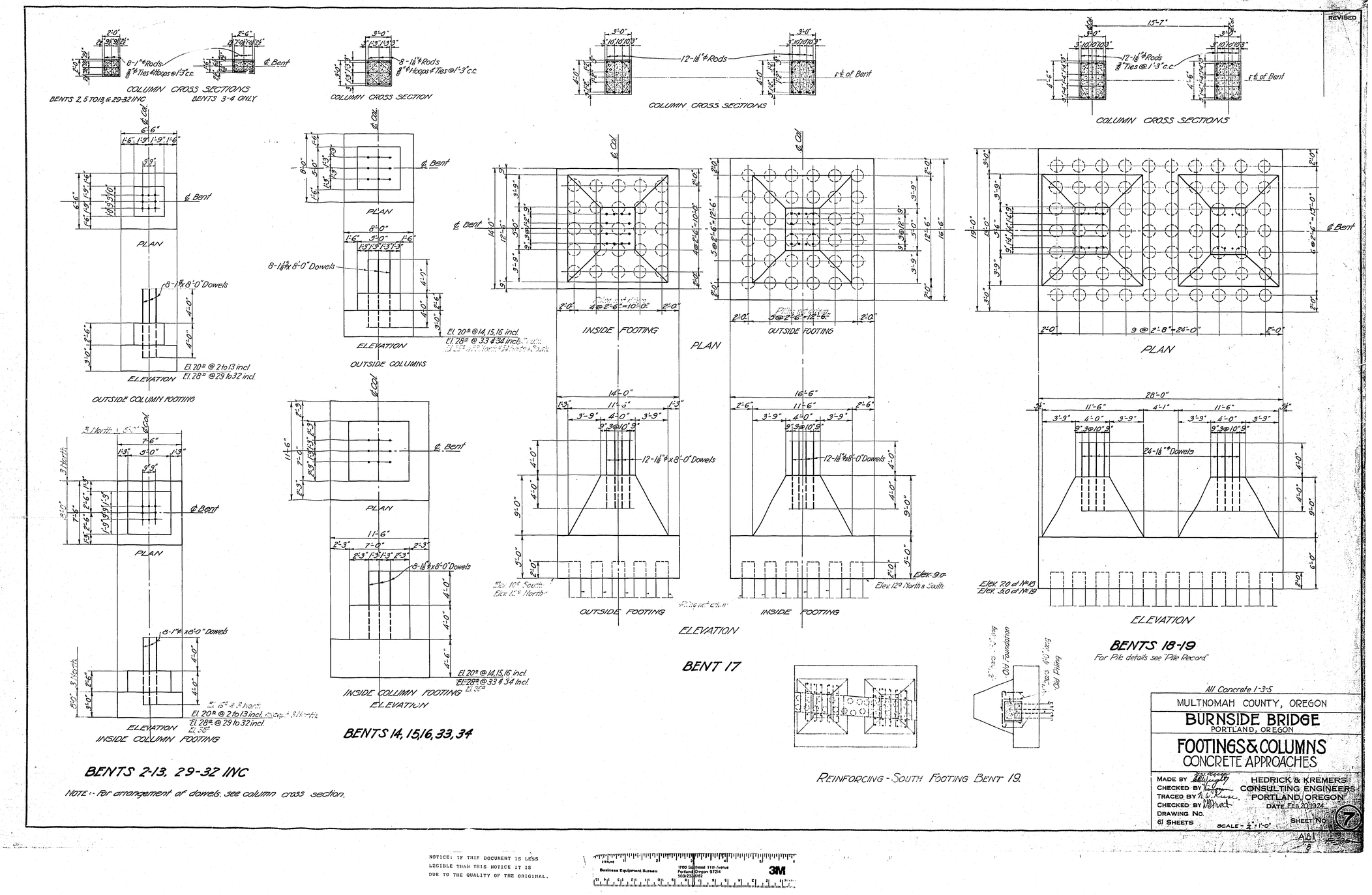

All Concrete 1-3-5

MULTNOMAH COUNTY, OREGON

BURNSIDE BRIDGE
PORTLAND, OREGON

FOOTINGS & COLUMNS
CONCRETE APPROACHES

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TRACED BY [signature]
CHECKED BY [signature]
DRAWING No.
61 SHEETS

HEDRICK & KREMERS
CONSULTING ENGINEERS
PORTLAND, OREGON
DATE FEB 20, 1924
SCALE - 1/4" = 1'-0"
SHEET No. 7

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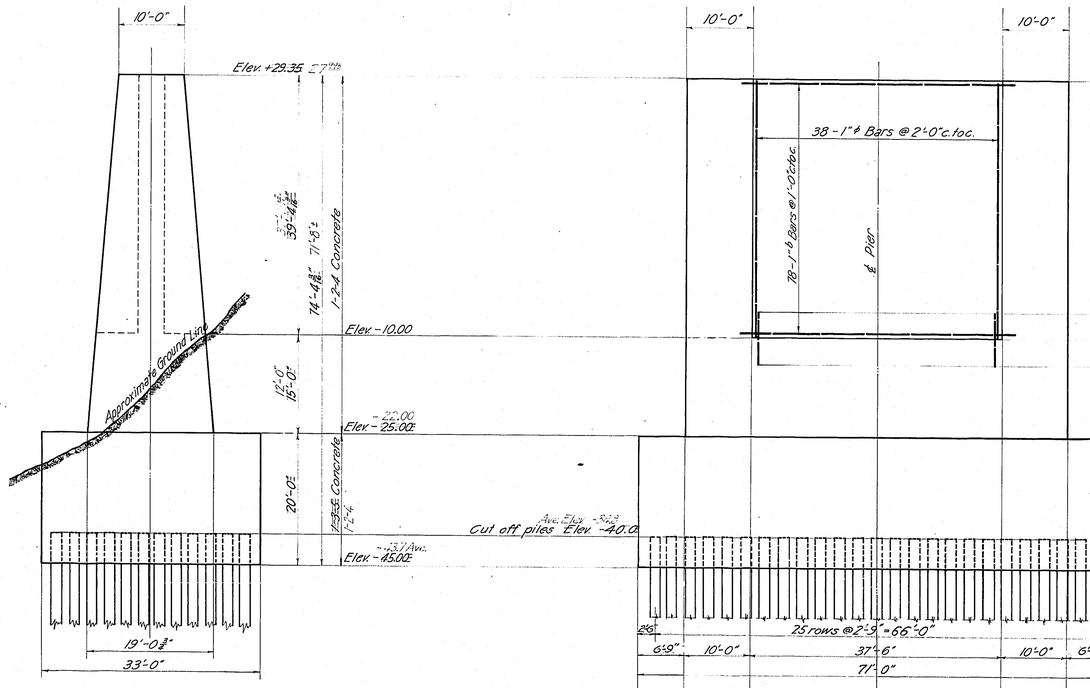
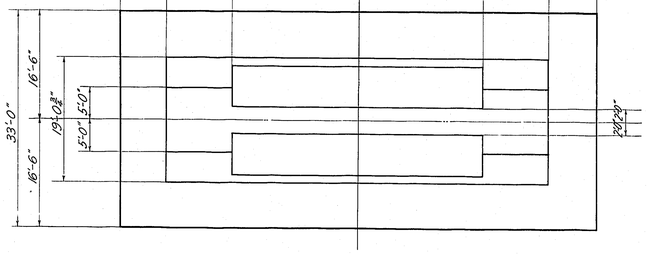


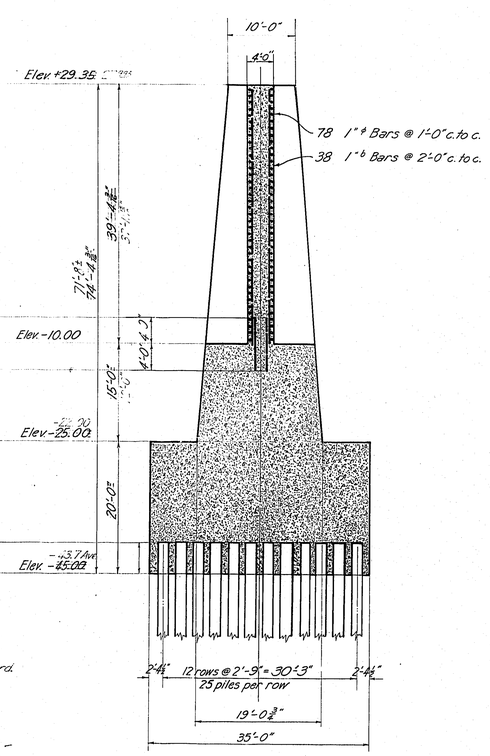
SIDE ELEVATION

END ELEVATION



PLAN

Pile ℄
Number driven = 276
Ave. Elev point = -42.3
See Pile Record.



SECTION THROUGH CENTER

MULTNOMAH COUNTY — OREGON

BURNSIDE BRIDGE
PORTLAND, OREGON

DETAILS OF

WEST ABUTMENT

MADE BY R. Kingsbury
CHECKED BY D. Shrock
TRACED BY Clayton
CHECKED BY
DRAWING NO.
SHEETS

HEDRICK & KREMERS
CONSULTING ENGINEERS,
PORTLAND, OREGON
DATE

SHEET NO. T8

AB

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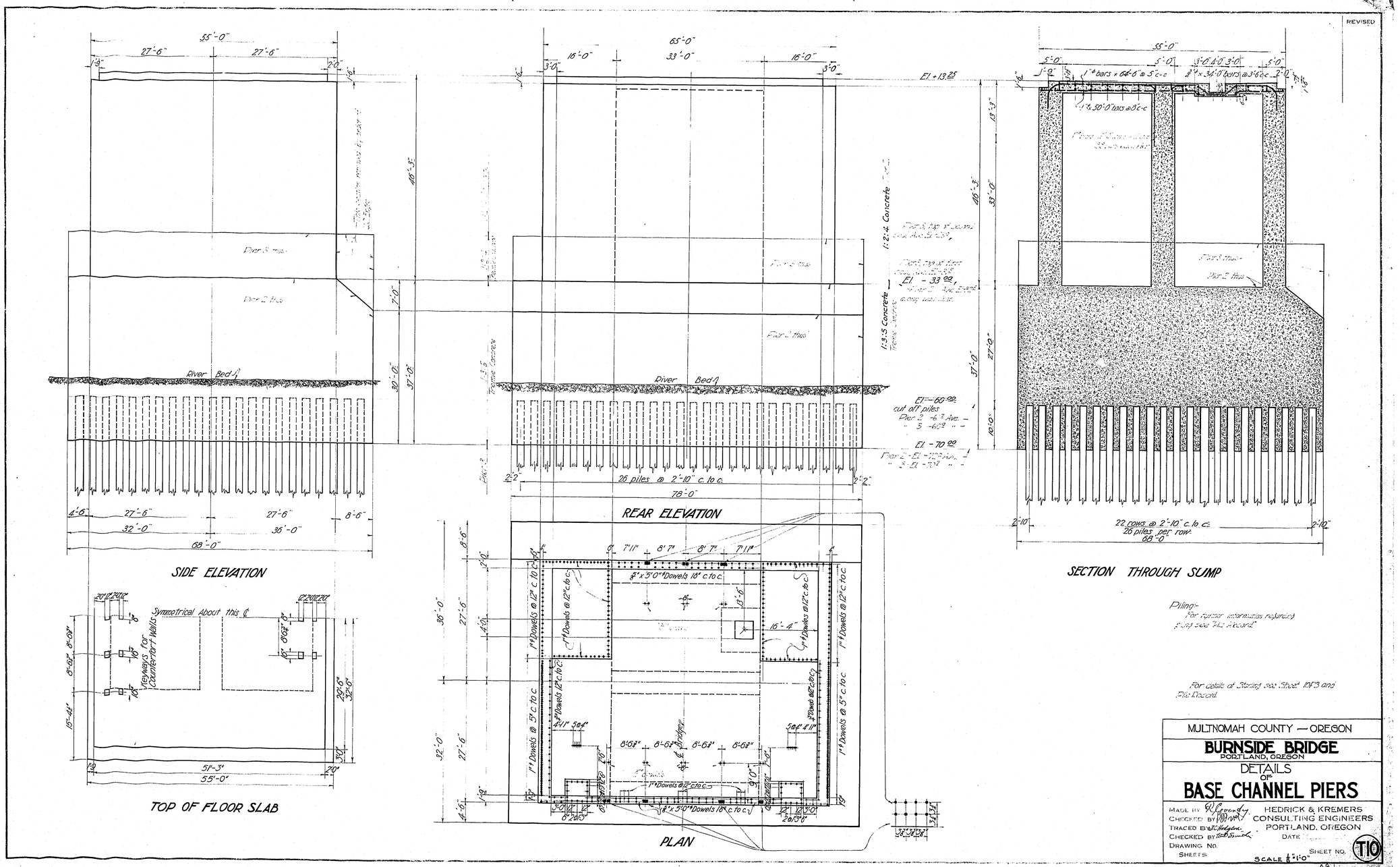

MULTNOMAH COUNTY — OREGON

BURNSIDE BRIDGE
PORTLAND, OREGON

DETAILS OF
BASE CHANNEL PIERS

MADE BY R. Lavendy
CHECKED BY
TRACED BY J.C. Hodgson
CHECKED BY
DRAWING NO.
SHEETS

HEDRICK & KREMERS
CONSULTING ENGINEERS
PORTLAND, OREGON
DATE
SHEET NO. T10
SCALE 1/8" = 1'-0"

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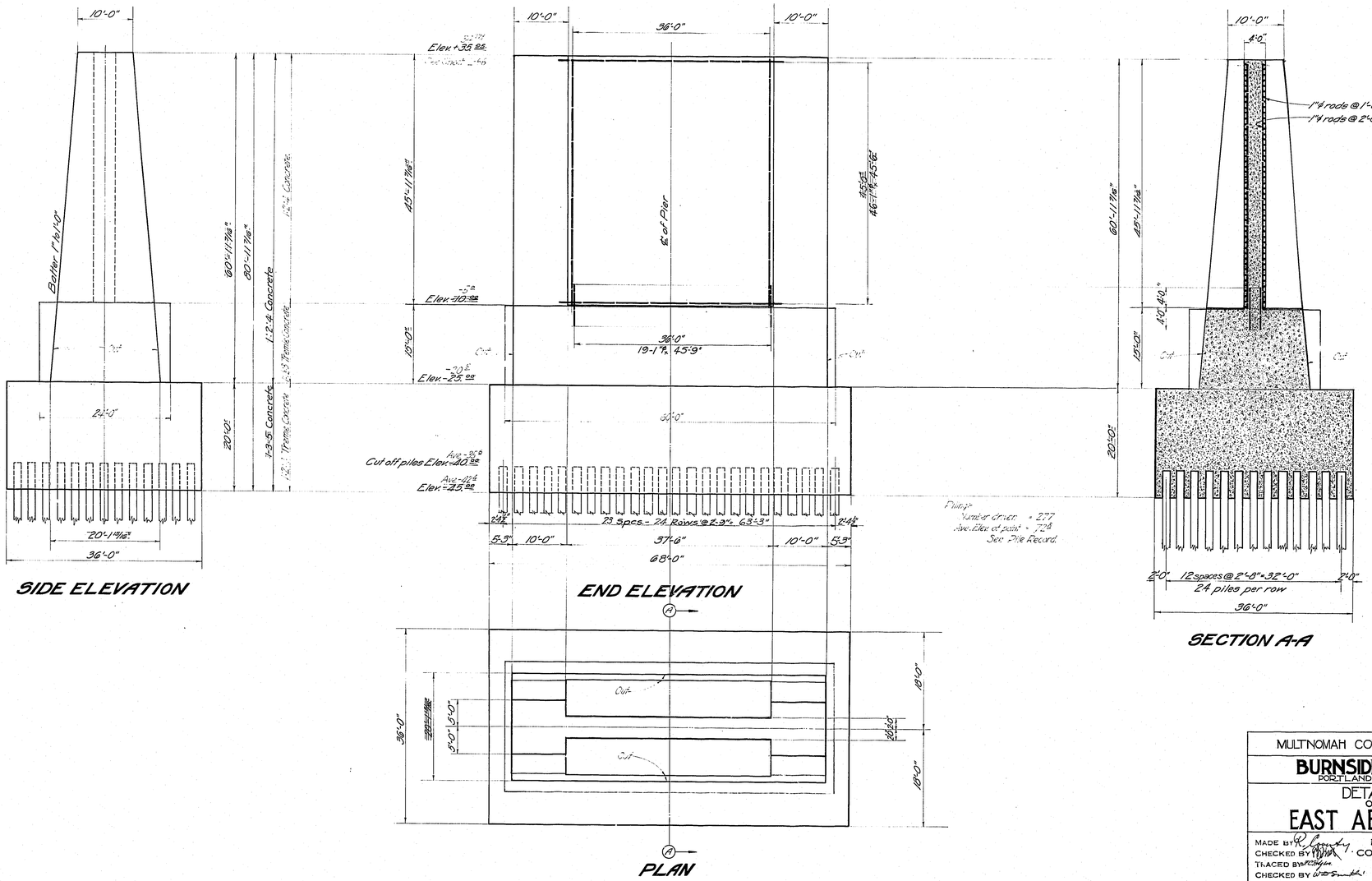

REVISED

MULTNOMAH COUNTY — OREGON

BURNSIDE BRIDGE
PORTLAND, OREGON

DETAILS OF
EAST ABUTMENT

MADE BY R. County
CHECKED BY [illegible]
TRACED BY [illegible]
CHECKED BY [illegible]
DRAWING NO.
SHEETS

HEDRICK & KREMERS
CONSULTING ENGINEERS
PORTLAND, OREGON
DATE FEB. 14, 1924
SHEET NO. T 16

A.B.I. 17 FL-25

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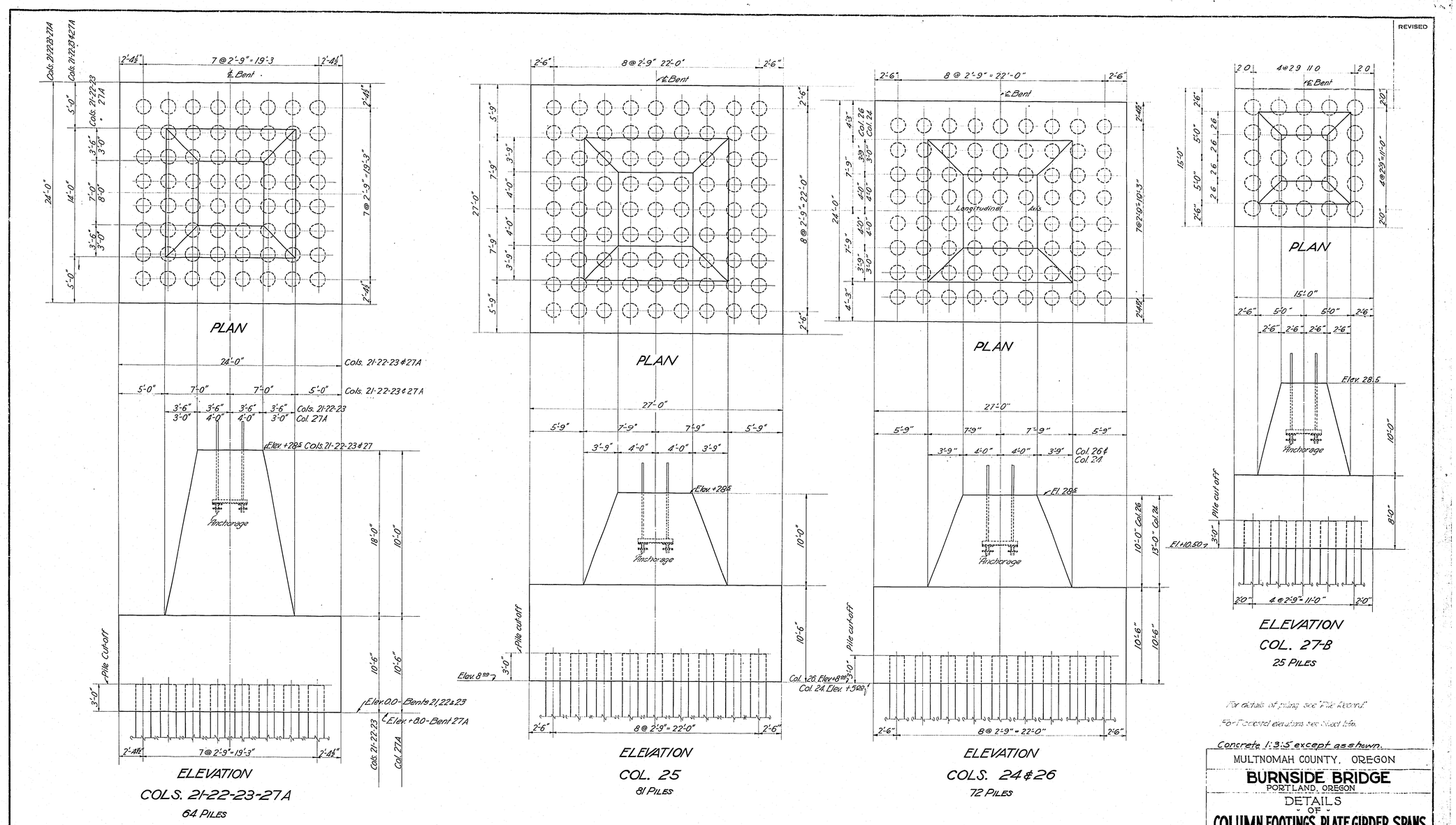

REVISED

For details of piling see "Pile Record"

For Pedestal elevations see Sheet 1-6a.

Concrete 1:3:5 except as shown.

General Notes:-
All piles are to be accurately spaced as indicated, and cut off to horizontal plane at correct elevation.
All anchorages and anchor bolts for columns - are to be set in exact position and held at top - by means of rigid wooden template.

Note: Elevations of all piers show sides parallel to longitudinal axis.

MULTNOMAH COUNTY, OREGON

BURNSIDE BRIDGE
PORTLAND, OREGON

DETAILS
- OF -
COLUMN FOOTINGS, PLATE GIRDER SPANS

MADE BY G.B. Wright
CHECKED BY
TRACED BY H.H. Norman
CHECKED BY
DRAWING NO.
SHEETS

HEDRICK & KREMERS
CONSULTING ENGINEERS
PORTLAND, OREGON
DATE FEB. 18, 1924

Scale 1/4" = 1'-0"

SHEET NO. 18

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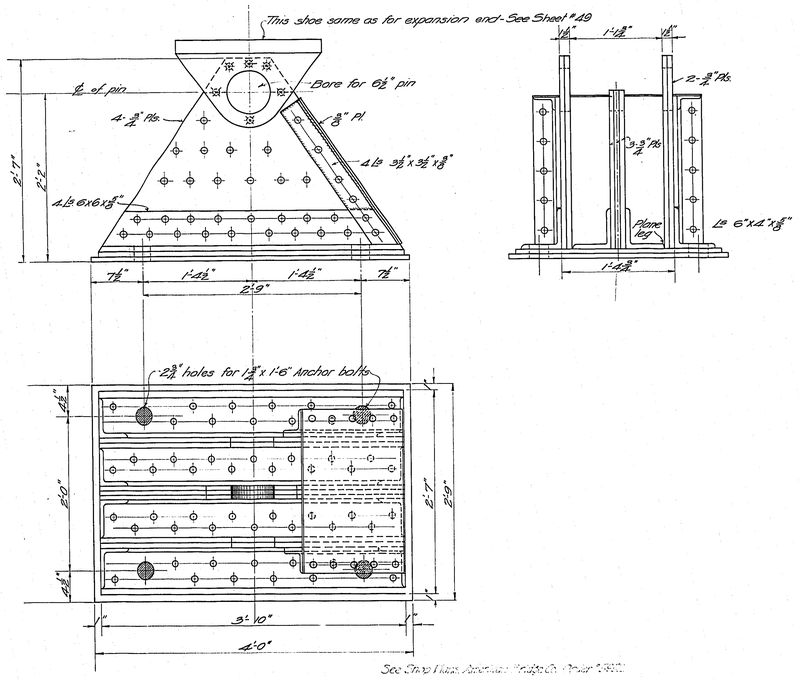
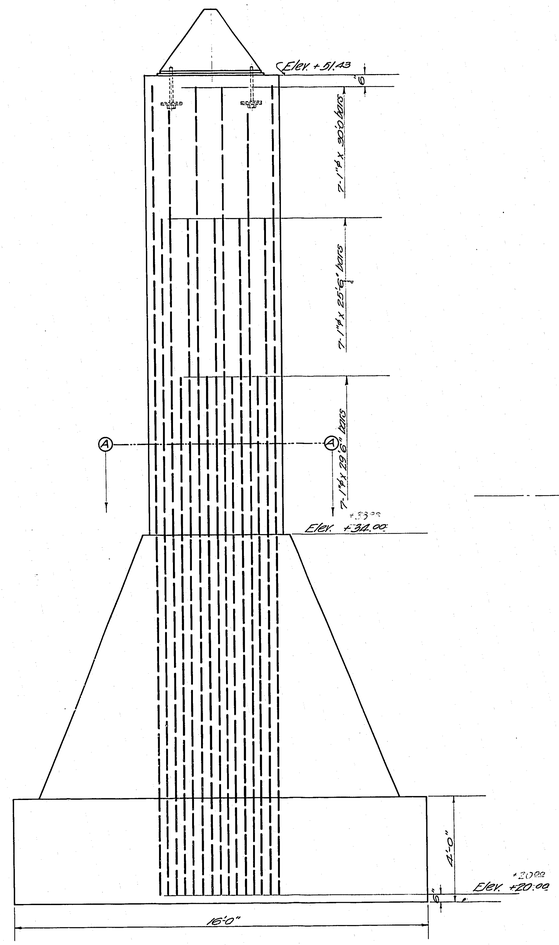
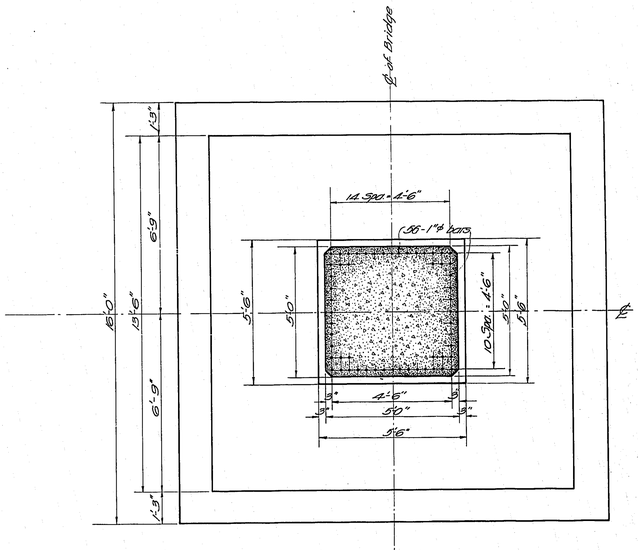


See Shop Plans, American Bridge Co. Order #[illegible]

FIXED SHOE - COL. 28 3-Required
Scale - 1½" = 1'-0"



ELEVATION ON TRANSVERSE AXIS
Scale - ½" = 1'-0"



SECTION A-A
Scale ½" = 1'-0"

Concrete 1:2:4

MULTNOMAH COUNTY, OREGON

BURNSIDE BRIDGE
PORTLAND, OREGON

DETAILS
- OF -
BENT NO. 28

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CHECKED BY
TRACED BY [signature]
CHECKED BY
DRAWING NO.
SHEETS

HEDRICK & KREMERS
CONSULTING ENGINEERS
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DATE FEB. 20-24

SCALE AS SHOWN
SHEET NO. 48

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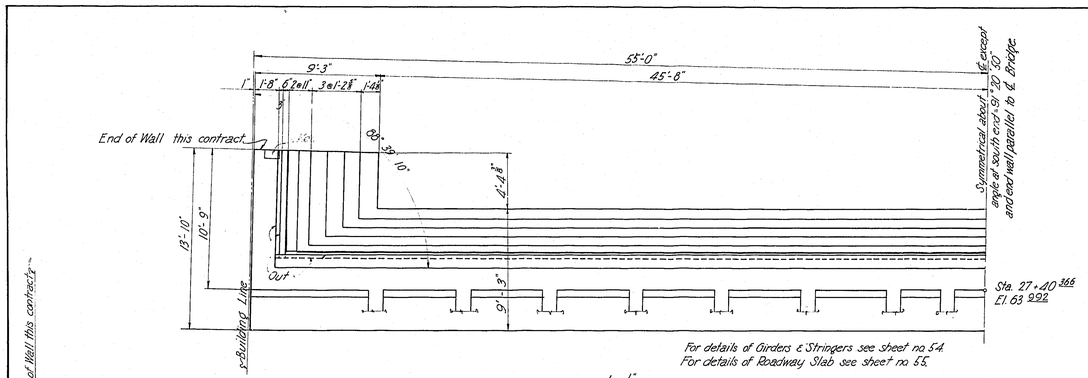
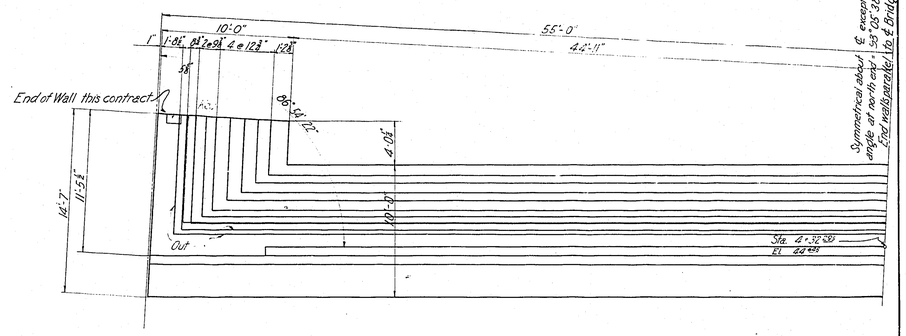
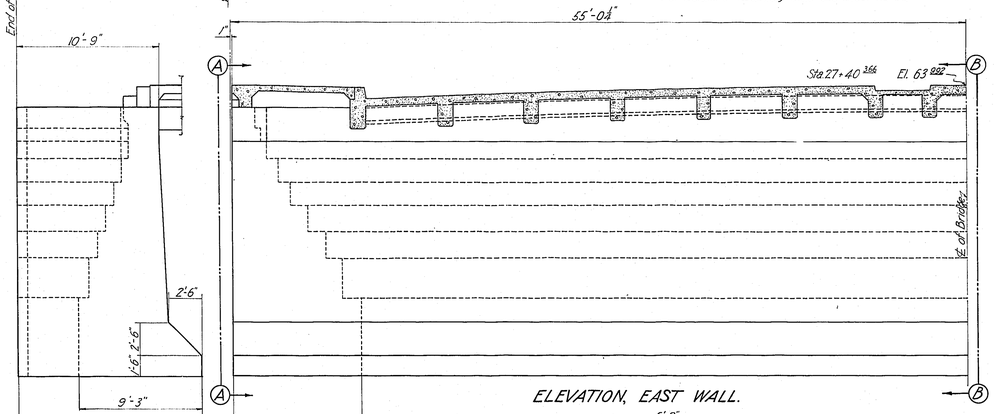
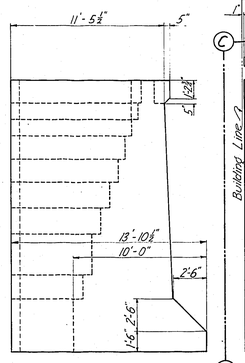


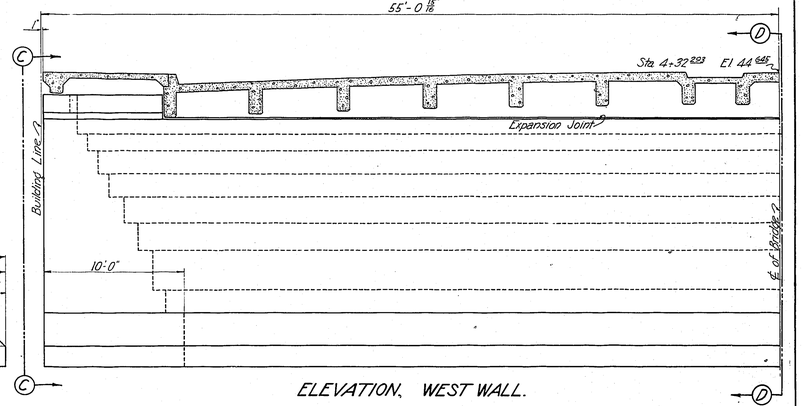




ELEVATION, EAST WALL.

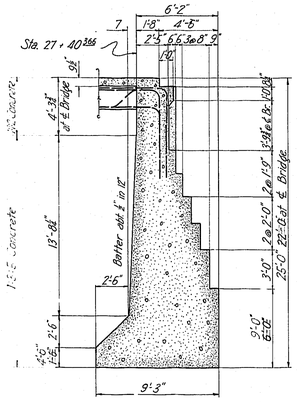


VIEW C-C.

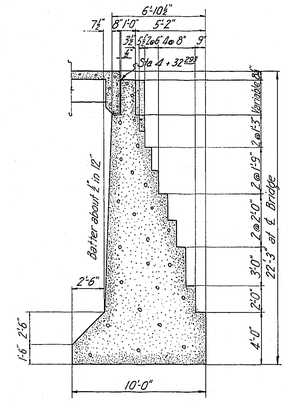


ELEVATION, WEST WALL.

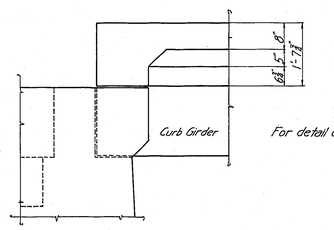
VIEW A-A



SECTION B-B.



SECTION D-D.



For detail of Expansion Joint see sheet 6.

VIEW ON C-C SHOWING POSITION OF FACIA GIRDER.

Scale ¾" = 1'-0"

All concrete 1:3:5

Construction Revisions Mar. 17th 1926 NWP

MULTNOMAH COUNTY, OREGON

BURNSIDE BRIDGE

PORTLAND, OREGON.

REVISED

EAST-WEST ABUTMENT WALLS

MADE BY	R.C.	GUSTAV LINDENTHAL CONSULTING ENGINEER
CHECKED BY	K.H.S.	
TRACED BY	R.	NEW YORK PORTLAND, ORE.
CHECKED BY		DATE - APRIL 29, 1925.
DRAWING NO. GL 185-B.		SHEET NO. L-75
Scale - ¾" = 1'-0"		PORTLAND OFFICE

AEJ 8.3 L-24

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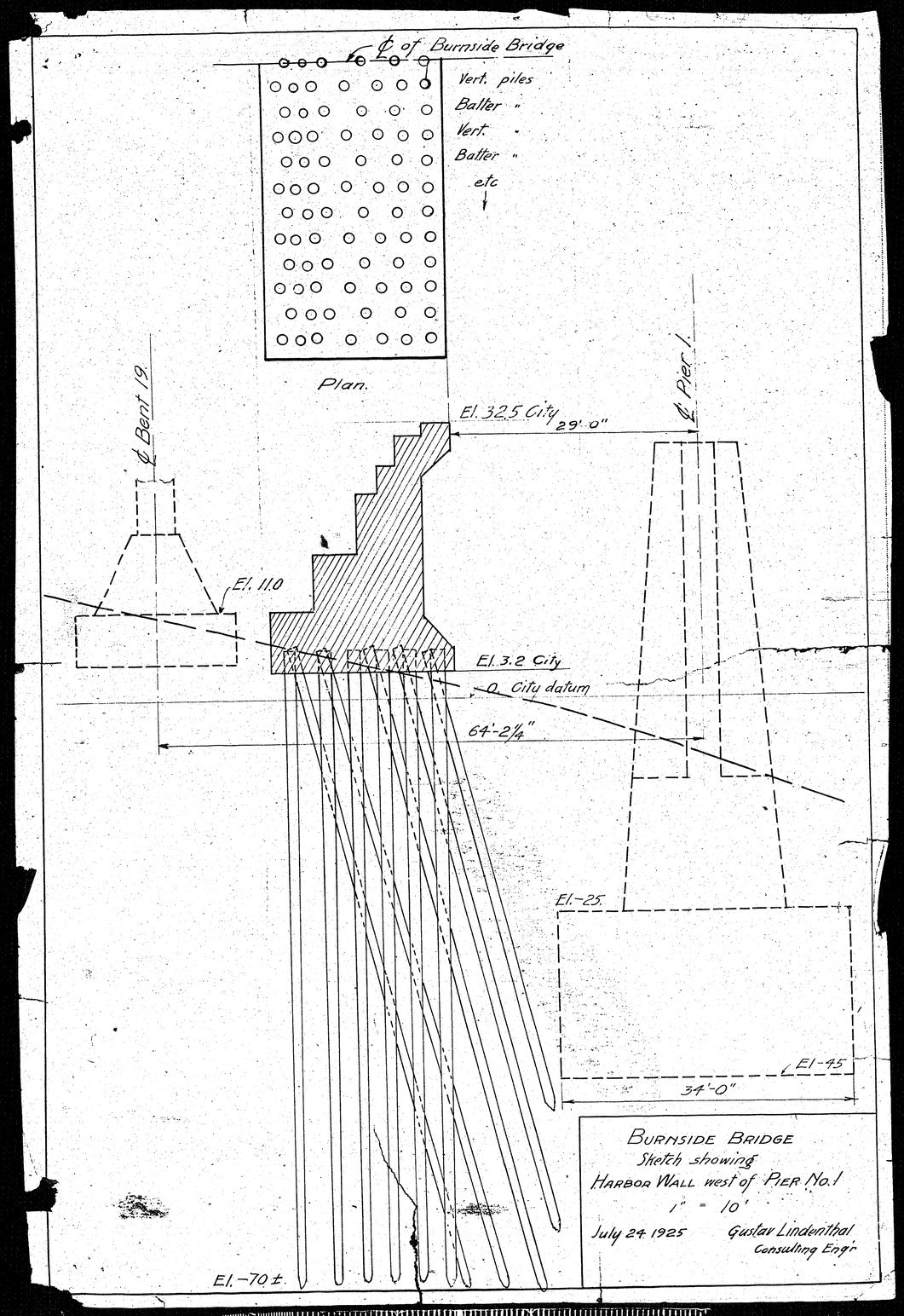
BURNSIDE BRIDGE — FOUNDATION PILING SUMMARY

Pier or Bent	Piling as per Plan			Piling as Driven			Deductions
	No.	Length each	Total Length	No.	Average Length	Total Length	Total Length
17 N.	61	49	2,989	None			2,989
17 S.	61	49	2,989	None			2,989
18 N.	70	59	4,130	68	13 8	937	3,193
18 S.	70	59	4,130	71	12 7	901	3,229
19 N.	70	65	4,550	59	44 5-	2,624	1,926
19 S.	70	65	4,550	50	31 6+	1,580	2,970
1	300	40	12,000	276	39 7	10,957	1,043
2	572	50	28,600	382	34 7-	13,249	15,351
3	572	50	28,600	392	33 8	13,255	15,345
4	312	80	24,960	277	37 2-	10,300	14,660
21 N.	64	98	6,272	63	72 2	4,549	1,723
21 S.	64	98	6,272	63	81 4	5,131	1,141
22 N.	64	98	6,272	61	63 8	3,891	2,381
22 S.	64	98	6,272	63	64 3	4,045	2,227
23 N.	64	98	6,272	62	59 5	3,690	2,582
23 S.	64	98	6,272	64	63 2	4,074	2,198
24 N.	72	98	7,056	72	63 2	4,548	2,508
24 S.	72	98	7,056	72	61 7	4,445	2,611
25 N.	81	99	8,019	77	70 7	5,446	2,573
25 S.	81	99	8,019	79	67 7	5,353	2,666
26 N.	72	99	7,128	70	72 9	5,039	2,089
26 S.	72	99	7,128	68	67 3	4,574	2,554
27 N.	64	99	6,336	63	62 5	3,940	2,396
27 C.	25	101 5	2,537 5	25	63 9	1,575	963
27 S.	64	99	6,336	64	63 9	4,090	2,246



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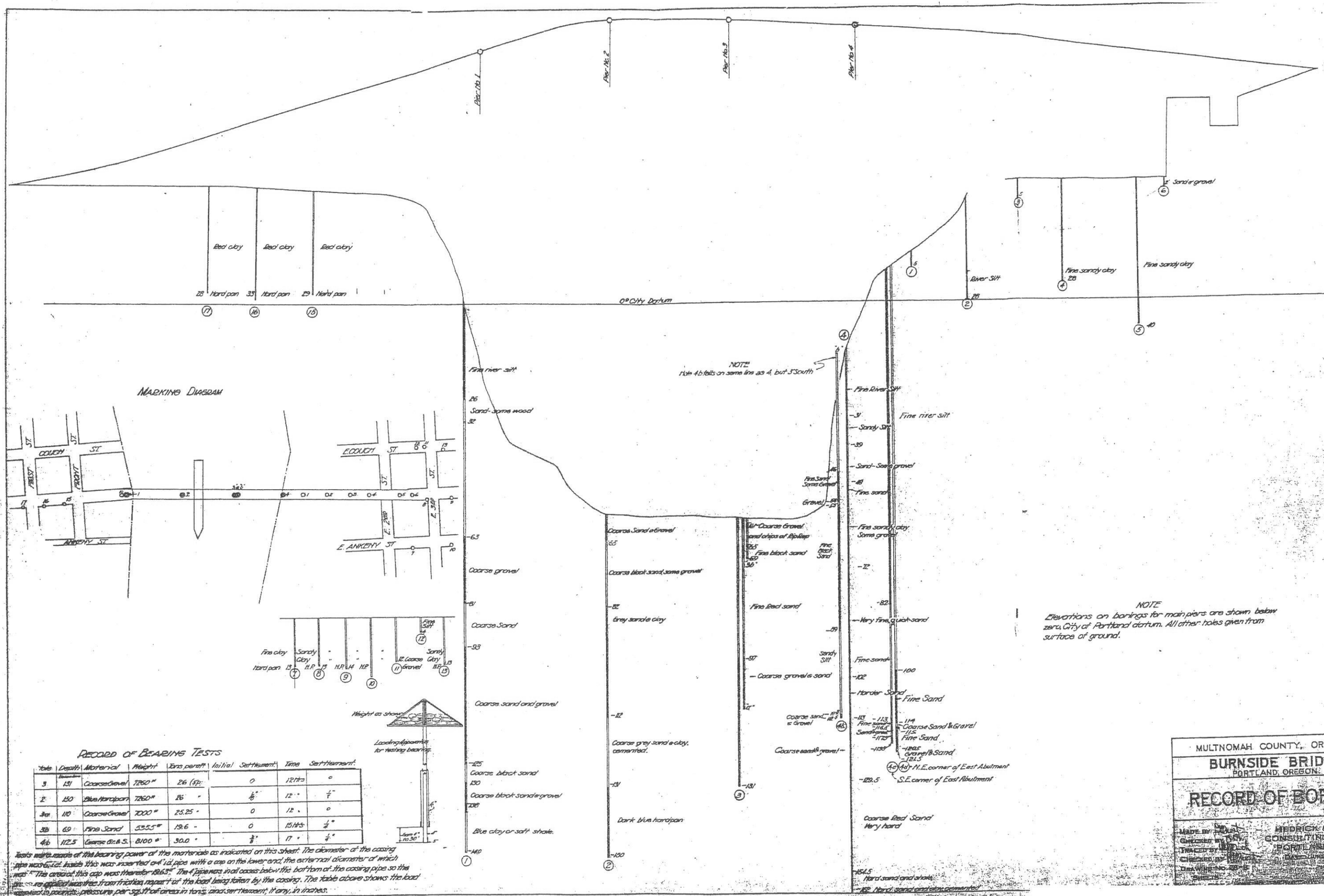
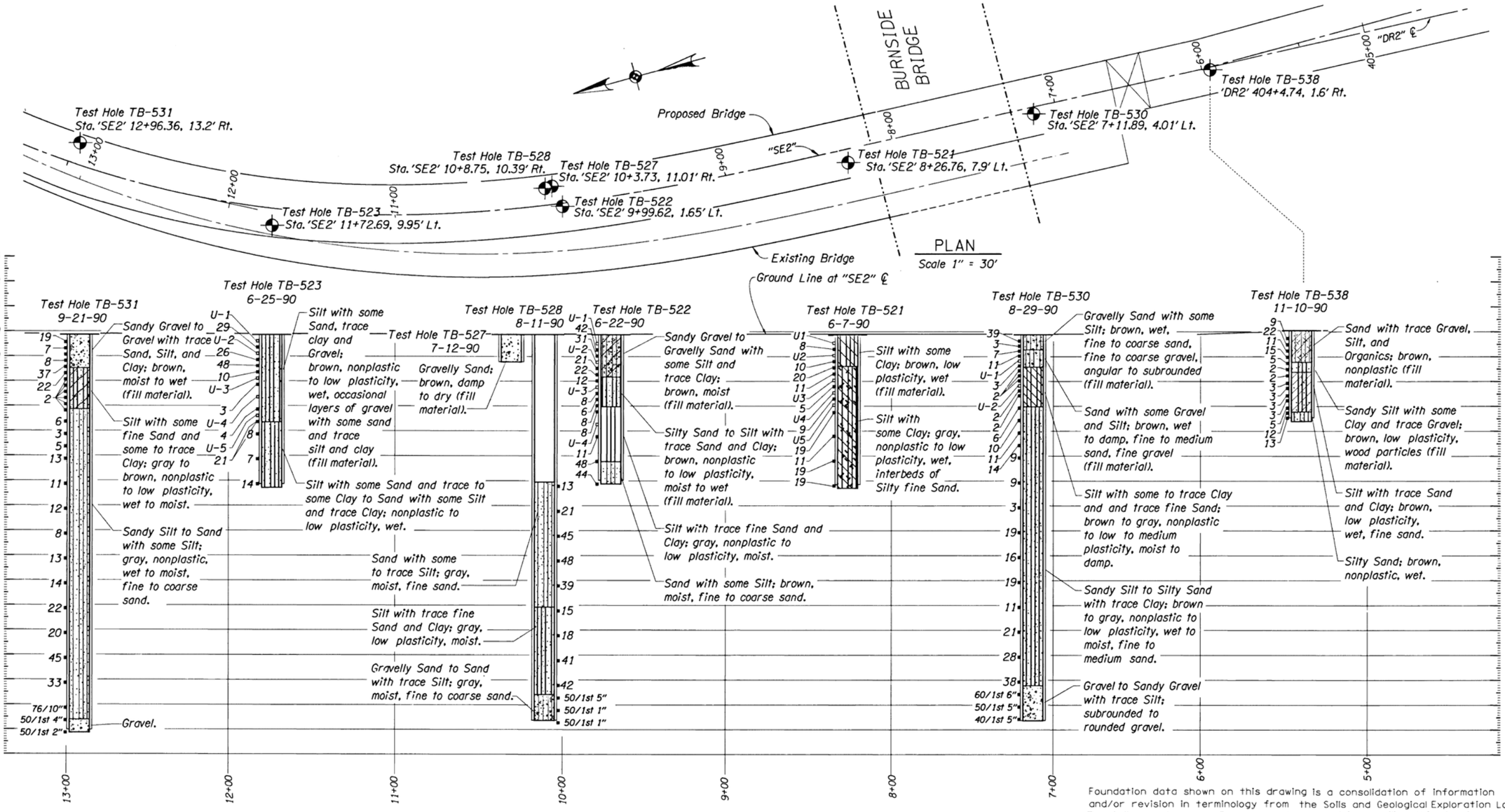

Pier No. 1
Pier No. 2
Pier No. 3
Pier No. 4
Reed clay
Hard pan
Reed clay
Hard pan
Reed clay
Hard pan
0° City Datum
Fine river silt
Sand - some wood
Coarse gravel
Coarse Sand
Coarse sand and gravel
Coarse black sand
Coarse black sand & gravel
Blue clay or soft shale.
Coarse Sand & Gravel
Coarse black sand, some gravel
Grey sandy clay
Coarse grey sand & clay, cemented.
Dark blue hardpan
River Silt
Fine sandy clay
Fine sandy clay
Sand & gravel
Fine River Silt
Fine river silt
Sandy Silt
Sand - Some gravel
Fine sand
Fine sandy clay some gravel
Very fine, quick sand
Fine Sand
Harder Sand
Fine Sand
Coarse Sand & Gravel
Fine Sand
Gravel & Sand
N.E. corner of East Abutment
S.E. corner of East Abutment
Coarse Reed Sand
Very hard
Hard sand and shale
Hard sand and shale, cemented
Fine Sand
Coarse Gravel
Sand chips of Riprap
Fine black sand
Fine Reed Sand
Coarse gravel & sand
Coarse sand & gravel
Fine Sand
Sandy Silt
Coarse Sand & Gravel
Fine Sand
Fine Sand
Coarse Sand & Gravel
Fine Sand
Gravel & Sand
Fine Sand
Sandy Silt
Fine Sand
Coarse Sand & Gravel
Fine Sand
Gravel & Sand



FOUNDATION DATA

Scale 1" = 30' (horiz.)
1" = 20' (vert.)

Foundation data shown on this drawing is a consolidation of information and/or revision in terminology from the Soils and Geological Exploration Logs. The Soils and Geological Exploration Logs used in compiling this drawing are available upon request.

LEGEND OF MATERIALS

Gravel | Silt. | Silty gravel, gravel-silt mixture. | Clayey gravel, gravel-clay mixture. | Silty clay mixture. | Siltstone, claystone, mudstone or shale. | Basalt

Sand. | Clay. | Silty sand, sand-silt mixture. | Clayey sand sand-clay mixture. | Sand-silt-clay mixture. | Sandstone or conglomerate.

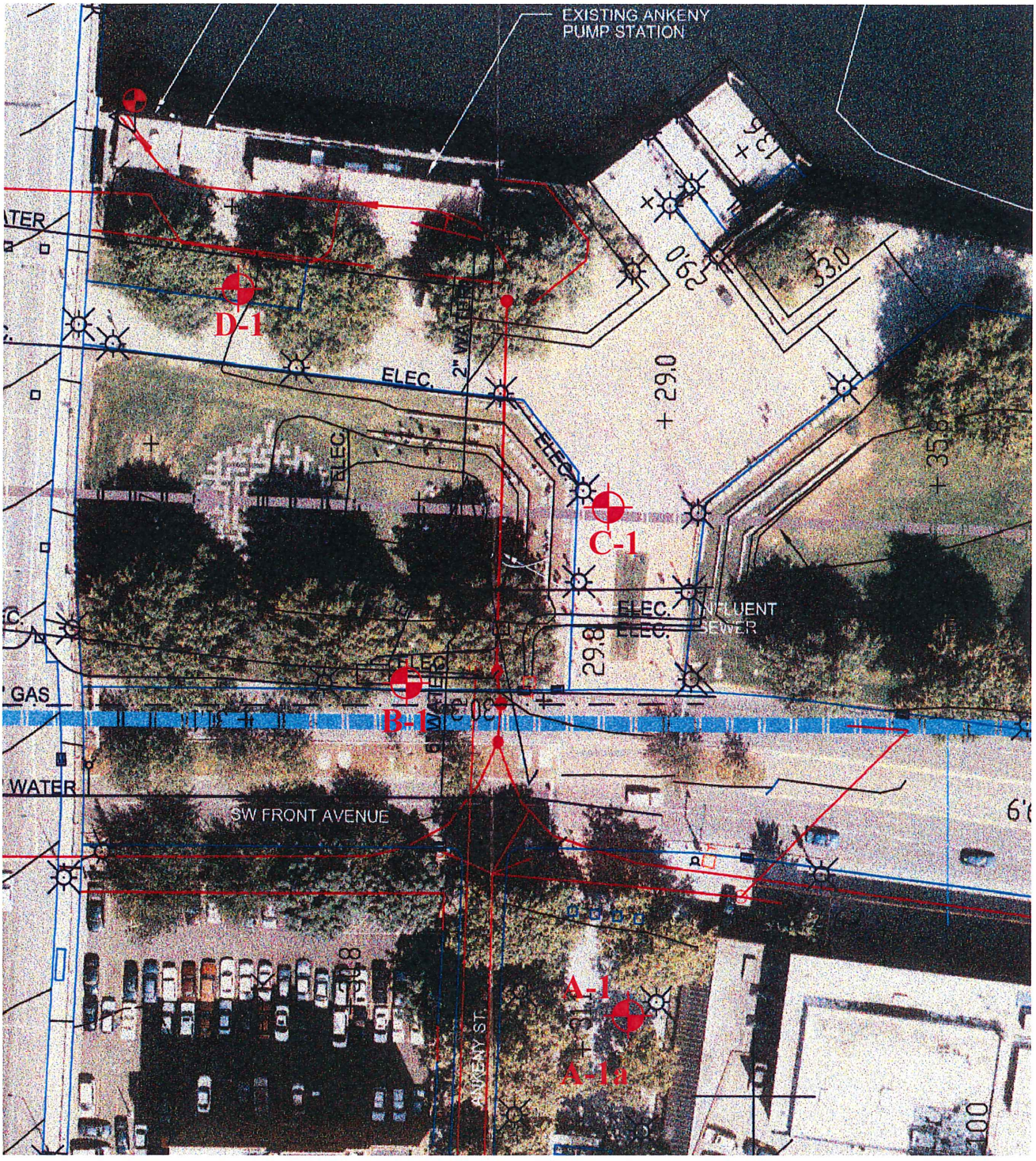
24 Standard Penetration Test. N value.

C = Core Sample.
U = Undistrubed Sample.
RQD = Rock Quality Designation.
▽ = Elevation ground water encountered.

REGISTERED PROFESSIONAL ENGINEER 13717 OREGON JULY 16, 1987 JAN LIEN, SIX

BRIDGE ENGINEER Thomas D. Culay PE NO. 8491	OREGON DEPARTMENT OF TRANSPORTATION BRIDGE DESIGN SECTION
DESIGNED J. Six PE NO. 13717	BANFIELD ACCESS RAMP
DRAWN K. Williams	
CHECKED R. W. Burns	FOUNDATION DATA
REVIEWED Marvin Croft	
DATE 11-96 REVISION As Constructed BY PGA	DATE MAR. 1991 CALC.BOOK Fnd. File SHEET 3 OF 66
	BRIDGE NO. 8588D-A DRAWING NO. 47977

ZG2:[200,203]KW8588.DGN [VIEW=2] [PGRID=C1] 15-Oct-1991 HERNANDEZ



Scale 1 Inch = 60 Feet

30 0 30 60

NORTH

Ankeny Pump Station
Portland, Oregon

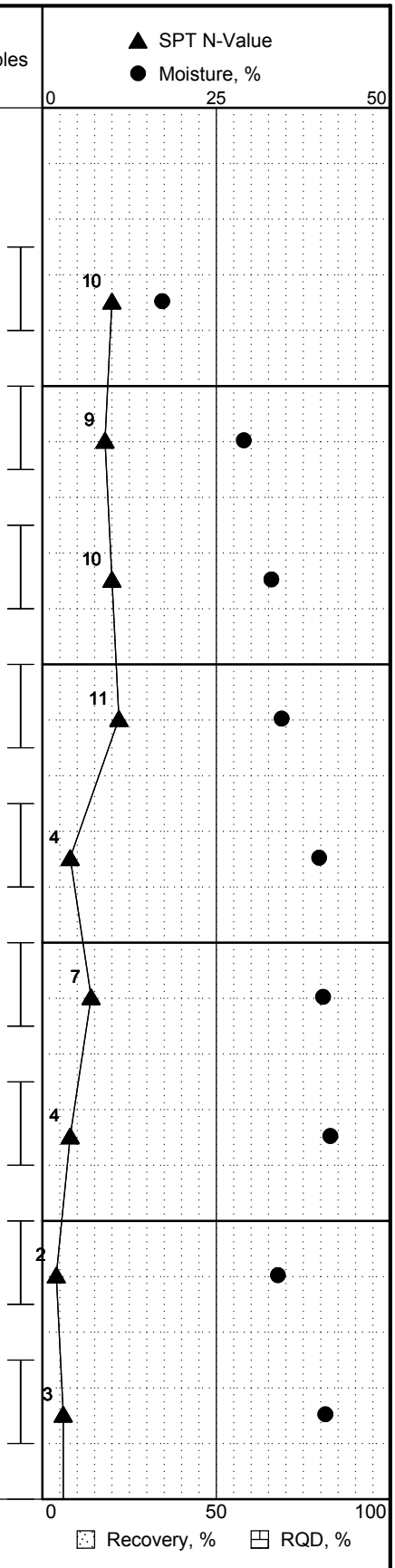
PLAN OF EXPLORATIONS

June 2001 F-3112.01

FUJITANI HILTS & ASSOCIATES
Geotechnical Consultants
Portland, Oregon

FIG. 1

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Log	Depth In Feet	Samples
		31.0				
		30.9	**Artificial Granite PAVER** (Pavement)		0	
		0.1	**CONCRETE** (Pavement)			
		30.5	**SILT FILL**, slightly clayey, stiff, dark gray, moist, low plasticity, scattered crushed rock and charcoal. (Fill)			
		0.5				
		28.0				
		3.0	**SILT**, slightly sandy, slightly clayey, stiff, light brown & rust w/ gray mottling, moist, low plasticity, micaceous, with scattered rock fragments. (Pleistocene Flood Deposits)			S-1
					5	S-2
						S-3
					10	S-4
		18.5				
		12.5	**Clayey SILT**, slightly sandy, soft to medium stiff, gray brown w/ rust, moist, low plasticity, micaceous. (Pleistocene Flood Deposits)			S-5
	-200 = 95%				15	S-6
		13.5				
		17.5	Sandy			S-7
	-200 = 87%					
		11.0				
		20.0	**Sandy SILT**, slightly clayey, soft, light brown, moist becoming wet, low plasticity, micaceous. (Pleistocene Flood Deposits)		20	S-8
	-200 = 57%					
▼	10/16/2000					S-9
	-200 = 71%					
		6.0				



LEGEND

- ⊥ = 2.0" O.D. Split Spoon Sample
- ⊥ = 3.0" O.D. Thin-Walled Sample
- * = Sample Not Recovered
- ⊥ = 3.0" O.D. Split Spoon Sample
- ⊥ = 3.25" O.D. Split Spoon Sample
- ■ = Core Rock Sample

NOTE:
Lines between soil/rock units are approximate and transition may be gradual.

- Impervious Seal (Bentonite)
- Cement Grout
- Random Backfill
- Granular Backfill
- ▽ Ground Water Level on Date Shown
- Piezometer/Inclinometer Tubing
- Perforated Zone

ATTERBERG LIMITS
- Liquid Limit
- Natural Water Content
- Plastic Limit

Ankeny Pump Station
Portland, Oregon

LOG OF BORING A-1

Page 1 of 3

December 2000 *F-3112.01*

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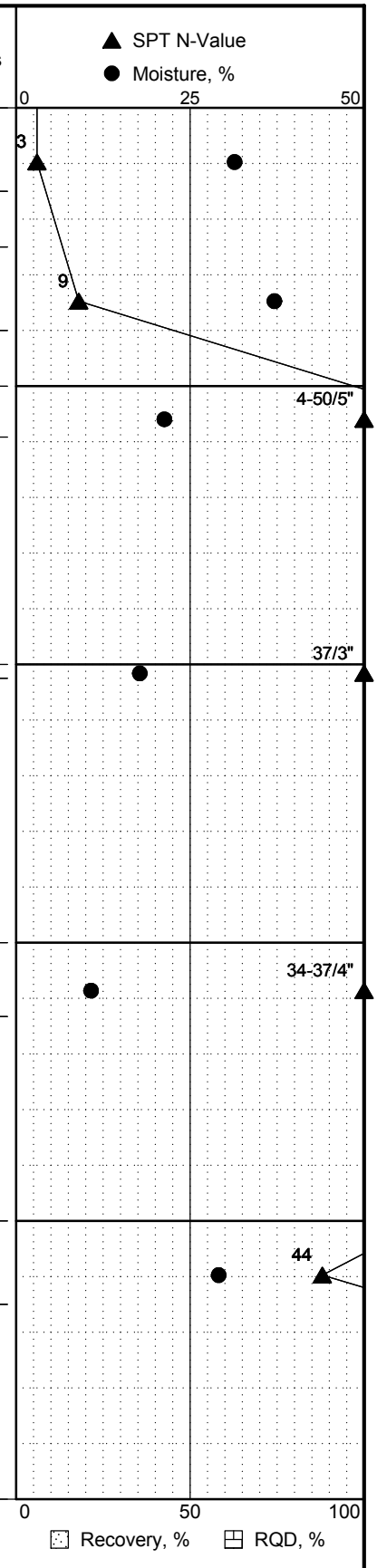
Portland, Oregon

FIG.

Log: Typ: Rev:

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Log	Depth In Feet	Samples
		25.0	**Silty SAND**, very loose to loose, light brown, wet, low to no plasticity in matrix, fine-grained. (Pleistocene Flood Deposits)			
	-200 = 25%					S-10
		3.5				
		27.5	**Sandy SILT**, slightly clayey, stiff, light brown, wet, low to no plasticity, micaceous. (Pleistocene Flood Deposits)			
	-200 = 74%					S-11
		1.0				
	-200 = 89%	30.0	Slightly sandy		30	
		0.5				S-12
		30.5	**Sandy GRAVEL**, very dense, gray, wet, non-plastic, fine- to coarse-grained sand, fine- to coarse-grained rounded gravel, well-graded, scattered cobbles. (Pleistocene Flood Deposits)			
					35	S-13
					40	S-14
		-10.5				
		41.5	**SAND**			
		-11.5				
		42.5	**Clayey SAND**, dense, brown & orange, damp, low plasticity, micaceous, fine-grained, weathered, indurated. (Troutdale Formation)			
					45	S-15
		-19.0				



LEGEND

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- Perforated Zone

ATTERBERG LIMITS
- Liquid Limit
- Natural Water Content
- Plastic Limit

Ankeny Pump Station
Portland, Oregon

LOG OF BORING A-1

December 2000 *F-3112.01*

SHANNON & WILSON, INC.
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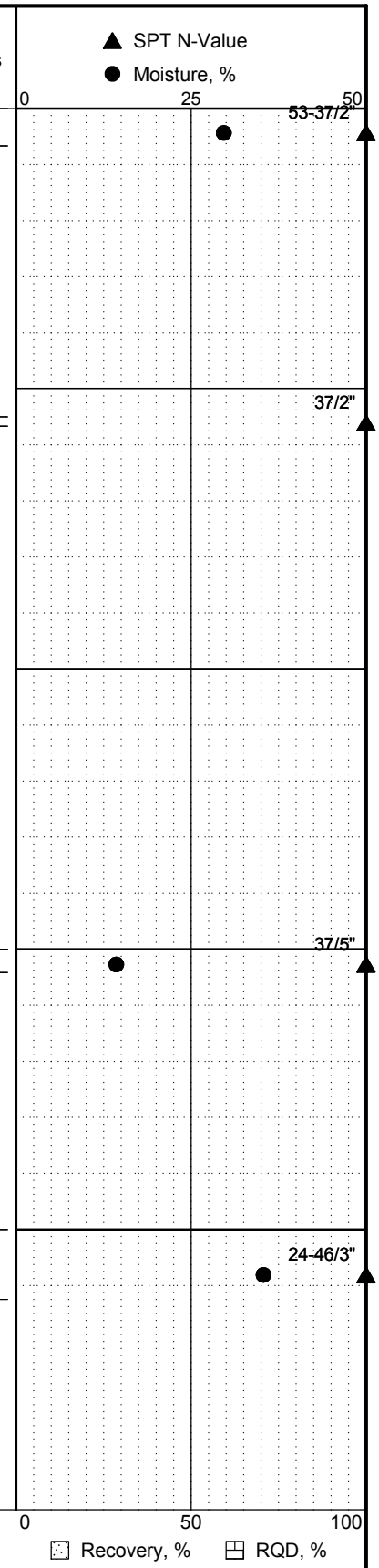
Portland, Oregon

FIG.

Log: Typ: Rev:

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Depth In Feet	Samples
		50.0	**SAND**, slightly clayey, very dense, dark brown, damp, low plasticity in matrix, micaceous, fine-grained, weathered, indurated, scattered rounded cobbles. (Troutdale Formation)	55	S-16
		-33.0			
		64.0	**Sandy GRAVEL & COBBLES**, very dense, gray and black, wet, fine-grained sand, fine- to coarse-grained, poorly graded, rounded gravel. (Troutdale Formation)	60	S-17
		-36.0			
	Dry density = 122.6 pcf	67.0	**SAND**, very dense, brown, moist, non-plastic, micaceous, fine-grained, indurated, trace of clay, scattered cobbles. (Troutdale Formation)	65	S-18
		-40.2		70	S-19
		71.2	Bottom of Boring, Completed 10/17/00		



LEGEND

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- Cement Grout
- Random Backfill
- Granular Backfill
- Ground Water Level on Date Shown
- Piezometer/Inclinometer Tubing
- Perforated Zone

ATTERBERG LIMITS
- Liquid Limit
- Natural Water Content
- Plastic Limit

Ankeny Pump Station
Portland, Oregon

LOG OF BORING A-1

December 2000 *F-3112.01*

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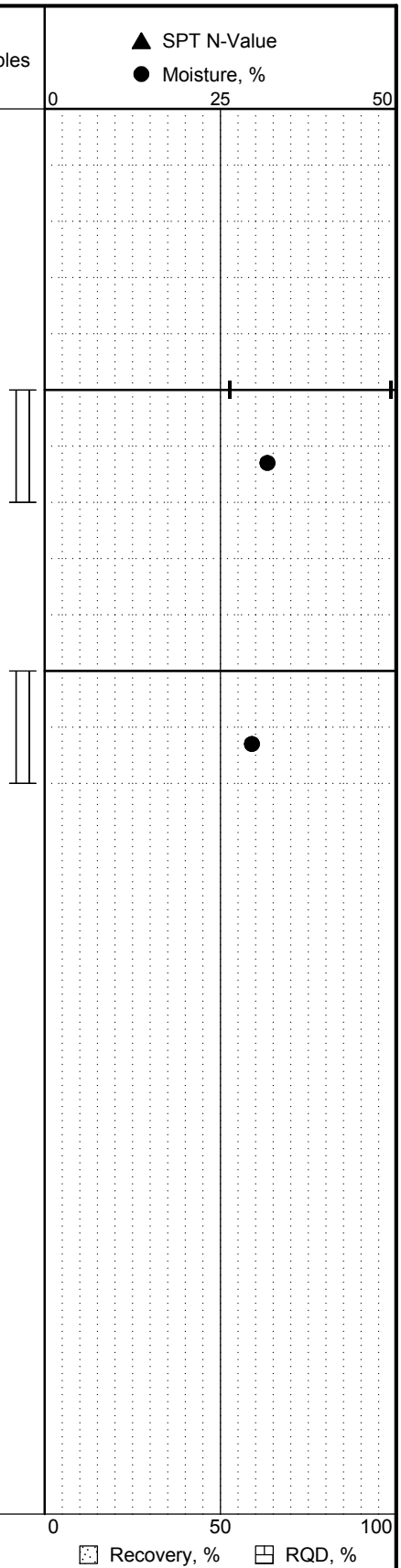
FIG.

Log: Typ: Rev:

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet 31.0	CLASSIFICATION OF MATERIAL	Log	Depth In Feet	Samples
			SILT, slightly sandy, slightly clayey, light brown, moist, low to no plasticity, micaceous. (Pleistocene Flood Deposits)		0 5	S-1
			Sandy SILT,		10	S-2



LEGEND

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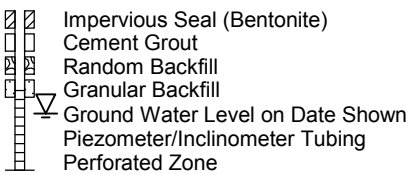
NOTE:
Lines between soil/rock units are approximate and transition may be gradual.



ATTERBERG LIMITS
- Liquid Limit
- Natural Water Content
- Plastic Limit

Ankeny Pump Station
Portland, Oregon

LOG OF BORING A-1a

Page 1 of 1

December 2000 *F-3112.01*

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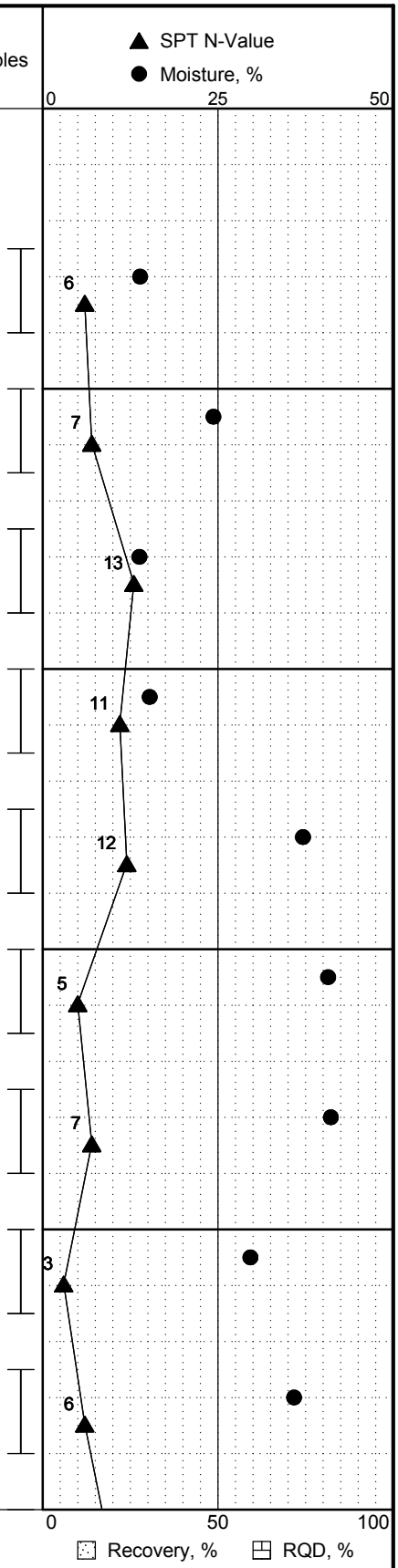
FIG.

Log: Typ: Rev:

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Log	Depth In Feet	Samples
		32.0				
			Silty SAND FILL, loose to medium dense, brown, dry, ranging to low plasticity slightly clayey SILT in places, fine-grained, scattered brick fragments to 9.5 feet. (Fill)		0	S-1
			Moist.		5	S-2
			Medium dense, scattered concrete fragments.			S-3
					10	S-4
			Scattered organics.			S-5
		17.0				
	-200 = 94%	15.0	**SILT FILL**, slightly sandy and clayey, medium stiff, light brown, moist, low plasticity, scattered brick fragments and organics. (Fill)		15	S-6
	-200 = 95%					S-7
	-200 = 75%		**Grading Sandy**, soft.		20	S-8
		10.0				
▼	8/30/2000 -200 = 65%	22.0	**Sandy SILT**, loose, brown, wet, micaceous, sand is fine-grained. (Pleistocene Flood Deposit)			S-9



LEGEND

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NOTE:
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- Impervious Seal (Bentonite)
- Cement Grout
- Random Backfill
- Granular Backfill
- Ground Water Level on Date Shown
- Piezometer/Inclinometer Tubing
- Perforated Zone

ATTERBERG LIMITS
- Liquid Limit
- Natural Water Content
- Plastic Limit

Ankeny Pump Station
Portland, Oregon

LOG OF BORING B-1

December 2000 *F-3112.01*

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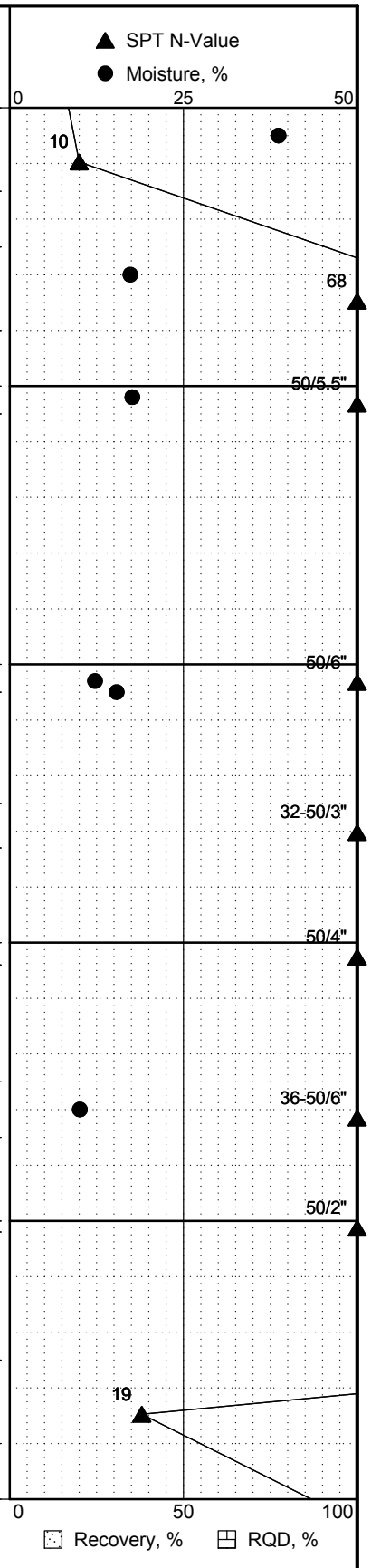
Portland, Oregon

FIG.

Log: Typ: Rev:

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Log	Depth In Feet	Samples
	-200 = 41%		**Grading to Silty SAND**.			S-10
		5.0				
		27.0	**Cobbly Sandy GRAVEL**, very dense, brown and gray, wet, fine to coarse subrounded gravel with numerous cobbles, sand is fine- to medium-grained. (Pleistocene Flood Deposits)			S-11
					30	S-12
					35	S-13
						S-14
			Cobbly Sandy GRAVEL continued		40	S-15*
						S-16
					45	S-17*
		-15.0				
		47.0	**SAND**, medium dense, brown, wet, fine-grained. (Pleistocene Flood Deposits)			S-18



LEGEND

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NOTE:
Lines between soil/rock units are approximate and transition may be gradual.

- Impervious Seal (Bentonite)
- Cement Grout
- Random Backfill
- Granular Backfill
- Ground Water Level on Date Shown
- Piezometer/Inclinometer Tubing
- Perforated Zone

ATTERBERG LIMITS
- Liquid Limit
- Natural Water Content
- Plastic Limit

Ankeny Pump Station
Portland, Oregon

LOG OF BORING B-1

December 2000 *F-3112.01*

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Portland, Oregon

FIG.

Log: Typ: Rev:

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Log	Depth In Feet	Samples	SPT N-Value / Moisture, % (0 25 50)
		-19.3				S-19	59
		51.3	**Sandy GRAVEL**, slightly clayey, very dense; gray, brown and yellow; wet, low plasticity matrix, fine to coarse rounded gravel with scattered cobbles, sand is fine-grained. (Pleistocene Flood Deposits with reworked Troutdale Formation material, possible Troutdale Formation))			S-20	60-50/3"
					55	S-21	50/4"
						S-22*	50/0"
		-27.5					
		59.5	**Clayey SAND**, very dense, yellow-brown, moist, low plasticity, fine-grained, scattered fine gravel, weathered, over-consolidated, poorly graded. (Troutdale Formation)		60	S-23	31-50/3"
						S-24	14-37-50/0"
		-33.0					
		65.0	**Sandy GRAVEL**, slightly clayey, very dense; gray, brown and yellow; wet, low plasticity matrix, fine to coarse rounded gravel with scattered cobbles, sand is fine-grained, weathered, over-consolidated, poorly graded. (Troutdale Formation)		65	S-25	50/3"
						S-26	50-50/3"
		-38.3			70	S-27	50/3"
		70.3	Bottom of Boring, Completed 8/31/00				

0 50 100
Recovery, % RQD, %

LEGEND

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NOTE:
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- Impervious Seal (Bentonite)
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- Granular Backfill
- Ground Water Level on Date Shown
- Piezometer/Inclinometer Tubing
- Perforated Zone

ATTERBERG LIMITS
- Liquid Limit
- Natural Water Content
- Plastic Limit

Ankeny Pump Station
Portland, Oregon

LOG OF BORING B-1

December 2000 *F-3112.01*

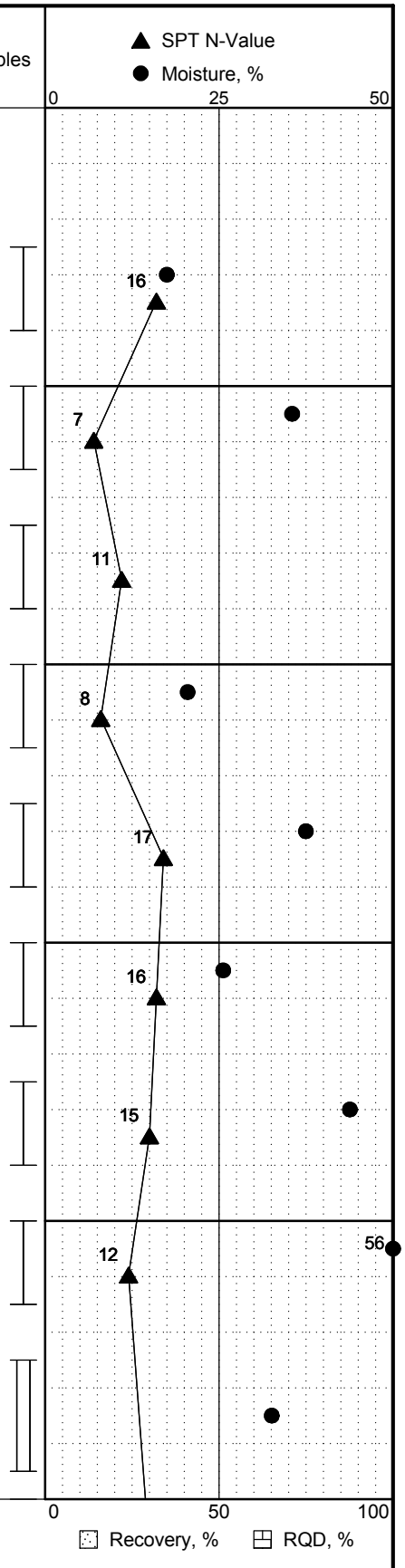
SHANNON & WILSON, INC.
Geotechnical Consultants
Portland, Oregon

FIG.

Log: Typ: Rev:

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Log	Depth In Feet	Samples
		30.0				
		29.2	**BRICK and CONCRETE FILL**; BRICK from 0 to 0.2, CONCRETE with rebar from 0.2 to 0.85. (Pavement)		0	
		0.9	**SAND FILL**, medium dense, gray, moist, fine-grained, trace fine rounded gravel and crushed rock. (Fill)			S-1
		26.0				
		4.0	**Sandy SILT FILL**, slightly clayey, loose, light brown, moist, no to low plasticity, scattered fine rounded gravel. (Dredged sand fill)		5	S-2
						S-3
		20.0				
		10.0	**SAND FILL**, loose, gray brown, moist, fine-grained, scattered fine rounded gravel. (Dredged sand fill)		10	S-4
			Tree fragment, medium dense.			S-5
		16.0				
		14.0	**Silty SAND FILL**, slightly clayey, medium dense, gray, moist to wet, no to low plasticity, fine-grained, scattered to abundant wood fragments and red crushed rock.		15	S-6
	-200 = 33%					S-7
▼	8/28/2000 -200 = 35%				20	S-8
	-200 = 16%					S-9
		5.0				



Rev:
Typ:
Log:

LEGEND

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- Cement Grout
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- Perforated Zone

ATTERBERG LIMITS
- Liquid Limit
- Natural Water Content
- Plastic Limit

Ankeny Pump Station
Portland, Oregon

LOG OF BORING C-1

Page 1 of 3

December 2000 *F-3112.01*

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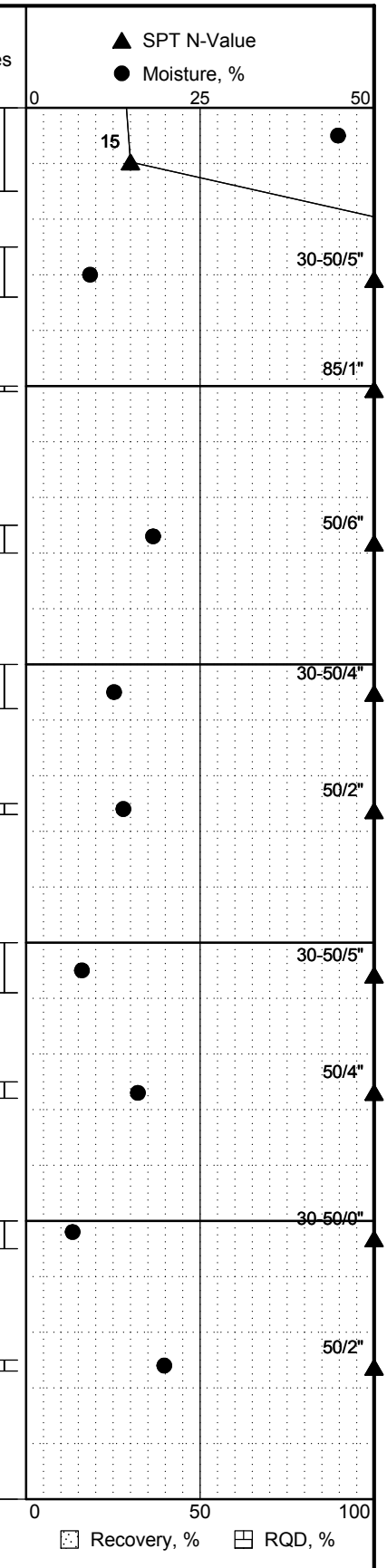
Portland, Oregon

FIG.

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Log	Depth In Feet	Samples
	-200 = 73%	25.0	**Clayey SILT**, stiff, gray, wet, low plasticity, micaceous. (Recent Alluvium)			S-10
		3.0				
		27.0	**Stratified Cobbly Sandy GRAVEL**, very dense, brown and gray, wet, fine to coarse subrounded gravel, sand is fine- to coarse-grained. (Pleistocene Flood Deposits)			S-11
					30	S-12*
						S-13
					35	S-14
						S-15
			Stratified Cobbly Sandy GRAVEL continued.		40	S-16
						S-17
					45	S-18
						S-19
	Wet density = 163.3 pcf	-18.5				
		48.5	**SAND,** very dense, no sample return. (Pleistocene Flood Deposits)			



LEGEND

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ATTERBERG LIMITS
- Liquid Limit
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Ankeny Pump Station
Portland, Oregon

LOG OF BORING C-1

December 2000 *F-3112.01*

SHANNON & WILSON, INC.
Geotechnical Consultants
Portland, Oregon

FIG.

Log: Typ: Rev:

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Log	Depth In Feet	Samples	SPT N-Value / Moisture, % (0 – 25 – 50)
		-21.0					
	Wet density = 165.4 pcf	51.0	**Clayey Gravelly SAND**, very dense, yellow-brown, moist, low plasticity, sand is fine-grained, fine to coarse rounded gravel, weathered, over-consolidated, poorly graded, gradational transition to underlying material. (Troutdale Formation)			S-20*	61
						S-21*	50/2"
					55	S-22	50/3"
						S-23*	50/3"
	Wet density = 170.0 pcf				60	S-24*	50/3"
						S-25*	50/.5"
	Wet density = 161.4 pcf						
		-35.0			65		
		65.0	**Gravelly SAND**, very dense, light brown, wet, non-plastic, sand is fine-grained, fine to coarse rounded gravel, over-consolidated, poorly graded. (Troutdale Formation)			S-26	80
					70		
		-40.8				S-27	18-50/3"
		70.8	Bottom of Boring, Completed 8/29/00				

0 50 100
Recovery, % RQD, %

LEGEND

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ATTERBERG LIMITS
- Liquid Limit
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Ankeny Pump Station
Portland, Oregon

LOG OF BORING C-1

December 2000 *F-3112.01*

SHANNON & WILSON, INC.
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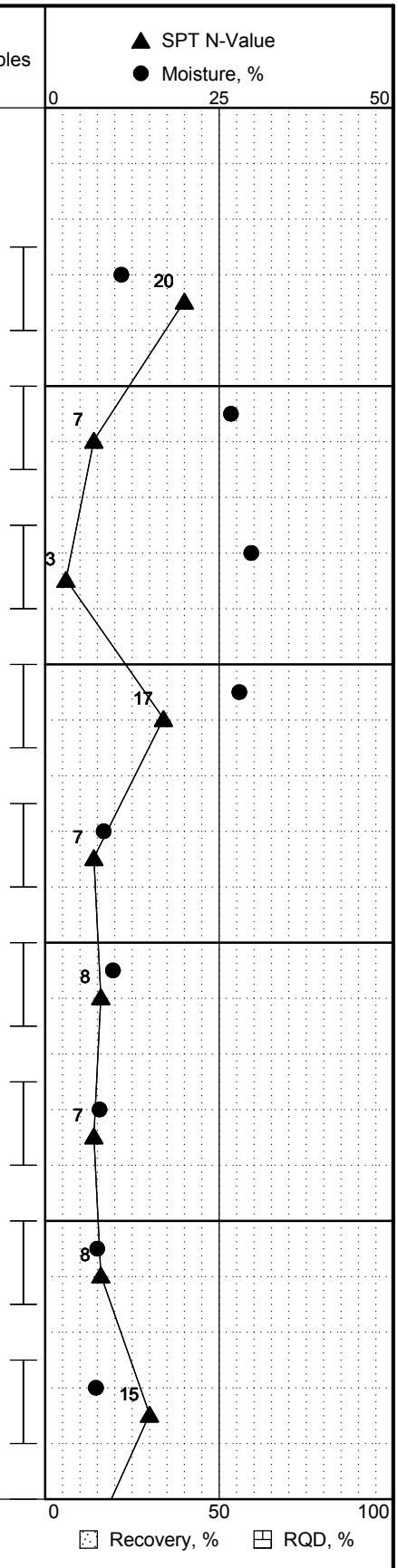
Portland, Oregon

FIG.

Log: Typ: Rev:

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Log	Depth In Feet	Samples
		32.0	**SAND FILL**, medium dense, brown, dry, fine-grained, scattered gravel, stratified silt. (Fill)		0	
		27.0			5	S-1
	Samples S-2, S-5, S-8 and S-10 taken with 3" SS and 140# hammer, n-values normalized	5.0	**Clayey SILT FILL**, stiff to soft, gray, moist, low plasticity, micaceous, scattered organics, trace metal scraps. (Fill)			S-2
						S-3
			Very stiff, slightly sandy, scattered crushed rock.		10	S-4
	-200 = 3%	19.5 12.5	**SAND FILL**, loose to medium dense, brown, moist, micaceous, fine-grained, scattered fine rounded gravel, trace clayey silt lenses. (Dredged sand fill)			S-5
	-200 = 7%				15	S-6
			2-inch Clayey SILT lens.			
	-200 = 4%					S-7
	-200 = 4%				20	S-8
			Gray, wood fragments.			
	-200 = 2%					S-9



LEGEND

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ATTERBERG LIMITS
- Liquid Limit
- Natural Water Content
- Plastic Limit

Ankeny Pump Station
Portland, Oregon

LOG OF BORING D-1

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December 2000 *F-3112.01*

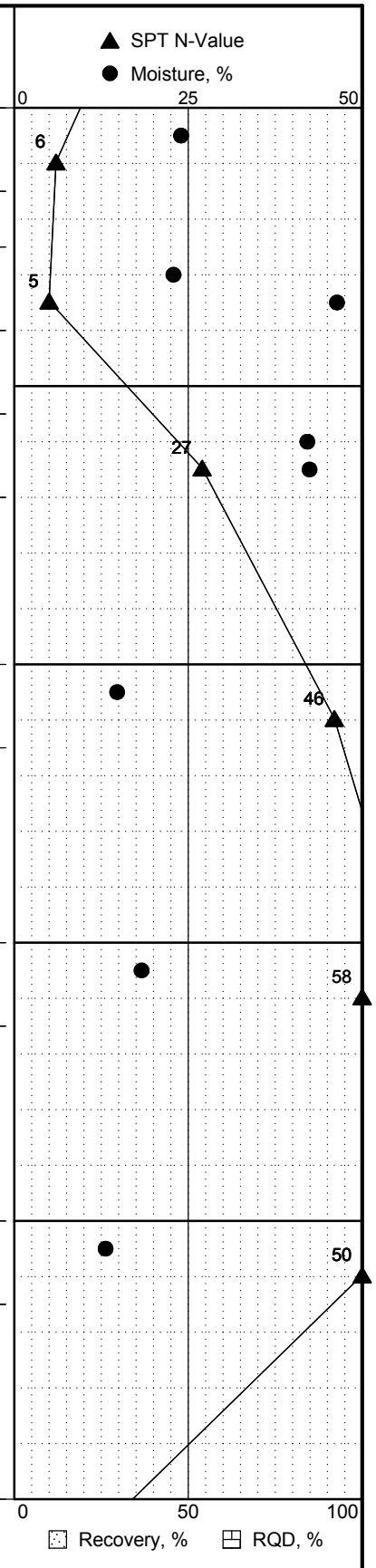
SHANNON & WILSON, INC.
Geotechnical Consultants
Portland, Oregon

FIG.

Log: Typ: Rev:

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Log	Depth In Feet	Samples
▼ 9/21/2000	-200 = 3%		Wet, some medium grained sand.			S-10
			Grading slightly silty with interstratified Clayey SILT.			
	-200 = 13%					S-11
			3-inch layer of Clayey SILT at base of fill. (Recent Alluvium)		30	
	-200 = 29%					S-12
		0.2				
		31.8	**Cobbly Sandy GRAVEL**, dense to very dense, gray and brown, wet, fine to coarse subrounded gravel, sand is fine- to medium-grained. (Pleistocene Flood Deposits)			
	-200 = 9%				35	S-13
	-200 = 67%		**Cobbly Sandy GRAVEL** continued.		40	S-14
	-200 = 5%				45	S-15
		-17.5				
		49.5	**SILT**, slightly clayey, stiff, light brown, moist, low			



LEGEND

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- * = Sample Not Recovered
- = 3.0" O.D. Split Spoon Sample
- = 3.25" O.D. Split Spoon Sample
- = Core Rock Sample

NOTE:
Lines between soil/rock units are approximate and transition may be gradual.

- Impervious Seal (Bentonite)
- Cement Grout
- Random Backfill
- Granular Backfill
- Ground Water Level on Date Shown
- Piezometer/Inclinometer Tubing
- Perforated Zone

ATTERBERG LIMITS
- Liquid Limit
- Natural Water Content
- Plastic Limit

Ankeny Pump Station
Portland, Oregon

LOG OF BORING D-1

December 2000 *F-3112.01*

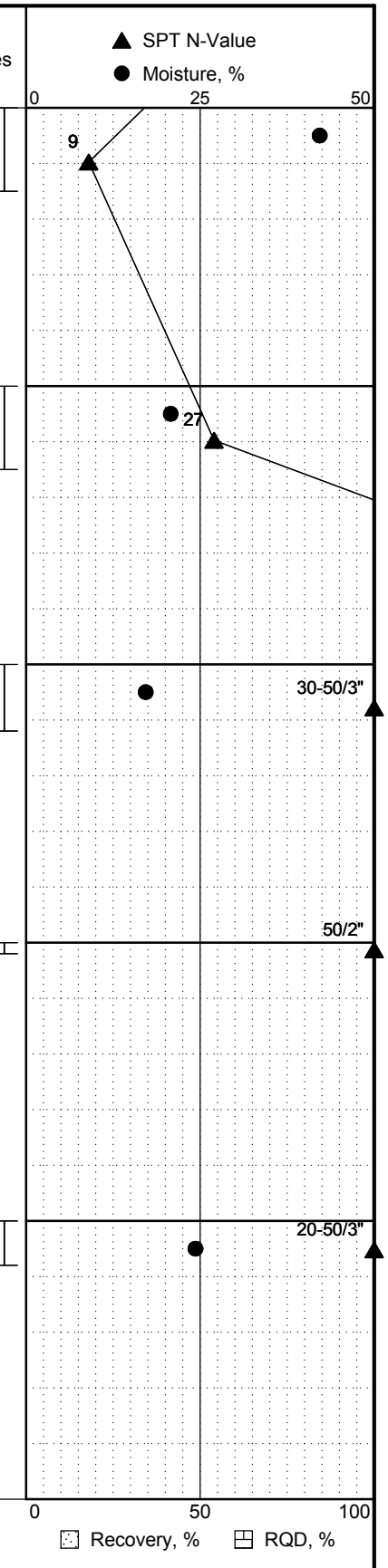
SHANNON & WILSON, INC.
Geotechnical Consultants
Portland, Oregon

FIG.

Log: Typ: Rev:

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Depth In Feet	Samples
	-200 = 99%		plasticity, micaceous. (Pleistocene Flood Deposits, silt interlayer)		S-16
		-22.0			
		54.0	**Gravelly SAND**, medium dense, gray, wet, sand is medium-grained, fine rounded gravel, gradational transition to underlying material. (Pleistocene Flood Deposits)	55	S-17
	-200 = 9%				
		-27.0			
		59.0	**Cobbly Sandy GRAVEL**, dense, gray and brown, wet, fine to coarse subrounded gravel, sand is fine- to medium-grained, poorly graded. (Pleistocene Flood Deposits)	60	S-18
		-33.0		65	S-19*
		65.0	**SAND**, slightly clayey, very dense, gray and brown, moist, fine-grained, micaceous, over-consolidated, weathered, gradational transition to underlying material. (Troutdale Formation)	70	S-20



LEGEND

- = 2.0" O.D. Split Spoon Sample
- = 3.0" O.D. Thin-Walled Sample
- * = Sample Not Recovered
- = 3.0" O.D. Split Spoon Sample
- = 3.25" O.D. Split Spoon Sample
- = Core Rock Sample

NOTE:
Lines between soil/rock units are approximate and transition may be gradual.

- Impervious Seal (Bentonite)
- Cement Grout
- Random Backfill
- Granular Backfill
- Ground Water Level on Date Shown
- Piezometer/Inclinometer Tubing
- Perforated Zone

ATTERBERG LIMITS
- Liquid Limit
- Natural Water Content
- Plastic Limit

Ankeny Pump Station
Portland, Oregon

LOG OF BORING D-1

December 2000 *F-3112.01*

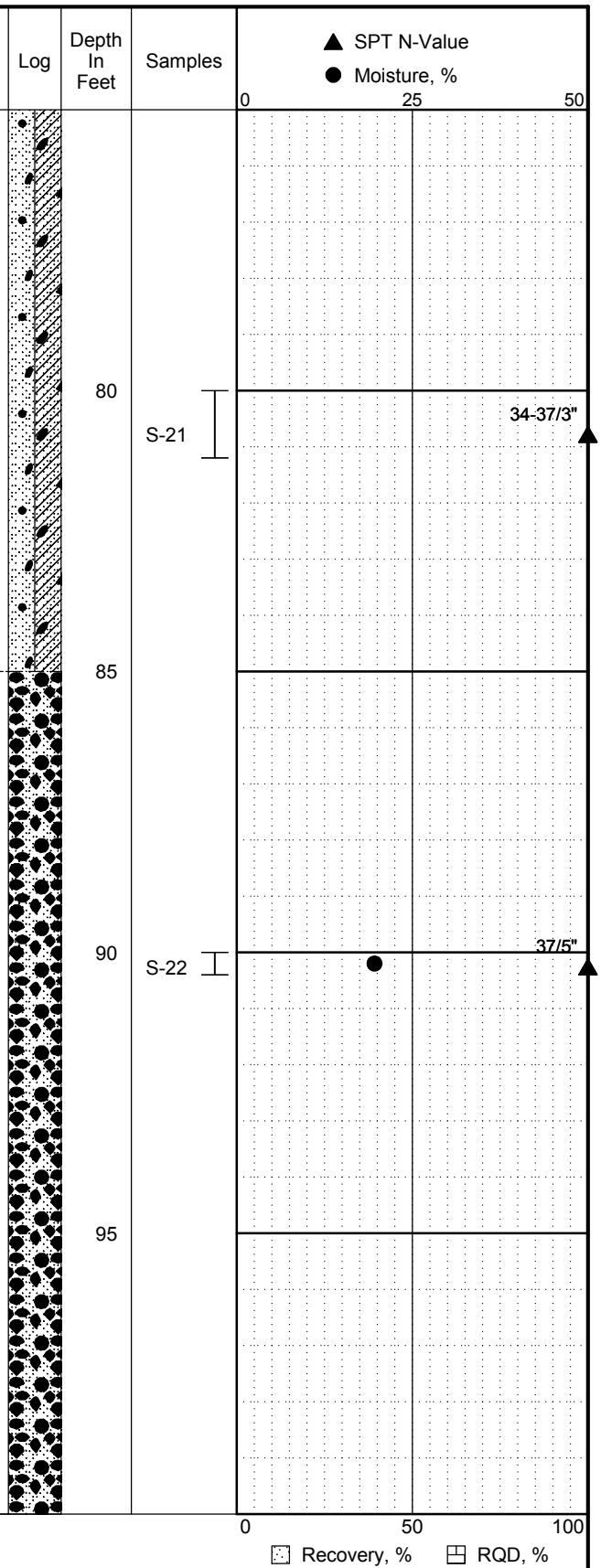
SHANNON & WILSON, INC.
Geotechnical Consultants
Portland, Oregon

FIG.

Log: Typ: Rev:

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Depth In Feet	Samples
	Wet density = 171.6 pcf		**SAND**, slightly clayey continued.	80	S-21
		-53.0			
		85.0	**Sandy GRAVEL**, slightly clayey, very dense, brown, wet, low plasticity matrix, fine to coarse rounded gravel with scattered cobbles, sand is fine- to medium-grained, over-consolidated, poorly graded. (Troutdale Formation)	85	
				90	S-22
				95	
	Hole collapsed while attempting to sample at	-68.0			



LEGEND

- = 2.0" O.D. Split Spoon Sample
- = 3.0" O.D. Thin-Walled Sample
- * = Sample Not Recovered
- = 3.0" O.D. Split Spoon Sample
- = 3.25" O.D. Split Spoon Sample
- = Core Rock Sample

NOTE:
Lines between soil/rock units are approximate and transition may be gradual.

- Impervious Seal (Bentonite)
- Cement Grout
- Random Backfill
- Granular Backfill
- Ground Water Level on Date Shown
- Piezometer/Inclinometer Tubing
- Perforated Zone

ATTERBERG LIMITS
- Liquid Limit
- Natural Water Content
- Plastic Limit

Ankeny Pump Station
Portland, Oregon

LOG OF BORING D-1

December 2000 *F-3112.01*

SHANNON & WILSON, INC.
Geotechnical Consultants
Portland, Oregon

FIG.

Log: Typ: Rev:

WLG ANKPS.GPJ 12/2/16

Ground Water	Remarks	Elev. Depth Feet	CLASSIFICATION OF MATERIAL	Log	Depth In Feet	Samples	▲ SPT N-Value ● Moisture, % 0 25 50
	100 feet.	100.0	Bottom of Boring, Completed 9/21/00				

Log: Typ: Rev:

LEGEND

- = 2.0" O.D. Split Spoon Sample
- = 3.0" O.D. Thin-Walled Sample
- * = Sample Not Recovered
- = 3.0" O.D. Split Spoon Sample
- = 3.25" O.D. Split Spoon Sample
- = Core Rock Sample

NOTE:
Lines between soil/rock units are approximate and transition may be gradual.

- Impervious Seal (Bentonite)
- Cement Grout
- Random Backfill
- Granular Backfill
- Ground Water Level on Date Shown
- Piezometer/Inclinometer Tubing
- Perforated Zone

ATTERBERG LIMITS
- Liquid Limit
- Natural Water Content
- Plastic Limit

0 50 100
Recovery, % RQD, %

Ankeny Pump Station
Portland, Oregon

LOG OF BORING D-1

Page 5 of 5

December 2000 *F-3112.01*

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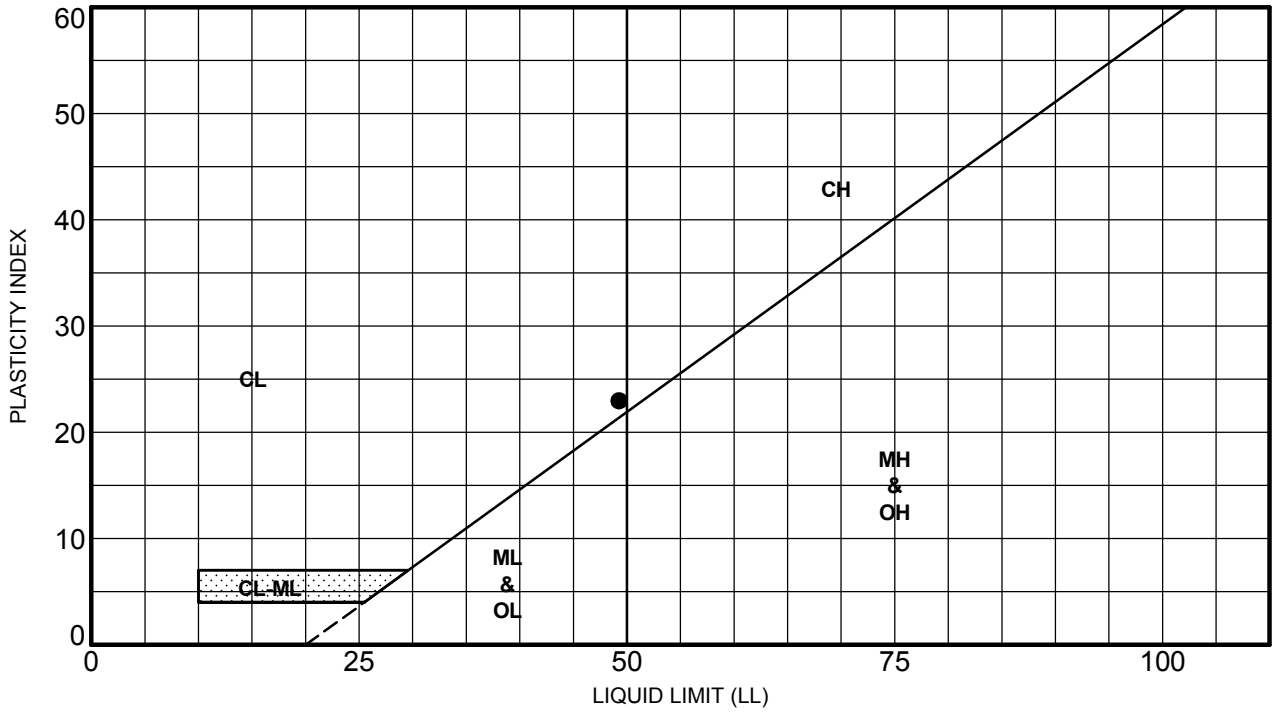
Geotechnical Consultants
Portland, Oregon

FIG.

WLG ANKPS.GPJ 12/2/16



	Hole	Depth	LL	PL	PI	wc %	Classification
●	A-1a	5.0	49	26	23		Clayey SILT, slightly sandy, medium plasticity. (S-1)

Ankeny Pump Station
Portland, Oregon

PLASTICITY CHART

December 2000 *F-3112.01*

SHANNON & WILSON, INC.
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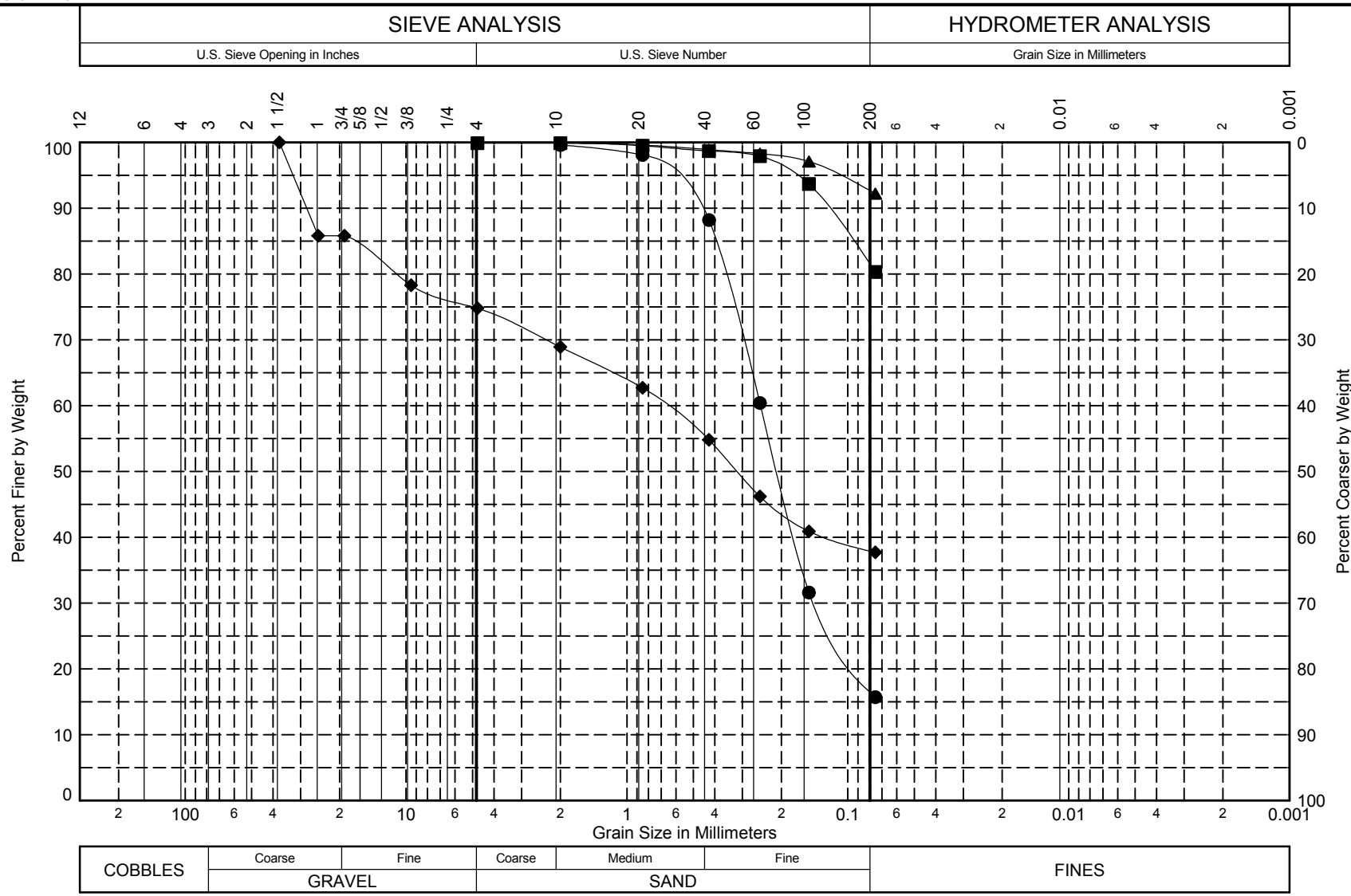
Portland, Oregon

FIG. 1

ATTCHART ANKPS.GPJ 12/1/16

GRNSIZE ANKPS.GPJ 12/1/16



Hole	Depth	USC	Classification	wc%	LL	PL	PI
● A-1	70.0		Silty SAND, brown, trace clay. (S-19)				
▲ A-1a	5.0		Clayey SILT, slightly sandy, medium plasticity. (S-1)		49	26	23
■ A-1a	10.0		Sandy Clayey SILT, brown. (S-2)				
◆ B-1	7.5		Gravelly Silty SAND, brown. (Combined S-1 - S-5)				

Ankeny Pump Station
Portland, Oregon

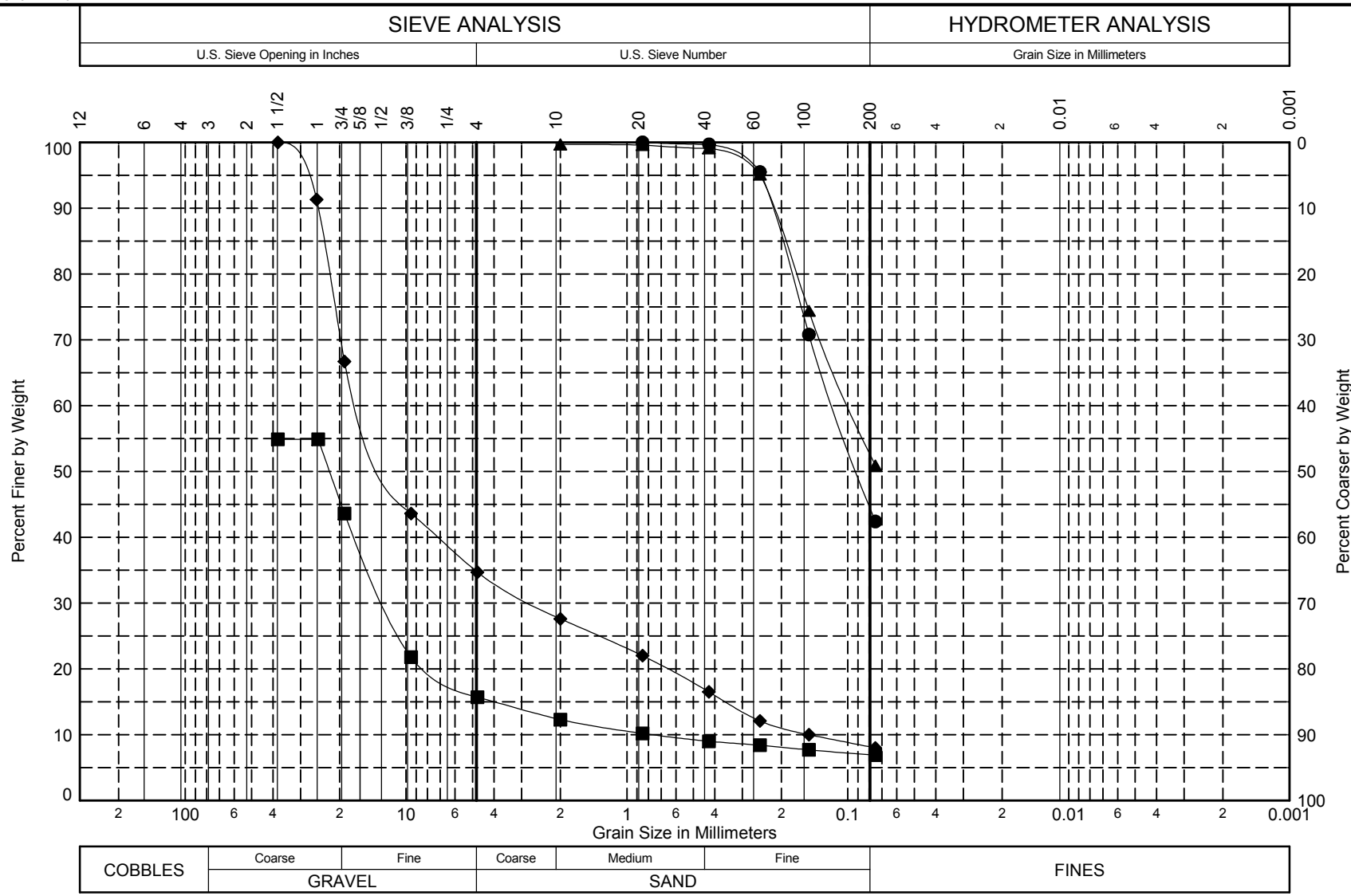
GRAIN SIZE DISTRIBUTION

December 2000 *F-3112.01*

SHANNON & WILSON, INC.
Geotechnical Consultants
Portland, Oregon

FIG. 1

GRNSIZE ANKPS.GPJ 12/1/16



Hole		Depth	USC	Classification	wc%	LL	PL	PI
●	B-1	25.0		Silty SAND, brown. (S-10a)				
▲	B-1	25.5		Sandy SILT, brown. (S-10b)				
■	B-1	35.5		GRAVEL, slightly sandy, slightly silty, brown, scattered cobbles. (S-13)				
◆	B-1	38.0		Sandy GRAVEL, slightly silty, brown. (S-14)				

Ankeny Pump Station
Portland, Oregon

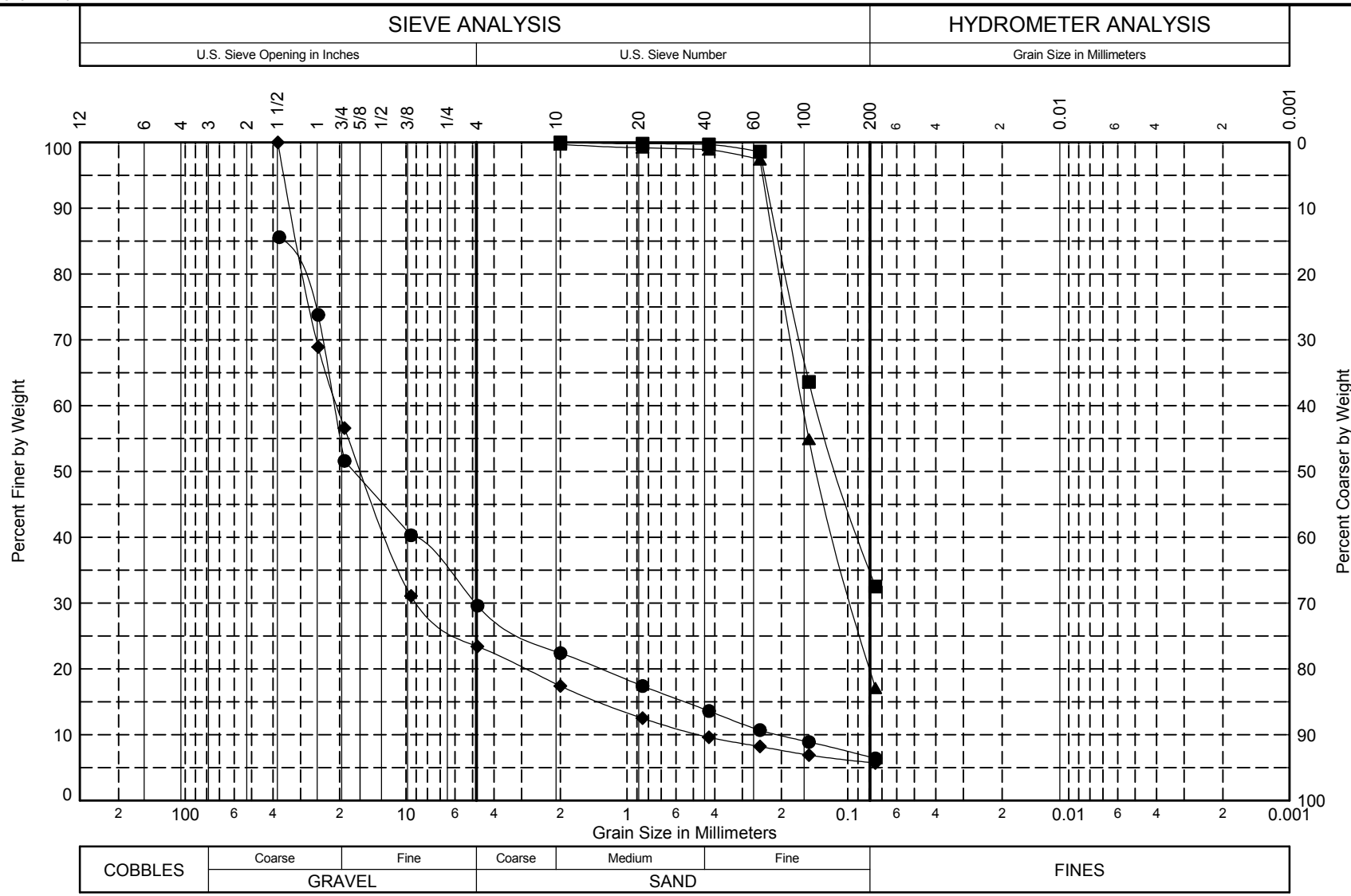
GRAIN SIZE DISTRIBUTION

December 2000 *F-3112.01*

SHANNON & WILSON, INC.
Geotechnical Consultants
Portland, Oregon

FIG. 2

GRNSIZE ANKPS.GPJ 12/1/16



Hole		Depth	USC	Classification	wc%	LL	PL	PI
●	B-1	43.0		Sandy GRAVEL, slightly silty, brown, scattered cobbles. (S-16)				
▲	B-1	47.5		Silty SAND, brown. (S-18)				
■	B-1	50.5		Silty SAND, brown, wet. (S-19)				
◆	B-1	53.0		Sandy GRAVEL, slightly silty, brown, trace clay. (S-20)				

Ankeny Pump Station
Portland, Oregon

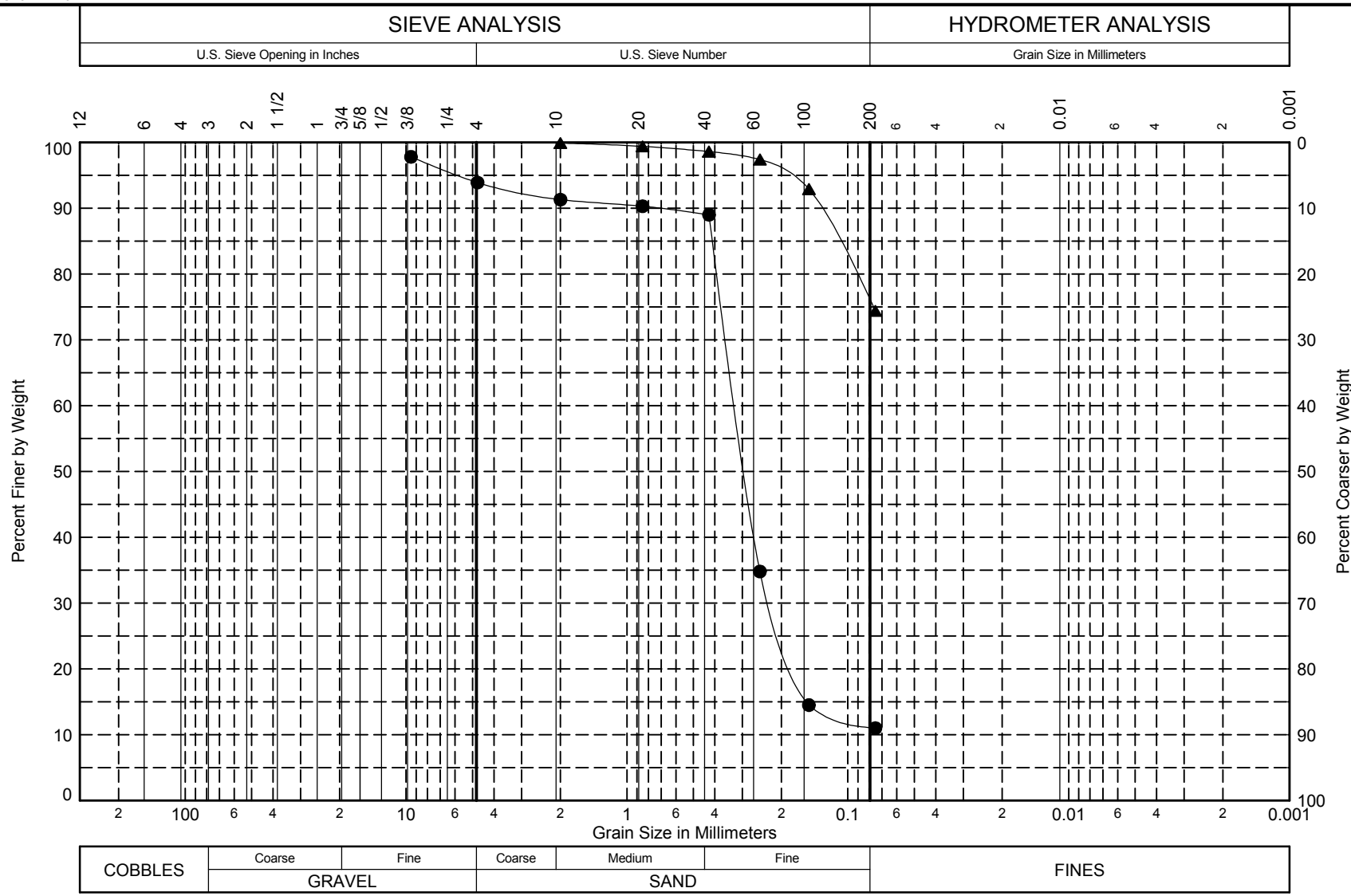
GRAIN SIZE DISTRIBUTION

December 2000 *F-3112.01*

SHANNON & WILSON, INC.
Geotechnical Consultants
Portland, Oregon

FIG. 3

GRNSIZE ANKPS.GPJ 12/1/16



Hole	Depth	USC	Classification	wc%	LL	PL	PI
● B-1	59.5		SAND, slightly silty, yellow-brown, trace clay, trace gravel. (S-23)				
▲ B-1	63.0		Sandy Clayey SILT, yellow brown. (S-24)				

Ankeny Pump Station
Portland, Oregon

GRAIN SIZE DISTRIBUTION

December 2000 *F-3112.01*

SHANNON & WILSON, INC.
Geotechnical Consultants
Portland, Oregon

FIG. 4

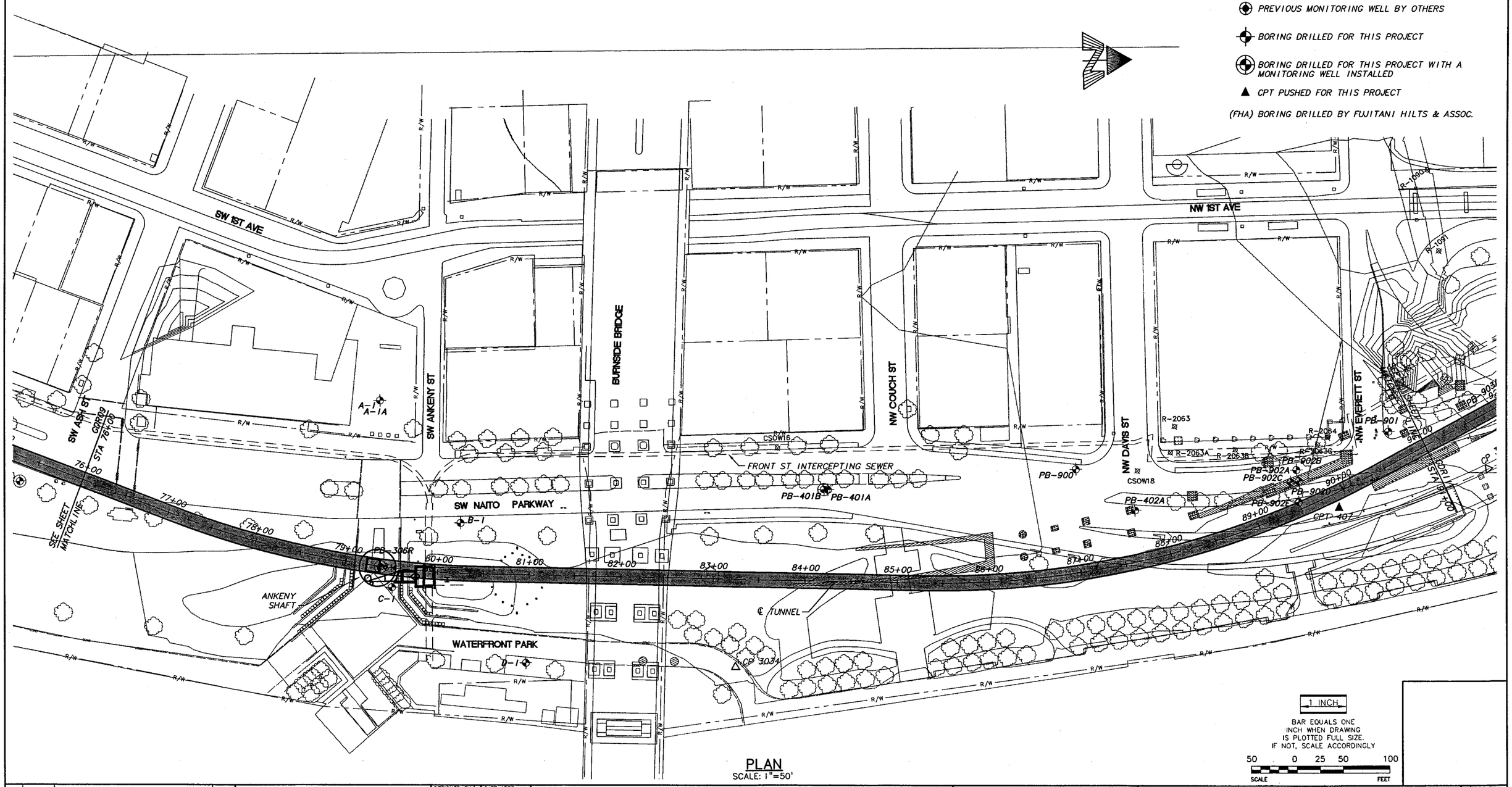
NOTES:

1. ABANDONED FOOTINGS ARE SHOWN SHADED

LEGEND

- PREVIOUS BORING BY OTHERS
- PREVIOUS MONITORING WELL BY OTHERS
- BORING DRILLED FOR THIS PROJECT
- BORING DRILLED FOR THIS PROJECT WITH A MONITORING WELL INSTALLED
- CPT PUSHED FOR THIS PROJECT

(FHA) BORING DRILLED BY FUJITANI HILTS & ASSOC.



PLAN
SCALE: 1"=50'

1 INCH

BAR EQUALS ONE INCH WHEN DRAWING IS PLOTTED FULL SIZE. IF NOT, SCALE ACCORDINGLY

50 0 25 50 100
SCALE FEET

NO.	DATE	DESCRIPTION	APPD.
		REVISION	

XREF(S) USED: 6680X01,..X02,..X10,..X11,..X12,..X13
ROTATION ANGLE: 271.68°
CONSTRUCTED BY
PROJECT COMPLETED
MAP CORRECTED BY _____ CHECKED BY _____
FINAL MAP DATA
GDR10.dwg, 05/29/02 at 09:22

DESIGNED BY SLB — DATE APPD.
DRAWN BY ASO — PROGRAM MGR. PTG
CHECKED BY MLF — CONST. MGR. PTG
DESIGN MGR. CMB — CADD MGR.

CITY OF PORTLAND
ENVIRONMENTAL SERVICES
WILLAMETTE RIVER CSO CONTROL PROJECT

PB PARSONS BRINCKERHOFF
400 S.W. Sixth Ave, Portland, OR 97204

WEST SIDE CSO PROJECT
BOREHOLE LOCATION PLAN
STA 76+00 TO STA 91+00
FIGURE 2.1

1/4 SECTION: VARIES
JOB NO.: 6680
SHEET NO.: GDR10
9 OF 23

PB PARSONS BRINCKERHOFF

BORING LOG
PB-305A

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 11/1/00 LOGGED BY AR

SHEET 1 OF 2
STATION NO. 75+37 (26 R)
SURFACE ELEV. 29.95 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobil Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. Manual 140 and 300 lb. drop

SAMPLE TYPE ☒ Ring (3.25" OD) ▮ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
						SILT (ML); low plasticity, brown and grey, moist to wet, (Topsoil).			
25	5	▮	1	4 5 12		FILL consisting of layered bricks, gravel, and wood fragments in a silt matrix; medium dense to very dense.			
20	10	▮	2	23 31 19					
15	15	▮	3	15 23 20		Drilling mud loss (200 gallons) at 17 feet.			
10	20	▮	4	5 3 1		Fill becomes very loose at 20 feet.			
						Fill becomes very dense at 25 feet.			
5	25	▮	5	10 27 23					
		☒	6	2 21 50		SILTY SAND (SM); few gravel, trace wood fragments, non-plastic silt, grey-brown, wet, very dense, (Sand/silt alluvium).		50/5"	
0	30	☒	7	34 35 31		POORLY GRADED GRAVEL WITH SAND (GP); fine to coarse grained gravel, subangular to rounded gravel, grey, wet, very dense, (Gravel alluvium), clasts consist of basalt and minor quartzite.			
		☒	8	18 29 30					
-5	35	☒	9	22 28 25		Drilling mud loss encountered at 34.5 feet.			

PB PARSONS BRINCKERHOFF

BORING LOG
PB-305A

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 11/1/00 LOGGED BY AR

SHEET 2 OF 2
STATION NO. 75+37 (26 R)
SURFACE ELEV. 29.95 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobil Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. Manual 140 and 300 lb. drop

SAMPLE TYPE ☒ Ring (3.25" OD) ▮ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	PERCENT FINES (△) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
		☒	10	40 33 24		POORLY GRADED GRAVEL WITH SAND (GP); fine to coarse grained gravel, subangular to rounded gravel, grey, wet, very dense, (Gravel alluvium), clasts consist of basalt and minor quartzite.			
-10	40	☒	11	20 20 17					
		☒	12	50				50/4"	
-15	45	☒	13	50				50/2"	
		☒	14	12 17 18	△	SILTY SAND (SM); fine to medium grained, low plasticity silt, grey-brown, wet, medium dense to dense, (Sand/silt alluvium).			
-20	50	☒	15	12 11 12	△				
		☒	16	13 17 23	△				
-25	55	☒	17	50		POORLY GRADED GRAVEL WITH COBBLES, SAND, AND SILT (GP-GM); fine to coarse grained gravel, subrounded, low plasticity silt, grey and brown, very dense, uncemented to moderately cemented, (Troutdale Formation).		50/6"	
		☒	18	21 29 50					
-30	60	☒	19	25 37 50				50/5"	
		☒	20	50				50/5"	
-35	65	☒	21	18 18 19					
		☒	22	11 13 16		POORLY GRADED SAND WITH SILT (SP-SM); fine to medium grained, low plasticity silt, grey-brown, wet, dense, (Troutdale Formation).			
-40	70	☒	23	17 16 23					
						Bottom of Boring at 71.5 feet.			

PARSONS BRINCKERHOFF

BORING LOG
PB-306R

PACRIM GEOTECHNICAL INC.
GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 027-003
DATE DRILLED 4/9/01 to 4/11/01

SHEET 1 OF 8
STATION NO. 79+38 (2' R)
SURFACE ELEV. 28.95 ft

INITIAL GWL@ 23.0 ft (4/10/01)
EQUIPMENT RotoSonic Drill
DRILLING METHOD Rotosonic - 6" OD Core Barrel
LOGGED BY KJL

SAMPLE TYPE G Grab Sample ◯ No Recovery

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	PID (ppm)	METHANE (ppm)	LAB TESTS	MOISTURE CONT.	% FINES	BOX NUMBER	LITHOLOGY	SOIL DESCRIPTION	WELL
											Grass	
				190	0						**Artificial Fill (Qaf)** POORLY GRADED SAND WITH GRAVEL (SP); 70-75% sand, fine to medium, subangular to rounded, hard, quartz and basalt, moist; 25-30% gravel, fine to coarse, subrounded to rounded. SILTY CLAY TO CLAYEY SAND WITH GRAVEL (CL-SC) and brick fragments; 45-50% silty clay, low to medium plasticity, no dilatancy; 35-40% sand, fine to medium; 10-15% gravel, brick fragments and glass shards; mottled gray and brown, moist.	
25		G	1	200	300				1			
	5										POORLY GRADED SAND WITH GRAVEL, COBBLES AND BOULDERS (SP); 70-75% sand, fine to medium, hard; 25-30% gravel, fine to coarse, cobbles to boulders, angular, moist. BOULDERS. POORLY GRADED GRAVEL (GP); 90% cobbles and boulders. Rip Rap Fill -- cobbles and boulders.	
					300							
									2		No recovery at 8 to 11 ft.	
20	10											
									3			
15	15											
									4			
10	20										TIMBER PILE.	

PARSONS BRINCKERHOFF

BORING LOG
PB-306R

PACRIM GEOTECHNICAL INC.
GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 027-003
DATE DRILLED 4/9/01 to 4/11/01

SHEET 2 OF 8
STATION NO. 79+38 (2' R)
SURFACE ELEV. 28.95 ft

INITIAL GWL@ 23.0 ft (4/10/01)
EQUIPMENT RotoSonic Drill
DRILLING METHOD Rotosonic - 6" OD Core Barrel
LOGGED BY KJL

SAMPLE TYPE G Grab Sample ◯ No Recovery

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	PID (ppm)	METHANE (ppm)	LAB TESTS	MOISTURE CONT.	% FINES	BOX NUMBER	LITHOLOGY	SOIL DESCRIPTION	WELL
▼									5		**(Qal Cont'd)**	
5	25			>1000							WOOD TIMBER PILE.	
				>1000					6			
0	30										SILTY GRAVEL WITH WOOD AND SAND (GM); 60-65% gravel, fine to coarse, subrounded to rounded, hard, predominantly basalt; 25-30% silt and pieces of wood; wet, gray.	
					450				7		**Gravel Alluvium (Qfc)** POORLY GRADED GRAVEL WITH COBBLES, SAND AND SILT (GP-GM); 70-75% gravel, fine to coarse, cobbles to 5" in diameter, hard basalt; 20-25% sand, fine to medium; 5-10% silt; gray to brown; wet.	
-5	35		2								POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP); 60-65% gravel, fine to coarse, cobbles > 6" in length, subangular to rounded, predominantly basalt and quartzite; 35-40% sand, fine to coarse; brown to reddish brown, wet.	
					600						POORLY GRADED GRAVEL WITH COBBLES AND SAND (GP); 85-90% gravel, fine to coarse, cobbles to >6" in diameter; subangular to rounded, hard, predominantly basalt, some quartzite; 10-15% sand, fine to medium, subangular to subrounded; brown, wet.	
-10	40		3		1400				8			
					1850						WELL GRADED GRAVEL WITH COBBLES AND SAND (GW); 70-75% gravel, fine to coarse, cobbles >6" in diameter, subangular to subrounded, hard, predominantly basalt, some quartzite; 25-30% sand, fine to coarse, subangular to rounded, hard, basalt and quartz; brown, wet.	
									9			
-15			4								No recovery from 44 ft to 46 ft.	

PB PARSONS BRINCKERHOFF

BORING LOG
PB-306R

PACRIM GEOTECHNICAL INC.
GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 027-003
DATE DRILLED 4/9/01 to 4/11/01

SHEET 3 OF 8
STATION NO. 79+38 (2' R)
SURFACE ELEV. 28.95 ft

INITIAL GWL@ 23.0 ft (4/10/01)
EQUIPMENT RotoSonic Drill
DRILLING METHOD Rotosonic - 6" OD Core Barrel
LOGGED BY KJL

SAMPLE TYPE G Grab Sample ◯ No Recovery

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	PID (ppm)	METHANE (ppm)	LAB TESTS	MOISTURE CONT.	% FINES	BOX NUMBER	LITHOLOGY	SOIL DESCRIPTION	WELL
											Troutdale (Tt) POORLY GRADED GRAVEL WITH COBBLES AND SAND (GP); 70-75% gravel, fine to coarse, cobbles to 5" in length, subangular to rounded, hard, predominantly basalt; 25-30% sand, fine to medium, subangular to subrounded, hard, predominantly quartz and some basalt; brown, wet, some iron staining and occasional spotty coating of fine to medium sand cemented to surface of gravel.	
					1400				10		POORLY GRADED SAND (SP); 100% sand, fine to medium, subangular to rounded, hard, predominantly quartz, some basalt and mica; yellowish brown, wet.	
-20	50	G	5		0							
					3500				11			
-25	55	G	6		>5000							
		G	7A			GSD	10	11	12		POORLY GRADED GRAVEL WITH SILTY CLAY, SAND AND COBBLES (GP-GC); 65-70% gravel, fine to coarse, cobbles to 4" in diameter, subangular to rounded, hard, quartzite and basalt; 25-30% sand, fine to medium, subangular to subrounded, hard, predominantly quartz, mica and basalt; 5-10% silty clay and silt, low to medium plasticity, no dilatancy, mottled dark gray brown, rusty brown, wet; some iron staining on gravel and some have thin spotty coating of fine to medium sand cemented to surface.	
-30	60	G	7									
									13			
-35	65	G	8								POORLY GRADED GRAVEL WITH SAND (GP); 75-80% gravel, fine to coarse, subrounded to rounded, hard, quartzite and basalt; 20-25% sand, subangular to subrounded; <5% silty clay.	
											Note: From 66' to 76', core fell out while being retrieved and was resampled out of 8" casing. It has been washed and is highly disturbed.	

PB PARSONS BRINCKERHOFF

BORING LOG
PB-306R

PACRIM GEOTECHNICAL INC.
GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 027-003
DATE DRILLED 4/9/01 to 4/11/01

SHEET 4 OF 8
STATION NO. 79+38 (2' R)
SURFACE ELEV. 28.95 ft

INITIAL GWL@ 23.0 ft (4/10/01)
EQUIPMENT RotoSonic Drill
DRILLING METHOD Rotosonic - 6" OD Core Barrel
LOGGED BY KJL

SAMPLE TYPE G Grab Sample ◯ No Recovery

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	PID (ppm)	METHANE (ppm)	LAB TESTS	MOISTURE CONT.	% FINES	BOX NUMBER	LITHOLOGY	SOIL DESCRIPTION	WELL
-40	70								14		**(Tt Cont'd)** POORLY GRADED GRAVEL WITH SILTY CLAY AND SAND (GP-GM); 60-65% gravel, fine to coarse, subangular to rounded, hard, quartzite and basalt; 25-30% sand, fine to medium; 5-15% silty clay, occurs as lenses, dark gray.	
-45	75	G	9		>5000				15		WELL GRADED GRAVEL WITH SAND (GW); 70-75% gravel, fine to coarse, subangular to rounded, hard, quartzite and basalt; 20-25% sand, fine to coarse, subangular to rounded, hard, quartz and basalt; <5% silt, some gravel has thin spotty coating of fine to medium sand cemented to the surface.	
-50	80	G	10		>5000	GSD	10	11	16		SILTY CLAYEY GRAVEL WITH SAND (GC-GM); 60-65% gravel, fine to coarse, subrounded to rounded, hard, quartzite and basalt; 20-35% sand, fine to coarse, hard, quartz, basalt and others; angular to subrounded; 10-20% silty clay, light gray to brown, wet; matrix composed of silty clayey sand with pockets/lenses of fine to coarse sand.	
					>5000							
			TUNNEL CROWN									
-55	85	G	11		>5000				17		POORLY GRADED SAND WITH SCATTERED GRAVEL (SP); 90-95% sand, fine to medium, subangular to rounded, predominantly basalt; 5-10% gravel, fine to medium, subrounded, hard, basalt and quartzite; reddish black, wet. SILTY CLAYEY GRAVEL WITH SAND (GC-GM); 70-75% gravel, fine to coarse, subrounded to rounded, hard, basalt and quartzite; 15-20% sand, fine to medium, subangular to rounded, hard, quartz and basalt; 10-15% silty clay; matrix contains pockets of clean fine to medium sand.	
					>5000							
-60		G	12						18		POORLY GRADED GRAVEL WITH SAND, SILTY CLAY AND COBBLES (GP-GM); 70-75% gravel, fine to coarse, cobbles to 4" in diameter, subangular to rounded, hard, quartzite and basalt; 15-20% sand, fine to coarse, subangular to rounded, basalt and quartz; 5-10% silty clay; matrix has pockets of fine to coarse sand, brown, wet.	

PARSONS BRINCKERHOFF

BORING LOG
PB-306R

PACRIM GEOTECHNICAL INC.
GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 027-003
DATE DRILLED 4/9/01 to 4/11/01

SHEET 5 OF 8
STATION NO. 79+38 (2' R)
SURFACE ELEV. 28.95 ft

INITIAL GWL@ 23.0 ft (4/10/01)
EQUIPMENT RotoSonic Drill
DRILLING METHOD Rotosonic - 6" OD Core Barrel
LOGGED BY KJL

SAMPLE TYPE Grab Sample No Recovery

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	PID (ppm)	METHANE (ppm)	LAB TESTS	MOISTURE CONT.	% FINES	BOX NUMBER	LITHOLOGY	SOIL DESCRIPTION	WELL
					>5000						**(Tt Cont'd)**	
											SILTY CLAY (CL); 100% silty clay, medium plasticity, no dilatancy, medium dry strength, medium toughness, dark gray, moist.	
					400				19			
-65			13			AL	43					
	95				300						POORLY GRADED GRAVEL WITH SAND (GP), trace silty clay; 75-80% gravel, fine to coarse, cobbles <4" in diameter, subangular to rounded; 15-20% sand, fine to coarse, subangular to rounded, predominantly basalt; <5% silty clay, dark gray, wet.	
					2100						POORLY GRADED GRAVEL WITH COBBLES, SAND AND SILTY CLAY (GP-GC); 70-75% gravel, fine to coarse, cobbles to 4" in diameter, subangular to rounded, hard, with basalt and quartzite, some with spotty coating of fine to medium sand cemented to surface; 10-15% sand, fine to medium, subangular to rounded; 5-10% silty clay; dark gray, wet.	
			TUNNEL INVERT									
									20			
-70			14			FC	9	9				
	100				4600							
					>5000							
									21		CLAYEY GRAVEL WITH SAND (GC); 65-70% gravel, fine to coarse; 10-20% sand, fine to medium, subangular to rounded, predominantly basalt; 10-15% silty clay; dark gray.	
-75			15		>5000	GSD	11	15				
	105										POORLY GRADED GRAVEL WITH COBBLES (GP); 95-100% gravel, fine to coarse, with cobbles > 5" in diameter, subangular to rounded, predominantly basalt with some quartzite; dark gray.	
					3700						POORLY GRADED SAND (SP); 100% sand, fine to medium, subangular, predominantly quartz, basalt and mica, grayish green/greenish gray, wet.	
									22		POORLY GRADED GRAVEL WITH COBBLES, SAND AND SILTY CLAY (GP-GC); 70-75% gravel, fine to coarse with cobbles to 5" in length, subrounded to rounded, hard, basalt and quartzite; 15-20% sand, fine to medium, hard, quartz, basalt and mica; 5-10% silty clay; some gravel has spotty coating of fine to medium sand cemented to surface.	
-80			16									
	110				2300							
					>5000							

PARSONS BRINCKERHOFF

BORING LOG
PB-306R

PACRIM GEOTECHNICAL INC.
GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 027-003
DATE DRILLED 4/9/01 to 4/11/01

SHEET 6 OF 8
STATION NO. 79+38 (2' R)
SURFACE ELEV. 28.95 ft

INITIAL GWL@ 23.0 ft (4/10/01)
EQUIPMENT RotoSonic Drill
DRILLING METHOD Rotosonic - 6" OD Core Barrel
LOGGED BY KJL

SAMPLE TYPE G Grab Sample ◯ No Recovery

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	PID (ppm)	METHANE (ppm)	LAB TESTS	MOISTURE CONT.	% FINES	BOX NUMBER	LITHOLOGY	SOIL DESCRIPTION	WELL
											(Tt Cont'd)	
-85		G	17			GSD	7	8	23			
	115				>5000							
					>5000				24		POORLY GRADED GRAVEL WITH COBBLES, SAND AND SILTY CLAY (GP-GC); 70-75% gravel, fine to coarse with cobbles to 5" in length, subrounded to rounded, hard, basalt and quartzite; 15-20% sand, fine to medium, hard, quartz, basalt and mica; 5-10% silty clay; some gravel has spotty coating of fine to medium sand cemented to surface.	
-90		G	18									
	120				>5000							
					>5000				25			
-95		G	19									
	125				4000							
					3000						Slough from 126 ft to 127.5 ft. POORLY GRADED SAND (SP); 100% sand, fine to medium, subangular to rounded, hard, quartz, basalt and others.	
-100		G	20						26		WELL GRADED GRAVEL WITH SAND (GW), trace silt and cobbles; 75-80% fine to coarse gravel, with cobbles to 5" in length, subrounded to rounded; 15-20% sand, fine to coarse, subangular to rounded, hard, basalt, quartz and others; <5% silt; dark gray, wet.	
	130				>5000							
					>5000				27		POORLY GRADED GRAVEL WITH SAND, SILT AND COBBLES (GP-GM); 65-70% gravel, fine to coarse, with occasional cobbles to 4", subrounded to rounded, hard, predominantly basalt; 20-25% sand, fine to coarse, subangular to rounded, basalt and quartz; 5-10% silt to silty clay; dark gray, wet; some gravel has spotty coating of fine to medium sand cemented to surface.	
-105		G	21			GSD	7	7				

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BORING LOG
PB-306R

PACRIM GEOTECHNICAL INC.
GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 027-003
DATE DRILLED 4/9/01 to 4/11/01

SHEET 7 OF 8
STATION NO. 79+38 (2' R)
SURFACE ELEV. 28.95 ft

INITIAL GWL@ 23.0 ft (4/10/01)
EQUIPMENT RotoSonic Drill
DRILLING METHOD Rotosonic - 6" OD Core Barrel
LOGGED BY KJL

SAMPLE TYPE: G Grab Sample; ◯ No Recovery

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	PID (ppm)	METHANE (ppm)	LAB TESTS	MOISTURE CONT.	% FINES	BOX NUMBER	LITHOLOGY	SOIL DESCRIPTION	WELL
					>5000						**(Tt Cont'd)**	
					3900						POORLY GRADED SAND (SP); with scattered gravel at top of layer; 95-100% sand, fine to medium, subangular to subrounded, hard basalt and quartz, mica; greenish gray to grayish green, wet.	
									28		Becomes dark gray poorly graded gravel with sand, silt and cobbles (GP-GM).	
110		G	22			GSD	31	67			SILTY SAND (SM-ML); 45-55% sand, fine subangular to subrounded, quartz, basalt and others; 45-55% silt, non-plastic, moderately cemented sandstone/siltstone; very dense, dry to moist.	
	140				3350							
					2600							
		G	23						29			
115												
	145				>5000						SILTY CLAYEY SAND WITH GRAVEL (SM); 55-60% sand, fine to medium; 15-20% gravel, fine to medium, subrounded to rounded; 25-30% silt and clay; greenish gray, very dense, weakly cemented conglomerate.	
					>5000						CONGLOMERATE (GC); weak to moderately indurated with angular clasts of green clayey moderately strong sandstone and matrix of gray silty clay with gravel from 146' to 147.5'.	
											CONGLOMERATE (GC); with mottled green, dark gray matrix of weakly indurated silty claystone; gravel, fine to coarse, subrounded to rounded.	
									30			
120		G	24		>5000	GSD	7	31			CLAYEY GRAVEL TO WEAK CONGLOMERATE (GC); occasional zones of moderately indurated gravel conglomerate with claystone matrix, interbedded with layers of poorly indurated/weakly cemented clayey gravel; 60-65% gravel, fine to coarse subangular to rounded; 35-40% silty clay; mottled green, dark green, dark gray, wet and occasional cobbles to 4".	
	150											
					>5000							
									31			
125		G	25									
	155				>5000							
											Sandy River Mudstone (Tsr)	

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BORING LOG
PB-306R

PACRIM GEOTECHNICAL INC.
GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 027-003
DATE DRILLED 4/9/01 to 4/11/01

SHEET 8 OF 8
STATION NO. 79+38 (2' R)
SURFACE ELEV. 28.95 ft

INITIAL GWL@ 23.0 ft (4/10/01)
EQUIPMENT RotoSonic Drill
DRILLING METHOD Rotosonic - 6" OD Core Barrel
LOGGED BY KJL

SAMPLE TYPE G Grab Sample ◯ No Recovery

ELEVATION (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	PID (ppm)	METHANE (ppm)	LAB TESTS	MOISTURE CONT.	% FINES	BOX NUMBER	LITHOLOGY	SOIL DESCRIPTION	WELL
130	160	G	26		600	AL, FC	25	93	32		SILTY CLAY (CL-ML); medium plasticity, high dry strength, no dilatancy, medium toughness, mottled rusty brown, greenish gray, gray; dry to moist; with scattered gravel at 156.5 ft. **(Tsr Cont'd)**	
											CLAYSTONE / SILTY CLAY (CL-ML); medium plasticity, medium toughness, medium to high dry strength, no dilatancy, greenish gray, dry to moist, very hard.	
135	165	G	27		0	FC	25	70	33		Occasional lense of silty sand/sandstone; 85-90% sand, fine.	
											SANDSTONE / POORLY GRADED SILTY SAND (SM); 85-90% sand, fine, subangular, predominantly quartz; 10-15% silt, non plastic. Sandstone is poorly indurated, easily carved with knife, greenish gray, very dense, dry, moderately to strongly cemented.	
140	170										Boring completed to a depth of 166 ft on 04/11/01.	
145	175											
150												

PB PARSONS BRINCKERHOFF

BORING LOG
PB-401A

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 3/6/01 LOGGED BY AR

SHEET 1 OF 3
STATION NO. 84+19 (99L)
SURFACE ELEV. 30.62 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobil Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. Manual 140 lb. drop

SAMPLE TYPE ☒ Ring (3.25" OD) ▮ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
30						ASPHALTIC CONCRETE and PORTLAND CEMENT CONCRETE, (Road Material).			
						POORLY GRADED GRAVEL WITH SAND (GP); angular gravel, grey to red, moist, dense, numerous brick fragments, (Fill).			
25	5		1	24 28 17					
						SILT (ML); trace fine sand, low plasticity, brown, moist, stiff, (Sand/Silt Alluvium).			
20	10		2	4 5 7					
	15		3	2 3 3		Soil becomes medium stiff and increases in sand content below 15 feet.			
15			4			SILT (ML); low plasticity, brown, moist, medium stiff, (Sand/Silt Alluvium).			
10	20		5	3 3 3					
	25		6	1 2 5		SILTY SAND (SM); fine sand, non plastic to low plasticity, brown, wet, medium dense, (Sand/Silt Alluvium)			
5			7						
			8	30 50		SILTY GRAVEL WITH SAND (GM); some sand, fine to coarse subrounded gravel, low plasticity fines, brown, wet, very dense, (Gravel Alluvium).		50/5"	
0	30								
	35		9	50		POORLY GRADED GRAVEL WITH SAND (GP); trace silt, fine to coarse subrounded gravel, grey, wet, very dense, (Gravel Alluvium).		50/5½"	
-5									

PB PARSONS BRINCKERHOFF

BORING LOG
PB-401A

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 3/6/01 LOGGED BY AR

SHEET 2 OF 3
STATION NO. 84+19 (99L)
SURFACE ELEV. 30.62 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobil Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. Manual 140 lb. drop

SAMPLE TYPE ☒ Ring (3.25" OD) ▮ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
-10	40		10	50		POORLY GRADED GRAVEL WITH SAND (GP); trace silt, fine to coarse subrounded gravel, grey, wet, very dense, (Gravel Alluvium).		50/4"	
-15	45		11	41 50		POORLY GRADED GRAVEL WITH SAND (GP); trace silt, fine to coarse rounded gravel, grey-orange, wet, very dense, (Troutdale Formation).		50/3½"	
-20	50		12	7 12 14		SILT (ML); some clay, medium plasticity, brown, wet, stiff, (Troutdale Formation).			
-25	55		13 14	6 12 21		POORLY GRADED SAND (SP); trace silt, fine to medium sand, grey, wet, dense, (Troutdale Formation).			
-30	60		15	40 37 37		Little fine to coarse rounded gravel below 60 feet.			
-35	65		16	50		POORLY GRADED GRAVEL WITH SAND (GP); trace silt, some fine to coarse sand, fine to coarse rounded gravel, grey to brown, wet, very dense, (Troutdale Formation).		50/2½"	
-40	70		17	50				50/2"	

PB PARSONS BRINCKERHOFF

BORING LOG
PB-401A

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 3/6/01 LOGGED BY AR

SHEET 3 OF 3
STATION NO. 84+19 (99L)
SURFACE ELEV. 30.62 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobil Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. Manual 140 lb. drop

SAMPLE TYPE ☒ Ring (3.25" OD) ▮ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
-45		■	18	50		Lense of sand with gravel at 75 feet.		50/4½"	
	80	■	19	50		POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse rounded gravel, low plasticity fines, yellow-brown to grey, wet, very dense, weak cementation, (Troutdale Formation).		50/4½"	
-50						Bottom of boring at 80.33 feet.			
	85					**TUNNEL CROWN**			
-55									
	90								
-60									
	95								
-65									
	100					**TUNNEL INVERT**			
-70									
	105								
-75									
	110								
-80									

PB PARSONS BRINCKERHOFF

BORING LOG
PB-401B

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 3/15/01 LOGGED BY AR

SHEET 1 OF 4
STATION NO. 84+23 (99L)
SURFACE ELEV. 30.66 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobile Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. Manual 140 and 300 lb. drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	△ PERCENT FINES △ 20 40 60 80 PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
30						Drilled 0 to 85 feet without sampling. Material description between 0 and 80 feet is show on PB-401A.			
25	5								
20	10								
15	15								
10	20								
5	25								
0	30								
-5	35								

PB PARSONS BRINCKERHOFF

BORING LOG
PB-401B

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 3/15/01 LOGGED BY AR

SHEET 2 OF 4
STATION NO. 84+23 (99L)
SURFACE ELEV. 30.66 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobile Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. Manual 140 and 300 lb. drop

SAMPLE TYPE ☒ Ring (3.25" OD) ▌ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	△ PERCENT FINES △ 20 40 60 80 PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
-10	40					Drilled 0 to 85 feet without sampling. Material description between 0 and 80 feet is show on PB-401A.			
-15	45								
-20	50								
-25	55								
-30	60								
-35	65								
-40	70								

PARSONS BRINCKERHOFF

BORING LOG
PB-401B

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 3/15/01 LOGGED BY AR

SHEET 3 OF 4
STATION NO. 84+23 (99L)
SURFACE ELEV. 30.66 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobile Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. Manual 140 and 300 lb. drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
-45						Drilled 0 to 85 feet without sampling. Material description between 0 and 80 feet is show on PB-401A.			
-50	80					POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse rounded gravel, grey-brown, wet, very dense, weakly cemented, (Troutdale Formation).			
	85		1	50	TUNNEL CROWN			50/2"	
-55			2	50				50/4"	
	90		3	17 50		SILT (ML) some clay, low to medium plasticity, grey, wet, hard, (Troutdale Formation).		50/4"	
-60			4	50		POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse rounded gravel, grey-brown, wet, very dense, weakly cemented, (Troutdale Formation).		50/1"	
	95		5	50				50/0"	
-65			6	50		Falling head permeability test conducted at 97.5 to 99.5 ft. Hydraulic conductivity is approx. 5E-06 cm/sec		50/0"	
	100		7	50	TUNNEL INVERT			50/2"	
-70			8	50		Becomes dark green to grey below 102 feet.		50/3"	
	105		9	50				50/2½"	
-75			10	50				50/2"	
	110		11	50		Falling head permeability test conducted at 110 to 112 ft. Hydraulic conductivity is approx. 3E-06 cm/sec		50/1"	
-80									

PB PARSONS BRINCKERHOFF

BORING LOG
PB-401B

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 3/15/01 LOGGED BY AR

SHEET 4 OF 4
STATION NO. 84+23 (99L)
SURFACE ELEV. 30.66 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobile Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. Manual 140 and 300 lb. drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
			12	50		POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse rounded gravel, dark grey to green, wet, very dense, weakly cemented, (Troutdale Formation).		50/1"	
-85	115		13	50				50/2"	
			14	50				50/2½"	
-90	120		15	50				50/1"	
			16	50				50/2½"	
-95	125		17	50				50/1"	
			18	50				50/3½"	
-100	130		19	50		Trace clay encountered below 130 feet.		50/3½"	
-105	135		20	50				50/4"	
-110	140		21	50		Bottom of boring at 140.5 feet.		50/5¾"	
-115	145								

PB PARSONS BRINCKERHOFF

BORING LOG
PB-402A

Foundation Engineering, Inc

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 10/17/00 LOGGED BY AR

SHEET 1 OF 3
STATION NO. 87+72 (55 L)
SURFACE ELEV. 31.9 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobil Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. Manual 140 lb. drop

SAMPLE TYPE ☒ Ring (3.25" OD) ▮ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
30						ASPHALTIC CONCRETE AND PORTLAND CEMENT CONCRETE (Road surface). GRAVELLY SILT WITH SAND (ML); fine to coarse grained sand, angular gravel, low plasticity, grey-brown, moist, medium stiff, (Fill).			
25	5		1	6 4 3					
20	10		2	0 1 2		Scattered wood fragments encountered at 9 feet. Fill becomes soft with few gravel below 10 feet.			
15	15		3	9 8 8		Interbedded SANDY SILT and SILTY SAND (SM/ML); fine grained sand, low plasticity silt, grey and brown, wet, medium stiff/medium dense, stratified, (Sand/silt alluvium).			
10	20		4	13 9 10					
5	25		5	3 4 3					
0	30		6	2 4 9					
	35		7	11 8 9					
-5			8*	16 14 11		* 3 inch sampler/140 lb hammer			

PB PARSONS BRINCKERHOFF

BORING LOG
PB-402A

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 10/17/00 LOGGED BY AR

SHEET 2 OF 3
STATION NO. 87+72 (55 L)
SURFACE ELEV. 31.9 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobil Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. Manual 140 lb. drop

SAMPLE TYPE ☒ Ring (3.25" OD) ▮ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	PERCENT FINES (△) 20 40 60 80 / PLASTIC — M.C. — LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
		■	9	5 6 7		Interbedded SANDY SILT and SILTY SAND (SM/ML); fine grained sand, low plasticity silt, grey and brown, wet, medium stiff/medium dense, stratified, (Sand/silt alluvium).			
	40	☒	10*	4 5 10	△				
-10		■	11	2 2 3					
	45	■	12	2 2 2	⊢●⊣	SILT AND ELASTIC SILT (MH); few to little fine sand, low plasticity, grey, wet, soft becoming medium stiff to stiff, (Sand/silt alluvium).			
-15		■	13	2 3 5					
	50	☒	14*	5 12 12	● △	Scattered wood fragments encountered below 50 feet.			
-20		■	15	7 11 8					
	55	■	16	2 4 5	⊢●⊣				
-25		■	17	6 5 5					
	60	■	18	4 4 4					
-30		■	19	2 3 3					
	65	☒	20*	6 8 8					
-35		☒	21*	6 11 11					
	70	■	22	7 6 6		* 3 inch sampler/140 lb hammer			
-40		☒	23*	8 19 18					

PB PARSONS BRINCKERHOFF

BORING LOG
PB-402A

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 10/17/00 LOGGED BY AR

SHEET 3 OF 3
STATION NO. 87+72 (55 L)
SURFACE ELEV. 31.9 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobil Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. Manual 140 lb. drop

SAMPLE TYPE ☒ Ring (3.25" OD) ▮ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
-45	80	▮	24	3 3 4					
		▮	25	3 4 4					
-50	85					Bottom of Boring at 81.5 feet.			
-55						**TUNNEL CROWN**			
	90								
-60									
	95								
-65									
	100								
-70						**TUNNEL INVERT**			
	105								
-75									
	110								
-80									

PB PARSONS BRINCKERHOFF

BORING LOG
PB-900

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 9/20/00 LOGGED BY AR

SHEET 1 OF 3
STATION NO. 87+12 (111 L)
SURFACE ELEV. 30.2 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobil Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. None

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
30						AC and PCC (Road surface).			
						BASEROCK (Road material). No sampling during drilling. Soil identification based on cuttings and drilling action.			
25	5					Interbedded SILTY SAND and SANDY SILT (ML/SM); fine grained sand, low plasticity silt, stratified, (Fill over alluvium).			
20	10								
15	15								
10	20								
5	25								
0	30								
-5	35					Wood chips encountered between 35 and 35.5 feet followed by a 3 inch gravel layer. Wood encountered between 36 and 39 feet.			

PB PARSONS BRINCKERHOFF

BORING LOG
PB-900

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 9/20/00 LOGGED BY AR

SHEET 2 OF 3
STATION NO. 87+12 (111 L)
SURFACE ELEV. 30.2 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobil Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. None

SAMPLE TYPE ☒ Ring (3.25" OD) ▮ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	△ PERCENT FINES △ 20 40 60 80 PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
-10	40					Interbedded SANDY SILT AND SILTY SAND (ML/SM), trace wood fragments; fine grained sand, low plasticity silt, stratified, (Sand/silt alluvium).			
-15	45								
-20	50								
-25	55								
-30	60					Few to little organics encountered below 60 feet.			
-35	65								
-40	70					Gravel lense encountered at 73 feet.			

PB PARSONS BRINCKERHOFF

BORING LOG
PB-900

Foundation Engineering, Inc.

PROJECT West Side CSO Project
CITY Portland, Oregon
PROJECT NO. 2002013
DATE DRILLED 9/20/00 LOGGED BY AR

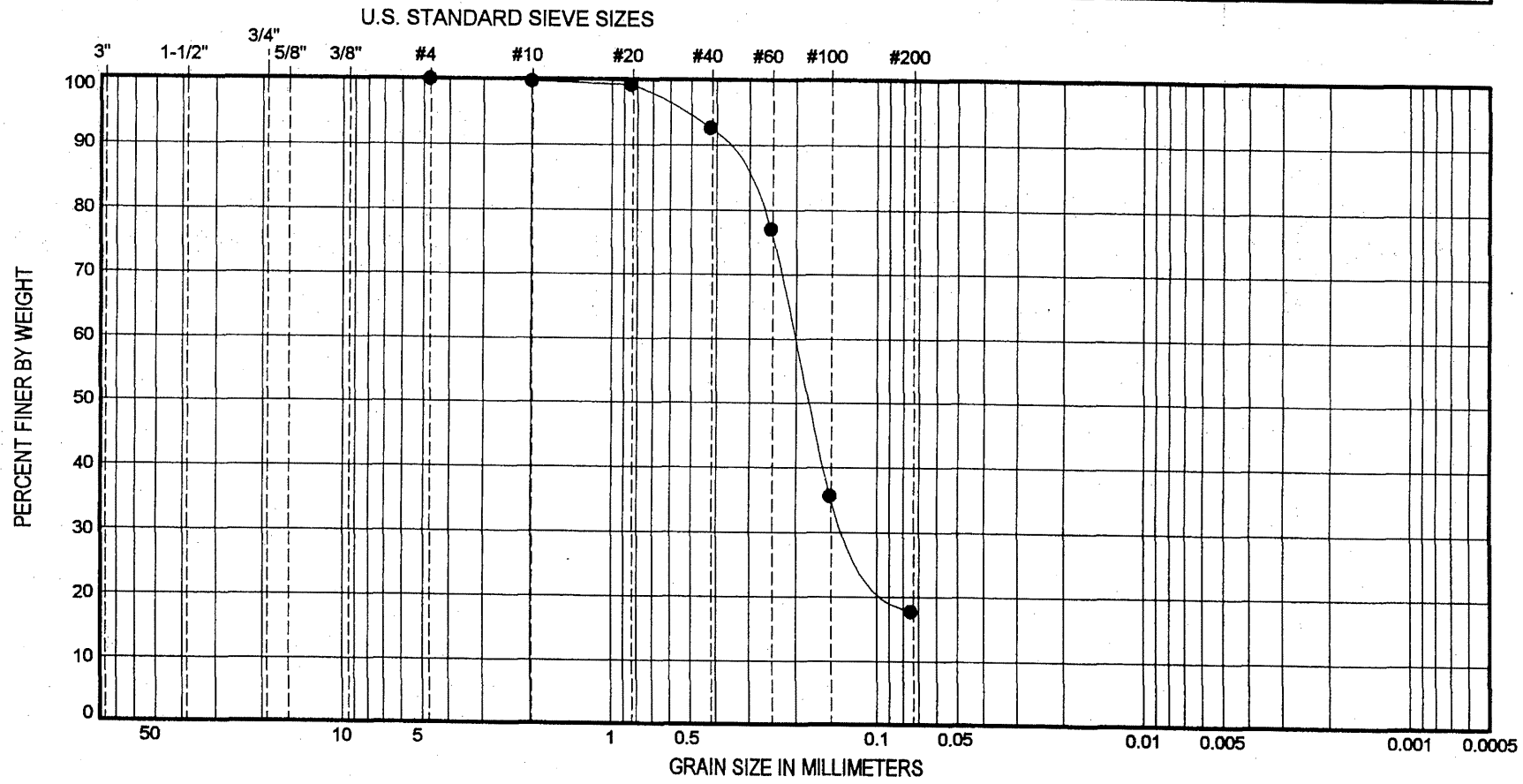
SHEET 3 OF 3
STATION NO. 87+12 (111 L)
SURFACE ELEV. 30.2 ft

INITIAL GWL@ Not Available
EQUIPMENT Mobil Drill B-59
DRILLING METHOD Mud Rotary
HAMMER SYS. None

SAMPLE TYPE ☒ Ring (3.25" OD) ▮ Standard Penetration Test (2" OD) ■ Shelby Tube

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	△ PERCENT FINES △ 20 40 60 80 PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
-45						Interbedded SANDY SILT AND SILTY SAND (ML/SM), trace wood fragments; fine grained sand, low plasticity silt, stratified, (Sand/silt alluvium).			
-50	80					Bottom of Boring at 80 feet.			
-55	85					**TUNNEL CROWN**			
-60	90								
-65	95								
-70	100					**TUNNEL INVERT**			
-75	105								
-80	110								

GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		



SYMBOL	SAMPLE		DEPTH	CLASSIFICATION	% MC	LL	PL	PI	% Gravel	% Sand	% Fines
●	PB-305A	DM-305-14	47.5 - 49.0	SILTY SAND (SM)	36.3				0.0	82.3	17.7

FOUNDATION ENGINEERING INC.
PROFESSIONAL GEOTECHNICAL SERVICES

West Side CSO Project

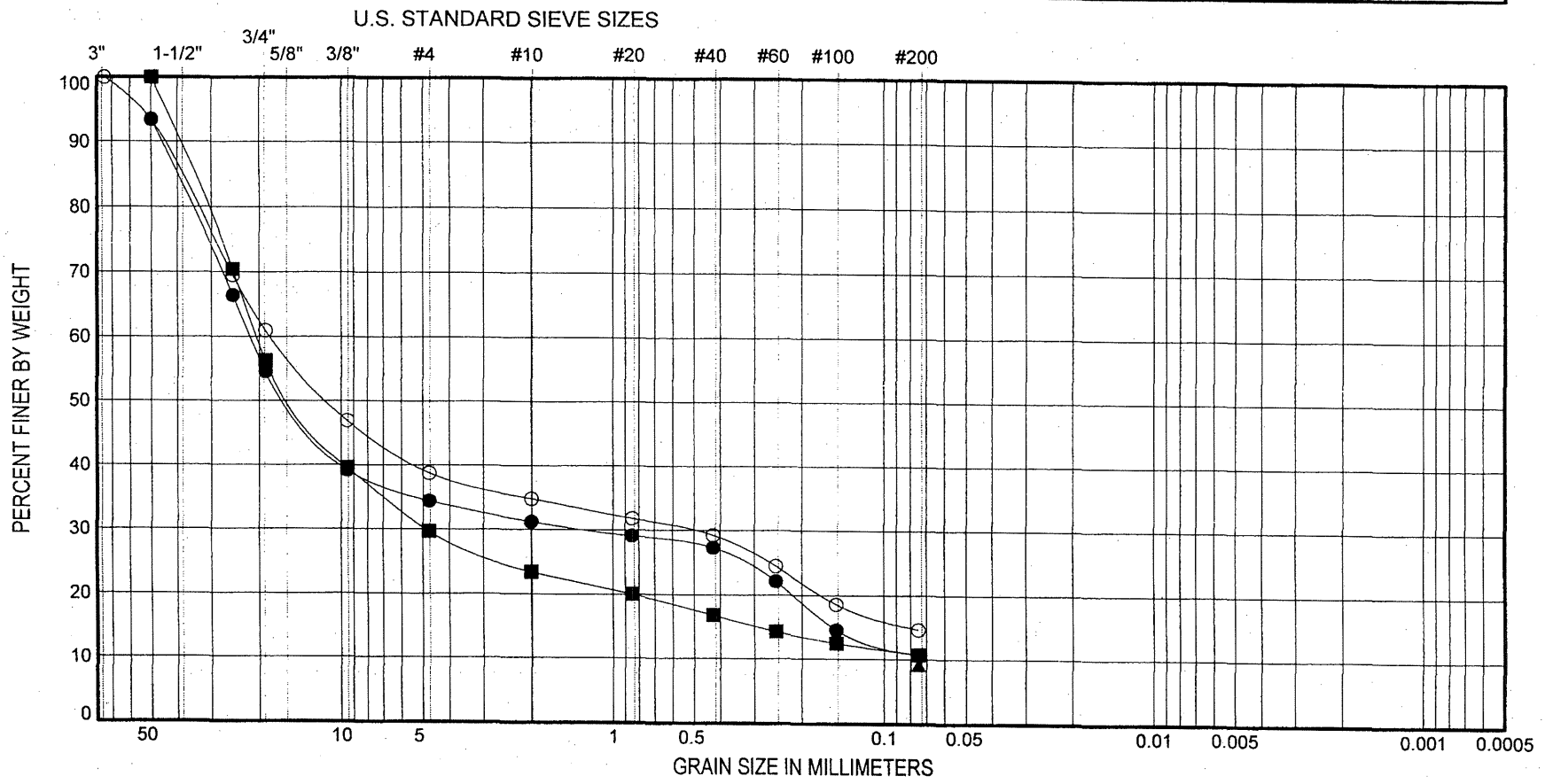
Parsons Brinkerhoff

GRAIN SIZE ANALYSIS TEST RESULTS

Project No. 2002013

FIGURE

GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Gravel	% Sand	% Fines
●	PB-306R	7A	58.0 - 58.5	Poorly graded GRAVEL with cobbles, sand, and clay (GP-GC) (Tt)	10				59	24	11
■	PB-306R	10	79.0 - 79.5	Poorly graded GRAVEL with sand and silt (GP-GM) (Tt)	10				70	19	11
▲	PB-306R	14	99.0 - 99.5	Poorly graded GRAVEL with sand and clay (GP-GC) (Tt)	9						9
○	PB-306R	15	104.0 - 104.5	Clayey GRAVEL (GC) (Tt)	11				61	24	15

PACRIM GEOTECHNICAL INC.
GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

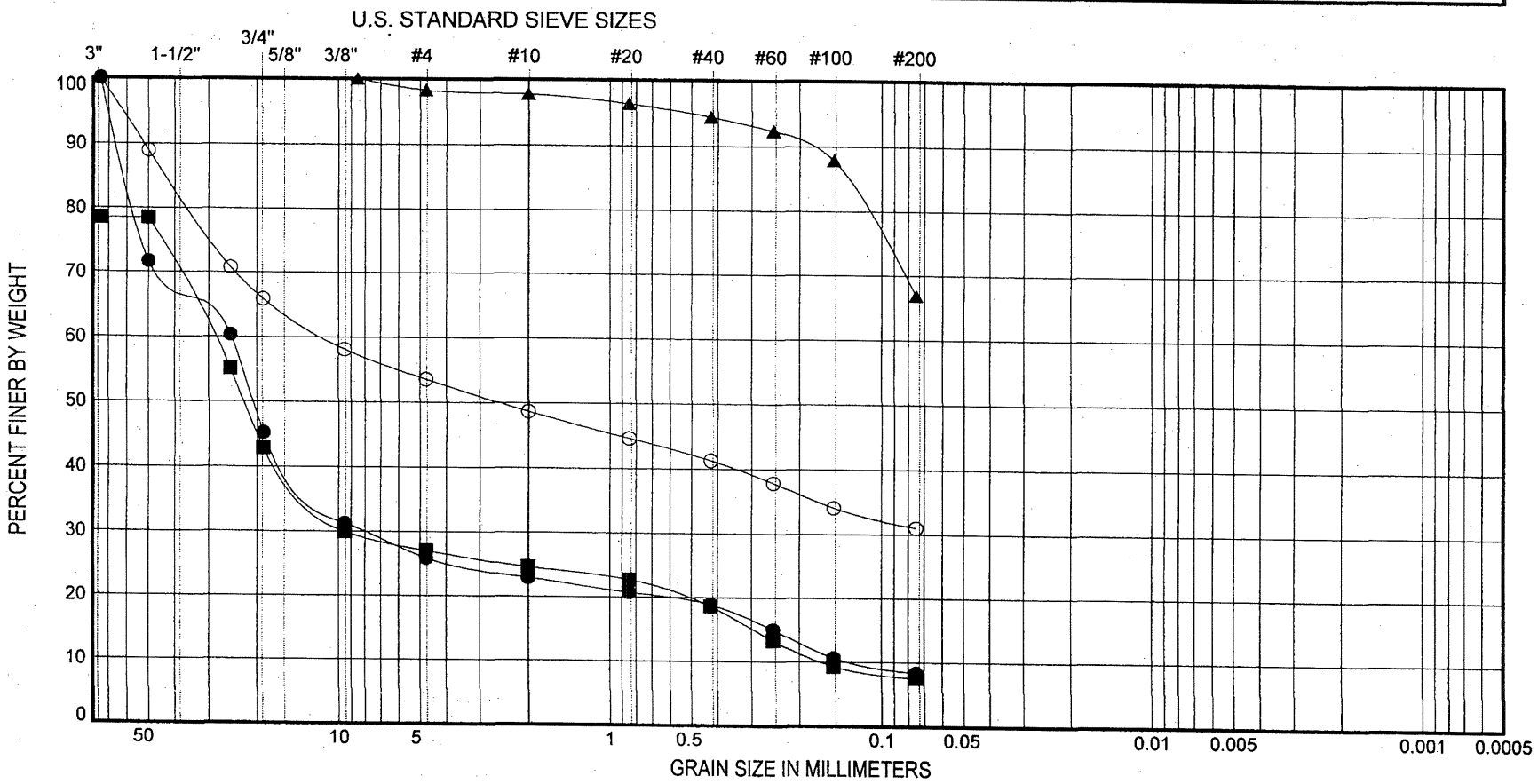
West Side CSO Project

Parsons Brinckerhoff

GRAIN SIZE ANALYSIS TEST RESULTS

Project No. 027-003

GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Gravel	% Sand	% Fines
●	PB-306R	17	114.0 - 114.5	Poorly graded GRAVEL with sand and silt (GP-GM) (Tt)	7				74	18	8
■	PB-306R	21	134.0 - 134.5	Poorly graded GRAVEL with cobbles, sand, and silt (GP-GM) (Tt)	7				51	20	7
▲	PB-306R	22	139.0 - 139.5	Sandy SILT (ML) (SRM)	31				2	31	67
○	PB-306R	24	149.0 - 149.5	Clayey GRAVEL with sand (GC) (SRM)	7				46	23	31

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GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

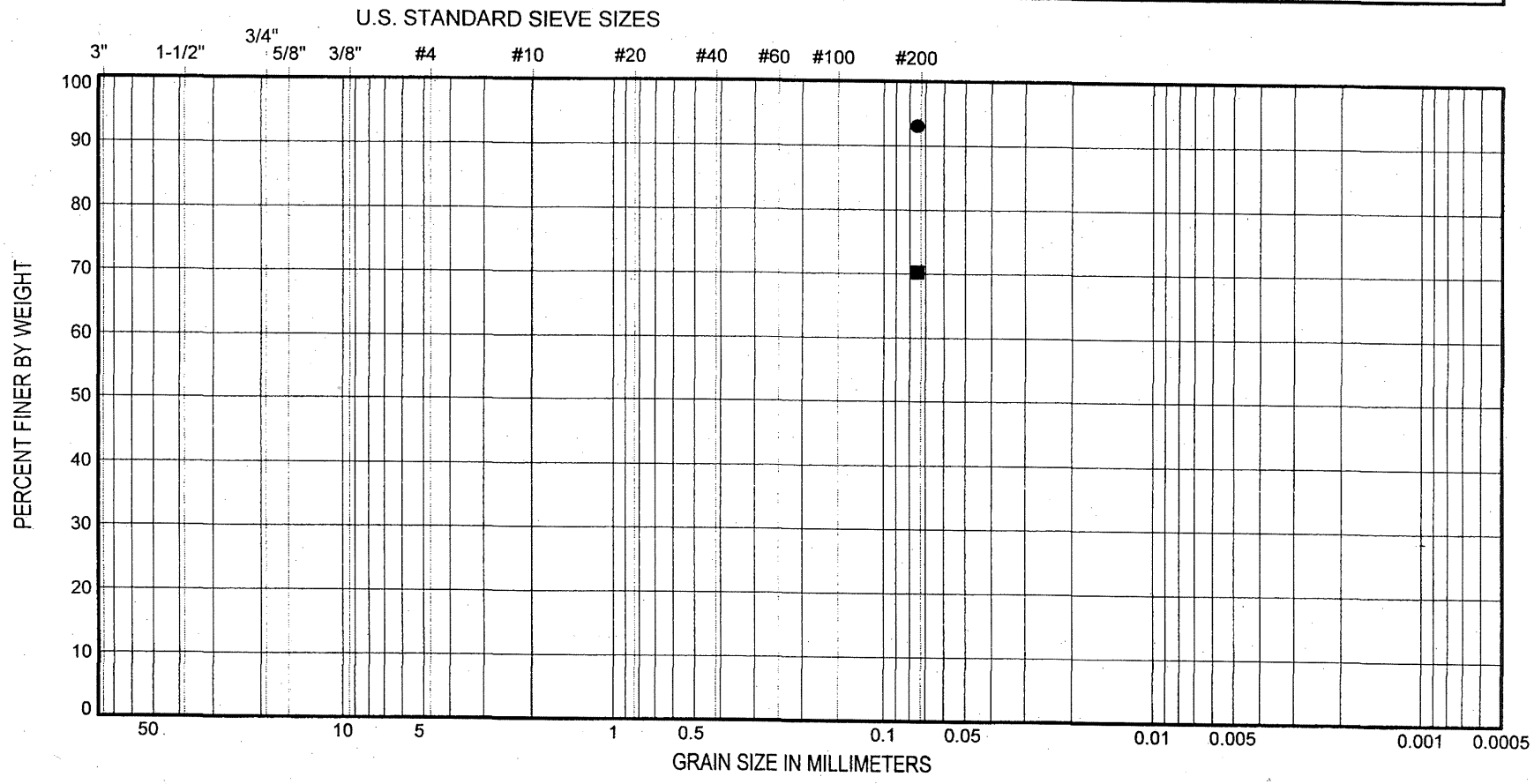
West Side CSO Project

Parsons Brinckerhoff

GRAIN SIZE ANALYSIS TEST RESULTS

Project No. 027-003

GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Gravel	% Sand	% Fines
●	PB-306R	26	159.0 - 159.5	Silty CLAY (CH) (SRM)	25	65	19	46			93
■	PB-306R	27	164.0 - 164.5	Claystone / Silty CLAY (CL-ML) (SRM)	25						70

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West Side CSO Project

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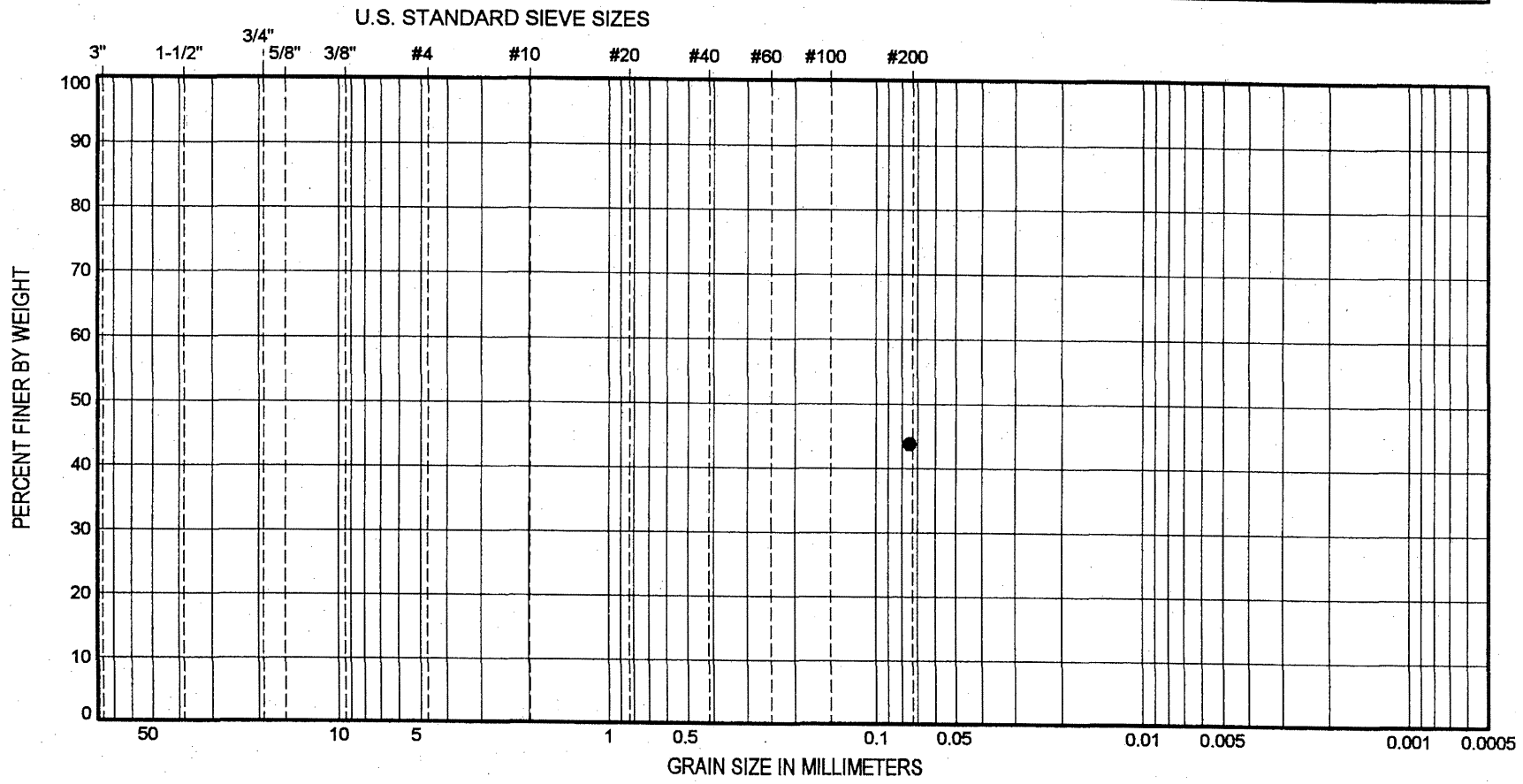
GRAIN SIZE ANALYSIS TEST RESULTS

Project No. 027-003

GRAVEL		SAND			SILT	CLAY
Coarse	Fine	Coarse	Medium	Fine		



SYMBOL	SAMPLE		DEPTH	CLASSIFICATION	% MC	LL	PL	PI	% Gravel	% Sand	% Fines
●	PB-402A	DM-402-10	40.0 - 41.5	SILTY SAND (SM)	47.0						43.8

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West Side CSO Project

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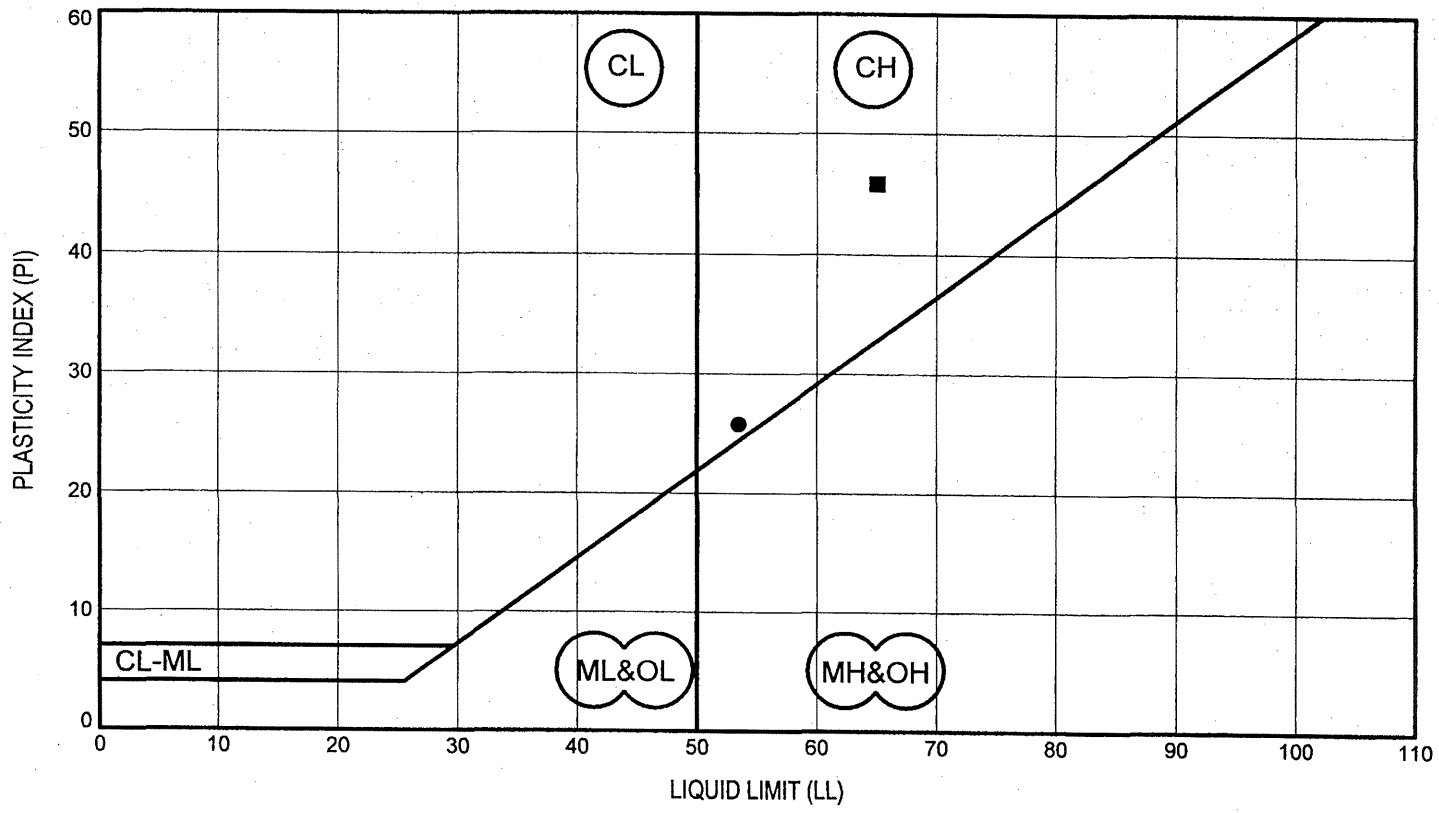
GRAIN SIZE ANALYSIS TEST RESULTS

Project No. 2002013

FIGURE



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Fines
●	PB-306R	13	94.0 - 94.5	Silty CLAY (CH) (Tt)	43	53	28	25	
■	PB-306R	26	159.0 - 159.5	Silty CLAY (CH) (SRM)	24	65	19	46	93

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GEOTECHNICAL ENGINEERING AND APPLIED EARTH SCIENCES

West Side CSO Project

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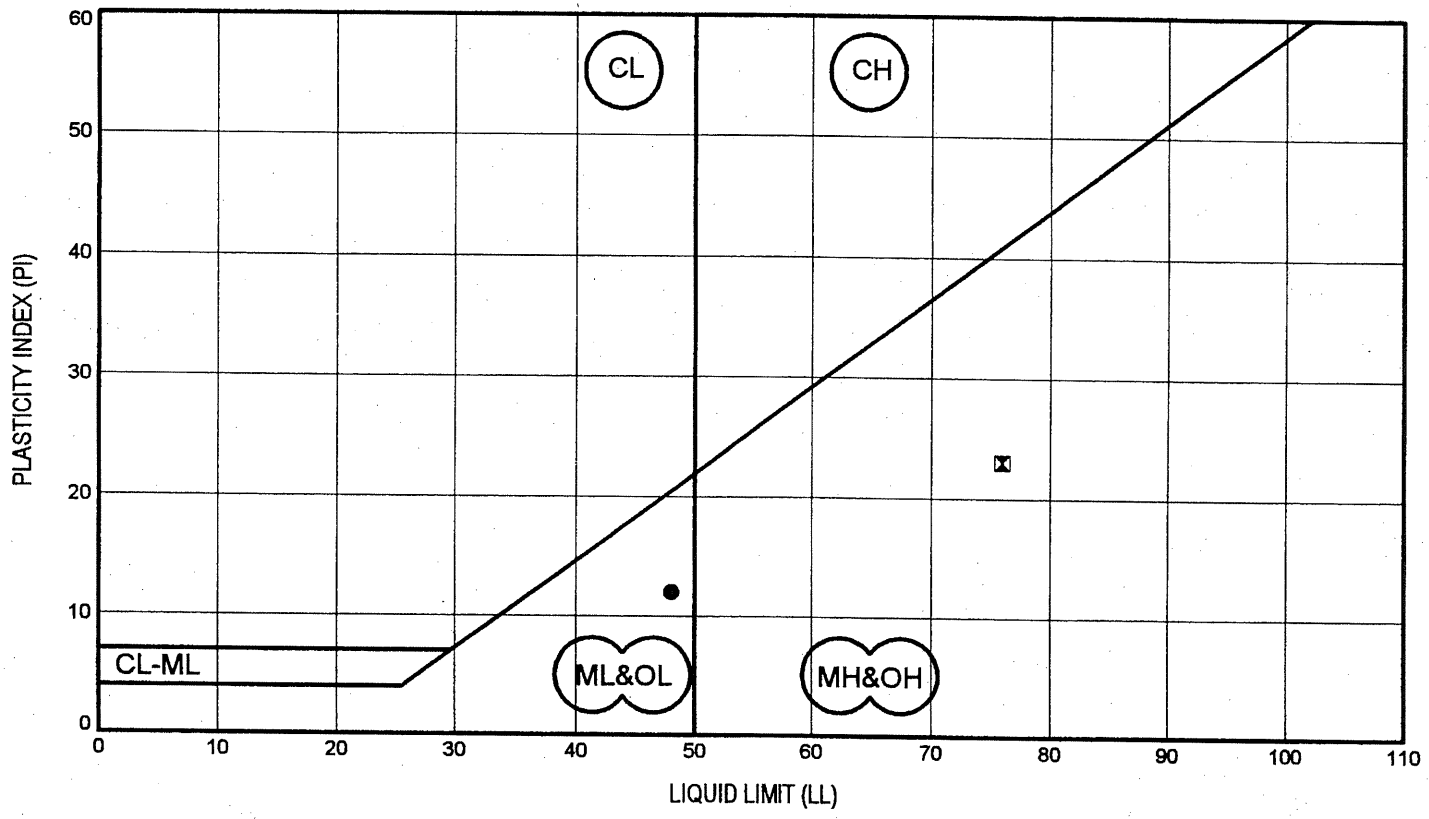
ATTERBERG LIMITS TEST RESULTS

Project No. 027-003



SYMBOL	SAMPLE		DEPTH (ft)	CLASSIFICATION	% MC	LL	PL	PI	% Fines
●	PB-402A	SS-402-12	45.0 - 46.5	SILT (ML)	50	48	36	12	
⊠	PB-402A	SS-402-16	55.0 - 56.5	ELASTIC SILT (MH)	63	76	53	23	

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West Side CSO Project

Parsons Brinkerhoff

ATTERBERG LIMITS TEST RESULTS

Project No. 2002013

FIGURE

APPENDIX E.2
CORROSIVITY DATA

GROUNDWATER

Shaft Locations	Boring No.	Depth (ft)	Date Sample Collected	Chlorides (mg/L)	Sulfate (mg/L)	Sulfides (mg/L)	Total Dissolved Solids (mg/L)	Total Solids (mg/L)	Total Suspended Solids (mg/L)	Conductivity (µmhos/cm)	pH	Nitrates (mg/L)
Min Values Detected (not incl non-detects)				5.5	2.04	0.22	240	238	0	330	6.6	1.7
Maximum Values Detected				34.1	60.7	0.22	410	902,000	548	670	8.3	4.6
Clay Street Shaft	PB-109R	74	06/15/01	14	60.7		400	398	1	530	7.2	
Ankeny Shaft	PB-306R		7/19/01	9.1	3.5	0.22	250	251	2.4	370	7.4	
Albers Mill Access Shaft	PB-602A	18	4/2/01									
	PB-602A	115-125	6/27/01	17	4.1		240	310	71	363	7.2	
Swan Island Pump Station	PB-1003R	20	6/20/01									
	PB-1003R	55	6/21/01									
	PB-1003R	142-194.5	6/14/01	14	2.04		240	238	1	340	7.8	
	PB-1005R	24	6/22/01									
	PB-1005R	55	6/22/01									

Field Data from Shallow Grab and Deep Groundwater Samples

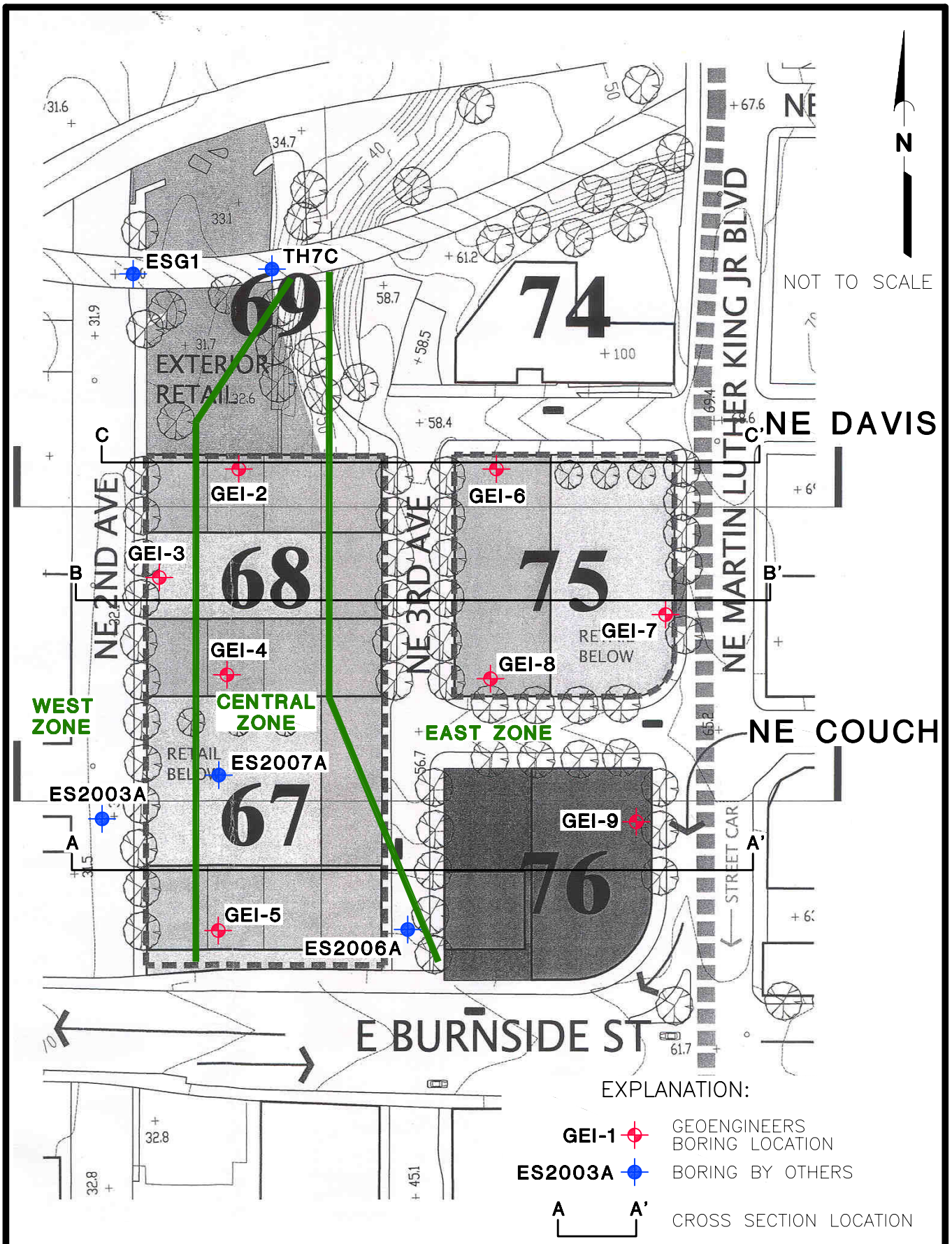
Specific Conductance (µSiemens/cm)	Temp (C)	pH	Eh (mV)	Turbidity Data from wells only (NTUs)
104.3	9.5	5.97	-505	0.67
1,814	26.2	7.83	71.4	8
492	16.8	6.71	-260	0.8
654.7	13.2	6.48	28	
353	14.7	6.7	-177	8
1,122	21.2	7.83	-258	---
995	21.6	6.07	-176.8	---
330.6	17.2	7.52	-306.2	2.81
1,622	15.4	6.57	-215.4	---
1,475	16	6.65	-193.5	---

Notes:
1. Data presented only at shaft locations. All other corrosivity data presented in the Environmental Data Report.
2. Data collected by CH2M Hill through October 30, 2001.

SOIL

Locations	Boring No.	Depth (ft)	Soil Description	Formation	pH	Chlorides* (ppm)	Sulfate* (ppm)	Redox Potential (millivolt)	Minimum Resistivity (ohm-cm)
			TEST METHOD		ASTM D4972	SM 4500 - Cl^- B	SM 4500 SO_4^{2-} E	ASTM D1498	Specific Conductance
Couch Lake	PB-504	90-100	Silty Sand to Sandy Silt	Qal	6.3	28	55	55	4,720
Peninsular FM	PB-1402A / PB-1404A	15-26	Poorly Graded Sand	Qaf	6.8	7	10	10	23,530
	PB-1404A / PB-1405A	12-16	Silty Sand	Qaf	6.7	14	21	21	21,980
Swan Island PS	PB-1202A	15.5-30.5	Silty Clay	Qaf	5.6	70	180	180	1,870

Notes:
* - 1:1 water extraction, 24 hours
1. Tests run on soil samples collected during Phase B and C geotechnical investigations.
2. Qaf - Fill; Qal - Sand/Silt Alluvium
3. SM - Standard Methods for the Examination of Water and Wastewater, 18th ed, 1992.
4. ASTM - American Standard for Testing and Materials



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SITE PLAN

FIGURE 2

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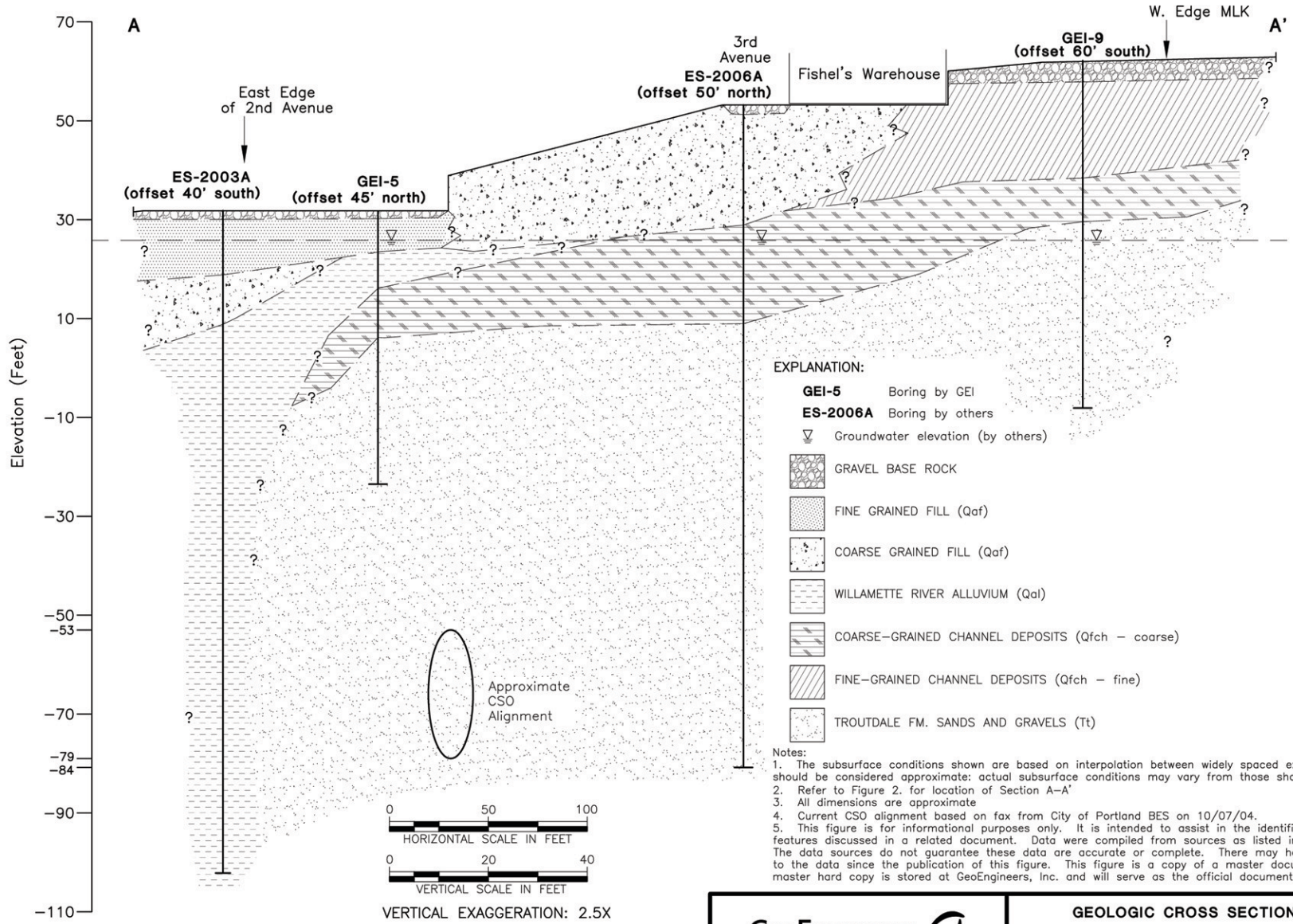

Notes:
1. The subsurface conditions shown are based on interpolation between widely spaced explorations and should be considered approximate: actual subsurface conditions may vary from those shown.
2. Refer to Figure 2. for location of Section A-A'
3. All dimensions are approximate
4. Current CSO alignment based on fax from City of Portland BES on 10/07/04.
5. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The master hard copy is stored at GeoEngineers, Inc. and will serve as the official document of record.

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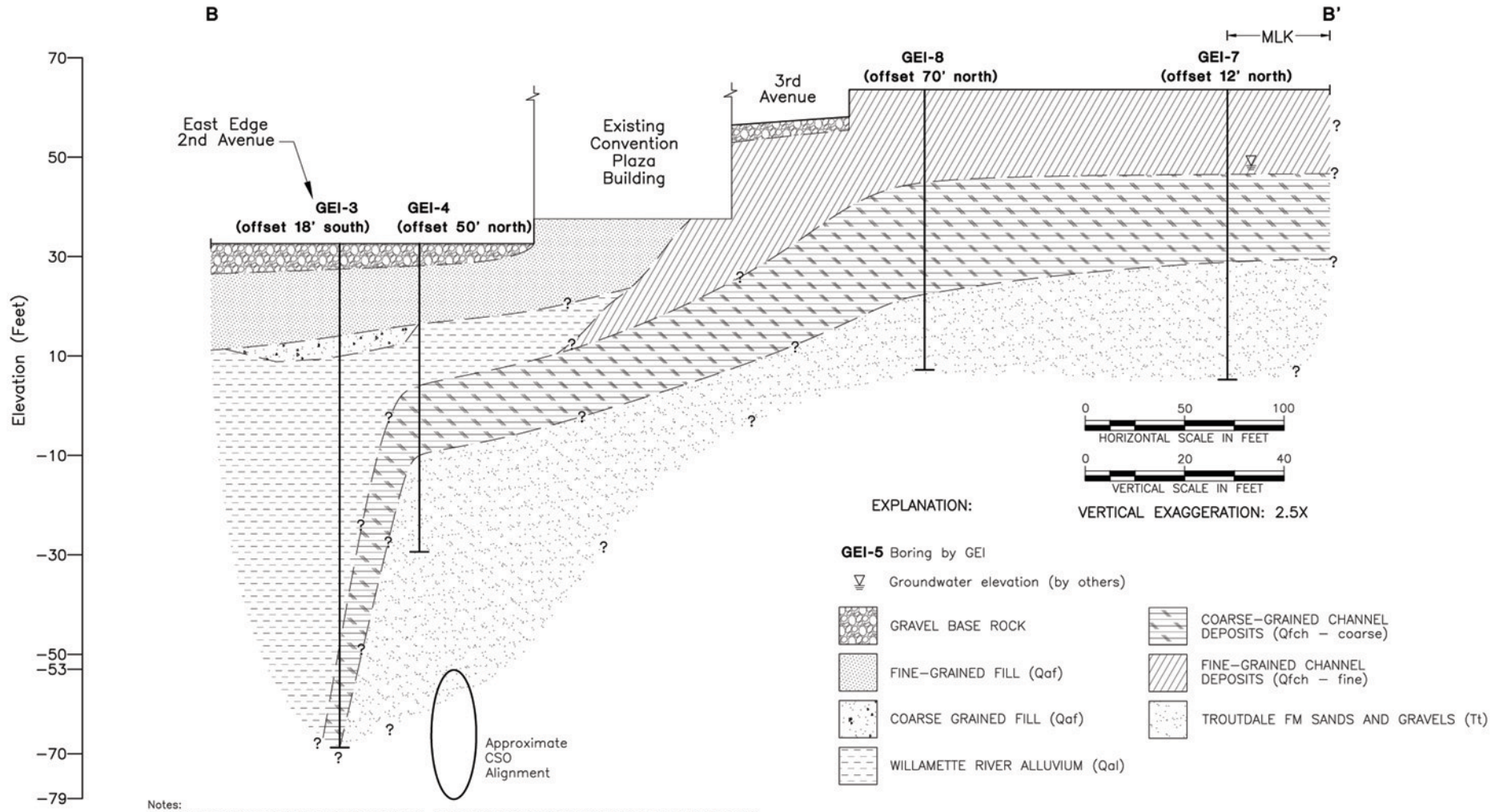
GEOLOGIC CROSS SECTION A-A'

FIGURE 4

Portland\P:\1\1792018\00\Cad\CrossAA.dwg TWB:MWJ 10/27/04



Notes:
1. The subsurface conditions shown are based on interpolation between widely spaced explorations and should be considered approximate: actual subsurface conditions may vary from those shown.
2. Refer to Figure 2. for location of Section B−B'
3. All dimensions are approximate
4. Current CSO alignment based on fax from City of Portland BES on 10/07/04.
5. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The master hard copy is stored at GeoEngineers, Inc. and will serve as the official document of record.

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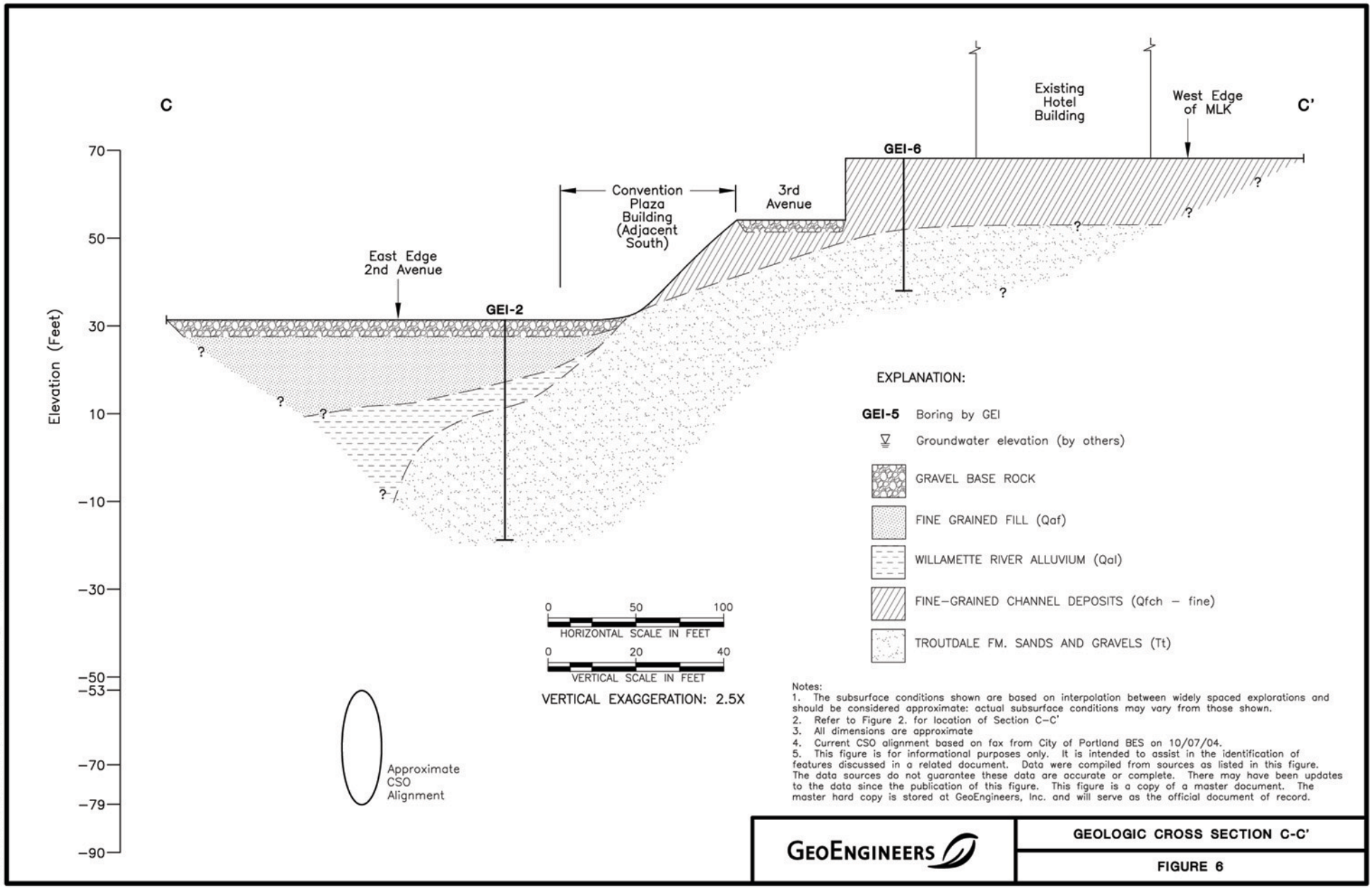
GEOLOGIC CROSS SECTION B-B'

FIGURE 5

Portland\P:\1\1792018\00\Cad\CrossBB.dwg TWB:MWJ 10/27/04



Notes:
1. The subsurface conditions shown are based on interpolation between widely spaced explorations and should be considered approximate: actual subsurface conditions may vary from those shown.
2. Refer to Figure 2. for location of Section C−C'
3. All dimensions are approximate
4. Current CSO alignment based on fax from City of Portland BES on 10/07/04.
5. This figure is for informational purposes only. It is intended to assist in the identification of features discussed in a related document. Data were compiled from sources as listed in this figure. The data sources do not guarantee these data are accurate or complete. There may have been updates to the data since the publication of this figure. This figure is a copy of a master document. The master hard copy is stored at GeoEngineers, Inc. and will serve as the official document of record.

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GEOLOGIC CROSS SECTION C-C'

FIGURE 6

Portland\P:\1\1792018\00\Cad\CrossCC.dwg TWB:MWJ 10/27/04

Date(s) Drilled	07/07/04 - 07/08/04	Logged By	MR2	Checked By	TWB
Drilling Contractor	Subsurface Technologies, Inc.	Drilling Method	Mud Rotary	Sampling Methods	SPT / D&M / Grab
Auger Data	Tri-Cone	Hammer Data	140 lb hammer/ 30 in drop	Drilling Equipment	Mobile Drill B-57
Total Depth (ft)	50	Surface Elevation (ft)	32	Groundwater Elevation (ft)	Not Encountered
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0								GP	Pea gravel (fill)			Drill times in parentheses
		18	6		1			ML	Brown/green micaceous silt and sand, roots (medium stiff, moist)			
5		18	10		2				Increasing roots/organics becomes hard	33	89	(1350)
		18	4		3				Decreasing sand becomes medium stiff			(1400)
10		12	6		4				Brown/gray	38	87	(1410)
15		3	12		5				With occasional well rounded gravel becomes hard	26		(1420)
								GW-GM	Coarse round gravel with sand and silt (very dense, wet)			
20		6	50/6"		6					17		Boulders deflect rod (1435)
									Hole caves, lose mud at 24 feet			End of day, 7/7/04 at 1600. Start drilling 7/8/04 at 0800
25												

Note: See Figure A-1 for explanation of symbols

V6 GTBORING P:\1\1792018\00\FINALS\179201800.GPJ GEIV6_1.GDT 10/28/04

LOG OF BORING GEI-2

GEOENGINEERS

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 2
Sheet 1 of 2

Depth feet	SAMPLES: Interval	SAMPLES: Recovered (in)	SAMPLES: Blows/foot	SAMPLES: Sub-Sample	SAMPLES: Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
25		6	50/6"		7				Gravels are 60% basalt and 40% metaphorphic quartzite, drilling hard	8		(0845)
30					8				Gravels are 60% basalt and 40% felsic, drilling hard			On boulders, no sample; Grab sample (0940)
35					9				Drilling easier			Grab sample (1000)
									Drilling hard, apparent boulders			
40					10				Gravels are 50% basalt and 50% felsic, hard drilling			Grab sample (1035)
45					11							Grab sample (1110)
50									Gravels 40% basalt and 60% felsic			Grab sample (1145)
									Boring terminated at 50 feet Groundwater depth not determined			
55												

V6 GTBORING P:\1\1792018000\FINALS\1792018000.GPJ GEIV6 1.GDT 10/28/04

LOG OF BORING GEI-2 (continued)

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 2
Sheet 2 of 2

Date(s) Drilled	07/16/04 - 07/17/04	Logged By	DRL	Checked By	TWB
Drilling Contractor	Subsurface Technologies, Inc.	Drilling Method	Mud Rotary	Sampling Methods	SPT / D&M / Shelby
Auger Data	Tri-cone	Hammer Data	140 lb hammer/ 30 in drop	Drilling Equipment	Mobile Drill B-57
Total Depth (ft)	106.5	Surface Elevation (ft)	32	Groundwater Elevation (ft)	Not Encountered
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Depth feet	SAMPLES: Interval Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0						CR	2 inches asphalt concrete over base course (fill)			Drill times in parentheses
						GM	Brown silty fine gravel with sand (dense, moist) (fill)			
	7	65	1							(0922)
							Grades to silty fine to coarse gravel			
5	6	9	2			ML	Gray silt with fine gravel (medium stiff to stiff, moist) (fill)	33		(0955)
	5	7	3							
10	0	8	4				Becomes soft			(1005)
15	0		5					30		
	18	65	6			GM	Gray silty fine gravel with sand and wood/organics (medium dense, moist, mottling) (fill)			No recovery; buried log 17.5-21'
20	8	67	7							Lose mud
						ML	Gray silt with fine gravel and organic matter (wood) (soft, moist)			11:55 to 13:30 pull rods, set casing
25										

Note: See Figure A-1 for explanation of symbols

V6 GTBORING P:\1\1792018000\FINALS\1792018000.GPJ GEIV6_1.GDT 10/28/04

LOG OF BORING GEI-3

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 3
Sheet 1 of 4

Depth feet	SAMPLES: Interval	SAMPLES: Recovered (in)	SAMPLES: Blows/foot	SAMPLES: Sub-Sample	SAMPLES: Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
25		7	7		8							(1445)
												Boring terminated at 26.5 feet due to refusal on wood and brick; started new boring 6 feet south
30		18	4		9				Gray silt (soft, wet)	57		(1650)
35		0	11		10							(1700) lose sample
40		0			11				Becomes very soft	56		Grab sample; most is lost
									Grades with occasional fine gravel			
45		18	4		12				Grades to very soft to soft			(1730) Driller reports small gravel
50		18	3		13					48		
55		0			14							

V8_GTBORING P:\1179201800\FINALS\1179201800.GPJ GEIV8_1.GDT 10/26/04

LOG OF BORING GEI-3 (continued)

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 3
Sheet 2 of 4

Depth feet	SAMPLES: Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
60		12	3		15				Grades to clayey with fine sand and occasional medium to coarse sand (soft, wet)	59		% Fines=81 (1840)
65		18	4		16					54		% Fines =89 End of day, 07/16/04 at 2000. Start drilling 07/17/04 at 0910
70		3	12		17				Becomes stiff			
75		0							Drive Shelby 12 inches and hit hard object; stopped			Let sit 10 minutes; no recovery
80		4	44		18			GW-GM	Rounded gravel with sandy silt (dense, wet)			(0955)
									Hard drilling			
85		4	58		19			SW-SM	Coarse sand with silt and gravel (dense, wet) (70% basalt and 30% felsic)	21		% Fines =7 Lose mud, hole caves (1100)

V8_GTBORING P:\1\1792018\00\FINALS\1792018 00.GPJ GEIV6_1.GDT 10/28/04

LOG OF BORING GEI-3 (continued)

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 3
Sheet 3 of 4

Depth feet	SAMPLES: Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
90								GW	Increasing cobble size			
		6	30		20							Lose mud; blow pressure relief valve (1230)
95					21				Drill past caving zone increasing gravel (60% basalt, 40% felsic) too much slough to do SPT's			Grab sample (1410)
100		12	98/11"		22			GW-GM	Sandy coarse gravel (dense, wet) drove 36 inches through slough (final blow counts suspect)	18		% Fines =11 (1450)
105		14	25		23			SP-SM	Orange-brown medium sand with gravel and silt; grades to coarse sand			Hole caves (1610)
									Boring terminated due to caving Groundwater not determined			
110												
115												

V8 GTBORING P:\1\1792018\00\FINALS\1179201800.GPJ GEIV8 1.GDT 10/28/04

LOG OF BORING GEI-3 (continued)

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 3
Sheet 4 of 4

Date(s) Drilled	07/08/04 - 07/09/04	Logged By	MR2	Checked By	TWB
Drilling Contractor	Subsurface Technologies, Inc.	Drilling Method	Mud Rotary	Sampling Methods	SPT / D&M / Grab
Auger Data	Tri-Cone	Hammer Data	140 lb hammer/ 30 in drop	Drilling Equipment	Mobile Drill B-57
Total Depth (ft)	61	Surface Elevation (ft)	32	Groundwater Elevation (ft)	Not Encountered
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Depth feet	SAMPLES Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0								ML				Drilling times in parentheses
		12	6		1				Brown/gray silt occasional fine sand, brick, roots (medium stiff, moist) (fill)	21		
5		12	9		2				Increased sand and roots			
		18	5		3				Becomes blue/gray with roots and branches			
10		12	9		4				Increasing sand - wood particles (black) decayed with clay	33	90	
15		18	4		5			ML	Blue/gray mottled silt with sand and decayed organics (soft, moist)			
20		15	5		6				Increasing clay, occasional gravel, becomes medium stiff			Driller reports gravel, deflects rod
25												

Note: See Figure A-1 for explanation of symbols

V6 GTBORING P:\1\1792018\00\FINALS\1792018000.GPJ GEIV6_1.GDT 10/28/04

LOG OF BORING GEI-4

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 4
Sheet 1 of 3

Depth feet	SAMPLES: Interval	SAMPLES: Recovered (in)	SAMPLES: Blows/foot	SAMPLES: Sub-Sample	SAMPLES: Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
25			12		7			SM	Brown silty sand with gravel (medium dense, moist)	22		
					8			GW-GM	Gravels: 70% basalt and 30% felsic (occasional quartzite) with sand and silt			
30		18	42		9			GW	Rounded to sub-rounded coarse gravel with occasional cobbles (medium dense to dense) Hard drilling			
35		2	50/2"		10			GW-GM	Subrounded to sub angular coarse gravel with sand and silt (very dense) gravels are 70% basalt, 30% felsic			
		0			11				Less silt, gravels 60% basalt, 40% felsic			
40		0	50/1"		12			GW	Well-graded gravel with sand (very dense). Gravels 50% basalt, 50% felsic. Hard drilling.			
45		0										
			50/0"		13				Gravels 40-50% basalt, 50-60% felsic. Hard drilling			Grab sample
50		3	50/3"		14				Increasing basalt fragments			
55		9	50/3"		15			SW	Orange/brown medium sand with silt, occasional coarse basalt black sand (very dense) Interpret as Troutdale			

V8_GTBORING P:\1\1792018000\FINALS\1792018000.GPJ GEIV8_1.GDT 10/28/04

LOG OF BORING GEI-4 (continued)

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 4
Sheet 2 of 3

Depth feet	SAMPLES: Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
60									Sandstone.			
		0	50/0"		16							(1510)
									Boring terminated at 61 feet Groundwater not determined			
65												
70												
75												
80												
85												

V6 GTBORING P:\1\1792018\00\FINALS\1792201800.GPJ GEIV6_1.GDT 10/28/04

LOG OF BORING GEI-4 (continued)

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 4
Sheet 3 of 3

Date(s) Drilled	07/06/04 - 07/07/04	Logged By	MR2	Checked By	TWB
Drilling Contractor	Subsurface Technologies, Inc.	Drilling Method	Mud Rotary	Sampling Methods	SPT / D&M
Auger Data	Tri-Cone	Hammer Data	140 lb hammer/ 30 in drop	Drilling Equipment	Mobile Drill B-57
Total Depth (ft)	55	Surface Elevation (ft)	32	Groundwater Elevation (ft)	Not Encountered
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Depth feet	SAMPLES Interval	Recovered (In)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0								AC	6 inches asphalt concrete			Drilling times in parentheses
								GW	12 inches base rock (fill)			
								ML	Mottled gray green clayey silt with occasional gravel (stiff, moist) (fill)			
		18	16		1							
5		10	8		2					16	103	
		12	7		3				Becomes medium stiff with roots, brick fragments and some medium sand			
10		18	3		4			ML	Silt with clay and occasional coarse sand (soft, moist)			(0935)
15		0	39		5			GW-GM	Subangular to subrounded well graded gravel 80% basalt 20% felsic (medium dense, moist). Hard drilling			Grab sample at 16 feet. Lose mud
		6	22		7					18		(1000)
20		6	39		8				Becomes more coarse with possible cobbles, and increasing sand and silt (dense)	9		% Fines =2 (1145)
25												

Note: See Figure A-1 for explanation of symbols

V6_GTBORING P:\1\1792\018\00\FINALS\1792018600.GPJ GEIVB_1.GDT 10/28/04

LOG OF BORING GEI-5

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 5
Sheet 1 of 2

Depth feet	SAMPLES: Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
25		12	50/6"		9				Becomes very dense			(1240)
												(1400) Hole caved, redrill
									Rounded gravels and increasing sand			
30		4	50/4"		10							(1535)
35		3	50/3"		11							End of day, 7/6/04 at 1625. Start drilling 7/7/04 at 0900.
									Hard drilling			
40		6	50/6"		12			SW	Coarse sand to fine gravel (very dense, moist)			(1015)
									Clasts are 80% basalt, 20% felsic			
45		4	50/4"		13				Gravels are 70% basalt, 30% felsic			(1105)
50		3	50/3"		14							(1205)
55												(1300) Hole caves; no sample
									Boring terminated due to caving Groundwater not determined			

V6 GTBORING P:\1\1792018\00\FINALS\1792018 00.GPJ GEIV6_1.GDT 10/28/04

LOG OF BORING GEI-5 (continued)

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 5
Sheet 2 of 2

Date(s) Drilled	06/28/04	Logged By	RNM	Checked By	TWB
Drilling Contractor	Subsurface Technologies, Inc.	Drilling Method	Mud Rotary	Sampling Methods	SPT/ D&M / Grab
Auger Data	Tri-Cone	Hammer Data	140 lb hammer/ 30 in drop	Drilling Equipment	Mobile Drill B-53
Total Depth (ft)	30.3	Surface Elevation (ft)	65	Groundwater Elevation (ft)	Not Encountered
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Depth feet	SAMPLES: Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0								AC	3 inches asphalt concrete			
								ML	Brown silt (very stiff, moist)			
5		18	32		1				Becomes sandy	37	83	
10		18	38		2					32	87	CS
15		18	99/11"		3			GW	Gray to brown fine to coarse gravel with sand, trace silt (very dense, moist)			
								GW-GM	Brown fine to coarse gravel with sand and silt (very dense, moist)			
20		2	50/3"		4							
25												

Note: See Figure A-1 for explanation of symbols

V6_GTBORING P:\1\1792018\00\FINAL\S\1792018 00.GPJ GEIV6_1.GDT 11/4/04

LOG OF BORING GEI-6

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 6
Sheet 1 of 2

Depth feet	SAMPLES: Interval	SAMPLES: Recovered (in)	SAMPLES: Blows/foot	SAMPLES: Sub-Sample	SAMPLES: Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
25			58		5			SP-SM	Gray fine to medium sand with silt, occasional gravel (very dense, moist)	13		
								GW-GM	Brown fine to coarse gravel with sand and silt (very dense, moist)			
30		2	50/4"		6				Boring terminated at 30.3 feet Groundwater not determined			
35												
40												
45												
50												
55												

V6_GTBORING P:\1\1792018\00\FINALS\1792001800.GPJ GEV6_1.GDT 11/4/04

LOG OF BORING GEI-6 (continued)

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A-6
Sheet 2 of 2

Date(s) Drilled	06/29/04 - 06/30/04	Logged By	RMN	Checked By	TWB
Drilling Contractor	Subsurface Technologies, Inc.	Drilling Method	Direct Push/Hollow Stem Auger	Sampling Methods	SPT/ D&M
Auger Data	Tri-cone	Hammer Data	140 lb hammer/ 30 in drop	Drilling Equipment	Mobile Drill B-57
Total Depth (ft)	58	Surface Elevation (ft)	65	Groundwater Elevation (ft)	50
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Depth feet	Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0								AC	3 inches asphalt concrete			
								ML	Brown silt (stiff to very stiff, moist)			
5		16	30		1					23	84	
10		24			2							DS
15		15	67		3				Becomes sandy	29		Perched groundwater
								GW-GM	Gray fine to coarse gravel with sand and silt (very dense, moist)			
								SP	Gray fine to medium sand with gravel, trace silt (very dense, moist)			
20		14	65		4					6		
25												

Note: See Figure A-1 for explanation of symbols

V6_GTBORING P:\1\1792018000\FINALS\1792018000.GPJ GEIV6_1.GDT 10/26/04

LOG OF BORING GEI-7

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A-7
Sheet 1 of 3

Depth feet	SAMPLES: Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
25		16	36		5			ML	Brown with orange mottling, silt with occasional fine gravel			End drilling 1650; start drilling at 0905 on 06/30/04
								SP	Gray fine to medium sand with occasional fine gravel, trace silt (dense, moist)			
								SW-SM	Gray fine to coarse sand with silt, occasional fine gravel (very dense, moist)			
30		8	84/11"		6					21		(1015)
								GW-GM	Gray to brown fine to coarse gravel with sand and silt (very dense, moist)			
35		8	91/10"		7							(1035)
40		8	63/9"		8							Stop drilling for groundwater; sample by others
									Hard drilling			
45		2	50/3"		9					11		(1220)
50		1	50/2"		10							Grab sample (1310)
55		0.5	50/1"		11							Grab sample (1410) Replace bit at 55'

V8_GTBORING P:\1\1792018000\FINALS\1792018000.GPJ GEIV6_1.GDT 10/28/04

LOG OF BORING GEI-7 (continued)

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 7
Sheet 2 of 3

Depth feet	SAMPLES: Interval Recovered (in)	SAMPLES: Blows/foot	SAMPLES: Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
										End drilling at 1520

Boring completed at 58 feet
Perched groundwater encountered at 15 feet bgs

60
65
70
75
80
85

V6_GTBORING P:\1\1792018000\FINALS\1792018000.GPJ GEIV6_1.GDT 10/28/04

LOG OF BORING GEI-7 (continued)

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 7
Sheet 3 of 3

Date(s) Drilled	07/01/04 - 07/02/04	Logged By	RNM	Checked By	TWB
Drilling Contractor	Subsurface Technologies, Inc.	Drilling Method	Direct Push	Sampling Methods	SPT/ D&M / Shelby
Auger Data	Tri-Cone	Hammer Data	140 lb hammer/ 30 in drop	Drilling Equipment	Mobile Drill B-53
Total Depth (ft)	52	Surface Elevation (ft)	64	Groundwater Elevation (ft)	Not Encountered
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Depth feet	SAMPLES: Interval	Recovered (in)	Blows/foot	Sub-Sample	Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0								AC	2 inches asphalt concrete			Drilling times in parentheses
								GP	Gray fine gravel with occasional sand, trace silt (fill) (medium dense, moist)			
								ML	Brown silt (very stiff, moist)			
5		18	31		1					36	72	(1050)
10		16			2							(1115)
								GW	Gray to brown fine to coarse gravel with sand, trace silt (dense, moist)			Hard drilling at 13 feet; gravel cuttings
								ML	Brown sandy silt (stiff, moist)			
15		16	32		3					34		(1125)
								GP-GM	Gray to brown fine gravel with sand and silt (dense, moist)			
								GW-GM	Gray to brown fine to coarse gravel with sand and silt (very dense, moist)			Hard drilling
20		16	41		4			SP-SM	Gray to brown fine to medium sand with silt and occasional fine gravel (dense, moist)	17		(1150)
									Increasing gravel content			
								SW-SM	Gray to brown fine to coarse sand with gravel and silt (very dense, moist)			
25												

Note: See Figure A-1 for explanation of symbols

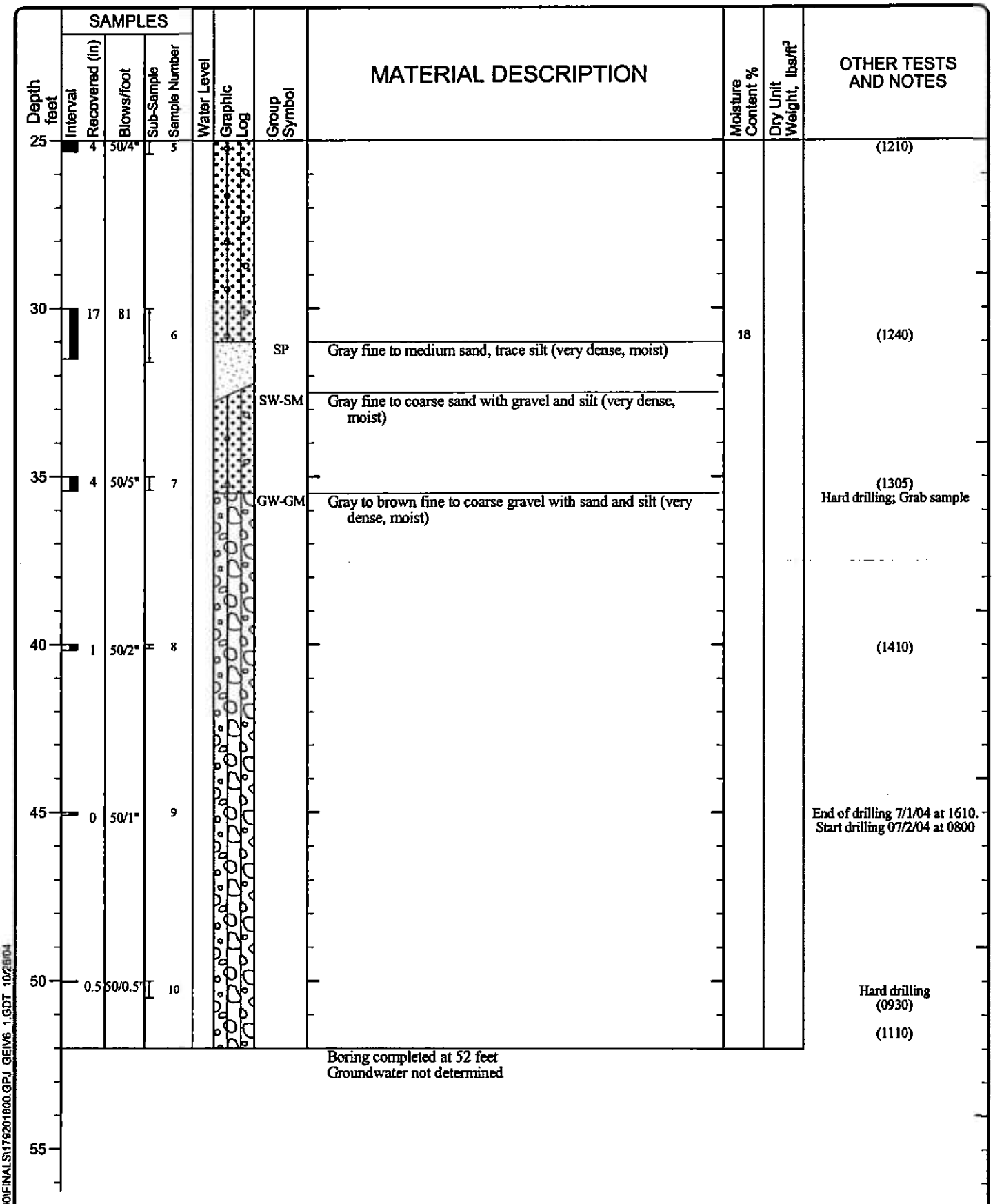
V6 GTBORING P:\1\1792018\00\FINALS\1792001800.GPJ GEIV6_1.GDT 10/28/04

LOG OF BORING GEI-8

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 8
Sheet 1 of 2



V6_GTBORING P:\1\1792018\00\FINALS\1792018600.GPJ GEIV6_1.GDT 10/28/04

LOG OF BORING GEI-8 (continued)

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 8
Sheet 2 of 2

Date(s) Drilled	06/28/04 - 06/29/04	Logged By	RNM	Checked By	TWB
Drilling Contractor	Subsurface Technologies, Inc.	Drilling Method	Mud Rotary	Sampling Methods	SPT / D&M / Shelby
Auger Data	Tri-Cone	Hammer Data	140 lb hammer/ 30 in drop	Drilling Equipment	Mobile Drill B-53/B-57
Total Depth (ft)	70.1	Surface Elevation (ft)	63	Groundwater Elevation (ft)	Not Encountered
Vertical Datum		Datum/ System		Easting(x): Northing(y):	

Depth feet	Interval	Recovered (in)	Blows/foot	Sub-Sample Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
0							AC	2 inches asphalt concrete			Drilling times in parentheses (1325)
							GM	Brown silty gravel with sand (medium dense, moist) (fill)			
							ML	Brown silt (stiff, moist)			
5		18	21	1					41	80	
10		8		2							Pushed hard
15		9	66/9"	3			GW-GM	Gray to brown fine to coarse gravel with sand and silt (very dense, moist)	38	88	(1420)
20		12	41	4			SP-SM	Gray fine to medium sand with silt, occasional fine gravel (dense, moist)	17		(1500)
							SW-SM	Gray fine to coarse sand with silt, occasonal fine gravel (dense, moist)			
25											

Note: See Figure A-1 for explanation of symbols

V8 GTBORING P:\1\1792018000\FINALS\1792018000.GPJ GEIV6 1.GDT 10/28/04

LOG OF BORING GEI-9

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 9
Sheet 1 of 3

Depth feet	SAMPLES: Interval	SAMPLES: Recovered (in)	SAMPLES: Blows/foot	SAMPLES: Sub-Sample	SAMPLES: Sample Number	Water Level	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Moisture Content %	Dry Unit Weight, lbs/ft³	OTHER TESTS AND NOTES
25		7	83/11"		5					16		(1550)
30		12	85		6				Becomes very dense	17		End drilling 6/28/04 at 1635. Start drilling 6/29/04 at 0845
35		8	95/10"		7					18		
40		1	50/3"		8							(1000)
45		14	88/8"		9					21		(1025)
50		2	50/4"		10							(1050)
55		1	50/3"		11				Increasing gravel			(1130)

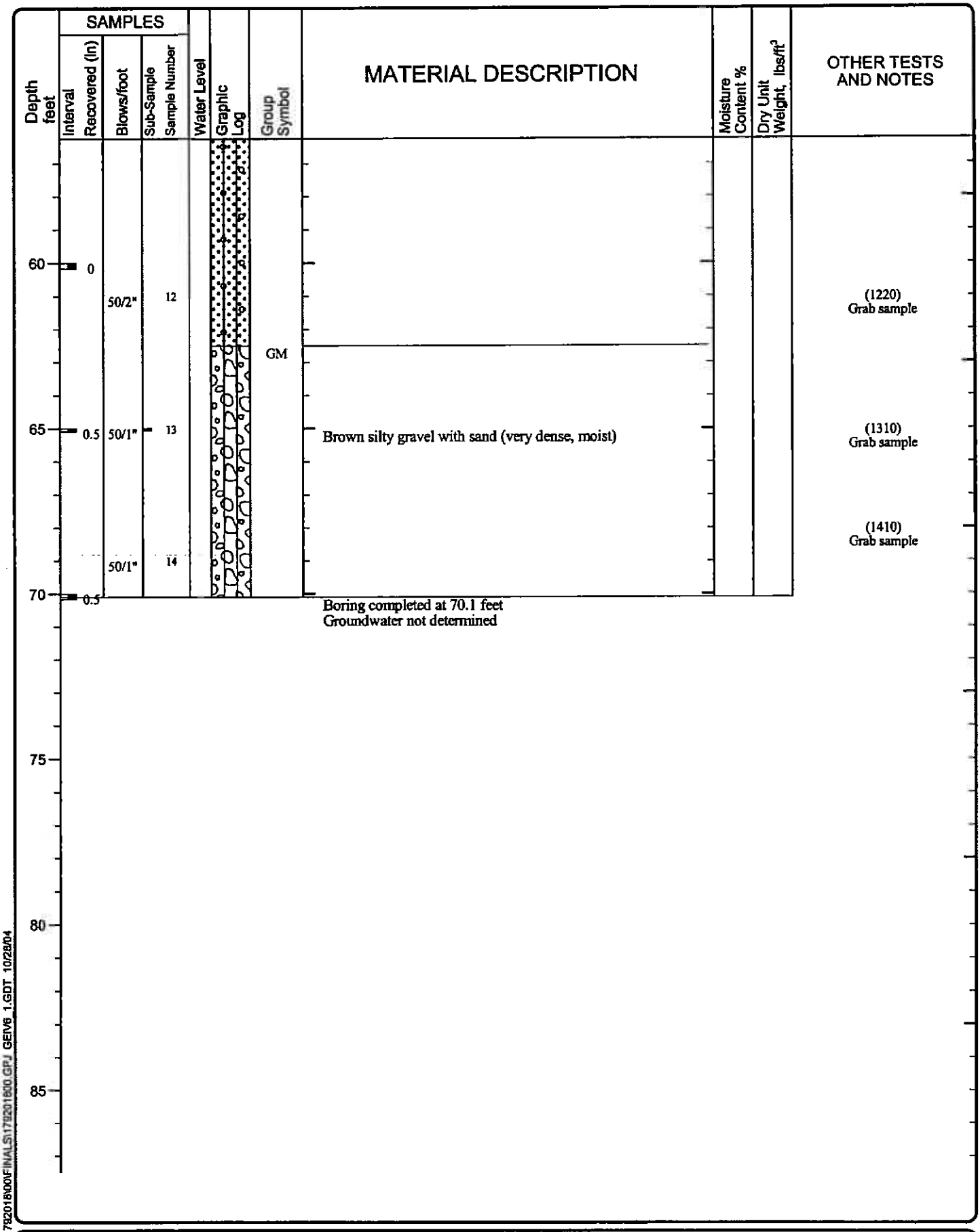
V6_GTBORING P:\1\1792016\00\FINALS\1792016\00.GPJ GEIV6_1.GDT 10/28/04

LOG OF BORING GEI-9 (continued)

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 9
Sheet 2 of 3



V6_GTBORING P:\1\1792018\00\FINALS\1792018600.GPJ GEIV6_1.GDT 10/28/04

LOG OF BORING GEI-9 (continued)

GeoEngineers

Project: Portland Development Commission
Project Location: Portland, Oregon
Project Number: 1792-018-00

Figure: A- 9
Sheet 3 of 3

LEGEND

- ESCSO BOREHOLE
- ESCSO BOREHOLE WITH A MONITORING WELL INSTALLED
- ESCSO CPT PROBE

PREVIOUS BORINGS BY OTHERS

- BURN-7 – BURNSIDE BRIDGE

SE 1ST AVE
SE 2ND AVE
SE 3RD AVE
SE WASHINGTON ST
SE STARK ST
SE OAK ST
SE ASH ST
SE ANKENY ST
E BURNSIDE ST
SE PINE ST
SE MLK BLVD
ES-2020A
ES-2021A
ES-2023A
ES-2030R
ES-CPT2
ES-2024A
ES-2001R
ES-2025A
ES-2005C
BURN-7
OF37 AND OF38 DIVERSION PIPELINE
GDR-2J STA 348+00
STA 363+00 GDR-2L
349+00
350+00
351+00
352+00
353+00
354+00
355+00
356+00
357+00
358+00
359+00
360+00
361+00
362+00
14+00
15+00
16+55.71
12+61.95
10+72.57
10+00
11+00
12+00
SEE SHEET MATCHLINE
MATCHLINE SEE SHEET

PLAN
SCALE: 1"=50'

KEY PLAN

1 INCH
BAR EQUALS ONE INCH WHEN DRAWING IS PLOTTED FULL SIZE. IF NOT, SCALE ACCORDINGLY
50 0 25 50 100
SCALE:1"=50'

NO.	DATE	DESCRIPTION	APPD.
	02/11/05	GDR	

REVISION

XREF(S) USED:
ROTATION ANGLE:
CONSTRUCTED BY
PROJECT COMPLETED
MAP CORRECTED BY ____ CHECKED BY ____
FINAL MAP DATA
GDR-2K.DWG, 07/20/05 at 15:19

DESIGNED BY	TMP	DATE APPD.	
DRAWN BY	TAS	PROGRAM MGR	PTG
CHECKED BY	MLF	CONST. MGR.	GC
DESIGN MGR.	RFC	PROJECT MGR.	TRC

CITY OF PORTLAND
ENVIRONMENTAL SERVICES
WILLAMETTE RIVER CSO CONTROL PROJECT

PB PARSONS BRINCKERHOFF
400 S.W. Sixth Ave, Portland, OR 97204

EAST SIDE CSO PROJECT

FIGURE 2-K
BOREHOLE LOCATION PLAN

1/4 SECTION
JOB NO. 5516
SHEET NO. GDR-2K
-- OF --

K:\CADD\MISC\TOM-P\GDR-011405\GDR-2K.DWG, Layout1, 7/20/2005 3:19:43 PM

LEGEND

- ESCSO BOREHOLE
- ESCSO BOREHOLE WITH A MONITORING WELL INSTALLED
- ESCSO CPT PROBE

PREVIOUS BORINGS BY OTHERS

- BURN–4 – BURNSIDE BRIDGE
- PDC–2 – PORTLAND DEVELOPMENT COMMISSION
- SPS–1 – SULLIVAN PUMP STATION
- BAN–6C – I–84 (BANFIELD) INTERCHANGE

WILLAMETTE RIVER

BURNSIDE BRIDGE

SE 1ST AVE

SE 2ND AVE

SE 3RD AVE

NE COUCH ST

NE DAVIS ST

NE LLOYD BLVD

NE OLSEN ST

I-5

I-84 INTERCHANGE

OF40 DIVERSION PIPELINE

ES–G1 ES–G2 ES–G3 ES–G4 ES–G5 ES–G6 ES–G6 ES–G11 ES–G12 ES–G13 ES–G14 ES–G15

ES–G7 ES–G8 ES–G9 ES–G10 ES–G11

ES–2027A

BURN–4 BURN–5 BURN–6 BURN–8 BURN–11 BURN–12

PDC–2 PDC–3 PDC–4 PDC–5 PDC–6 PDC–8

BAN–5B BAN–6C BAN–7B BAN–7C BAN–6A BAN–7A BAN–8A BAN–9A BAN–9B BAN–10A BAN–10B

SPS–1 SPS–2

ES–2003A ES–2007A ES–2006C ES–2029A ES–CPT3 ES–CPT4 ES–2031R ES–2026R

GDR–2K STA 363+00 GDR–2M STA 378+00

SEE SHEET MATCH LINE

365+00 366+00 367+00 368+00 369+00 370+00 371+00 372+00 373+00 374+00 375+00 376+00 377+00 378+00 10+00 11+00 12+00

PLAN
SCALE: 1"=50'

KEY PLAN

1 INCH
BAR EQUALS ONE INCH WHEN DRAWING IS PLOTTED FULL SIZE. IF NOT, SCALE ACCORDINGLY
50 0 25 50 100
SCALE:1"=50'

NO.	DATE	DESCRIPTION	APPD.
	07/15/05	GDR	

REVISION

XREF(S) USED:
ROTATION ANGLE:
CONSTRUCTED BY
PROJECT COMPLETED
MAP CORRECTED BY ____ CHECKED BY ____
FINAL MAP DATA
GDR–2L.DWG, 07/20/05 at 15:20

DESIGNED BY	TMP	DATE APPD.	
DRAWN BY	TAS	PROGRAM MGR	PTG
CHECKED BY	MLF	CONST. MGR.	GC
DESIGN MGR.	RFC	PROJECT MGR.	TRC

CITY OF PORTLAND
ENVIRONMENTAL SERVICES
WILLAMETTE RIVER CSO TUNNEL PROGRAM

PB PARSONS BRINCKERHOFF
400 S.W. Sixth Ave, Portland, OR 97204

EAST SIDE CSO TUNNEL PROJECT

FIGURE 2–L
BOREHOLE LOCATION PLAN

1/4 SECTION
JOB NO. 5516
SHEET NO. GDR–2L
–– OF ––

K:\CADD\MISC\TOM-P\GDR-011405\GDR-2L.DWG, Layout1, 7/20/2005 3:20:33 PM

PB PARSONS BRINCKERHOFF

BORING LOG
ES-2003A

Foundation Engineering, Inc.

PROJECT East Side CSO - Final Design | SHEET 1 OF 4 | INITIAL GWL@ Not Available

CITY Portland, Oregon | SURF. EL. 31.8 ft STA. _____ OFST. _____ | EQUIPMENT CME 75

PROJECT NO. 2032011 | NORTHING 684338.1 EASTING 7647623.2 | DRILLING METHOD Mud Rotary

DATE DRILLED 9/9/03 LOGGED BY AR | LOCATION NE 2nd & Burnside | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ▣ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
30							**Pavement** ASPHALTIC CONCRETE OVER BASE ROCK.			
							Artificial Fill (Qaf) SILT WITH SAND (ML); trace to few sand, fine to coarse sand, low plasticity, to red-brown, moist, soft to very soft.			
25	5		1	1 0 1						
							SILTY SAND (SM); trace to some gravel, fine to medium sand, fine gravel, rounded, low plasticity, gray, moist, loose.			
20	10		2	3 5 5						
			3				GRAVELLY SILT (ML); fine gravel, rounded, low plasticity, gray, moist, soft.			
15	15		4	3 3 2						
							SILTY GRAVEL WITH SAND (GM); fine to coarse gravel, subrounded to angular, low plasticity silt, gray, moist to wet, medium dense.			
10	20		5	12 6 9			±230 gallons of mud loss between 20 and 23 feet.			
							Sand/Silt Alluvium (Qal) SILT (ML); low to medium plasticity, gray mottled brown, moist to wet, soft.			
5	25		6	1 1 1						
			7							
0	30		8	2 2 3						
			9							
-5	35		10	1 2 1						

ESCSO MUD 2005 2032011.GPJ 2042034-REV1.GPJ 7/1/05

PB PARSONS BRINCKERHOFF

BORING LOG
ES-2003A

Foundation Engineering, Inc.

PROJECT East Side CSO - Final Design | SHEET 2 OF 4 | INITIAL GWL@ Not Available

CITY Portland, Oregon | SURF. EL. 31.8 ft STA. _____ OFST. _____ | EQUIPMENT CME 75

PROJECT NO. 2032011 | NORTHING 684338.1 EASTING 7647623.2 | DRILLING METHOD Mud Rotary

DATE DRILLED 9/9/03 LOGGED BY AR | LOCATION NE 2nd & Burnside | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ⧉ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	PERCENT FINES (20 40 60 80) / PLASTIC M.C. LIQUID (20 40 60 80)	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") (20 40 60 80)	WELL
							(Qal Cont'd) SILT (ML); low to medium plasticity, gray mottled brown, moist to wet, soft.			
-10	40		11	2 2 2						
-15	45		12	3 2 3						
-20	50		13	10 2 3						
-25	55		14	6 2 2						
-30	60		15							
-35	65		16	1 0 3						
-40	70		17	6 3 4			INTERBEDDED LAYERS OF SANDY SILT (ML) to SILT WITH SAND (ML); trace organics, fine sand, nonplastic to low plasticity silt, gray, wet, medium stiff to stiff.			
			18	7 6 7						

ESCSO MUD 2005 2032011.GPJ 2042034-REV1.GPJ 7/1/05

PB PARSONS BRINCKERHOFF

BORING LOG
ES-2003A

Foundation Engineering, Inc.

PROJECT East Side CSO - Final Design | SHEET 3 OF 4 | INITIAL GWL@ Not Available

CITY Portland, Oregon | SURF. EL. 31.8 ft STA. _____ OFST. _____ | EQUIPMENT CME 75

PROJECT NO. 2032011 | NORTHING 684338.1 EASTING 7647623.2 | DRILLING METHOD Mud Rotary

DATE DRILLED 9/9/03 LOGGED BY AR | LOCATION NE 2nd & Burnside | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE: ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ⧉ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	PERCENT FINES (20 40 60 80) / PLASTIC M.C. LIQUID (20 40 60 80)	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") (20 40 60 80)	WELL
-45	80		19	3 7 7	AL MC		**(Qal Cont'd)** INTERBEDDED LAYERS OF SANDY SILT (ML) to SILT WITH SAND (ML); trace organics, fine sand, nonplastic to low plasticity silt, gray, wet, medium stiff to stiff.			
			20	2 3 3						
-50	85		21		MC		Becomes SILT (ML); low plasticity, gray, wet, stiff.			
			22	3 7 6						
-55	90		23	2 5 4						
			24	3 2 4	MC AL FC					
-60	95		25	4 13 23			SILTY GRAVEL WITH SAND (GM); some sand, fine to coarse gravel, rounded, low plasticity silt, gray to brown, wet, dense to very dense.			
			26	30 65 50						
-65	100	☒	27	50/6"			POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); some sand, trace to few silt, fine to coarse gravel, subrounded to rounded, nonplastic silt, gray brown, wet, dense to very dense, some quartzite gravel.		50/6"	
			28	22 18 15						
-70	105		29	50/6"					50/6"	
			30	50/6"					50/6"	
-75	110		31A	20	MC		SILTY SAND (SM) to SANDY SILT (ML); fine sand, nonplastic to low plasticity, brown, wet, stiff.			
			31B	8 10	FC					
			32	5 5 5	MC					
-80			33		MC FC		±20 gallons of mud loss between 113 and 115 feet.			
				11	GSD					

ESCSO MUD 2005 2032011.GPJ 2042034-REV1.GPJ 7/1/05

PB PARSONS BRINCKERHOFF

BORING LOG
ES-2003A

Foundation Engineering, Inc.

PROJECT East Side CSO - Final Design | SHEET 4 OF 4 | INITIAL GWL@ Not Available

CITY Portland, Oregon | SURF. EL. 31.8 ft STA. ____ OFST. ____ | EQUIPMENT CME 75

PROJECT NO. 2032011 | NORTHING 684338.1 EASTING 7647623.2 | DRILLING METHOD Mud Rotary

DATE DRILLED 9/9/03 LOGGED BY AR | LOCATION NE 2nd & Burnside | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ⧉ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	PERCENT FINES (20 40 60 80) / PLASTIC M.C. LIQUID (20 40 60 80)	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") (20 40 60 80)	WELL
			34	10 29			SILTY GRAVEL WITH SAND (GM); fine sand, fine to coarse gravel, subrounded to rounded, nonplastic to low plasticity, brown, wet, dense.			
	115		35	4 6 6	MC FC		SANDY SILT (ML); fine sand, nonplastic, brown, wet, stiff.			
-85			36	5 5 6	MC FC					
	120		37	31 50/4"	GSD		**Gravel Alluvium (Qfc)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); some sand, trace to few silt, fine to coarse gravel, subrounded to rounded, gray brown, wet, dense to very dense.		50/4"	
-90			38	17 14 19						
	125		39	17 19 26						
-95			40	25 27 33	GSD					
	130		41	16 18 21						
-100			42	14 25 17						
							Bottom of boring at 134 ft.			
	135									
-105										
	140									
-110										
	145									
-115										

ESCSO MUD 2005 2032011.GPJ 2042034-REV1.GPJ 7/1/05

PB PARSONS BRINCKERHOFF

BORING LOG
ES-2005C

Foundation Engineering, Inc.

PROJECT East Side CSO - Final Design | SHEET 1 OF 4 | INITIAL GWL@ 28.8 ft ()

CITY Portland, Oregon | SURF. EL. 43.6 ft | STA. | OFST. | EQUIPMENT CME/B-59

PROJECT NO. 2032011 | NORTHING 684044 | EASTING 7648465.5 | DRILLING METHOD Mud Rotary

DATE DRILLED 2/2/04 | LOGGED BY AR/NMC | LOCATION SE 3rd & Ankeny | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE: ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ⧈ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
40	5	■	1	3 0 50			**Pavement** ASPHALTIC CONCRETE OVER CONCRETE. **Artificial Fill (Qaf)** POORLY GRADED GRAVEL (GP); loose. SILTY GRAVEL (GM) to GRAVELLY SILT (ML); fine to coarse gravel, angular, low plasticity, gray to brown, moist, loose gravel, soft silt. CONCRETE RUBBLE GRAVELLY SILT (ML)		50/½"	
35	10	■	2	3 2 3			SILT (ML); low plasticity, light brown, moist, medium stiff. SILTY GRAVEL (GM) POORLY GRADED SAND (SP); trace to few gravel, trace silt, fine sand, fine to coarse gravel, angular, light brown, moist, dense.			
30	15	■	3	17 19 27			BOULDER at 18.0 to 19.5 feet. **Gravel Alluvium (Qfc)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, low plasticity, gray brown, wet, very dense.			
25	20	■	4	28 26 28					50/4"	
20	25	■	5	50			**Troutdale Formation (Tt)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, low plasticity silt, gray brown, wet, very dense.			
15	▼									
10	30	☒	6	50			POORLY GRADED GRAVEL WITH SAND (GP); trace silt, fine to coarse gravel, subrounded, nonplastic, gray gravel, light brown sand, wet, very dense.		50/2¾"	
	35	■	7	50					50/5½"	

ESCSO MUD 2005 2032011.GPJ 2042034-REV1.GPJ 7/1/05

PB PARSONS BRINCKERHOFF

BORING LOG
ES-2005C

Foundation Engineering, Inc.

PROJECT East Side CSO - Final Design | SHEET 2 OF 4 | INITIAL GWL@ 28.8 ft ()
CITY Portland, Oregon | SURF. EL. 43.6 ft | STA. | OFST. | EQUIPMENT CME/B-59
PROJECT NO. 2032011 | NORTHING 684044 | EASTING 7648465.5 | DRILLING METHOD Mud Rotary
DATE DRILLED 2/2/04 | LOGGED BY AR/NMC | LOCATION SE 3rd & Ankeny | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE: ☒ Ring (3.25" OD) | ◧ Standard Penetration Test (2" OD) | ■ Shelby Tube | Ⓖ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
5							**(Tt Cont'd)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, low plasticity silt, gray gravel, light brown sand, wet, very dense, some quartzite.			
	40		8	50/3"					50/3"	
0										
	45		9	50/3"					50/2½"	
-5										
	50		10	50/3"			With interbedded layers of POORLY GRADED GRAVEL WITH SAND (GP)		50/3½"	
-10										
	55		11	50/3"					50/3"	
-15										
	60		12	50/3"					50/½"	
-20										
	65		13	50/3"					50/½"	
-25										
	70		14	50/3"			Driller indicates formation becomes more cemented.		50/½"	
-30							Matrix becomes low to medium plasticity.			

ESCSO MUD 2005 2032011.GPJ 2042034-REV1.GPJ 7/1/05

PB PARSONS BRINCKERHOFF

BORING LOG
ES-2005C

Foundation Engineering, Inc.

PROJECT East Side CSO - Final Design | SHEET 3 OF 4 | INITIAL GWL@ 28.8 ft ()
CITY Portland, Oregon | SURF. EL. 43.6 ft STA. OFST. | EQUIPMENT CME/B-59
PROJECT NO. 2032011 | NORTHING 684044 EASTING 7648465.5 | DRILLING METHOD Mud Rotary
DATE DRILLED 2/2/04 LOGGED BY AR/NMC LOCATION SE 3rd & Ankeny | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE: ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ⧉ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	PERCENT FINES 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
			15	50/3"			**(Tt Cont'd)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, gray gravel, light brown sand, low to medium plasticity, wet, very dense.		50/½"	
-35	80		16	50/3"					50/3½"	
-40	85		17	50/3"					50/3½"	
-45	90		18	50/3"					50/1"	
-50	95		19	50/3"					50/1"	
-55	100									
-60	105									
-65	110		22	50/3"					50/1"	

ESCSO MUD 2005 2032011.GPJ 2042034-REV1.GPJ 7/1/05

PB PARSONS BRINCKERHOFF

BORING LOG
ES-2005C

Foundation Engineering, Inc.

PROJECT East Side CSO - Final Design | SHEET 4 OF 4 | INITIAL GWL@ 28.8 ft ()

CITY Portland, Oregon | SURF. EL. 43.6 ft STA. _____ OFST. _____ | EQUIPMENT CME/B-59

PROJECT NO. 2032011 | NORTHING 684044 EASTING 7648465.5 | DRILLING METHOD Mud Rotary

DATE DRILLED 2/2/04 LOGGED BY AR/NMC LOCATION SE 3rd & Ankeny | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ⧉ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	PERCENT FINES (20 40 60 80) / PLASTIC M.C. LIQUID (20 40 60 80)	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") (20 40 60 80)	WELL
-70	115		23	50/3"	FC MC	△	**(Tt Cont'd)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, gray gravel, light brown sand, low to medium plasticity, wet, very dense. Becomes SILTY GRAVEL (GM).		50/1½"	
-75	120		24	50/3"						
-80	125		25	50/3"	FC MC	△			50/2"	
-85	130		26	50/3"					50/½"	
-90	135		27	50/3"					50/1"	
-95	140		28	50/3"					50/2"	
-100			29	50/3"			Bottom of boring at 143 ft.		50/3"	
-105	145									

ESCSO MUD 2005 2032011.GPJ 2042034-REV1.GPJ 7/1/05

PB PARSONS BRINCKERHOFF

BORING LOG
ES-2006C

Foundation Engineering, Inc.

PROJECT East Side CSO - Final Design | SHEET 1 OF 5 | INITIAL GWL@ Not Available

CITY Portland, Oregon | SURF. EL. 47.7 ft | STA. | OFST. | EQUIPMENT CME 75

PROJECT NO. 2032011 | NORTHING 684319.2 | EASTING 7648477 | DRILLING METHOD Mud Rotary

DATE DRILLED 3/12/04 | LOGGED BY AR | LOCATION SE 3rd & Burnside | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE: ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ⧉ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	PERCENT FINES (△) 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
45							**Pavement** ASPHALTIC CONCRETE OVER BASE ROCK. **Artificial Fill (Qaf)** SILT WITH SAND AND COBBLES (ML); soft to medium stiff.			
	5		1	2 4 14	FC MC	△	SILT (ML) to SILTY SAND (SM); fine sand, nonplastic, brown, loose. SILTY GRAVEL WITH SAND (GM); fine to coarse gravel, angular, low plasticity silt, gray brown, moist, medium dense.			
40	10		2	50	MC		POORLY GRADED GRAVEL WITH SAND (GP); trace silt, fine to coarse gravel, angular to subrounded, nonplastic, gray, very dense.		50/3½"	
35							POORLY GRADED SAND (SP); trace silt, fine sand, light brown, moist, medium dense.			
	15		3	12 12 16	MC					
30										
	20		4	50			**Gravel Alluvium (Qfc)** POORLY GRADED SAND WITH GRAVEL (SP); fine to coarse gravel, subrounded to subangular, light brown, very dense.		50/5½"	
25							POORLY GRADED GRAVEL WITH SAND (GP); trace silt.			
	25		5	50	MC		CLAYEY GRAVEL (GC). **Gravel Alluvium (Qfc)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, low plasticity to nonplastic silt, gray brown, moist to wet, very dense.		50/6"	
20	30		6	50					50/4½"	
15										
	35		7	50					50/5"	

ESCSO MUD 2005 2032011.GPJ 2042034-REV1.GPJ 7/1/05

PB PARSONS BRINCKERHOFF

BORING LOG
ES-2006C

Foundation Engineering, Inc.

PROJECT East Side CSO - Final Design | SHEET 2 OF 5 | INITIAL GWL@ Not Available
CITY Portland, Oregon | SURF. EL. 47.7 ft STA. ____ OFST. ____ | EQUIPMENT CME 75
PROJECT NO. 2032011 | NORTHING 684319.2 EASTING 7648477 | DRILLING METHOD Mud Rotary
DATE DRILLED 3/12/04 LOGGED BY AR | LOCATION SE 3rd & Burnside | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube Ⓖ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
10							**(Qfc Cont'd)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, nonplastic silt, gray to brown, wet, very dense.			
	40		8	50					50/4"	
5										
	45		9	50			**Troutdale Formation (Tt)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, nonplastic, gray to brown, wet, very dense.		50/3"	
0										
	50		10	50					50/2½"	
-5										
	55		11	50					50/3	
-10										
	60		12	50			Becomes with some quartzite.		50/2½"	
-15										
	65		13	50					50/3½"	
-20										
	70		14	50	GSD	△	Becomes with low plasticity fines, gray to yellow brown, some moderately weathered gravels.		50/3½"	
-25										

ESCSO MUD 2005 2032011.GPJ 2042034-REV1.GPJ 7/1/05

PB PARSONS BRINCKERHOFF

BORING LOG
ES-2006C

Foundation Engineering, Inc.

PROJECT East Side CSO - Final Design | SHEET 3 OF 5 | INITIAL GWL@ Not Available

CITY Portland, Oregon | SURF. EL. 47.7 ft STA. _____ OFST. _____ | EQUIPMENT CME 75

PROJECT NO. 2032011 | NORTHING 684319.2 EASTING 7648477 | DRILLING METHOD Mud Rotary

DATE DRILLED 3/12/04 LOGGED BY AR | LOCATION SE 3rd & Burnside | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ▣ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	PERCENT FINES (20 40 60 80) / PLASTIC M.C. LIQUID (20 40 60 80)	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") (20 40 60 80)	WELL
			15	50			**(Tt Cont'd)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, nonplastic to low plasticity silt, yellow brown to gray, wet, very dense, some quartzite, some slightly to moderately weathered gravels.		50/2"	
-30	80	☒	16	50	GSD	△			50/5"	
-35	85	■	17	50					50/2"	
-40	90	■	18	50					50/3"	
-45	95	■	19	50	GSD	△	Sand lens at 95.4 to 96.5 feet.		50/4"	
							Sand lens at 97 to 97.5 feet.			
-50	100	═	20	50					50/1½	
-55	105	■	21	50	GSD	△	Interbedded sand lenses from 105 to 110 feet.		50/1"	
-60	110	■	22	50			±7-inch diameter cobble at 112 feet.		50/2½"	

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BORING LOG
ES-2006C

Foundation Engineering, Inc.

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CITY Portland, Oregon | SURF. EL. 47.7 ft STA. ____ OFST. ____ | EQUIPMENT CME 75
PROJECT NO. 2032011 | NORTHING 684319.2 EASTING 7648477 | DRILLING METHOD Mud Rotary
DATE DRILLED 3/12/04 LOGGED BY AR | LOCATION SE 3rd & Burnside | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ⧉ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
-65							**(Tt Cont'd)** POORLY GRADED GRAVEL WITH SILT, SAND AND COBBLES (GP-GM); trace to few cobbles, fine to coarse gravel, subrounded, low plasticity silt, olive gray to black, wet, very dense, some slightly weathered gravels.			
	115		23	50					50/4½"	
-70										
	120		24	50					50/3"	
-75										
	125		25	50					50/1"	
-80										
	130		26	50					50/1"	
-85										
	135		27	50					50/2"	
-90										
	140		28	50					50/2"	
-95										
	145		29	50					50/1"	
-100										

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CITY Portland, Oregon | SURF. EL. 47.7 ft STA. _____ OFST. _____ | EQUIPMENT CME 75

PROJECT NO. 2032011 | NORTHING 684319.2 EASTING 7648477 | DRILLING METHOD Mud Rotary

DATE DRILLED 3/12/04 LOGGED BY AR | LOCATION SE 3rd & Burnside | HAMMER SYS. 140 + 300 lb. hammer, 30 inch dro

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ⧉ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	△ PERCENT FINES △ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
		■	30	50			Bottom of boring at 150.2 ft.		50/2½"	
105	155									
110	160									
115	165									
120	170									
125	175									
130	180									
135	185									

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PROJECT East Side CSO - Final Design | SHEET 1 OF 5 | INITIAL GWL@ Not Available

CITY Portland, Oregon | SURF. EL. 32.1 ft STA. _____ OFST. _____ | EQUIPMENT CME 75

PROJECT NO. 2032011 | NORTHING 684425.8 EASTING 7648334.6 | DRILLING METHOD Mud Rotary

DATE DRILLED 3/3/04 LOGGED BY AR | LOCATION NE 2nd & Burnside (Parking Lot) | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ▣ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	PERCENT FINES (20 40 60 80) / PLASTIC M.C. LIQUID (20 40 60 80)	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") (20 40 60 80)	WELL
30							**Pavement** ASPHALTIC CONCRETE OVER BASE ROCK. **Artificial Fill (Qaf)** GRAVELLY SILT TO SILT (ML); fine to coarse gravel, subangular to subrounded, low to medium plasticity, brown, moist, medium stiff.			
25	5		1	1 3 3	GSD MC	△				
20	10		2	19 29 38	GSD	△	POORLY GRADED GRAVEL WITH SAND AND COBBLES (GP); trace silt, trace to few cobbles, fine to coarse gravel, angular to subrounded, gray to brown, moist, very dense.			
15	15		3	22 50	GSD	△			50/4½"	
10	20		4	50/5¾"			**Troutdale Formation (Tt)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, low plasticity silt, yellow brown to gray, moist to wet, very dense.		50/5¾"	
5	25		5	50/4"					50/4"	
0	30		6	50/2"					50/2"	
-5	35		7	50/2½"					50/2½"	

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CITY Portland, Oregon | SURF. EL. 32.1 ft STA. _____ OFST. _____ | EQUIPMENT CME 75

PROJECT NO. 2032011 | NORTHING 684425.8 EASTING 7648334.6 | DRILLING METHOD Mud Rotary

DATE DRILLED 3/3/04 LOGGED BY AR | LOCATION NE 2nd & Burnside (Parking Lot) | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ⧉ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	PERCENT FINES 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
							(Tt Cont'd) POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, low plasticity silt, yellow brown to gray, moist to wet, very dense.			
-10	40		8	50/2"					50/2"	
	45		9	50/5"	GSD MC	△ ●	POORLY GRADED SAND WITH SILT (SP-SM); fine sand, yellow brown, wet, very dense.		50/5"	
-15							POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, gray to yellow brown, wet, very dense.			
-20	50		10	50/3"					50/3"	
	55		11	50/3½"			Sand lens at 56 to 57 feet.		50/3½"	
-25							Sand lens at 58 to 59 feet.			
	60		12	50/5"	GSD	△	Becomes with some slightly to moderately weathered gravel, some quartzite.		50/5"	
-30							Slight caving from 63 to 65 feet.			
	65		13	50/2"					50/2"	
-35							Sand lens at 67.5 to 69.5 feet.			
	70		14	50/3"					50/3"	
-40										

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CITY Portland, Oregon | SURF. EL. 32.1 ft STA. ____ OFST. ____ | EQUIPMENT CME 75

PROJECT NO. 2032011 | NORTHING 684425.8 EASTING 7648334.6 | DRILLING METHOD Mud Rotary

DATE DRILLED 3/3/04 LOGGED BY AR | LOCATION NE 2nd & Burnside (Parking Lot) | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ⧉ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	PERCENT FINES (20 40 60 80) / PLASTIC M.C. LIQUID (20 40 60 80)	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") (20 40 60 80)	WELL
-45			15	50/2"			**(Tt Cont'd)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, low plasticity silt, gray to yellow brown, wet, very dense, some slightly to moderately weathered gravel, some quartzite.		50/2"	
	80		16	50/3"					50/3"	
-50										
	85		17	50/½"					50/½"	
-55										
	90		18	50/5"	GSD	△			50/5"	
-60										
	95		19	50/4"	GSD	△	POORLY GRADED SAND WITH SILT (SP-SM); trace gravel, olive gray, wet, very dense.		50/4"	
-65							POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, low plasticity silt, olive gray, wet, very dense, some quartzite.			
	100		20	50/3½"					50/3½"	
-70										
	105		21	50/2"					50/2"	
-75										
	110		22	50/½"					50/½"	
-80										

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PROJECT East Side CSO - Final Design | SHEET 4 OF 5 | INITIAL GWL@ Not Available
CITY Portland, Oregon | SURF. EL. 32.1 ft STA. ____ OFST. ____ | EQUIPMENT CME 75
PROJECT NO. 2032011 | NORTHING 684425.8 EASTING 7648334.6 | DRILLING METHOD Mud Rotary
DATE DRILLED 3/3/04 LOGGED BY AR | LOCATION NE 2nd & Burnside (Parking Lot) | HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE ☒ Ring (3.25" OD) ◧ Standard Penetration Test (2" OD) ■ Shelby Tube ⧉ Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	PERCENT FINES 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
-85	115		23	50/2½"	GSD	△	**(Tt Cont'd)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, low plasticity silt, olive gray, wet, very dense, some quartzite.		50/2½"	
-90	120		24	50/2"					50/2"	
-95	125		25	50/2"					50/2"	
-100	130		26	50/3"					50/3"	
							POORLY GRADED SAND WITH SILT (SP-SM).			
-105	135		27	50/4"	GSD	△	POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, nonplastic silt, gray to yellow brown, wet, very dense.		50/4"	
-110	140		28	50/2"					50/2"	
-115	145		29	50/2"					50/2"	

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Foundation Engineering, Inc.

PROJECT East Side CSO - Final Design	SHEET 5 OF 5		INITIAL GWL@ Not Available
CITY Portland, Oregon	SURF. EL. 32.1 ft	STA. ____ OFST. ____	EQUIPMENT CME 75
PROJECT NO. 2032011	NORTHING 684425.8	EASTING 7648334.6	DRILLING METHOD Mud Rotary
DATE DRILLED 3/3/04 LOGGED BY AR	LOCATION NE 2nd & Burnside (Parking Lot)		HAMMER SYS. 140 + 300 lb. hammer, 30 inch drop

SAMPLE TYPE: Ring (3.25" OD) | Standard Penetration Test (2" OD) | Shelby Tube | Grab Sample

Elevation (ft)	DEPTH (ft)	SAMPLE TYPE	SAMPLE NO	FIELD BLOWS /6"	LAB TESTS	PERCENT FINES 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	SOIL DESCRIPTION	LITHOLOGY	UNCORRECTED BLOW COUNTS (last 12") 20 40 60 80	WELL
			30	50/2"			**(Tt Cont'd)** POORLY GRADED GRAVEL WITH SILT AND SAND (GP-GM); fine to coarse gravel, subrounded, nonplastic silt, gray to yellow brown, wet, very dense.		50/2"	
-120										
	155		31	50/2"					50/2"	
-125										
	160		32	50/2"					50/2"	
							Bottom of boring at 160.2 ft.			
-130										
	165									
-135										
	170									
-140										
	175									
-145										
	180									
-150										
	185									
-155										

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APPENDIX B: DRILLING EXPLORATIONS

Appendix B

Drilling Explorations

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Drill Logs and Sonic Core Photographs (see Table B1 for complete list of borings)

APPENDIX B: DRILLING EXPLORATIONS

B.1 GENERAL

Shannon & Wilson, Inc., explored subsurface conditions at the bridge site during two phases of the project with a total of 33 geotechnical borings, designated B-01 through B-33. During both phases, some borings were drilled on land, and some were drilled in the Willamette River from a floating barge. This appendix describes the general techniques used to advance and sample the borings, discusses installation and backfill details, includes logs of the materials encountered during drilling, and presents groundwater measurement data.

Completed borehole locations were measured in the field relative to existing site features and/or with a hand-held GPS. Approximate borehole coordinates (OCRS Portland Zone) and elevations (NAVD88) are presented on the drill logs in this appendix. Approximate borehole locations are also shown graphically on the Site and Exploration Plan and Interpretive Subsurface Profile A-A', Figure 2-2.

B.2 DRILLING

The initial phase of geotechnical borings was drilled between September 19, and October 25, 2016, and the second phase of geotechnical borings was drilled between July 28, and November 18, 2021. Drilling contractors included Western States Soil Conservation, Inc., of Hubbard, Oregon, and Salisbury & Associates, Inc., of Spokane, Washington. The borings were advanced to depths ranging from 41.5 to 230.3 feet using mud rotary drilling techniques, rotary sonic coring, casing advancer, and direct push techniques, as noted on the Drill Logs. Drilling dates, subcontractors, equipment, and other general drilling information such as boring depths, instrumentation installations, and completed in situ testing are indicated on Table B1.

The in-water borings were drilled in the Willamette River using cased and open-hole, mud rotary and rotary sonic drilling techniques through a circulation casing. The in-water borings were drilled from floating barges provided and operated by Mark Marine Service, Inc., of Washougal, Washington. To prevent migration of potential contaminants via drill fluids, the upper 25 feet of most onshore borings were advanced using rotary sonic, hollow stem auger, or direct push methods to allow environmental sampling. Additionally, some explorations drilled during the second phase were performed solely for environmental sampling and are included in a separate report by Coles & Betts Environmental Consulting, LLC. Shannon & Wilson representatives were present during the explorations to locate the borings, observe the drilling, collect soil samples, and log the materials encountered.

At the initial location of boring B-02, designated on Figure 2-2 as B-02A, we encountered concrete and metal debris that resulted in extreme mud loss and practical drilling refusal at a depth of approximately 8 feet below the mudline. The location of boring B-02 was moved approximately 28 feet south, and 7 feet west of B-02A, where it was drilled to its ultimate depth of 148.2 feet below mudline.

At the initial location of boring B-12, designated on Figure 2-2 as B-12A, after drilling to 75 feet below mudline, the barge shifted about 30 feet overnight bending a spud, and could not be repositioned on the borehole. The location of boring B-12 was moved approximately 40 feet south and 15 feet west of B-12A, where it was drilled to its ultimate depth of 129 feet below mudline. Drill Logs of both holes are included in this appendix.

B.3 SAMPLING

B.3.1 Disturbed Sampling

Disturbed samples were collected in the borings, typically at 2.5-, 5-, or 10-foot depth intervals, using a standard 2-inch outside diameter (O.D.) split spoon sampler in conjunction with Standard Penetration Testing standards. In a Standard Penetration Test (SPT), ASTM D1586, the sampler is driven 18 inches into the soil using a 140-pound hammer dropped 30 inches. The number of blows required to drive the sampler the last 12 inches is defined as the standard penetration resistance, or N-value. The SPT N-value provides a measure of in situ relative density of cohesionless soils (silt, sand, and gravel), and the consistency of cohesive soils (silt and clay). All disturbed samples were visually identified and described in the field, sealed to retain moisture, and returned to our laboratory for additional examination and testing.

SPT N-values can be significantly affected by several factors, including the efficiency of the hammer used. Several automatic hammers and one cathead hammer were used over the course of the exploration program. Automatic hammers generally have higher energy transfer efficiencies than cathead driven hammers. Based on information we received from Western States, the average energy efficiencies of their automatic hammers used on site ranged from 81 to 93 percent, as indicated on the Drill Logs and in Table B1. For reference, cathead hammers are typically assumed to have an average energy efficiency of 60 percent. The drill rig from Salisbury & Associates used on site, incorporates a cathead hammer for sampling. All N-values presented in this report are in blows per foot, as counted in the field. No corrections of any kind have been applied.

An SPT was considered to have met refusal where more than 50 blows were required to drive the sampler 6 inches. If refusal was encountered in the first 6-inch interval (for

example, 50 for 1.5"), the count is reported as 50/1st 1.5". If refusal was encountered in the second 6-inch interval (for example, 48, 50 for 1.5"), the count is reported as 50/1.5". If refusal was encountered in the last 6-inch interval (for example, 39, 48, 50 for 1.5"), the count is reported as 98/7.5". Sample recovery is identified as a percentage of material retained for the length the sampler was driven.

B.3.2 Relatively Undisturbed Sampling

Relatively undisturbed samples were collected in 3-inch O.D. thin-wall Shelby tubes, which were hydraulically pushed into the undisturbed soil at the bottoms of boreholes. The soils exposed at the ends of the tubes were examined and described in the field. After examination, the ends of the tubes were sealed to preserve the natural moisture of the samples. The sealed tubes were stored in the upright position, and care was taken to avoid shock and vibration during their transport and storage in our laboratory.

B.3.3 Rotosonic Sampling

Sonic drilling, also referred to as rotosonic or sonic rotary drilling, combines high frequency vibrations, downward pressure, and relatively slow rotations to advance through and sample soil and rock. Rotosonic drilling allows for continuous sampling of a borehole. Typically, a core barrel is advanced first. Then, to maintain borehole integrity, a larger-diameter outer casing is advanced over the core barrel. If the borehole will reliably remain open, the outer casing is not required. Hardened steel casing shoe-type bits are attached to the bottom of both the core barrel and the outer drill casing. The bits have several carbide buttons around the tips and outer edges that cut through the soil and rock as the drill string is vibrated and rotated. Drilling can be completed without the use of drill fluids, but water is commonly used to flush material from the annular space between the core barrel and outer casing, while the outer casing is driven.

To retrieve a core sample, the core barrel is withdrawn from the hole and the sample is extruded into tubular plastic bags using vibration. During this exploration program, the boreholes were typically advanced in 10- to 20-foot intervals while continuously core sampling. The bags of approximately 4-inch diameter core were placed into wooden boxes and logged and photographed by a Shannon & Wilson representative.

B.4 BOREHOLE INSTALLATIONS AND ABANDONMENT

B.4.1 Vibrating Wire Transducers

Vibrating wire pressure transducers were installed at a depth of 55 feet below ground surface in Borings B-07, B-08, B-16, and B-32 to allow ongoing measurements of

groundwater levels. A vibrating-wire pressure transducer measures pressure using a pressure-sensitive diaphragm with a vibrating-wire element attached to it. A cable runs from the transducer to the ground surface, where a readout device can be attached. Pressure acting on the outside face of the diaphragm causes it to deflect, which changes the tension of the wire element and the frequency of its vibration. The readout device measures the frequency of the induced vibration, which is converted to pressure, or head of groundwater above the transducer.

The vibrating wire pressure transducers were permanently installed in the boreholes and grouted into place in accordance with Oregon Water Resources Department procedures. The instruments were taped to measured lengths of PVC pipe to control the depth of installation. Prior to insertion, initial "zero" readings were taken at "zero" head. With the transducers and PVC pipe in place, the holes were tremie grouted with a bentonite-cement grout. Cables leading up from the transducers are protected at the surface by flush-mount monuments set in concrete. Installation details are indicated on the drill logs, along with the highest and lowest measured water levels. Measured water levels can also be found in Figure B1, Willamette River and Groundwater Level Data.

B.4.2 Borehole Abandonment

All borings other than the four with vibrating wire pressure transducers were backfilled with bentonite cement grout or bentonite chips in accordance with Oregon Water Resource Department regulations. No wells or other instruments were installed in the remaining boreholes. Backfill of borings that penetrated a paved surface were finished at the surface with a matching section of ODOT-approved asphalt cold patch and nominally compacted gravel extending to a depth of at least 2 feet below the ground surface.

B.5 MATERIALS DESCRIPTION

In the field, soil samples were described and identified visually in accordance with the ODOT Soil and Rock Classification Manual (1987). The ASTM International (ASTM) D2488 Visual-Manual method was also used as a guide in determining the key diagnostic properties of soils. Consistency, color, relative moisture, degree of plasticity, peculiar odors, and other distinguishing characteristics of the samples were noted. Once returned to our laboratory, the samples were re-examined, various standard laboratory tests were conducted, and the field descriptions and identifications were modified where necessary. Please refer to the ODOT Soil and Rock Classification Manual (1987) for definitions of descriptive terminology used in the Drill Logs.

B.6 DRILL LOGS AND CORE PHOTOGRAPHS

Summary logs of the borings are presented in the attached Drill Logs. Drill logs of borings that included rotosonic coring are followed by core photographs. Soil descriptions and interfaces on the logs are interpretive, and actual changes may be gradual. The left-hand portion of the drill logs gives individual sample intervals, percent recovery, Standard Penetration Test data, and natural moisture content measurements. Material descriptions and geotechnical unit designations are shown in the center of the drill log, and the right-hand portion provides a graphic log, miscellaneous comments, and a graphic depicting hole backfill details.

Table B1 - Drilling Summary

Boring	Northing (ft)[1,3]	Easting (ft)[1,3]	Hole Collar Elevation (ft)[2,3]	Total Depth (ft)	Start Date	End Date	Drill Company	Drill Rig	Hammer Efficiency (%)[4]	Vibrating Wire Piezometer Installation Depth (ft bgs)	Downhole Testing
B-01	172523	348678	35	221.5	10/3/2016	10/7/2016	WSSC	CME-75 Truck	93		OYO
B-02	172324	349067	-38	148.2	10/17/2016	10/25/2016	WSSC	CME-75 Truck	93		OYO
B-03	172391	349874	32	230.3	9/19/2016	9/22/2016	WSSC	CME-75 Truck	93		OYO
B-04	172494	348080	42	110.1	9/27/2021	9/29/2021	WSSC	CME-75 Truck	87		
B-05	172407	348331	32	110.1	9/27/2021	9/28/2021	WSSC	CME-75 Truck	81		
B-06	172411	348442	33	140.2	9/22/2021	9/24/2021	WSSC	CME-75 Truck	81		OYO
B-07	172527	348603	34	140.5	9/16/2021	9/21/2021	WSSC	CME-75 Truck	81	55.0	
B-08	172411	348711	34	170.0	9/20/2021	9/22/2021	WSSC	CME-75 Truck	87	55.0	OYO
B-09	172357	348830	-25	151.3	8/13/2021	8/19/2021	WSSC	CME-75 Truck	81		OYO
B-10	172524	349033	-54	183.6	7/28/2021	8/4/2021	WSSC	CME-75 Truck	81		OYO, PMT
B-11	172522	349346	-35	180.9	8/4/2021	8/13/2021	WSSC	CME-75 Truck	87		PMT
B-12	172348	349376	-48	129.0	8/20/2021	8/25/2021	WSSC	CME-75 Truck	81		OYO
B-12A	172388	349391	-51	76.5	8/16/2021	8/18/2021	WSSC	CME-75 Truck	87		
B-13	172378	349522	-48	160.1	7/28/2021	8/3/2021	WSSC	CME-75 Truck	87		OYO
B-14	172404	349688	16	130.1	11/15/2021	11/18/2021	SAI	Viper Specialty Drill Rig	60		
B-15	172292	349728	39	215.0	9/12/2021	9/15/2021	WSSC	CME-75 Truck	87		OYO
B-16	172490	349814	31	210.1	8/27/2021	9/1/2021	WSSC	CME-75 Truck	87	55.0	OYO
B-17	172470	350069	34	195.0	8/23/2021	8/25/2021	WSSC	CME-75 Truck	87		OYO
B-18	172371	350239	34	185.2	8/23/2021	8/26/2021	WSSC	CME-75 Truck	87		
B-19	172503	350466	50	85.1	9/7/2021	9/8/2021	WSSC	CME-75 Truck	87		
B-20	172430	350598	65	41.5	9/9/2021	9/10/2021	WSSC	CME-75 Truck	87		
B-21	172546	348222	31	120.1	11/8/2021	11/10/2021	WSSC	GeoProbe 7822DT	85		
B-22	172566	348513	33	150.0	11/9/2021	11/11/2021	WSSC	GeoProbe 8150LS Tracked	N/A		

Table B1 - Drilling Summary

Boring	Northing (ft)[1,3]	Easting (ft)[1,3]	Hole Collar Elevation (ft)[2,3]	Total Depth (ft)	Start Date	End Date	Drill Company	Drill Rig	Hammer Efficiency (%)[4]	Vibrating Wire Piezometer Installation Depth (ft bgs)	Downhole Testing
B-23	172467	348580	34	140.0	11/2/2021	11/5/2021	WSSC	GeoProbe 8150LS Tracked	N/A		
B-24	172566	349045	-56	160.0	9/8/2021	9/14/2021	WSSC	GeoProbe 8150LS Tracked	N/A		
B-25	172407	349007	-47	165.0	9/20/2021	9/22/2021	WSSC	GeoProbe 8150LS Tracked	N/A		
B-26	172511	349102	-32	158.0	9/14/2021	9/17/2021	WSSC	GeoProbe 8150LS Tracked	N/A		
B-27	172371	349058	-32	178.8	8/5/2021	8/10/2021	WSSC	CME-75 Truck	81		OYO, PMT
B-28	172556	349386	-61	136.4	10/19/2021	10/22/2021	WSSC	GeoProbe 8150LS Tracked	N/A		
B-29	172362	349316	-51	160.3	10/12/2021	10/14/2021	WSSC	GeoProbe 8150LS Tracked	N/A		
B-30	172363	349114	-37	163.0	10/25/2021	10/27/2021	WSSC	GeoProbe 8150LS Tracked	N/A		
B-31	172384	349429	-65	153.8	10/15/2021	10/19/2021	WSSC	GeoProbe 8150LS Tracked	N/A		
B-32	172354	350124	32	195.1	9/8/2021	9/13/2021	WSSC	CME-75 Truck	81	55.0	OYO
B-33	172380	349993	34	195.1	9/1/2021	9/7/2021	WSSC	CME-75 Truck	81		

NOTES:

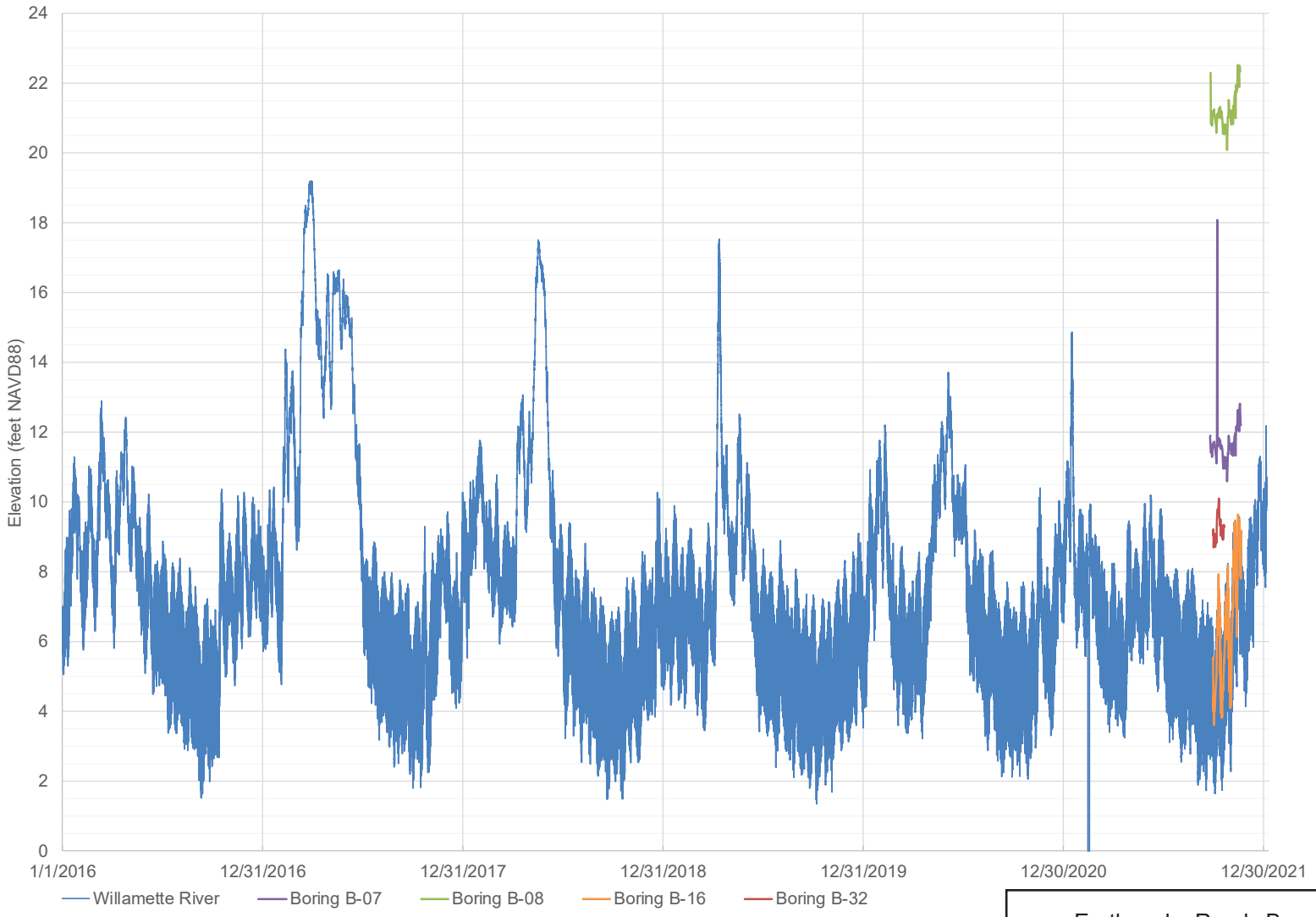
1 Oregon Coordinate Reference System (OCRS), Portland Zone, 2011

2 North American Vertical Datum of 1988 (NAVD88)

3 Boreholes not surveyed; locations based on GPS and/or field measurements relative to existing site features.

4 Hammer energy of 60% assumed for cathead hammer. SPT testing not performed in borings drilled with rotary sonic method.

N/A = Not Applicable; OYO = OYO Suspension (P-S Wave Velocity) Logging; PMT = Pressuremeter Testing; SAI = Salisbury & Associates, Inc.; WSSC = Western States Soil Conservation, Inc.



Boring	Maximum Elevation (ft)		Minimum Elevation (ft)	
B-07	17.6	10/6/21	10.1	10/24/21
B-08	22.7	11/13/21	20.3	10/24/21
B-16	10.8	11/13/21	4.8	9/30/21
B-32	9.6	10/9/21	8.2	9/30/21

NOTES:

1. Willamette River elevations based on USGS gage 14211720, located near the Morrison Bridge.
2. See Figure 3 for approximate boring locations.

Earthquake Ready Burnside Bridge
Portland, Oregon

WILLAMETTE RIVER AND GROUNDWATER LEVEL DATA

January 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. B1

FIG. B1

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-01**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,523**	Easting: **~ 348,678**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig (Hammer Efficiency = 92.6%)**		Driller **Western States/Brad**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Elizabeth Barnett**	Ground Elev. **~ 35 ft.**
Start Date **October 3, 2016**	End Date **October 7, 2016**	Total Depth **221.50 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0					SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.				
						0.00 - 8.50 Sandy GRAVEL with some silt; GP-GM; Orange-brown; Nonplastic fines; Wet; Medium Dense; Fine to coarse, subrounded gravel; Mostly fine to medium sand, trace coarse sand; Trace brick fragments; Trace iron oxide staining; (Fill)		Mud rotary drilling technique (5-inch hole); OYO suspension logging performed between depths of 1.6 feet and 206.7 feet	
5	N1	13	7-6-6		N- 1 (5.00-6.50) Sandy GRAVEL with some silt; GP-GM; Orange-brown; Nonplastic fines; Wet; Medium Dense; Fine to coarse, subrounded gravel; Mostly fine to medium sand, trace coarse sand; Trace brick fragments; Trace iron oxide staining; Poor recovery; (Fill)				
						8.50 - 12.00 Silty CLAY with trace sand; CL; Blue-gray; Medium plasticity; Moist; Medium Stiff; Fine to medium sand; Trace brick fragments; (Fill)		Wood fragments in cuttings between depths of 8.5 feet and 25.0 feet	
10	N2	20	5-2-3		N- 2 (10.00-11.50) Silty CLAY with trace sand; CL; Blue-gray; Medium plasticity; Moist; Medium Stiff; Fine to medium sand; Trace brick fragments; Poor recovery; (Fill)				
						12.00 - 25.00 Clayey GRAVEL with some sand; GC; Gray to dark gray; Low to medium plasticity fines; Moist to wet; Loose; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Few to some wood and charcoal fragments; Trace brick fragments; (Fill)			
15	N3	13	4-3-6		N- 3 (15.00-16.50) Clayey GRAVEL with some sand; GC; Gray; Low to medium plasticity fines; Wet; Loose; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Few wood fragments; Trace brick fragments; Poor recovery; (Fill)			Possible wood stump or log between depths of 17 feet and 19 feet	
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N4	13	8-3-3		N- 4 (20.00-21.50) Clayey GRAVEL with some sand; GC; Dark gray; Low to medium plasticity fines; Moist; Loose; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Some wood and charcoal fragments; Trace fine brick fragments; Poor recovery; (Fill)			Wood fragment content decreases and includes small twigs at 22 feet	
25	N5	0	12-4-4		N- 5 (25.00-26.50) No Recovery	**25.00 - 38.25 Sandy SILT to Sandy SILT with trace gravel; ML; Gray; Low plasticity; Moist to wet; Medium Stiff; Fine to coarse, subrounded gravel; Fine to medium sand; Trace organics and thin laminations of PEAT; (Sand/Silt Alluvium)**			
30	N6	13	3-2-3		N- 6 (30.00-31.50) Sandy SILT with trace gravel; ML; Gray; Low plasticity; Wet; Medium Stiff; Fine to coarse, subrounded gravel (clast stuck in split spoon tip); Fine to medium sand; Poor recovery; (Sand/Silt Alluvium)				
35	N7	80	4-3-3		N- 7 (35.00-36.50) Sandy SILT; ML; Gray; Low plasticity; Moist to wet; Medium Stiff; Fine to medium sand; Micaceous; Trace organics and thin laminations of PEAT; (Sand/Silt Alluvium)			Atterberg Limits N7: LL=37, PL=29, PI=8; 33% sand, 67% fines.	
40	N8	100	0-1-3		N- 8 (40.00-41.50) Silty CLAY with trace sand; CL; Gray-green; Medium plasticity; Moist; Soft to Medium Stiff; Fine to coarse sand; Trace organics; (Fine-grained Alluvium)	**38.25 - 42.00 Silty CLAY with trace sand; CL; Gray-green; Medium plasticity; Moist; Soft to Medium Stiff; Fine to coarse sand; Trace organics; (Fine-grained Alluvium)**			
45	N9	20	14-21-45		N- 9 (45.00-46.50) GRAVEL with some clay and some sand; GP-GC; Gray; Low to medium plasticity fines; Wet; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Trace fine organics; Poor recovery; (Gravel Alluvium)	**42.00 - 48.25 GRAVEL with some clay and some sand; GP-GC; Gray; Low to medium plasticity fines; Wet; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Trace fine organics; (Gravel Alluvium)**			
50						**48.25 - 58.25 Sandy GRAVEL with some silt to Gravelly SAND with some silt;**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N10	100	45-45-50		N- 10 (50.00-51.50) Sandy GRAVEL with some silt; GP-GM; Brown and gray; Nonplastic fines; Moist; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Trace layers of Silty SAND (SM); Some iron oxide staining; (Gravel Alluvium)	**GP-GM, SP-SM; Brown and gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse or medium to coarse sand; Trace layers of Silty SAND (SM); Some iron oxide staining; (Gravel Alluvium)**		N10: 46% gravel, 44% sand, 10% fines.	
55	N11	100	27-36-26		N- 11 (55.00-56.50) Sandy GRAVEL with some silt to Gravelly SAND with some silt; GP-GM/SP-SM; Gray; Low plasticity fines; Moist; Very Dense; Fine to coarse, subangular to subrounded gravel; Medium to coarse sand; (Gravel Alluvium)				
60	N12	67	18-18-17		N- 12 (60.00-61.50) SAND with some silt and trace gravel; SP-SM; Light gray-brown; Nonplastic fines; Wet; Dense; Fine to coarse, subrounded gravel; Mostly medium to coarse sand, trace fine sand; Some iron oxide staining; (Sand Alluvium)	**58.25 - 63.25 SAND with some silt and trace gravel; SP-SM; Light gray-brown; Nonplastic fines; Wet; Dense; Fine to coarse, subrounded gravel; Mostly medium to coarse sand, trace fine sand; Some iron oxide staining; (Sand Alluvium)**			
65	N13	0	50/1st 3"		N- 13 (65.00-65.25) GRAVEL with cobbles; GP; Dark gray; Wet; Very Dense; Single, broken basalt cobble retrieved from 3-inch sampler; (Gravel Alluvium)	**63.25 - 75.00 GRAVEL with cobbles; GP; Gray to dark gray; Wet; Very Dense; Fine to coarse, subangular to subrounded gravel; (Gravel Alluvium)**		Lost approximately 60 gallons of drilling mud between 65 feet and 80 feet; No recovery in sample N13, used 3-inch sampler after SPT to retrieve sample	
70	N14	59	50/1st 2"		N- 14 (70.00-70.17) GRAVEL with cobbles; GP; Gray; Wet; Very Dense; Recovered one fine gravel-sized fragment of andesite; (Gravel Alluvium)				
75	N15	75	43-50/2"		N- 15 (75.00-75.67) GRAVEL with some sand and trace silt; GP; Gray and brown; Nonplastic fines; Moist; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Upper Troutdale Formation)	**75.00 - 80.00 GRAVEL with some sand and trace silt; GP; Gray and brown; Nonplastic fines; Moist; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Upper Troutdale Formation)**			
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N16	93	35-50/3"		N- 16 (80.00-80.75) Clayey GRAVEL with some sand; GC; Yellow-brown; Medium plasticity fines; Moist; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Some iron oxide staining; (Upper Troutdale Formation)	**80.00 - 88.00 Clayey GRAVEL with some sand grading down to Sandy clayey GRAVEL; GC; Gray and yellow-brown; Medium plasticity fines; Moist; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse or fine to medium sand; Some iron oxide staining; (Upper Troutdale Formation)**			
85	N17	55	40-50/5"		N- 17 (85.00-85.92) Sandy clayey GRAVEL; GC; Gray and yellow-brown; Medium plasticity fines; Moist; Very Dense; Fine to coarse, subangular to subrounded gravel; Mostly fine to medium sand, trace coarse sand; Some iron oxide staining; (Upper Troutdale Formation)				
90	N18	100	14-17-23		N- 18 (90.00-91.50) Clayey SILT with trace sand; MH; Gray; Medium plasticity; Moist; Hard; Fine sand; Trace organics; (Upper Troutdale Formation)	**88.00 - 94.00 Clayey SILT with trace sand; MH; Gray; Medium plasticity; Moist; Hard; Fine sand; Trace organics; (Upper Troutdale Formation)**		Atterberg Limits N18: LL=56, PL=32, PI=24.	
95	N19	100	50/1st 2"		N- 19 (95.00-95.17) Sandy clayey GRAVEL; GC; Dark gray; Low to medium plasticity fines; Wet; Very Dense; Fine to coarse, subrounded gravel; Fine to coarse sand; Some iron oxide staining; (Lower Troutdale Formation)	**94.00 - 98.25 Sandy clayey GRAVEL; GC; Dark gray; Low to medium plasticity fines; Wet; Very Dense; Fine to coarse, subrounded gravel; Fine to coarse sand; Some iron oxide staining; (Lower Troutdale Formation)**			
100	N20	60	50/1st 2"		N- 20 (100.00-100.17) GRAVEL with some silt and some sand; GP-GM; Gray and yellow-brown; Low plasticity fines; Wet; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Lower Troutdale Formation)	**98.25 - 126.00 GRAVEL with some sand to Gravel with some silt and some sand; GP, GP-GM; Gray to dark gray and yellow-brown; Nonplastic to low plasticity fines; Moist to wet; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Some micaceous zones; Some iron oxide staining; Some zones of weak cementation; (Lower Troutdale Formation)**			
105	N21	100	50/1st 1"		N- 21 (105.00-105.08) Silty SAND with some gravel; SM; Olive; Low plasticity fines; Moist; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; Some iron oxide staining; Weak cementation; (Lower Troutdale Formation)				
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110					SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.				
115	N22	80	50/1st 3"		N- 22 (115.00-115.25) GRAVEL with some sand; GP; Dark gray; Moist; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Lower Troutdale Formation)				
120									
125	N23	0	50/1st 2"		N- 23 (125.00-125.17) No Recovery				
						126.00 - 133.00 SAND with some silt to Silty SAND; SP-SM/SM; Dark green-gray; Nonplastic fines; Moist; Very Dense; Fine to medium sand; Micaceous; (Lower Troutdale Formation)			
130	N24	100	32-35-41		N- 24 (130.00-131.50) SAND with some silt to Silty SAND; SP-SM/SM; Dark green-gray; Nonplastic fines; Moist; Very Dense; Fine to medium sand; Micaceous; (Lower Troutdale Formation)				
						133.00 - 150.00 Clayey GRAVEL with some sand; GC; Dark green-gray; Low to medium plasticity fines; Moist; Very Dense; Fine to coarse, subrounded gravel; Fine to coarse sand; Trace iron oxide staining; (Lower Troutdale Formation)			
135									
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	N25	100	49-50/5"		N- 25 (140.00-140.92) Clayey GRAVEL with some sand; GC; Dark green-gray; Low to medium plasticity fines; Moist; Very Dense; Fine to coarse, subrounded gravel; Fine to coarse sand; Trace iron oxide staining; (Lower Troutdale Formation)				
145									
150	N26a	100	40-34-45		N- 26a (150.00-150.75) Silty SAND with some gravel; SM; Green-gray; Nonplastic to low plasticity fines; Moist; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Lower Troutdale Formation)	**150.00 - 155.00 Silty SAND with some gravel grading down to Sandy SILT with trace gravel; SM, ML; Green-gray; Nonplastic to low plasticity fines; Moist; Very Dense / Very Hard; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
	N26b	100			N- 26b (150.75-151.50) Sandy SILT with trace gravel; ML; Green-gray; Nonplastic to low plasticity; Moist; Very Hard; Fine subrounded gravel; Mostly fine sand, trace medium sand; Micaceous; (Lower Troutdale Formation)				
155						**155.00 - 169.00 GRAVEL to GRAVEL with some silt and some sand; GP, GP-GM; Very Dense; Inferred based on drill action and drill cuttings; (Lower Troutdale Formation)**		Lost approximately 20 gallons of drilling mud between 157 feet and 160 feet	
160	N27	0	50/1st 5"		N- 27 (160.00-160.42) No Recovery				
165									
170						**169.00 - 185.75 Silty CLAY to CLAY**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
170	N28	0	16-22-22		N- 28 (170.00-171.50) Silty CLAY to CLAY; CL/CH; Gray and green-mottled; Medium to high plasticity; Moist; Hard; Micaceous; (Sandy River Mudstone)	**with trace sand; CL/CH; Gray to gray and green-mottled; Medium to high plasticity; Moist; Hard; Fine sand; Micaceous; Trace organics; (Sandy River Mudstone)**		No recovery in sample N28, used 3-inch sampler after SPT to retrieve sample	
175									
180	N29	100	10-19-24		N- 29 (180.00-181.50) CLAY with trace sand; CH; Gray; Medium to high plasticity; Moist; Hard; Fine sand; Micaceous; Trace organics; (Sandy River Mudstone)				
185						**185.75 - 215.75 Silty SAND to Silty SAND with trace gravel; SM; Gray, green-gray, and purple; Nonplastic to low plasticity fines; Moist; Very Dense; Fine, subrounded gravel; Fine to medium or fine to coarse sand; Some micaceous zones; Few 2- to 3-inch thick interbeds of Sandy SILT (ML) above 203 feet; Few gravelly lenses below 203 feet based on drill action; (Sandy River Mudstone)**			
190	N30	100	20-33-34		N- 30 (190.00-191.50) Silty SAND and Sandy SILT; SM, ML; Green-gray; Low plasticity fines; Moist; Very Dense / Very Hard; Fine to medium sand; SM and ML interbedded in 2- to 3-inch-thick layers; (Sandy River Mudstone)				
195									
200									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
200	N31	80	35-43-50		N- 31 (200.00-201.50) Silty SAND with trace gravel; SM; Gray; Nonplastic to low plasticity fines; Moist; Very Dense; Fine, subrounded gravel; Fine to coarse sand; 1- to 3-inch-thick layers with finer and coarser sand; (Sandy River Mudstone)			Intermittent drill chatter below 203 feet	
205									
210	N32	80	28-32-40		N- 32 (210.00-211.50) Silty SAND; SM; Purple and green-gray; Nonplastic to low plasticity fines; Moist; Very Dense; Fine to medium sand; Micaceous; (Sandy River Mudstone)				
215						**215.75 - 221.50 SAND to SAND with some silt; SP/SP-SM; Purple and green-gray; Nonplastic fines; Moist; Very Dense; Mostly fine to medium sand, trace coarse sand; Trace 1- to 2-inch-thick interbeds of Sandy SILT (ML); (Sandy River Mudstone)**			
220	N33	100	39-35-31		N- 33 (220.00-221.50) SAND to SAND with some silt; SP/SP-SM; Purple and green-gray; Nonplastic fines; Moist; Very Dense; Mostly fine to medium sand, trace coarse sand; Trace 1- to 2-inch thick interbeds of Sandy SILT (ML); (Sandy River Mudstone)	**221.50 End of Hole**			
225									
230									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-02**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,324**	Easting: **~ 349,067**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig (Hammer Efficiency = 92.6%)**		Driller **Western States/Brad**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Elizabeth Barnett**	Ground Elev. **~ -38 ft.**
Start Date **October 17, 2016**	End Date **October 25, 2016**	Total Depth **148.20 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
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Drilling Methods	Drilling Remarks
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CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 14.10 SAND with trace silt grading to SAND with trace silt and trace gravel; SP; Dark gray; Nonplastic fines; Wet; Very Dense; Fine, subrounded gravel; Fine to medium sand; Some possible wood debris; (Sand Alluvium)**		Boring drilled from barge using mud rotary drilling technique (5-inch hole); all depths are below mudline; HWT casing advanced progressively after each sample, up to a depth of 41 feet, in order to maintain borehole stability; OYO suspension logging performed between depths of 41.0 feet and 134.5 feet	
5									
10	N1	100	6-22-29		N- 1 (10.70-12.20) SAND with trace silt and trace gravel; SP; Dark gray; Nonplastic fines; Wet; Very Dense; Fine, subrounded gravel; Fine to medium sand; (Sand Alluvium)			Wood fragments in cuttings at 10 feet; increased gravel content based on drill action; possible heave prior to sample N1	
15	N2	67	6-4-5		N- 2 (16.00-17.50) Gravelly SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Sand Alluvium)	**14.10 - 24.35 Gravelly SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular to subrounded gravel; Fine to medium or fine to coarse sand; (Sand Alluvium)**		N2: 32% gravel, 67% sand, 2% fines. Lost approximately 40 gallons of drilling mud between 16.5 feet and 18 feet	
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N3	67	7-4-5		N- 3 (21.00-22.50) Gravelly SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Loose; Fine to coarse, subrounded gravel; Mostly fine to medium sand, trace coarse sand; (Sand Alluvium)			Some sand heaving and mud loss at 22 feet; driller added Barite to mud	
25	N4	80	8-7-7		N- 4 (26.20-27.70) SAND with some gravel and trace silt; SP; Dark gray; Nonplastic fines; Wet; Medium Dense; Fine to coarse, subrounded gravel; Mostly fine to medium sand, trace coarse sand; (Sand Alluvium)	**24.35 - 40.00 SAND with some gravel and trace silt to Silty SAND with some gravel; SP, SP-SM, SM; Dark gray; Nonplastic fines; Wet; Medium Dense; Fine to coarse, subrounded gravel; Mostly fine to medium sand, trace coarse sand; Some micaceous zones; Some zones with trace wood and twigs; (Sand Alluvium)**			
30	N5	13	8-8-10		N- 5 (31.50-33.00) Silty SAND with some gravel; SM; Dark gray; Nonplastic fines; Wet; Medium Dense; Fine to coarse, subrounded gravel; Mostly fine to medium sand, trace coarse sand; Trace wood and twigs; Poor recovery; (Sand Alluvium)				
35	N6	67	6-6-10		N- 6 (36.50-38.00) SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Medium Dense; Fine to medium sand; Micaceous; (Sand Alluvium)			Lost approximately 80 gallons of drilling mud around 36 feet; some sand heaving; driller added Barite to mud N6: 94% sand, 6% fines.	
40	N7	33	32-31-33		N- 7 (41.00-42.50) GRAVEL with some sand and trace silt; GP; Dark gray; Nonplastic fines; Wet; Very Dense; Fine to coarse, subrounded gravel; Fine to coarse sand; Trace 0.25-inch-thick interbeds of green-gray SILT (ML); (Gravel Alluvium)	**40.00 - 53.00 GRAVEL with trace sand to Sandy GRAVEL with trace silt; GP; Dark gray; Nonplastic fines; Wet; Medium Dense to Very Dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Trace 0.25-inch-thick interbeds of SILT (ML) and 2-inch-thick interbeds of Silty SAND (SM); (Gravel Alluvium)**		Lost approximately 300 gallons of drilling mud between 40 feet and 47 feet; driller added N-Seal to borehole to mitigate mud loss	
45	N8	33	17-14-14		N- 8 (45.70-47.20) GRAVEL with trace sand; GP; Dark gray; Wet; Medium Dense; Fine to coarse, subrounded gravel; Sample could be slough; (Gravel Alluvium)				
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50									
	N9	67	22-18-25		N- 9 (51.20-52.70) Sandy GRAVEL with trace silt; GP; Dark gray; Nonplastic fines; Wet; Dense; Fine to coarse, subrounded to rounded gravel; Mostly coarse sand, trace fine to medium sand; Trace 2-inch-thick interbeds of Silty SAND (SM); (Gravel Alluvium)				
						53.00 - 72.00 Sandy SILT to Sandy SILT with trace gravel; ML; Gray; Low plasticity; Moist; Very Stiff to Hard; Fine to coarse, subrounded to rounded gravel; Fine sand; Trace organics; Trace interbeds of Silty SAND (SM) with nonplastic fines; (Sand/Silt Alluvium)			
55									
	N10	33	28-20-13		N- 10 (56.90-58.40) Sandy SILT with trace gravel; ML; Gray; Low plasticity; Moist; Hard; Fine, subrounded gravel; Fine sand; Trace interbeds of Silty SAND (SM) with nonplastic fines; (Sand/Silt Alluvium)				
60									
	N11	7	10-12-14		N- 11 (62.00-63.50) Poor Recovery; One coarse, rounded gravel clast stuck in split spoon tip; (Sand/Silt Alluvium)				
65									
	N12	67	4-2-15		N- 12 (67.10-68.60) Sandy SILT; ML; Gray; Low plasticity; Moist; Very Stiff; Fine sand; Trace organics; (Sand/Silt Alluvium)			N12: 1% gravel, 33% sand, 66% fines.	
70									
	N13	30	50/1st 4"		N- 13 (72.70-73.03) GRAVEL; GP; Gray; Wet; Very Dense; Fine to coarse, subrounded gravel; Possible cobbles based on drill action; (Gravel Alluvium)	**72.00 - 73.50 GRAVEL; GP; Gray; Wet; Very Dense; Fine to coarse, subrounded gravel; Possible cobbles; (Gravel Alluvium)**			
75						**73.50 - 80.00 CLAY with some sand; CH; Yellow-brown to green-gray with orange mottling; Medium to high plasticity; Moist; Hard; Fine sand; (Upper Troutdale Formation)**			
	N14	100	25-23-30		N- 14 (77.00-78.50) CLAY with some sand; CH; Yellow-brown to green-gray with orange mottling; Medium to high plasticity; Moist; Hard; Fine sand; (Upper Troutdale Formation)			Atterberg Limits N14: LL=56, PL=26, PI=30; 24% sand, 76% gravel.	
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80						**80.00 - 82.00 Silty CLAY with trace gravel; CL; Gray-brown; Medium plasticity; Moist; Very Hard; Fine to coarse gravel; Micaceous; (Upper Troutdale Formation)**			
	N15a	100	15-26-42		N- 15a (81.50-82.00) Silty CLAY with trace gravel; CL; Gray-brown; Medium plasticity; Moist; Very Hard; Fine to coarse gravel; Micaceous; Orange-mottled in bottom 2 to 3 inches; (Upper Troutdale Formation)				
	N15b	100			N- 15b (82.00-83.00) Sandy SILT; ML; Light brown and orange-mottled; Nonplastic; Moist; Very Dense; Fine sand; Micaceous; (Upper Troutdale Formation)	**82.00 - 89.00 Sandy SILT; ML; Brown to light brown and orange-mottled; Nonplastic; Moist; Dense to Very Dense; Fine sand; Micaceous; (Upper Troutdale Formation)**			
85									
	N16	100	14-20-28		N- 16 (86.30-87.80) Sandy SILT; ML; Brown; Nonplastic; Moist; Dense; Fine sand; Micaceous; (Upper Troutdale Formation)				
						89.00 - 116.00 GRAVEL with some sand to GRAVEL with some silt and some sand; GP, GP-GM; Gray, yellow, and brown; Nonplastic to low plasticity fines; Wet; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Some iron oxide staining and zones of weak cementation; (Lower Troutdale Formation)			
90									
	N17	60	50/1st 2"		N- 17 (91.50-91.67) GRAVEL with some sand; GP; Yellow and gray; Wet; Very Dense; Fine to coarse, subangular to subrounded gravel with weathered surfaces and traces of cemented fine to medium sand; (Lower Troutdale Formation)				
95									
	N18	100	50/1st 1"		N- 18 (96.90-96.98) GRAVEL with some silt and some sand; GP-GM; Yellow and brown; Low plasticity fines; Wet; Very Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Some iron oxide staining; (Lower Troutdale Formation)				
100									
105									
	N19	100	50/1st 1"		N- 19 (107.40-107.48) GRAVEL with some sand and trace silt; GP; Gray; Nonplastic fines; Wet; Very Dense; Fine to coarse, subangular to subrounded gravel; Mostly fine sand, trace medium and coarse sand; Some iron oxide staining and weak cementation; (Lower Troutdale Formation)				
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110								
115								
	N20	75	49-50/2"		N- 20 (118.70-119.37) SAND with some silt to Silty SAND; SP-SM/SM; Green-gray; Nonplastic fines; Moist; Very Dense; Fine to medium sand; Micaceous; (Sandy River Mudstone)	**116.00 - 130.00 SAND with some silt to Silty SAND; SP-SM, SM; Green-gray to gray-brown; Nonplastic to low plasticity fines; Moist; Very Dense; Fine to medium sand; Some micaceous zones; Some zones with sand grains that can be reduced to Silty CLAY (CL) under finger pressure; (Sandy River Mudstone)**			
120								
125								
	N21	99	25-40-50/5"		N- 21 (128.20-129.62) Silty SAND; SM; Gray-brown; Nonplastic to low plasticity fines; Moist; Very Dense; Fine to medium sand; Some iron oxide staining; Sand grains can be reduced to clay under finger pressure; (Sandy River Mudstone)				
130						**130.00 - 141.95 Silty CLAY to CLAY; CL/CH; Blue-green and gray; Medium to high plasticity; Moist; Very Hard; Some mottled iron oxide staining; (Sandy River Mudstone)**			
135								
	N22	100	30-33-43		N- 22 (136.50-138.00) Silty CLAY to CLAY; CL/CH; Blue-green and gray; Medium to high plasticity; Moist; Very Hard; Some mottled iron oxide staining; (Sandy River Mudstone)				
140								

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140								
						141.95 - 148.20 Silty CLAY with some sand; CL; Blue-green and gray with dark green mottling; Low to medium plasticity; Moist; Hard; Fine sand; (Sandy River Mudstone)			
145	N23	100	12-14-21		N- 23 (145.90-147.40) Silty CLAY with some sand; CL; Blue-green and gray with dark green mottling; Low to medium plasticity; Moist; Hard; Fine sand; (Sandy River Mudstone)			
						148.20 End of Hole		Boring B-2 was first attempted approximately 28 feet north and 7 feet east of its final location. At the northern location (B-2A), concrete and metal debris were encountered at a depth of approximately 8 feet below the mudline, causing drilling refusal.
150								
155								
160								
165								
170								

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-03**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,391**	Easting: **~ 349,874**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig (Hammer Efficiency = 92.6%)**		Driller **Western States/Brad**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Elizabeth Barnett**	Ground Elev. **~ 32 ft.**
Start Date **September 19, 2016**	End Date **September 22, 2016**	Total Depth **230.25 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 4.00 Silty GRAVEL with some sand; GM; Inferred from drill action and drill cuttings; (Fill)**		Mud rotary drilling technique (5-inch hole); OYO suspension logging performed between depths of 6.6 feet and 216.5 feet	
5	N1	20	5-3-4		N- 1 (5.00-6.50) SAND with some silt and some gravel; SP-SM; Brown; Nonplastic fines; Wet; Loose; Fine, subrounded gravel; Fine to medium sand; ; Poor recovery; (Fill)	**4.00 - 13.00 SAND with some silt and some gravel; SP-SM; Brown; Nonplastic fines; Moist to wet; Loose; Fine, subrounded gravel; Fine to medium sand; Some iron oxide staining; (Fill)**			
10	N2	33	3-3-3		N- 2 (10.00-11.50) SAND with some silt and some gravel; SP-SM; Brown with orange staining; Nonplastic fines; Moist; Loose; Fine, subrounded gravel; Fine to medium sand; (Fill)			N2: 16% gravel, 77% sand, 7% fines.	
15	N3	53	0-0-0		N- 3 (15.00-16.50) Silty CLAY; CL; Gray; Medium to high plasticity; Wet; Very Soft; Trace charcoal fragments; (Fine-grained Alluvium)	**13.00 - 18.25 Silty CLAY; CL; Gray; Medium to high plasticity; Wet; Very Soft; Trace charcoal fragments; (Fine-grained Alluvium)**		Wood fragments in cuttings from 13 to 15 feet	
20						**18.25 - 23.25 Sandy SILT; ML; Gray; Low plasticity; Moist to wet; Very**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N4	100	0-0-0		N- 4 (20.00-21.50) Sandy SILT; ML; Gray; Low plasticity; Moist to wet; Very Soft; Fine sand; Micaceous; (Fine-grained Alluvium)	**Soft; Fine sand; Micaceous; (Fine-grained Alluvium)**			
25	N5	67	1-1-0		N- 5 (25.00-26.50) Silty SAND; SM; Brown; Low plasticity fines; Wet; Very Loose; Fine sand; Micaceous; Some iron oxide staining; (Sand/Silt Alluvium)	**23.25 - 38.25 Silty SAND; SM; Brown to gray-brown; Nonplastic to low plasticity fines; Wet; Very Loose to Loose; Fine sand grading to fine to medium sand; Micaceous; Some iron oxide staining; Trace 1-inch-thick layers of Sandy silty CLAY (CL); (Sand/Silt Alluvium)**		Atterberg Limits N5: LL=33, PL=27, PI=6; 57% sand, 43% fines.	
30	U1	100			U- 1 (30.00-32.00) Inferred Silty SAND; SM; (Sand/Silt Alluvium)				
	N6	100	2-3-6		N- 6 (32.00-33.50) Silty SAND; SM; Brown; Low plasticity fines; Wet; Loose; Fine sand; Micaceous; (Sand/Silt Alluvium)			N6: 57% sand, 43% fines.	
35	N7	100	3-5-2		N- 7 (35.00-36.50) Silty SAND; SM; Gray-brown; Nonplastic fines; Wet; Loose; Fine to medium sand; Micaceous; Some iron oxide staining; Trace 1-inch-thick layers of Sandy silty CLAY (CL); (Sand/Silt Alluvium)				
40	N8	100	3-2-4		N- 8 (40.00-41.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Medium Stiff; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**38.25 - 43.25 Sandy SILT; ML; Gray; Low plasticity; Wet; Medium Stiff; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)**			
45	N9	33	7-5-6		N- 9 (45.00-46.50) SAND with some silt to Silty SAND; SP-SM/SM; Dark gray; Wet; Medium Dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**43.25 - 48.25 SAND with some silt to Silty SAND; SP-SM/SM; Dark gray; Wet; Medium Dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)**			
50						**48.25 - 63.25 Silty SAND; SM; Gray to gray-brown; Nonplastic to low**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N10	0	4-12-12		N- 10 (50.00-51.50) Silty SAND; SM; Gray; Nonplastic to low plasticity fines; Wet; Medium Dense; Fine to medium sand; Micaceous; Stratified with 2- to 3-inch-thick layers of Silty CLAY (CL); (Sand/Silt Alluvium)	**plasticity fines; Wet; Loose to Medium Dense; Fine to medium sand; Micaceous; Stratified with 1- to 4-inch thick layers of Silty CLAY to Sandy Silty CLAY (CL); (Sand/Silt Alluvium)**		No recovery in sample N10, used 3-inch sampler after SPT to retrieve sample Drill chatter from 52 feet to 53 feet; possible gravel lens	
55	N11	67	5-5-8		N- 11 (55.00-56.50) Silty SAND; SM; Gray; Nonplastic to low plasticity fines; Wet; Medium Dense; Fine to medium sand; Micaceous; Stratified with 3- to 4-inch-thick layers of Silty CLAY (CL); (Sand/Silt Alluvium)				
60	N12	67	4-6-3		N- 12 (60.00-61.50) Silty SAND; SM; Gray-brown; Nonplastic to low plasticity fines; Wet; Loose; Fine to medium sand; Micaceous; Stratified with 1- to 2-inch-thick layers of Sandy silty CLAY (CL); (Sand/Silt Alluvium)				
						63.25 - 88.25 Sandy SILT; ML; Gray; Low plasticity; Moist to wet; Medium Stiff to Stiff; Fine Sand; Micaceous; Trace roots and wood fragments; Stratified with 1- to 3-inch layers of Silty/Clayey SAND (SM/SC) with nonplastic to medium plasticity fines; (Sand/Silt Alluvium)			
65	N13	80	5-3-2		N- 13 (65.00-66.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Medium Stiff; Fine sand; Micaceous; Trace roots and wood fragments; Stratified with 1- to 2-inch layers of Silty SAND (SM); (Sand/Silt Alluvium)				
70	N14	100	0-1-12		N- 14 (70.00-71.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Stiff; Fine sand; Micaceous; Trace wood fragments; Stratified with 2- to 3-inch layers of Silty/Clayey SAND (SM/SC); (Sand/Silt Alluvium)			Atterberg Limits N14: LL=37, PL=28, PI=9; 43% sand, 57% fines.	
75	N15	100	9-5-3		N- 15 (75.00-76.50) Sandy SILT; ML; Gray; Low plasticity; Moist; Medium Stiff to Stiff; Fine sand; Micaceous; (Sand/Silt Alluvium)				
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N16	100	8-5-1		N- 16 (80.00-81.50) Sandy SILT; ML; Gray; Low plasticity; Moist; Medium Stiff; Fine to medium sand; Micaceous; Trace interbeds of Silty SAND (SM) with nonplastic fines; (Sand/Silt Alluvium)				
85	N17	100	3-2-7		N- 17 (85.00-86.50) SILT with some sand; ML; Gray; Low plasticity; Moist to wet; Stiff; Fine sand; Micaceous; Trace rootlets; Trace 0.25- to 1-inch-thick layers of Silty SAND with nonplastic fines (SM); (Sand/Silt Alluvium)	**85.00 Grades to SILT with some sand; ML**		Atterberg Limits N17: LL=42, PL=34, PI=8; 23% sand, 77% fines.	
90	N18	100	7-10-6		N- 18 (90.00-91.50) Silty SAND; SM; Gray; Nonplastic fines; Moist to wet; Medium Dense; Fine to medium sand; Micaceous; Stratified with 2-inch-thick layers of low plasticity SILT (ML); (Sand/Silt Alluvium)	**88.25 - 93.25 Silty SAND; SM; Gray; Nonplastic fines; Moist to wet; Medium Dense; Fine to medium sand; Micaceous; Stratified with 2-inch-thick layers of low plasticity SILT (ML); (Sand/Silt Alluvium)**			
95	N19	100	0-1-5		N- 19 (95.00-96.50) SILT with some sand; ML; Gray; Low plasticity; Moist to wet; Medium Stiff; Fine sand; Micaceous; Trace organics; Stratified with 0.5- to 1-inch-thick layers of Silty SAND (SM); (Fine-grained Alluvium)	**93.25 - 113.25 SILT with some sand; ML; Gray; Low plasticity; Moist to wet; Soft to Medium Stiff; Fine to medium sand; Micaceous; Stratified with up to 2-inch-thick layers of Sandy SILT (ML) and Silty SAND (SM); (Fine-grained Alluvium)**			
100	N20	100	3-1-1		N- 20 (100.00-101.50) SILT with some sand; ML; Gray; Low plasticity; Moist to wet; Soft; Fine sand; Micaceous; Stratified with up to 1-inch-thick layers of Sandy SILT (ML); (Fine-grained Alluvium)			Atterberg Limits N20: LL=40, PL=33, PI=9; 27% sand, 73% fines.	
105	N21	100	8-5-1		N- 21 (105.00-106.50) SILT with some sand; ML; Gray; Low plasticity; Wet; Medium Stiff; Fine to medium sand; Micaceous; Stratified with 1- to 2-inch-thick layers of Silty SAND (SM); (Fine-grained Alluvium)				
110									

ODOT DRILL LOG 102636.GPJ ODOT_MAN.GDT 1/17/22

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N22	100	0-1-3		N- 22 (110.00-111.50) SILT with some sand; ML; Gray; Low plasticity; Wet; Soft to Medium Stiff; Fine sand; Laminated with thin seams of Silty SAND (SM); (Fine-grained Alluvium)				
115	N23	80	13-12-9		N- 23 (115.00-116.50) Silty SAND; SM; Gray-brown; Nonplastic fines; Moist to wet; Medium Dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**113.25 - 118.25 Silty SAND; SM; Gray-brown; Nonplastic fines; Moist to wet; Medium Dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)**		N23: 83% sand, 17% fines.	
120	N24	100	0-8-6		N- 24 (120.00-121.50) Sandy SILT; ML; Gray; Nonplastic to low plasticity; Moist; Stiff; Fine sand; Laminated with thin seams of Silty SAND (SM); (Sand/Silt Alluvium)	**118.25 - 138.25 Sandy SILT grading to SILT with some sand; ML; Gray; Nonplastic to low plasticity; Moist to wet; Stiff; Fine sand; Micaceous; Stratified with thin seams to 2-inch-thick layers of Silty SAND (SM); (Sand/Silt Alluvium)**		Atterberg Limits N24: LL=36, PL=32, PI=4; 32% sand, 68% fines.	
125	N25	0	5-8-9		N- 25 (125.00-126.50) No Recovery				
130	N26	80	5-1-8		N- 26 (130.00-131.50) SILT with some sand; ML; Gray; Low plasticity; Moist to wet; Stiff; Fine sand; Micaceous; Stratified with 2-inch-thick layers of Silty SAND (SM); (Sand/Silt Alluvium)				
135	N27	67	8-1-0		N- 27 (135.00-136.50) SILT with some sand; ML; Gray; Low plasticity; Moist to wet; Very Soft; Fine sand; Micaceous; Stratified with 1- to 2-inch-thick layers of Silty SAND (SM); (Sand/Silt Alluvium)	**135.00 Grades to very soft**			
140						**138.25 - 142.00 SAND with some silt to Silty SAND; SP-SM/SM; Dark**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	N28	33	11-14-10		N- 28 (140.00-141.50) SAND with some silt to Silty SAND; SP-SM/SM; Dark gray; Nonplastic fines; Wet; Medium Dense; Fine to medium sand; (Sand Alluvium)	**gray; Nonplastic fines; Wet; Medium Dense; Fine to medium sand; (Sand Alluvium)**			
						142.00 - 167.00 GRAVEL with some silt and some sand to Sandy GRAVEL with some silt; GP-GM; Dark gray and brown; Nonplastic to low plasticity fines; Wet; Very Dense; Fine to coarse, subrounded gravel; Fine to coarse sand; Some iron oxide staining; (Gravel Alluvium)			
145	N29	33	46-30-40		N- 29 (145.00-146.50) GRAVEL with some silt and some sand; GP-GM; Dark gray; Nonplastic to low plasticity fines; Wet; Very Dense; Fine to coarse, subrounded gravel; Fine to coarse sand; Slight iron oxide staining; (Gravel Alluvium)				
150	N30	60	50/1st 6"		N- 30 (150.00-150.50) GRAVEL with some silt and some sand; GP-GM; Brown to dark gray; Low plasticity fines; Wet; Very Dense; Fine to coarse, subrounded gravel; Fine to coarse sand; Some iron oxide staining; (Gravel Alluvium)				
155	N31	67	31-34-50		N- 31 (155.00-156.50) Sandy GRAVEL with some silt; GP-GM; Gray and brown; Nonplastic to low plasticity fines; Wet; Very Dense; Fine to coarse, subrounded gravel; Fine to coarse sand; Some iron oxide staining; (Gravel Alluvium)				
160	N32	98	50/1st 5"		N- 32 (160.00-160.42) GRAVEL with some silt and some sand; GP-GM; Gray and brown; Nonplastic fines; Moist to wet; Very Dense; Fine to coarse, subrounded gravel; Fine to coarse sand; Some iron oxide staining; (Gravel Alluvium)				
165						**167.00 - 180.20 Sandy silty GRAVEL; GM; Dark green-gray; Low plasticity fines; Moist; Very Dense; Fine to coarse, subrounded to**			
170									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
170	N33	100	50/1st 3"		N- 33 (170.00-170.25) Sandy silty GRAVEL; GM; Dark green-gray; Low plasticity fines; Moist; Very Dense; Fine to coarse, subrounded to rounded gravel; Mostly fine to medium sand, trace coarse sand; Micaceous; Some iron oxide staining; (Lower Troutdale Formation)	**rounded gravel; Mostly fine to medium sand, trace coarse sand; Micaceous; Some iron oxide staining; (Lower Troutdale Formation)**			
175									
180	N34a	100	50/1st 3"		N- 34a (180.10-180.20) Silty SAND; SM; Dark gray; Low to medium plasticity fines; Wet; Very Dense; Fine to medium sand; Trace thin laminations of Silty CLAY (CL); (Lower Troutdale Formation)	**180.20 - 195.00 GRAVEL with some silt and some sand; GP-GM; Dark green-gray to gray and brown; Low plasticity fines; Moist to wet; Very Dense; Fine to coarse, subrounded to rounded gravel; Mostly fine to medium sand, trace coarse sand; Some iron oxide staining; (Lower Troutdale Formation)**			
	N34b	100			N- 34b (180.20-180.35) GRAVEL with some silt and some sand; GP-GM; Dark green-gray; Low plasticity fines; Wet; Very Dense; Fine to coarse, subrounded to rounded gravel; Mostly fine to medium sand, trace coarse sand; (Lower Troutdale Formation)				
185									
190	N35	100	50/1st 1"		N- 35 (190.00-190.08) GRAVEL with some silt and some sand; GP-GM; Gray and brown; Low plasticity fines; Moist to wet; Very Dense; Fine to coarse, subrounded to rounded gravel; Mostly fine to medium sand, trace coarse sand; Some iron oxide staining; (Lower Troutdale Formation)				
195						**195.00 - 230.25 Sandy silty GRAVEL; GM; Gray and yellow-brown; Low to medium plasticity fines; Moist; Very Dense; Fine to coarse, subrounded to rounded gravel; Mostly fine to medium sand, trace coarse sand;**			
200									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
200	N36	0	50/1st 3"		N- 36 (200.00-200.25) No Recovery	**Micaceous; Some iron oxide staining; Some cemented sand on surfaces of gravel clasts; (Lower Troutdale Formation)**			
205									
210	N37	60	50/1st 2"		N- 37 (210.00-210.17) Sandy silty GRAVEL; GM; Gray and yellow-brown; Low to medium plasticity fines; Moist; Very Dense; Fine to coarse, subrounded to rounded gravel; Mostly fine to medium sand, trace coarse sand; Micaceous; Some iron oxide staining; (Lower Troutdale Formation)				
215									
220	N38	100	50/1st 3"		N- 38 (220.00-220.25) Sandy silty GRAVEL; GM; Gray and yellow-brown; Low to medium plasticity fines; Moist; Very Dense; Fine to coarse, subrounded to rounded gravel; Mostly fine to medium sand, trace coarse sand; Micaceous; Some iron oxide staining; (Lower Troutdale Formation)			Drill advances quickly through inferred softer layer and increased silt/clay in cuttings between 221 feet and 224 feet	
225									
230									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
230	N39	100	50/1st 3"		N- 39 (230.00-230.25) Sandy silty GRAVEL; GM; Gray and yellow-brown; Low to medium plasticity fines; Moist; Very Dense; Fine to coarse, subrounded to rounded gravel; Mostly fine to medium sand, trace coarse sand; Micaceous; Some iron oxide staining; Some evidence of cementation on surfaces of gravel clasts; (Lower Troutdale Formation)	**230.25 End of Hole**			
235									
240									
245									
250									
255									
260									

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-04**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,494**	Easting: **~ 348,080**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #9 (Hammer Efficiency = 87.4%)**		Driller **Western States/Lucas**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **David J. & Veronica B.**	Ground Elev. **~ 42 ft.**
Start Date **September 27, 2021**	End Date **September 29, 2021**	Total Depth **110.10 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 0.30 Asphalt Concrete; (Fill)**		Borehole vacuum excavated to 8.3 feet due to nearby utilities.	
						0.30 - 1.30 Portland Cement Concrete; (Fill)			
						1.30 - 8.30 Vacuum Excavated Soils. Gravelly soil observed; (Fill)			
5									
						8.30 - 8.80 Portland Cement Concrete; (Fill)		Encountered concrete that appears to be an old road. Switched to open-hole mud rotary drilling technique (5-inch hole) at 8.3 feet.	
10	N1	78	39-25-17		N- 1 (10.00-11.50) Silty GRAVEL with some sand; GM; Brown and gray; Low plasticity fines; Moist; Dense; Fine to coarse, angular to subrounded gravel; Fine to coarse sand; (Fill)	**8.80 - 12.00 Silty GRAVEL with some sand; GM; Brown and gray; Low plasticity fines; Moist; Dense; Fine to coarse, angular to subrounded gravel; Fine to coarse sand; (Fill)**			
	N2	100	2-2-4	29	N- 2 (12.50-14.00) SILT with trace sand; ML; Dark brown; Low plasticity; Moist; Medium stiff; Fine sand; Micaceous; Some organics and wood debris; Trace brick fragments; Disturbed texture; (Fill)	**12.00 - 20.00 SILT with trace sand to Silty CLAY with trace sand; ML, CL; Dark brown and brown mottled dark brown; Low to medium plasticity; Moist; Medium stiff to stiff; Fine sand; Micaceous; Trace to some organics and wood debris; Trace brick fragments; Disturbed texture; (Fill)**			
15	N3	100	4-5-7	34	N- 3 (15.00-16.50) Silty CLAY with trace sand; CL; Brown mottled dark brown; Medium plasticity; Moist; Stiff; Fine sand; Micaceous; Trace organics; (Fill)				
	N4	0	4-5-3		N- 4 (17.50-19.00) No Recovery			Lost drilling mud circulation from 17.5 to 65 feet.	
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N5	100	0-1-2	37	N- 5 (20.00-21.50) SILT with trace sand; ML; Gray-brown mottled; Low plasticity; Moist; Soft; Fine sand; Micaceous; (Fine-grained Alluvium)	**20.00 - 23.00 SILT with trace sand; ML; Gray-brown mottled; Low plasticity; Moist; Soft; Fine sand; Micaceous; (Fine-grained Alluvium)**			
25	N6	100	0-2-2	43	N- 6 (25.00-26.50) SILT with trace sand; ML; Light brown; Low plasticity; Moist; Soft to medium stiff; Fine sand; Micaceous; (Fine-grained Alluvium)	**23.00 - 28.50 SILT with trace sand; ML; Light brown; Low plasticity; Moist; Soft to medium stiff; Fine sand; Micaceous; (Fine-grained Alluvium)**		Atterberg Limits N6: LL=39, PL=27, PI=12.	
30	U1	100			U- 1 (30.00-32.00) Sandy SILT to Silty SAND; ML/SM; Brown; Nonplastic fines; Moist; Fine sand; Micaceous; (Sand/Silt Alluvium)	**28.50 - 34.00 Sandy SILT to Silty SAND; ML/SM; Brown; Nonplastic fines; Moist to wet; Loose; Fine sand; Micaceous; (Sand/Silt Alluvium)**			
	N7	100	2-4-3	33	N- 7 (32.00-33.50) Silty SAND; SM; Brown; Nonplastic fines; Moist to wet; Loose; Fine sand; Micaceous; (Sand/Silt Alluvium)			N7: 48% fines.	
35	N8	100	2-2-2	39	N- 8 (35.00-36.50) Sandy SILT; ML; Brown; Nonplastic; Wet; Very loose to loose; Fine sand; Micaceous; (Sand/Silt Alluvium)	**34.00 - 40.70 Sandy SILT; ML; Brown; Nonplastic; Moist to wet; Very loose to loose; Fine sand; Micaceous; (Sand/Silt Alluvium)**		N8: 61% fines.	
40	N9a	100	3-4-4	43	N- 9a (40.00-40.70) Sandy SILT; ML; Brown; Nonplastic; Wet; Loose; Fine sand; Micaceous; (Sand/Silt Alluvium)				
	N9b			37	N- 9b (40.70-41.50) SILT with some sand; ML; Light brown; Low plasticity; Moist; Medium stiff to stiff; Fine sand; Micaceous; (Fine-grained Alluvium)	**40.70 - 42.50 SILT with some sand; ML; Light brown; Low plasticity; Moist; Medium stiff to stiff; Fine sand; Micaceous; (Sand/Silt Alluvium)**		Increase in drill action. Drill "chatter" observed at 42.5 feet.	
45	N10	53	42-48-24		N- 10 (45.00-46.50) GRAVEL with some silt and sand; GP-GM; Gray-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**42.50 - 58.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray-brown; Nonplastic fines; Moist; Dense to very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N11	80	14-13-21		N- 11 (50.00-51.50) GRAVEL with some silt and sand; GP-GM; Gray-brown; Nonplastic fines; Moist; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)				
55	N12	100	50/1st 3"		N- 12 (55.00-55.25) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)				
						58.00 - 61.00 SAND with some silt and trace gravel; SP-SM; Yellow-brown; Nonplastic fines; Moist; Very dense; Fine, rounded gravel; Fine to medium sand; Micaceous; Slight iron oxide staining; (Upper Troutdale Formation)			
60	N13	100	22-50/5"	23	N- 13 (60.00-60.90) SAND with some silt and trace gravel; SP-SM; Yellow-brown; Nonplastic fines; Moist; Very dense; Fine, rounded gravel; Fine to medium sand; Micaceous; Slight iron oxide staining; (Upper Troutdale Formation)			Smooth drilling from 58 to 61 feet. N13: 11% fines.	
						61.00 - 74.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, red-brown, and gray-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)			
65	N14	0	50/1st 1"		N- 14 (65.00-65.10) No Recovery				
70	N15	80	50/1st 3"		N- 15 (70.00-70.25) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, red-brown, and gray-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Slight iron oxide staining; (Lower Troutdale Formation)				
						74.00 - 78.00 Silty CLAY with trace sand; CL; Light gray-brown mottled orange-brown; Low to medium plasticity; Moist; Hard; Fine sand; Micaceous; Slight to moderate iron oxide staining; (Lower Troutdale Formation)			
75	N16	100	10-18-24	30	N- 16 (75.00-76.50) Silty CLAY with trace sand; CL; Light gray-brown mottled orange-brown; Low to medium plasticity; Moist; Hard; Fine sand; Micaceous; Slight to moderate iron oxide staining; (Upper Troutdale Formation)			Atterberg Limits N16: LL=36, PL=21, PI=15. Smooth drilling from 74 to 78 feet.	
						78.00 - 93.00 Silty GRAVEL with			
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N17	80	48-46-28		N- 17 (80.00-81.50) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, dark brown, and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)	**some sand to Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, orange-brown, red-brown, tan-brown, brown, dark brown, and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Some slight iron-oxide staining; No to weak cementation; (Lower Troutdale Formation)**			
85	N18	40	50/1st 3"		N- 18 (85.00-85.25) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, dark brown, and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)				
90	N19	100	50/1st 5"		N- 19 (90.00-90.40) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Red-brown, orange-brown, tan-brown, brown, and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; (Lower Troutdale Formation)				
95	N20	100	50/1st 3"		N- 20 (95.00-95.25) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Dark green-black to gray-black; Low to medium plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Weak cementation; (Lower Troutdale Formation)	**93.00 - 98.00 Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Dark green-black to gray-black; Low to medium plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Weak cementation; (Lower Troutdale Formation)**			
100	N21	80	50/1st 3"		N- 21 (100.00-100.25) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, orange-brown, and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**98.00 - 103.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, orange-brown, and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
105	N22	100	50/1st 1"		N- 22 (105.00-105.10) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark green-black to green-gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining on gravel clasts; (Lower Troutdale Formation)	**103.00 - 110.10 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark green-black to green-gray; Low plasticity fines; Moist; Very dense; Fine to coarse**			
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N23	100	50/1st 1"		N- 23 (110.00-110.10) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark green-black to green-gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining on gravel clasts; (Lower Troutdale Formation)	**subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining on gravel clasts; (Lower Troutdale Formation)** **110.10 End of hole**			
115									
120									
125									
130									
135									
140									

SHANNON & WILSON, INC.
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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-05**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,407**	Easting: **~ 348,331**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #5 (Hammer Efficiency = 80.8%)**		Driller **Western States/Adonis**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Alp Balcay**	Ground Elev. **~ 32 ft.**
Start Date **September 27, 2021**	End Date **September 28, 2021**	Total Depth **110.10 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil Driving Resistance / Rock Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 0.50 Asphalt Concrete; (Fill)**		Borehole vacuum excavated to 7 feet due to nearby utilities.	
						0.50 - 1.50 Portland Cement Concrete; (Fill)			
						1.50 - 7.00 Vacuum Excavated Soils. Silty SAND and Cobbles observed; (Fill)			
5									
								Concrete fragments encountered at 7 feet. Borehole advanced using hollow-stem auger technique (8-inch hole) from 7 to 25 feet.	
						7.00 - 18.00 SILT with trace sand; ML; Brown; Low plasticity; Damp; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)			
10	N1	100	1-1-1	36	N- 1 (10.00-11.50) SILT with trace sand; ML; Brown; Low plasticity; Damp; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)				
	N2	100	0-0-1	39	N- 2 (12.50-14.00) Silty CLAY with trace sand; CL; Brown; Medium plasticity; Damp; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)				
15	N3	100	1-1-2	38	N- 3 (15.00-16.50) SILT with trace sand; ML; Brown; Low plasticity; Damp; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)			Atterberg Limits N3: LL=38, PL=26, PI=12.	
						18.00 - 28.00 SILT with some sand; ML; Brown; Nonplastic; Wet; Very Loose; Fine sand;			
20									

ODOT DRILL LOG 102636.GPJ ODOT_MAN.GDT 1/17/22

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N4	100	1-1-1	48	N- 4 (20.00-21.50) SILT with some sand; ML; Brown; Nonplastic; Wet; Very loose; Fine sand; Micaceous; (Fine-grained Alluvium)	**Micaceous; (Fine-grained Alluvium)**		N4: 75% fines.	
25	N5	100	1-0-2	37	N- 5 (25.00-26.50) SILT with some sand; ML; Brown; Nonplastic; Wet; Very loose; Fine sand; Micaceous; (Fine-grained Alluvium)			Switched to open-hole mud rotary technique (5-inch hole) at 25 feet. N5: 82% fines.	
30	N6	67	3-7-18		N- 6 (30.00-31.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to subrounded gravel; fine to coarse sand; (Gravel Alluvium)	**28.00 - 48.00 GRAVEL with some silt and sand to Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Medium dense to very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
35	N7	67	35-23-25		N- 7 (35.00-36.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; fine to coarse sand; (Gravel Alluvium)				
40	N8	67	14-31-38		N- 8 (40.00-41.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; fine to coarse sand; (Gravel Alluvium)				
45	N9	100	50/1st 5"		N- 9 (45.00-45.40) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; fine to coarse sand; (Gravel Alluvium)				
50						**48.00 - 60.00 Gravelly SAND with some silt to Gravelly silty SAND; SP-SM/SM;**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N10	100	14-29-50/5"	25	N- 10 (50.00-51.40) Gravelly SAND with some silt; SP-SM; Yellow-brown and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; (Upper Troutdale Formation)	**Yellow-brown, red-brown, and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Upper Troutdale Formation)**		N10: 31% gravel, 60% sand, 9% fines.	
55	N11	100	34-50/3"	20	N- 11 (55.00-55.80) SAND with some silt and gravel; SP-SM; Yellow-brown and red-brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Upper Troutdale Formation)				
60	N12	100	26-40-41	23	N- 12 (60.00-61.50) Silty SAND; SM; Yellow-brown and brown; Nonplastic fines; Wet; Very dense; Fine to medium sand; Micaceous; (Upper Troutdale Formation)	**60.00 - 64.00 Silty SAND; SM; Yellow-brown and brown; Nonplastic fines; Wet; Very dense; Fine to medium sand; Micaceous; (Upper Troutdale Formation)**		N12: 13% fines.	
65	N13	100	25-45-50/4"	23	N- 13 (65.00-66.40) SAND with some silt and trace gravel; SP-SM; Yellow-brown and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Upper Troutdale Formation)	**64.00 - 66.00 SAND with some silt and trace gravel; SP-SM; Yellow-brown and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Upper Troutdale Formation)**			
70	N14	100	50/1st 3"		N- 14 (70.00-70.30) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, red-brown, and brown; Low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	**66.00 - 98.00 Sandy GRAVEL with some silt to Sandy silty GRAVEL, with cobbles and possible boulders; GP-GM, GM; Yellow-brown, red-brown, and brown; Low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Some micas and sand adhered to gravel clasts; Some slight iron oxide staining; (Lower Troutdale Formation)**			
75	N15	100	50/1st 2"		N- 15 (75.00-75.20) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, red-brown, and brown; Low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)				
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N16	100	50/1st 5"		N- 16 (80.00-80.40) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, red-brown, and brown; Low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)				
85	N17	100	50/1st 4"		N- 17 (85.00-85.30) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Red-brown and brown; Low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)				
90	N18	0	50/1st 2"		N- 18 (90.00-90.20) No Recovery				
95	N19	0	50/1st 1"		N- 19 (95.00-95.10) No Recovery				
100	N20	100	50/1st 5.5"		N- 20 (100.00-100.50) Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Orange-brown, brown, tan-brown, and gray; Low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; (Lower Troutdale Formation)	**98.00 - 103.00 Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Orange-brown, brown, tan-brown, and gray; Low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; (Lower Troutdale Formation)**			
105	N21	100	50/1st 1"		N- 21 (105.00-105.10) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Green-gray, dark gray, and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-gray staining on gravel clasts; (Lower Troutdale Formation)	**103.00 - 110.10 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Green-gray, dark gray, and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand;**			
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N22	0	50/1st 1"		N- 22 (110.00-110.10) No Recovery	**Micaceous; Dark green-gray staining of gravel clasts; (Lower Troutdale Formation)**			
						110.10			
						End of hole			
115									
120									
125									
130									
135									
140									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-06**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,411**	Easting: **~ 348,442**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #5 (Hammer Efficiency = 80.8%)**		Driller **Western States/Adonis**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Alp Balcay**	Ground Elev. **~ 33 ft.**
Start Date **September 22, 2021**	End Date **September 24, 2021**	Total Depth **140.20 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 0.50 Asphalt Concrete; (Fill)**		Borehole vacuum excavated to 11 feet due to nearby utilities; OYO suspension logging performed from 25 to 128 feet.	
						0.50 - 1.50 Portland Cement Concrete; (Fill)			
						1.50 - 5.00 Vacuum Excavated Soils. Silty SAND observed; (Fill)			
5						**5.00 - 8.00 Vacuum Excavated Soils. GRAVEL with cobbles observed; (Fill)**			
						8.00 - 11.00 Vacuum Excavated Soils. Silty SAND observed; (Fill)			
10									
	N1	100	0-1-1		N- 1 (11.00-12.50) Silty CLAY with trace sand; CL; Brown; Low to medium plasticity; Moist; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)	**11.00 - 13.00 Silty CLAY to SILT with trace sand; CL/ML; Brown; Low to medium plasticity; Moist; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)**		Borehole advanced using hollow-stem auger technique (8-inch hole) from 11 to 25 feet.	
15	N2	100	0-0-1	42	N- 2 (15.00-16.50) SILT with trace sand; ML; Brown; Low plasticity; Moist; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)	**13.00 - 18.00 SILT with trace sand; ML; Brown; Low plasticity; Moist; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)**		Atterberg Limits N2: LL=38, PL=29, PI=9.	
						18.00 - 23.00 Silty SAND; SM; Brown; Nonplastic fines; Wet; Loose; Fine sand;			
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N3	67	2-3-3	38	N- 3 (20.00-21.50) Silty SAND; SM; Brown; Nonplastic fines; Wet; Loose; Fine sand; Micaceous; (Sand/Silt Alluvium)	**Micaceous; (Sand/Silt Alluvium)**		N3: 44% fines.	
25	N4	100	1-2-3	40	N- 4 (25.00-26.50) Sandy SILT; ML; Brown; Nonplastic; Wet; Loose; Fine sand; Micaceous; (Sand/Silt Alluvium)	**23.00 - 28.00 Sandy SILT; ML; Brown; Nonplastic; Wet; Loose; Fine sand; Micaceous; (Sand/Silt Alluvium)**		N4: 62% fines. Switched to open-hole mud rotary technique (5-inch hole) at 25 feet.	
30	N5	67	25-33-40	11	N- 5 (30.00-31.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Fill)	**28.00 - 60.00 GRAVEL with some silt and sand to Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Loss of drilling mud circulation at 28 feet. Gravel inferred.	
35	N6	67	34-33-36	10	N- 6 (35.00-36.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)				
40	N7	53	27-28-19	16	N- 7 (40.00-41.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)				
45	N8	67	33-32-50/5"		N- 8 (45.00-46.40) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)				
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50								Driller lost count of rods. Missed 50 and 55 foot samples.
55								
60	N9	100	25-45-50/5.5"	26	N- 9 (60.00-61.50) SAND with some silt; SP-SM; Brown to yellow-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; (Upper Troutdale Formation)	**60.00 - 67.00 SAND with some silt and trace gravel; SP-SM; Brown to yellow-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Micaceous; No to moderate iron oxide staining; (Upper Troutdale Formation)**		N9: 9% fines.	
65	N10	80	31-50/5.5"	22	N- 10 (65.00-66.00) SAND with some silt and trace gravel; SP-SM; Brown to red-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; Moderate iron oxide staining; (Upper Troutdale Formation)			Softer drilling 60-67 feet.	
70	N11	100	26-46-43	23	N- 11 (70.00-71.50) Silty SAND; SM; Yellow-brown and red-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; (Upper Troutdale Formation)	**67.00 - 75.00 Silty SAND; SM; Yellow-brown and red-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; (Upper Troutdale Formation)**			
75	N12	100	40-50/2"	21	N- 12 (75.00-75.70) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Tan-brown, brown, and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**75.00 - 140.20 GRAVEL with some silt and sand to Sandy silty GRAVEL, with cobbles and possible boulders; GP-GM, GM; Tan-brown, yellow-brown, brown, gray, green-gray, dark gray, and green-brown;**		Noted increase in drill action at 75 feet.	
80								

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N13	100	50/1st 5"		N- 13 (80.00-80.40) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**Nonplastic to low plasticity fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Some micas and sand adhered to gravel clasts; No to weak cementation; (Lower Troutdale Formation)**			
85	N14	100	50/1st 4"		N- 14 (85.00-85.30) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Yellow-brown, tan-brown, brown, and gray; Nonplastic to low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
90	N15	100	50/1st 3"		N- 15 (90.00-90.25) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown; Nonplastic to low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)				
95	N16	0	50/1st 1"		N- 16 (95.00-95.10) No Recovery				
100	N17	100	50/1st 2"		N- 17 (100.00-100.20) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, green-gray, and gray; Nonplastic to low plasticity fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)				
105									
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N18	100	50/1st 2"		N- 18 (110.00-110.20) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Green-gray, dark gray, and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
115									
120	N19	100	50/1st 5"		N- 19 (120.00-120.40) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Green-gray, dark gray, and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining on gravel clasts; (Lower Troutdale Formation)				
125									
130	N20	13	48-50/3"		N- 20 (130.00-130.80) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Green-gray, dark gray, and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining on gravel clasts; Poor recovery; (Lower Troutdale Formation)				
135									
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	N21	100	50/1st 2"		N- 21 (140.00-140.20) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Green-gray, green-brown, dark gray, and gray; Nonplastic to low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Weak cementation; (Lower Troutdale Formation)	**140.20 End of hole**			
145									
150									
155									
160									
165									
170									

Material Description: SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-07**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,527**	Easting: **~ 348,603**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #5 (Hammer Efficiency = 80.8%)**		Driller **Western States/Adonis**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Kevin J. Cowell & Alp Balcay**	Ground Elev. **~ 34 ft.**
Start Date **September 16, 2021**	End Date **September 21, 2021**	Total Depth **140.50 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil Driving Resistance / Rock Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 1.00 Asphalt Concrete; (Fill)**		Borehole vacuum excavated to 11 feet due to nearby utilities.	
						1.00 - 2.00 Base Aggregate; (Fill)			
						2.00 - 5.00 Vacuum Excavated Soil. Silty SAND observed; (Fill)			
5						**5.00 - 11.00 Vacuum Excavated Soil. GRAVEL with cobbles observed; (Fill)**			
10								Borehole advanced using hollow-stem auger drilling technique (8-inch hole) from 11 feet to 25 feet.	
	N1	100	0-0-1		N- 1 (11.00-12.50) SILT with trace sand; ML; Brown; Low plasticity; Damp; Very soft; Fine sand; (Fill)	**11.00 - 23.00 SILT with trace sand; ML; Brown; Low plasticity; Damp to wet; Very soft; Fine sand; Micaceous; (Fill)**			
15	N2	100	1-1-2	37	N- 2 (15.00-16.50) SILT with trace sand; ML; Brown; Low plasticity; Damp; Very soft; Fine sand; (Fill)			Atterberg Limits N2: LL=39, PL=32, PI=7. 10/6/21 ▽	
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N3	100	1-1-1	39	N- 3 (20.00-21.50) SILT with trace sand; ML; Brown; Low plasticity; Wet; Very soft; Fine sand; Micaceous; (Fill)			Atterberg Limits N3: LL=42, PL=29, PI=13.
						23.00 - 28.00 Sandy SILT; ML; Brown; Nonplastic; Wet; Medium dense; Fine sand; Micaceous; (Sand/Silt Alluvium)		10/24/21 ▽
25	N4	80	3-6-8	36	N- 4 (25.00-26.50) Sandy SILT; ML; Brown; Nonplastic; Wet; Medium dense; Fine sand; Micaceous; (Sand/Silt Alluvium)			Switched to open-hole mud rotary technique (5-inch hole) at 25 feet. N4: 56% fines.
						28.00 - 38.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Dense to very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)		Losing circulation at 28 feet, apprx. 30 gallons drilling mud loss. Increased drill action with "chatter." Gravel inferred at 30 feet.
30	N5	67	26-27-19	12	N- 5 (30.00-31.50) GRAVEL with some silt and sand; GP-GM; Brown and gray; Nonplastic fines; Wet; Dense; Fine to coarse subangular, to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)			
35	N6	75	19-50/3"		N- 6 (35.00-35.80) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)			Sloughing gravels during sampling at 35 feet.
						38.00 - 43.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)		
40	N7	100	50/1st 5.5"	15	N- 7 (40.00-40.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)			
						43.00 - 48.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)		
45	N8	100	50/1st 5.5"		N- 8 (45.00-45.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)			
						48.00 - 53.00 SILT; ML; Gray; Medium plasticity; Moist; Very stiff;		Smoother drilling at 48 feet.
50								

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N9	100	1-3-14	47	N- 9 (50.00-51.50) SILT; ML; Gray; Medium plasticity; Moist; Very stiff; Micaceous; (Fine-grained Alluvium)	**Micaceous; (Fine-grained Alluvium)**		Atterberg Limits N9: LL=49, PL=31, PI=18.	
55	N10	100	17-46-27	15	N- 10 (55.00-56.50) Gravelly SAND with some silt; SP-SM; Brown and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded gravel; Fine to coarse sand; (Sand Alluvium)	**53.00 - 58.00 Gravelly SAND with some silt; SP-SM; Brown and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded gravel; Fine to coarse sand; (Sand Alluvium)**		Gravel with sand interbeds at 53 feet based on drill action. N10: 36% gravel, 54% sand, 10% fines. Geokon 4500S-350kPa vibrating wire piezometer (S/N=2136464) installed at 55 feet below ground surface.	
60	N11	79	17-32-50/5"	20	N- 11 (60.00-61.40) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown, orange-brown, and gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded gravel; Fine to coarse sand; Slight iron oxide staining; (Gravel Alluvium)	**58.00 - 68.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown, orange-brown, and gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; No to slight iron oxide staining; (Gravel Alluvium)**			
65	N12	100	32-49-34	16	N- 12 (65.00-66.50) Sandy GRAVEL with some silt; GP-GM; Brown, orange-brown, and gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; (Gravel Alluvium)				
70	N13	100	23-50/5"		N- 13 (70.00-70.90) SAND with some silt and gravel; SP-SM; Yellow-brown to tan-brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Micaceous; (Upper Troutdale Formation)	**68.00 - 75.00 SAND with some silt and gravel; SP-SM; Yellow-brown to tan-brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Micaceous; (Upper Troutdale Formation)**			
75	N14	13	50/1st 2"		N- 14 (75.00-75.20) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray, brown, yellow-brown, and red-brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Poor recovery; (Lower Troutdale Formation)	**75.00 - 88.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, red-brown, brown, and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel;**			
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N15	100	50/1st 2"		N- 15 (80.00-80.20) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray, brown, yellow-brown, and red-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	**Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)**			
85	N16	100	50/1st 1"		N- 16 (85.00-85.10) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, gray, and brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
90	N17a N17b	22	21-50/5"		N- 17a (90.00-90.10) Silty CLAY with trace sand and gravel; CL; Dark brown; Medium plasticity; Moist; Very stiff; Fine, subangular to subrounded gravel; Fine to coarse sand; Micaceous; Poor recovery; (Lower Troutdale Formation) N- 17b (90.10-90.90) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Brown; Medium plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Poor recovery; (Lower Troutdale Formation)	**88.00 - 90.10 Silty CLAY with trace sand and gravel; CL; Dark brown; Medium plasticity; Moist; Very stiff; Fine, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)** **90.10 - 103.00 Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Yellow-brown, orange-brown, brown, and dark brown; Low to medium plasticity fines; Moist; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; No to moderate iron oxide staining; (Lower Troutdale Formation)**			
95	N18	0	50/1st 3"		N- 18 (95.00-95.25) No Recovery				
100	N19	40	50/1st 5.5"		N- 19 (100.00-100.50) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Yellow-brown, orange-brown, and brown; Low plasticity fines; Moist; Very dense; Fine to coarse, subangular to rounded gravel; Micaceous; Moderate iron oxide staining; (Lower Troutdale Formation)				
105	N20	25	50/1st 4"		N- 20 (105.00-105.30) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray, brown, and dark gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**103.00 - 140.50 Sandy GRAVEL with some silt to Sandy silty GRAVEL, with cobbles and possible boulders; GP-GM, GM; Yellow-brown, orange-brown, brown, gray, dark gray, and green-black; Nonplastic to low plasticity fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; No to**			
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N21	25	50/1st 4"		N- 21 (110.00-110.30) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Yellow-brown, orange-brown, brown, and gray; Nonplastic to low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**weak cementation; Some dark green-black staining on gravel clasts; (Lower Troutdale Formation)**			
115	N22	100	50/1st 1"		N- 22 (115.00-115.10) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Yellow-brown, orange-brown, brown, and gray; Nonplastic to low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
120	N23	0	50/1st 2"		N- 23 (120.00-120.20) No Recovery				
125	N24	0	50/1st 1"		N- 24 (125.00-125.10) No Recovery				
130	N25	0	50/1st 1"		N- 25 (130.00-130.10) No Recovery				
135	N26	0	50/1st 2"		N- 26 (135.00-135.20) No Recovery				
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	N27	80	50/1st 5.5"		N- 27 (140.00-140.50) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark gray, green-black, and gray; Low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Weak cementation; Dark green-black staining on gravel clasts; (Lower Troutdale Formation)	**140.50 End of hole**			
145									
150									
155									
160									
165									
170									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-08**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,411**	Easting: **~ 348,711**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #9 (Hammer Efficiency = 87.4%)**		Driller **Western States/Raymond**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **David S. Jacobson**	Ground Elev. **~ 34 ft.**
Start Date **September 20, 2021**	End Date **September 22, 2021**	Total Depth **170.00 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil: Driving Resistance / Rock: Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 0.60 Portland Cement Concrete; (Fill)**		Borehole vacuum excavated to 14.5 feet due to nearby utilities; OYO suspension logging performed from 32 to 158 feet.	
						0.60 - 7.50 Sandy GRAVEL to Sandy GRAVEL with some silt; GP/GP-GM; Based on observation of vacuum excavation; (Fill)			
5									
10						**7.50 - 15.75 SILT to Clayey SILT with some sand; ML/MH; Gray-brown; Medium plasticity; Moist; Medium stiff to stiff; Fine to coarse sand; Micaceous; Trace organics; (Fill)**		11/13/21 ▽	
								10/24/21 ▽	
15	N1a	56	1-4-4		N- 1a (15.00-15.75) Clayey SILT with some sand; MH; Gray-brown; Medium plasticity; Moist; Medium stiff to stiff; Fine to coarse sand; Micaceous; Few organics and wood debris; (Fill)			Borehole advanced using hollow-stem auger drilling technique (8-inch hole) from 14.5 feet to 30 feet.	
	N1b				N- 1b (15.75-16.50) SAND with some silt; SP-SM; Brown; Nonplastic fines; Moist; Loose; Fine to coarse sand; (Fill)	**15.75 - 19.50 SAND with some silt with trace gravel; SP-SM; Brown; Nonplastic fines; Moist; Loose; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Trace organics; (Fill)**			
	N2	56	3-3-4	10	N- 2 (17.50-19.00) SAND with some silt with trace gravel; SP-SM; Brown; Nonplastic fines; Moist; Loose; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Trace organics; (Fill)			N2: 5% fines.	
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N3	22	6-6-3		N- 3 (20.00-21.50) Sandy GRAVEL with some clay; GP-GC; Brown and gray; Low plasticity fines; Moist; Loose; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Trace organics; Few brick fragments; (Fill)	**19.50 - 23.00 Sandy GRAVEL with some clay; GP-GC; Brown and gray; Low plasticity fines; Moist; Loose; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Trace organics; Few brick fragments; (Fill)**			
25	N4	50	3-3-6	21	N- 4 (25.00-26.50) Clayey GRAVEL with some sand; GC; Gray; Medium plasticity; Moist; Loose; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Trace organics and wood debris; Trace brick fragments; (Fill)	**23.00 - 28.00 Clayey GRAVEL with some sand; GC; Gray; Medium plasticity; Moist; Stiff; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Trace organics and wood debris; Trace brick fragments; (Fill)**		N4: 37% fines.	
30	N5	56	2-3-12	29	N- 5 (30.00-31.50) Silty SAND with trace gravel; SM; Gray; Low plasticity fines; Wet; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Sand/Silt Alluvium)	**28.00 - 33.00 Silty SAND with trace gravel; SM; Gray; Low plasticity fines; Wet; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Sand/Silt Alluvium)**		Switched to open-hole mud rotary technique (5-inch hole) at 30 feet. N5: 24% fines.	
35	N6	6	10-7-8		N- 6 (35.00-36.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Poor recovery; (Gravel Alluvium)	**33.00 - 43.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic to low plasticity fines; Wet; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Harder drilling at 37 feet.	
40	N7	78	34-49-42	10	N- 7 (40.00-41.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)			N7: 70% gravel, 22% sand, 8% fines.	
45	N8	60	50/1st 5"		N- 8 (45.00-45.40) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray, dark blue-gray, and brown; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)	**43.00 - 50.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray, dark blue-gray, and brown; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
50								Out of gravel at 50 feet.	

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N9	100	4-5-9	42	N- 9 (50.00-51.50) Clayey SILT; MH; Brown mottled; Medium plasticity; Moist; Stiff; Micaceous; (Fine-grained Alluvium)	**50.00 - 53.80 Clayey SILT; MH; Brown mottled to brown and gray; Medium plasticity; Moist; Stiff; Micaceous; (Fine-grained Alluvium)**		Atterberg Limits N9: LL=54, PL=32, PI=22; 98% fines.	
	U1	50			U- 1 (52.00-53.80) Clayey SILT; MH; Brown and gray; Medium plasticity; Moist; Micaceous; Shelby tube crumpled during sampling; (Fine-grained Alluvium)			U1 Shelby tube crumpled during sampling at 52 feet.	
	N10	56	16-18-17	21	N- 10 (53.80-55.30) Silty SAND with trace gravel; SM; Dark gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular gravel; Medium to coarse sand; (Sand Alluvium)	**53.80 - 58.00 Silty SAND with trace gravel; SM; Dark gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular gravel; Medium to coarse sand; (Sand Alluvium)**		N10: 13% fines. Dense sand with gravel interbeds from 54 to 58 feet. Geokon 4500S-350kPa vibrating wire piezometer (S/N=2136465) installed at 55 feet below ground surface.	
55									
						58.00 - 66.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark gray, gray, and black; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)		Gravel at 58 feet.	
60	N11	83	31-43-48	14	N- 11 (60.00-61.50) Sandy GRAVEL with some silt; GP-GM; Dark gray and black; Nonplastic to low plasticity fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; (Gravel Alluvium)				
65	N12	56	46-50/3"		N- 12 (65.00-65.75) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)				
						66.00 - 73.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)		Harder drilling at 66 feet.	
70	N13	50	50/1st 4"		N- 13 (70.00-70.33) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)				
						73.00 - 82.00 Silty SAND; SM; Tan-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; Slight iron oxide staining; (Upper Troutdale Formation)		Smooth drilling from 73 to 74 feet.	
75	N14	100	26-36-37	24	N- 14 (75.00-76.50) Silty SAND; SM; Tan-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; (Upper Troutdale Formation)				
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N15	100	25-26-31	28	N- 15 (80.00-81.50) Silty SAND; SM; Tan-brown and orange-brown; Nonplastic fines; Moist; Very dense; Fine sand; Micaceous; Slight iron oxide staining; (Upper Troutdale Formation)			N15: 20% fines.	
						82.00 - 88.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown, orange-brown, and gray; Low plasticity fines; Moist to wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Weak cementation; (Lower Troutdale Formation)		Harder drilling at 82 feet.	
85	N16	100	50/1st 2"		N- 16 (85.00-85.20) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown, orange-brown, and gray; Low plasticity fines; Moist to wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Weak cementation; (Lower Troutdale Formation)				
						88.00 - 98.00 Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Gray, brown, tan-brown, and dark brown; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Weak cementation; (Lower Troutdale Formation)			
90	N17	100	50/1st 5"		N- 17 (90.00-90.40) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Gray, brown, tan-brown, and dark brown; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Weak cementation; (Lower Troutdale Formation)				
95	N18	0	50/1st 2"		N- 18 (95.00-95.20) No Recovery				
						98.00 - 110.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Brown, tan-brown, dark brown, and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Weak cementation; (Lower Troutdale Formation)			
100	N19	100	50/1st 2"		N- 19 (100.00-100.20) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Brown, tan-brown, dark brown, and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Weak cementation; (Lower Troutdale Formation)				
105									
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N20	100	50/1st 2"		N- 20 (110.00-110.20) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark brown, dark gray, and green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**110.00 - 149.50 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark brown, dark gray, and green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
115									
120	N21	0	50/1st 1"		N- 21 (120.00-120.10) No Recovery			Very hard and slow drilling below 120 feet.	
125									
130	N22	100	50/1st 1"		N- 22 (130.00-130.10) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark brown, dark gray, and green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
135									
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	N23	0	50/1st 1"		N- 23 (140.00-140.10) No Recovery				
145									
150	N24	100	23-36-43	36	N- 24 (150.00-151.50) Silty SAND; SM; Blue-green; Low plasticity fines; Moist; Very dense; Fine to medium sand; Micaceous; Interbedded with Sandy SILT (ML); (Lower Troutdale Formation)	**149.50 - 152.50 Silty SAND; SM; Blue-green; Low plasticity fines; Moist; Very dense; Fine to medium sand; Micaceous; Interbedded with Sandy SILT (ML); (Lower Troutdale Formation)**		Soft and smooth drilling from 149.5 to 152.5 feet. Atterberg Limits N24: LL=43, PL=33, PI=10.	
155						**152.50 - 170.00 Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Yellow-brown, brown, and gray; Low to medium plasticity fines; Moist; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)**		Gravel at 152.5 feet.	
160	N25	91	50/1st 5.5"		N- 25 (160.00-160.50) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Yellow-brown, brown, and gray; Low to medium plasticity fines; Moist; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)				
165									
170									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
170	N26	0	50/1st 0"		N- 26 (170.00-170.00) No Recovery	**170.00** **End of hole**			
175									
180									
185									
190									
195									
200									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-09**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,357**	Easting: **~ 348,830**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #5 (Hammer Efficiency = 80.8%)**		Driller **Western States/Adonis**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Seth S., Kyle R., and Veronica B.**	Ground Elev. **~ -25 ft.**
Start Date **August 13, 2021**	End Date **August 19, 2021**	Total Depth **151.30 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 12.00 Silty SAND; SM; Dark gray; Nonplastic to low plasticity fines; Wet; Very loose to medium dense; Fine to medium sand; Micaceous; Stratified with few interbeds up to 4 inches thick of SILT (ML); (Sand Alluvium)**		Borehole drilled from barge using mud rotary drilling technique (5-inch hole); all depths are reported in feet below mudline; 6-inch ID steel casing installed to 46.8 feet below mudline; OYO suspension logging performed from 46 to 138 feet. Lost drilling mud circulation at 2 feet.	
5	N1	33	0-4-6		N- 1 (7.40-8.90) Silty SAND; SM; Dark gray; Nonplastic fines; Wet; Loose to medium dense; Fine to medium sand; Micaceous; Stratified with few interbeds of SILT (ML); (Sand Alluvium)				
10	N2	100	0-0-1	48	N- 2 (10.00-11.50) Silty SAND; SM; Dark gray; Nonplastic fines; Wet; Very loose; Fine to medium sand; Micaceous; (Sand Alluvium)				
	N3	100	0-0-1	56	N- 3 (12.50-14.00) SILT with some sand; ML; Dark gray; Nonplastic to low plasticity; Wet; Very loose/Very soft; Fine to medium sand; Micaceous; Stratified with few 2- to 4-inch thick interbeds of Silty SAND (SM); (Sand/Silt Alluvium)	**12.00 - 14.50 SILT with some sand; ML; Dark gray; Nonplastic to low plasticity; Wet; Very loose/Very soft; Fine to medium sand; Micaceous; Stratified with few 2- to 4-inch thick interbeds of Silty SAND (SM); (Sand/Silt Alluvium)**		N3: 29% sand, 71% fines.	
15	N4	67	13-10-11		N- 4 (15.40-16.90) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**14.50 - 22.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray; Nonplastic fines; Wet; Medium**			
	N5	67	16-18-12		N- 5 (17.50-19.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray; Nonplastic fines; Wet; Medium dense to dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)				
20					N- 6 (19.70-21.20) Silty GRAVEL with some sand, with				

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N6	100	13-19-14		cobbles and possible boulders; GM; Dark gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**dense to dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
						22.00 - 27.00 Silty SAND; SM; Dark gray; Nonplastic fines; Wet; Loose; Fine sand; Micaceous; (Sand Alluvium)			
25	N7	67	3-1-3	43	N- 7 (25.40-26.90) Silty SAND; SM; Dark gray; Nonplastic fines; Wet; Loose; Fine sand; Micaceous; (Sand Alluvium)			N7: 46% fines.	
						27.00 - 31.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown; Low plasticity fines; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)			
30	N8a	67	3-4-3		N- 8a (29.90-31.00) Silty GRAVEL, with cobbles and possible boulders; GM; Brown; Low plasticity fines; Wet; Loose; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)				
	N8b				N- 8b (31.00-31.40) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown; Nonplastic fines; Wet; Loose; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**31.00 - 34.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown; Nonplastic fines; Wet; Loose; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Approximately 200 gallons drilling mud loss at 31 feet.	
35	N9	40	13-8-12		N- 9 (34.60-36.10) Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Gray; Low to medium plasticity fines; Wet; Medium dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Trace organics; (Gravel Alluvium)				
						34.00 - 37.50 Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Gray; Low to medium plasticity fines; Wet; Medium dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Trace organics; (Gravel Alluvium)			
	N10	100	50/1st 6"		N- 10 (39.30-39.80) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Orange-brown and gray; Nonplastic to low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Slight iron oxide staining; (Gravel Alluvium)				
40						**37.50 - 58.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Orange-brown and gray; Nonplastic to low plasticity fines; Moist to wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Gravel Alluvium)**			
	N11	100	34-42-50		N- 11 (44.40-45.90) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Orange-brown and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Gravel Alluvium)				
45									
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50									
55	N12	100	32-50/4"		N- 12 (54.50-55.30) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Orange-brown and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Gravel Alluvium)				
60	N13	86	50-50/1"		N- 13 (60.20-60.80) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Dark gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**58.00 - 70.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Dark gray; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Approximately 240 gallons drilling mud loss at 62 feet.	
65	N14	100	50/1st 4"		N- 14 (65.70-66.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Dark gray; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)				
70	N15	0	50/1st 2"		N- 15 (70.70-70.90) No Recovery	**70.00 - 93.50 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray, green-gray, and brown-gray; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining of gravel clasts; (Lower Troutdale Formation)**			
75	N16	100	50/1st 2"		N- 16 (74.90-75.10) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray and green-gray; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining of gravel clasts; (Lower Troutdale Formation)				
80	N17	100	50/1st 2"		N- 17 (79.20-79.40) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray and				

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80					green-gray; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining of gravel clasts; (Lower Troutdale Formation)				
	N18	88	42-50/4"		N- 18 (84.00-84.80) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray and green-gray; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining of gravel clasts; (Lower Troutdale Formation)				
85									
	N19	100	50/1st 2"		N- 19 (89.10-89.30) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray, green-gray, and brown-gray; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Sand and mica flakes adhered to gravel clasts; (Lower Troutdale Formation)				
90									
	U1	100			U- 1 (94.20-94.70) Silty SAND; SM; Green-gray; Nonplastic fines; Moist; Fine sand; Micaceous; Shelby tube refusal after 6 inches; (Lower Troutdale Formation)	**93.50 - 97.00 Silty SAND; SM; Green-gray; Nonplastic fines; Moist; Very dense; Fine sand; Micaceous; Stratified; (Lower Troutdale Formation)**			
	N20		26-40-50/1"	22	N- 20 (94.70-95.70) Silty SAND; SM; Green-gray; Nonplastic fines; Moist; Very dense; Fine sand; Micaceous; Stratified; (Lower Troutdale Formation)				
95									
						97.00 - 113.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark gray, brown, green-gray, and tan; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)			
100									
	N21	100	50/1st 2"		N- 21 (103.30-103.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark gray, brown, and tan; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
105									
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110									
	N22	100	50/1st 1"		N- 22 (111.10-111.20) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark gray, brown, and green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
						113.00 - 120.00 Silty CLAY with trace sand; CL; Gray; Medium plasticity; Moist; Very hard; Fine sand; Micaceous; Trace amounts of fine subrounded gravel at 139.6 feet; (Sandy River Mudstone)			
115									
	N23	100	11-23-33	30	N- 23 (116.30-117.80) Silty CLAY with trace sand; CL; Gray; Medium plasticity; Moist; Very hard; Fine sand; Micaceous; (Sandy River Mudstone)			Atterberg Limits N23: LL=47, PL=25, PI=22.	
120									
	N24	100	10-18-24	27	N- 24 (121.50-123.00) CLAY with trace sand; CH; Gray; Medium plasticity; Moist; Hard; Fine sand; Micaceous; (Sandy River Mudstone)	**120.00 - 129.00 CLAY with trace sand; CH; Gray; Medium plasticity; Moist; Hard to very hard; Fine sand; Micaceous; (Sandy River Mudstone)**			
125								Pressuremeter Tests at 124.5 and 126 feet.	
	N25	100	9-12-17	33	N- 25 (127.20-128.70) CLAY with trace sand; CH; Green-gray and brown; Medium plasticity; Moist; Very stiff; Fine to coarse sand; Micaceous; Trace organics and carbonized organics; (Sandy River Mudstone)			Atterberg Limits N25: LL=52, PL= 24, PI= 29. Pressuremeter Test attempted at 127.2 feet, poor data quality.	
130						**129.00 - 138.00 Silty CLAY with trace sand; CL; Gray; Medium plasticity; Moist; Hard; Fine sand; Micaceous; (Sandy River Mudstone)**			
	N26	100	11-20-29	31	N- 26 (131.20-132.70) Silty CLAY with trace sand; CL; Gray; Medium plasticity; Moist; Hard; Fine sand; Micaceous; (Sandy River Mudstone)			Pressuremeter Tests at 130.5 and 132 feet. Atterberg Limits N26: LL=47, PL=26, PI=21. Pressuremeter Test at 131.2 feet.	
135									
						138.00 - 151.30 Silty SAND; SM; Green-gray, gray, and brown; Low plasticity fines; Moist; Very			
140	N27	100	20-37-41	29	N- 27 (139.60-141.10) Silty SAND to Silty SAND with			N27: 3% gravel, 73%	

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140					trace gravel; SM; Green-gray and brown; Low plasticity fines; Moist; Very dense; Fine, subrounded gravel; Fine to medium sand; Micaceous; (Sandy River Mudstone)	**dense; Fine to medium sand; Micaceous; (Sandy River Mudstone)**		sand, 24% fines.	
145									
150	N28	100	29-39-37	40	N- 28 (149.80-151.30) Silty SAND; SM; Gray and brown; Low plasticity fines; Moist; Very dense; Fine to medium sand; Micaceous; (Sandy River Mudstone)				
						151.30 End of hole			
155									
160									
165									
170									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-10**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,524**	Easting: **~ 349,033**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #5 (Hammer Efficiency = 80.8%)**		Driller **Western States/Adonis**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Veronica C. Biesiada**	Ground Elev. **~ -54 ft.**
Start Date **July 28, 2021**	End Date **August 4, 2021**	Total Depth **183.60 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

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Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 9.50 Cobble and Boulder Riprap; (Fill)**		Borehole drilled from barge using mud rotary drilling technique (5-inch hole); all depths are reported in feet below mudline; 6-inch ID steel casing installed to 40 feet below mudline; OYO suspension logging performed from 56 to 172 feet.	
5	N1	0	8-12-22		N- 1 (5.00-6.50) No Recovery			Poor circulation 5 to 25 feet, approximately 800 gallons of drilling mud loss.	
	N2	0	28-17-15		N- 2 (7.50-9.00) No Recovery				
10	N3	14	6-3-6		N- 3 (10.00-11.50) Gravelly silty SAND; SM; Dark gray; Nonplastic fines; Wet; Loose; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Poor recovery; (Sand Alluvium)	**9.50 - 14.50 Gravelly silty SAND; SM; Dark gray; Nonplastic fines; Wet; Loose to medium dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)**			
	D&M4	27	13-14-14	14	D&M- 4 (12.50-14.00) Gravelly silty SAND; SM; Dark gray; Nonplastic fines; Wet; Loose; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)				
15	N5	47	12-18-21	11	N- 5 (15.00-16.50) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark gray; Nonplastic fines; Wet; Dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**14.50 - 17.50 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark gray; Nonplastic fines; Wet; Dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Cobbles and boulders inferred from drill action 15 to 22 feet.	
	N6	80	10-14-17	12	N- 6 (17.50-19.00) GRAVEL with some sand and silt, with cobbles and possible boulders; GP-GM; Multicolored; Nonplastic fines; Wet; Dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Sample may be slough; (Gravel Alluvium)	**17.50 - 31.50 GRAVEL with trace to**			
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N7	7	22-24-17		N- 7 (20.00-21.50) GRAVEL with trace sand, with cobbles and possible boulders; GP; Multicolored; Wet; Dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Poor recovery; (Gravel Alluvium)	**some sand and silt, with cobbles and boulders; GP/GP-GM; Dark gray to multicolored; Nonplastic fines; Wet; Medium dense to dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
25								Baroid added to drill mud to regain drilling mud circulation.	
	N8	27	12-14-11		N- 8 (27.00-28.50) GRAVEL with some sand and trace silt, with cobbles and possible boulders; GP; Dark gray; Nonplastic fines; Wet; Dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)				
30									
	N9	0	7-10-12		N- 9 (32.25-33.75) No Recovery	**31.50 - 40.00 Silty SAND with trace gravel; SM; Dark gray; Nonplastic fines; Moist to wet; Medium dense; Fine, subrounded to rounded gravel; Fine to medium sand; (Sand/Silt Alluvium)**		Sand inferred from drill action at approx. 31.5 feet.	
35									
	N10	100	7-11-13	28	N- 10 (37.50-39.00) Silty SAND with trace gravel; SM; Dark gray; Nonplastic fines; Moist; Medium dense; Fine, subrounded to rounded gravel; Fine to coarse sand; (Sand/Silt Alluvium)			Pressuremeter Tests at 36 and 37.5 feet.	
40						**40.00 - 52.00 Sandy SILT; ML; Dark gray; Nonplastic to low plasticity; Medium dense/Very soft to stiff; Fine to medium sand; stratified with interbeds of Silty SAND (SM); (Sand/Silt Alluvium)**			
	N11	100	1-1-10	38	N- 11 (42.50-44.00) Sandy SILT; ML; Dark gray; Nonplastic to low plasticity; Moist to wet; Medium dense/Stiff; Fine to medium sand; Stratified with interbeds of Silty SAND (SM); (Sand/Silt Alluvium)			N11: 47% sand, 53% fines.	
45									
	N12	100	3-0-0	37	N- 12 (47.50-49.00) Sandy SILT; ML; Dark gray; Low plasticity; Wet; Very soft; Fine to medium sand; (Sand/Silt Alluvium)			Atterberg Limits N12: LL=35, PL=27, PI=8; 64% fines.	
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50									
	U1	0	27-50/5"	12	U- 1 (52.00-52.10) No Recovery N- 13 (52.10-53.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded gravel; Fine to coarse sand; (Gravel Alluvium)	**52.00 - 54.00 Silty GRAVEL with some sand, with cobbles and boulders; GM; Dark gray; Nonplastic fins; Wet; Very dense; Fine to coarse subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Harder drilling at 52 feet. Cobbles and boulders inferred from drill action 52-54 feet. Smoother drilling at 54 feet.	
	N13	56							
55									
	N14	100	23-34-43	41	N- 14 (56.50-58.00) Silty SAND with trace gravel, with cobbles and possible boulders; SM; Yellow-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Upper Troutdale Formation)	**54.00 - 63.00 Silty SAND with trace gravel, with cobbles and possible boulders; SM; Yellow-brown to yellow to dark gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine, subangular to subrounded gravel; Fine to coarse sand; Stratified with 1/2-inch thick interbeds of Sandy silty CLAY (CL); (Upper Troutdale Formation)**			
60									
	N15	100	25-26-28	36	N- 15 (61.30-62.80) Silty SAND with trace gravel; SM; Yellow-brown to yellow to dark gray; Low to medium plasticity fines; Moist; Very dense; Fine, subangular to rounded gravel; Fine to coarse sand; Stratified with 1/2-inch thick interbeds of Sandy silty CLAY (CL); (Upper Troutdale Formation)			N15: 5% gravel, 72% sand, 23% fines.	
								Harder drilling at 63 feet.	
65						**63.00 - 93.00 GRAVEL with trace to some sand and silt to Silty GRAVEL with some sand, with cobbles and possible boulders; GP/GP-GM/GM; Dark gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Zones of weak cementation; (Lower Troutdale Formation)**			
	N16	33	50/1st 3"		N- 16 (66.30-66.60) GRAVEL with trace sand and silt, with cobbles and possible boulders; GP; Gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Poor recovery; (Lower Troutdale Formation)				
70								Pressuremeter Test at 70.5 feet.	
	N17	50	50/1st 2"		N- 17 (72.50-72.70) GRAVEL with some sand and silt, with cobbles and possible boulders; GP-GM; Dark gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Weak cementation; Quartzite fragments; (Lower Troutdale Formation)				
75									
	N18	66	50/1st 3"		N- 18 (77.50-77.70) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Weak cementation; (Lower Troutdale Formation)				
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80									
	N19	100	50/1st 1"		N- 19 (83.00-83.10) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Weak cementation; Poor recovery; (Lower Troutdale Formation)				
85									
	N20	100	50/1st 1"		N- 20 (89.00-89.10) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Lower Troutdale Formation)				
90									
						93.00 - 97.00 Silty SAND with trace gravel, with cobbles and possible boulders; SM; Green-gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine, rounded gravel; Fine to coarse sand; Weak cementation; (Lower Troutdale Formation)		Smoother drilling at 93 feet.	
	N21	100	35-50/4"	23	N- 21 (94.30-95.10) Silty SAND with some gravel, with cobbles and possible boulders; SM; Green-gray; Nonplastic to medium plasticity fines; Moist; Very dense; Fine, rounded gravel; Fine to coarse sand; Weak cementation; (Lower Troutdale Formation)			N21: 16% fines.	
95									
								Harder drilling at 97 feet.	
	N22	100	50/1st 1"		N- 22 (99.30-99.40) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark gray; Low plasticity fines; Moist; Very dense; Fine to coarse, angular to subrounded gravel; Fine to coarse sand; (Lower Troutdale Formation)	**97.00 - 116.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark gray; Low plasticity fines; Moist; Very dense; Fine to coarse, angular to subrounded gravel; Fine to coarse sand; (Lower Troutdale Formation)**			
100									
	N23	100	50/1st 2"		N- 23 (104.20-104.40) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark gray; Low plasticity fines; Moist; Very dense; Fine to coarse, angular to subrounded gravel; Fine to coarse sand; (Lower Troutdale Formation)				
105									
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110									
	N24	100	50/1st 2"		N- 24 (113.50-113.70) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark gray; Low plasticity fines; Moist; Very dense; Fine to coarse, angular to subrounded gravel; Fine to coarse sand; (Lower Troutdale Formation)				
115						**116.00 - 132.00 Sandy clayey SILT interbedded with Clayey SAND; MH/SC; Green-gray; High plasticity; Moist; Hard; Fine to medium sand; Some interbeds of CLAY (CH); (Sandy River Mudstone)**		Smoother drilling at 116 feet.	
120								High plasticity soils collaring off in borehole from 120 to 132 feet.	
	N25	100	8-14-23	42	N- 25 (123.00-124.50) Sandy clayey SILT; MH; Green-gray; High plasticity; Moist; Hard; Fine to medium sand; Interbedded with Clayey SAND (SC); Some interbeds of CLAY (CH); (Sandy River Mudstone)			Atterberg Limits N25: LL=60, PL=32, PI=28; 70% fines.	
125									
130						**132.00 - 183.60 Silty SAND; SM; Dark green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse sand; Micaceous; (Sandy River Mudstone)**		Pressuremeter Tests at 131.5 and 133 feet.	
	N26	100	34-48-43	24	N- 26 (133.50-135.00) Silty SAND; SM; Dark green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse sand; (Sandy River Mudstone)			N26: 1% gravel, 86% sand, 13% fines.	
135									
140								Pressuremeter Tests at 138 and 139.5 feet.	

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140									
	N27a	100	17-24-35	34	N- 27a (143.50-144.00) Silty SAND; SM; Dark green-gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse sand; (Sandy River Mudstone)				
	N27b			42	N- 27b (144.00-145.00) Silty SAND; SM; Dark green-gray; Nonplastic fines; Moist; Very dense; Fine to medium sand; (Sandy River Mudstone)			Atterberg Limits N27b: LL=NP, PL=NP, PI=NP; 38% fines.	
145									
150									
	N28	100	18-33-38	30	N- 28 (153.00-154.50) Silty SAND; SM; Dark green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse sand; Micaceous; (Sandy River Mudstone)				
155								Gravel layer inferred from drill action 156 to 157 feet. Sparse gravel inferred from 157 to 160 feet.	
160									
	N29	100	29-45-43	29	N- 29 (162.40-163.90) Silty SAND; SM; Dark green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse sand; Micaceous; (Sandy River Mudstone)				
165									
170									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
170					SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.				
	N30	100	27-41-46	30	N- 30 (172.20-173.70) Silty SAND; SM; Dark green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse sand; Micaceous; (Sandy River Mudstone)				
175									
180									
	N31	100	44-50/3"	25	N- 31 (182.80-183.60) Silty SAND; SM; Dark green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse sand; Micaceous; (Sandy River Mudstone)				
						183.60 End of hole			
185									
190									
195									
200									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-11**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,522**	Easting: **~ 349,346**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #9 (Hammer Efficiency = 87.4%)**		Driller **Western States/Raymond**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Kevin J. Cowell & David S. Jacobson**	Ground Elev. **~ -35 ft.**
Start Date **August 4, 2021**	End Date **August 13, 2021**	Total Depth **180.90 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0	N1	100	6-5-5	26	N- 1 (0.00-1.50) SAND with some silt and trace gravel; SP-SM; Gray; Nonplastic fines; Wet; Loose to medium dense; Fine to coarse, subangular gravel; Fine to medium sand; (Fill)	**0.00 - 4.50 SAND with trace to some silt and trace gravel; SP, SP-SM; Gray; Nonplastic fines; Wet; Very loose to medium dense; Fine to coarse, subangular gravel; Fine to medium sand; (Fill)**		Borehole drilled from barge using mud rotary drilling technique (5-inch hole); all depths are reported in feet below mudline; 6-inch ID steel casing installed to 50 feet below mudline. N1: 6% fines.	
	N2	40	3-0-1	33	N- 2 (2.50-4.00) SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Wet; Very loose; Fine to coarse, subangular gravel; Fine to medium sand; (Fill)				
5	N3	63	5-3-2		N- 3 (5.00-6.50) Sandy GRAVEL with some silt; GP-GM; Gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular gravel; Fine to coarse sand; Plastic fragments; (Fill)	**4.50 - 7.00 Sandy GRAVEL with some silt; GP-GM; Gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular gravel; Fine to coarse sand; Plastic fragments; (Fill)**			
	N4	33	3-1-1		N- 4 (7.50-9.00) GRAVEL with some sand and trace silt; GP; Gray; Nonplastic fines; Wet; Very loose; Fine to coarse, subangular gravel; Fine to coarse sand; (Fill)	**7.00 - 9.00 GRAVEL with some sand and trace silt; GP; Gray; Nonplastic fines; Wet; Very loose; Fine to coarse, subangular gravel; Fine to coarse sand; (Fill)**			
10	N5	40	2-3-2	21	N- 5 (10.00-11.50) Gravelly SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular gravel; Fine to coarse sand; (Fill)				
	N6	47	5-3-3	21	N- 6 (12.50-14.00) SAND with some gravel and silt; SP-SM; Dark gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular gravel; Fine to coarse sand; Metal and plastic fragments; (Fill)	**9.00 - 14.50 Gravelly SAND with some silt to SAND with some gravel and silt; SP-SM; Dark gray; Nonplastic fines; Wet Loose Fine to coarse, subangular gravel; Fine to coarse sand; Metal and plastic fragments; (Fill)**			
15	N7	67	6-4-4		N- 7 (15.00-16.50) Silty GRAVEL with some sand; GM; Dark gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular gravel; Fine to coarse sand; (Fill)				
	N8	50	4-3-3	27	N- 8 (17.50-19.00) SAND with some silt and trace gravel; SP-SM; Gray; Nonplastic fines; Wet; Loose; Fine subangular gravel; Fine to coarse sand; (Fill)	**14.50 - 17.00 Silty GRAVEL with some sand; GM; Dark gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular gravel;**			
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N9	60	3-4-3	28	N- 9 (20.00-21.50) SAND with some silt and trace gravel; SP-SM; Gray to green-gray; Nonplastic fines; Wet; Loose; Fine subrounded gravel; Fine to medium sand; Trace organics with wood fragments; (Fill)	**Fine to coarse sand; (Fill)**		Little to no DF circulation in upper 20 feet.	
						17.00 - 24.00 SAND with some silt and trace gravel; SP-SM; Gray; Nonplastic fines; Wet; Loose; Fine subangular to subrounded gravel; Fine to coarse sand; Trace organics and wood fragments; (Fill)			
	N10	80	5-4-3	28	N- 10 (22.50-24.00) SAND with some silt and trace gravel; SP-SM; Gray to green-gray; Nonplastic fines; Wet; Loose; Fine subrounded gravel; Fine to medium sand; Trace organics with wood fragments; (Fill)			N10: 8% fines.	
25						**24.00 - 29.50 Organic CLAY with some sand; OH; Gray to green-gray; Medium plasticity; Moist to wet; Very soft; Fine sand; Some wood fragments and other organics; (Fine-grained Alluvium)**			
	N11	100	1-0-0	89	N- 11 (27.50-29.00) Organic CLAY with some sand; OH; Gray to green-gray; Medium plasticity; Moist to wet; Very soft; Fine sand; Some wood fragments and other organics; (Fine-grained Alluvium)			Atterberg Limits N11: LL=72, PL=48, PI=24.	
30						**29.50 - 32.50 Silty SAND; SM; Gray; Nonplastic fines; Wet; Fine to medium sand; (Sand Alluvium)**			
	U1	75			U- 1 (30.50-32.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Fine to medium sand; (Sand Alluvium)				
	N12	40	4-6-4		N- 12 (32.50-34.00) Silty GRAVEL with some sand; GM; Gray; Nonplastic fines; Wet; Loose to medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Sand Alluvium)	**32.50 - 35.00 Silty GRAVEL with some sand; GM; Gray; Wet; Nonplastic fines; Loose to medium dense; Fine to coarse sand; Gravel interbeds inferred; (Sand Alluvium)**			
35						**35.00 - 52.50 SAND with some silt and trace gravel to Silty SAND with trace gravel; SP-SM/SM; Dark gray; Nonplastic fines; Wet; Medium dense; Fine to coarse subangular gravel; Fine to coarse sand; (Sand Alluvium)**		Pressuremeter Tests at 37.5 and 39 feet.	
	N13	100	12-7-10	31	N- 13 (39.00-40.50) SAND with some silt and trace gravel; SP-SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to coarse subangular gravel; Fine to coarse sand; (Sand Alluvium)			N13: 8% fines.	
40									
45								Pressuremeter Tests at 44.5 and 46 feet.	
	N14	73	7-8-8	35	N- 14 (46.00-47.50) Silty SAND with trace gravel; SM; Dark gray; Nonplastic fines; Wet; Medium dense; Fine to coarse subangular gravel; Fine to coarse sand; (Sand Alluvium)				
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	U2				U- 2 (50.50-52.50) SAND with some silt and trace gravel; SP-SM; Dark gray; Nonplastic fines; Moist to wet; Medium dense; Fine to medium sand; (Sand Alluvium)				
	N15	100	4-7-7	34	N- 15 (52.50-54.00) SAND with some silt; SP-SM; Gray and olive-gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; (Sand Alluvium)	**52.50 - 64.50 SAND with trace to some silt; SP/SP-SM; Gray and olive-gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; (Sand Alluvium)**		N15: 93% sand, 7% fines.	
55									
	N16	100	7-7-7	33	N- 16 (57.50-59.00) SAND with trace silt; SP; Gray and olive-gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; (Sand Alluvium)				
60									
	N17	80	5-6-7	36	N- 17 (62.50-64.00) SAND with trace silt; SP; Gray and olive-gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; (Sand Alluvium)				
65						**64.50 - 72.00 GRAVEL with some sand, with cobbles and possible boulders; GP; Gray; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Harder drilling at 64.5 feet.	
	N18	100	21-20-25		N- 18 (67.50-69.00) GRAVEL with some sand, with cobbles and possible boulders; GP; Gray; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)			Driller indicates sand interbeds at 68 feet.	
70								Pressuremeter Tests at 71.5 and 73 feet.	
	N19		9-8-10		N- 19 (73.50-75.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)	**72.00 - 77.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
75						**77.00 - 87.50 GRAVEL, with cobbles and possible boulders; GP; Gray; Wet; Dense; Fine to coarse, subangular to subrounded gravel;**			
	N20	11	18-19-26		N- 20 (78.00-79.50) GRAVEL, with cobbles and possible boulders; GP; Gray; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Poor recovery; (Gravel Alluvium)			Borehole instability and little to no drilling mud circulation with 750 gallons mud loss from 78 to 88 feet.	
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80						**Poor recovery; (Gravel Alluvium)**			
	N21	17	32-21-14		N- 21 (83.00-84.50) GRAVEL, with cobbles and possible boulders; GP; Gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Poor recovery; (Gravel Alluvium)				
85									
	N22	39	12-17-18		N- 22 (88.00-89.50) GRAVEL with some silt and trace sand, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**87.50 - 100.00 GRAVEL with some silt and trace to some sand, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Dense to very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Stratified with 3-inch interbeds of SAND with some silt (SP-SM); (Gravel Alluvium)**			
90									
	N23	60	34-44-50/3"		N- 23 (93.00-94.25) GRAVEL with some sand and silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Iron oxide staining of gravel clasts; (Gravel Alluvium)				
95									
	N24	100	31-40-31		N- 24 (98.00-99.50) GRAVEL with some sand and silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Stratified with 3-inch interbeds of SAND with some silt (SP-SM); (Gravel Alluvium)				
100						**100.00 - 132.50 GRAVEL with trace silt and sand, with cobbles and possible boulders; GP; Gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Slight iron oxide staining; Micas adhered to gravel; Poor recovery; (Lower Troutdale Formation)**			
	N25	50	50/1st 2"		N- 25 (103.00-103.20) GRAVEL with trace sand, with cobbles and possible boulders; GP; Gray; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Slight iron oxide staining; Micas adhered to gravel; (Lower Troutdale Formation)				
105									
	N26	100	50/1st 3"		N- 26 (108.00-108.25) GRAVEL with trace silt and sand, with cobbles and possible boulders; GP; Gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Iron oxide staining of gravel clasts; Micas adhered to gravel; (Lower Troutdale Formation)				
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110					SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.			Pressuremeter Tests at 112.5 and 114 feet.	
	N27	67	50/1st 3"		N- 27 (114.00-114.25) GRAVEL with trace sand, with cobbles and possible boulders; GP; Gray; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to medium sand; Iron oxide staining of gravel clasts; Micas adhered to gravel; (Lower Troutdale Formation)				
115									
120									
125	N28	50	50/1st 2"		N- 28 (125.00-125.20) GRAVEL with trace sand, with cobbles and possible boulders; GP; Gray; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to medium sand; Iron oxide staining of gravel clasts; Micas adhered to gravel; (Lower Troutdale Formation)				
130									
135	N29	100	50/1st 1"		N- 29 (135.00-135.10) GRAVEL with some sand, with cobbles and possible boulders; GP; Gray and tan; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Iron oxide staining of gravel clasts; Micas adhered to gravel; (Lower Troutdale Formation)	**132.50 - 142.50 GRAVEL with some sand, with cobbles and possible boulders; GP; Gray and tan; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand Iron oxide staining of gravel clasts; Poor recovery; (Lower Troutdale Formation)**			
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140								
145	N30	100	50/1st 1"		N- 30 (145.00-145.10) GRAVEL with trace sand, with cobbles and possible boulders; GP; Gray and tan; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Iron oxide staining of gravel clasts; Micas adhered to gravel; (Lower Troutdale Formation)	**142.50 - 150.00 GRAVEL with trace sand, with cobbles and possible boulders; GP; Gray and tan; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Iron oxide staining of gravel clasts; Micas adhered to gravel; Poor recovery; (Lower Troutdale Formation)**			
150						**150.00 - 157.50 SAND with trace silt; SP; Tan and yellow; Nonplastic fines; Moist; Very dense; Fine to coarse sand; Micaceous; Poor recovery; (Lower Troutdale Formation)**			
155	N31	100	50/1st 3"		N- 31 (155.00-155.25) SAND with trace silt; SP; Tan and yellow; Nonplastic fines; Moist; Very dense; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
160						**157.50 - 165.75 Silty SAND; SM; Brown and gray; Nonplastic fines; Moist; Very dense; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**		Smooth and hard drilling intervals between 155 and 165 feet.	
165	N32a	100	37-50/5"	28	N- 32a (165.00-165.75) Silty SAND; SM; Brown and gray; Nonplastic fines; Moist; Very dense; Fine to coarse sand; Micaceous				
	N32b			33	N- 32b (165.75-165.90) SILT to SILT with some sand; ML; Brown; Low to medium plasticity; Moist; Very hard; Fine sand; Micaceous; Laminated texture; (Sandy River Mudstone)	**165.75 - 168.00 SILT to SILT with some sand; ML; Brown; Low to medium plasticity; Moist; Very hard; Fine sand; Micaceous; Laminated texture; (Sandy River**		Harder drilling at 168 feet.	
170									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
170	N33	100	37-8-50/1"	25	N- 33 (170.00-171.10) Gravelly SAND with some silt to Sandy GRAVEL with some silt, with cobbles and possible boulders; SP-SM/GP-GM; Gray to brown; Nonplastic to low plasticity fines; Moist to wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Slight iron oxide staining; Micaceous, with some micas adhered to gravel; (Lower Troutdale Formation)	**Mudstone)** **168.00 - 175.00** **Gravelly SAND with some silt to Sandy GRAVEL with some silt; SP-SM/GP-GM; Gray to brown; Nonplastic to low plasticity fines; Moist to wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Slight iron oxide staining; Micaceous, with some micas adhered to gravel; (Sandy River Mudstone)** **175.00 - 180.90** **SAND with some silt; SP-SM; Blue-green; Nonplastic fines; Moist; Very dense; Fine to coarse sand; Micaceous; (Sandy River Mudstone)**		N33: 46% gravel, 44% sand, 10% fines.	
175									
180	N34	64	29-50/5"	31	N- 34 (180.00-180.90) SAND with some silt; SP-SM; Blue-green; Nonplastic fines; Moist; Very dense; Fine to coarse sand; Micaceous; (Sandy River Mudstone)	**180.90** **End of hole**			
185									
190									
195									
200									

SHANNON & WILSON, INC.
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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-12**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,348**	Easting: **~ 349,376**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #5 (Hammer Efficiency = 80.8%)**		Driller **Western States/Adonis**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Veronica C. Biesiada**	Ground Elev. **~ -48 ft.**
Start Date **August 20, 2021**	End Date **August 25, 2021**	Total Depth **129.00 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0					SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.	**0.00 - 12.50 Silty GRAVEL with some sand; GM; Gray to multicolored; Nonplastic fines; Wet; Loose; Fine, subrounded gravel; Fine to coarse sand; Plastic fragments; (Fill)**		Borehole drilled from barge using mud rotary drilling technique (5-inch hole); all depths are reported in feet below mudline; 6-inch ID steel casing installed to 84.8 feet below mudline; OYO suspension logging performed from 82 to 116 feet.	
5									
10	N1	13	1-2-3		N- 1 (9.90-11.40) Silty GRAVEL with some sand; GM; Gray to multicolored; Nonplastic fines; Wet; Loose; Fine, subrounded gravel; Fine to coarse sand; Poor recovery; (Fill)				
15	N2	87	2-3-3		N- 2 (15.00-16.50) SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Loose; Fine to coarse sand; (Sand Alluvium)	**12.50 - 33.50 SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Loose; Fine to coarse sand; (Sand Alluvium)**			
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20									
	N3	53	5-3-5		N- 3 (20.80-22.30) SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Loose; Fine to medium sand; (Sand Alluvium)				
25	N4	73	3-4-4		N- 4 (25.90-27.40) SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Loose; Fine to medium sand; (Sand Alluvium)				
30	N5	80	3-6-3		N- 5 (30.90-32.40) SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Loose; Fine to medium sand; (Sand Alluvium)				
35	N6	67	3-3-1		N- 6 (35.90-37.40) SAND; SP; Dark gray; Wet; Very loose to loose; Fine to medium sand; (Sand Alluvium)	**33.50 - 37.40 SAND; SP; Dark gray; Wet; Very loose to loose; Fine to medium sand; (Sand Alluvium)**		Borehole caving between 35 and 65 feet.	
	U1	60			U- 1 (37.40-39.40) SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Loose; Fine to medium sand; (Sand Alluvium)	**37.40 - 46.00 SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Loose; Fine to medium sand; (Sand Alluvium)**			
40									
	N7	100	1-4-5		N- 7 (43.20-44.70) SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Loose; Fine to medium sand; (Sand Alluvium)				
45						**46.00 - 57.00 SAND with trace to some silt; SP/SP-SM; Dark gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; (Sand Alluvium)**			
	N8	80	6-8-8		N- 8 (48.30-49.80) SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; (Sand Alluvium)				
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50									
	N9	87	4-5-6		N- 9 (53.70-55.20) SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; (Sand Alluvium)				
55						**57.00 - 62.50 SAND with trace gravel; SP; Dark gray; Moist to wet; Dense; Fine to medium sand; Stratified with interbeds of GRAVEL with some sand (GP); (Sand Alluvium)**			
	N10	47	5-11-26		N- 10 (58.80-60.30) SAND with trace gravel; SP; Dark gray; Moist to wet; Dense; Fine to medium sand; Stratified with interbeds of GRAVEL with some sand (GP); (Sand Alluvium)				
60								Harder drilling at 60 feet. Approx. 900 gallons of drilling mud loss, poor circulation, and caving from 60 to 85 feet.	
	N11a	100	14-22-29		N- 11a (64.00-64.80) SAND with trace silt; SP; Dark gray; Nonplastic fines; Moist to wet; Very dense; Fine to medium sand; (Gravel Alluvium)	**62.50 - 64.80 SAND with trace silt; SP; Dark gray; Nonplastic fines; Moist to wet; Very dense; Fine to medium sand; (Sand Alluvium)**			
65	N11b				N- 11b (64.80-65.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray to multicolored; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subrounded gravel; Fine to coarse sand; (Gravel Alluvium)	**64.80 - 68.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray to multicolored; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
70	N12	40	16-17-13		N- 12 (69.60-71.10) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray to multicolored; Nonplastic fines; Moist to wet; Medium dense to dense; Fine to coarse, subrounded gravel; Fine to coarse sand; (Gravel Alluvium)	**68.00 - 73.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray to multicolored; Nonplastic fines; Moist to wet; Medium dense to dense; Fine to coarse, subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
75	N13	60	32-26-17		N- 13 (75.00-76.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray to multicolored; Nonplastic to low plasticity fines; Moist to wet; Dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**73.00 - 83.70 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subrounded**			
80	N14	50	31-32-50/5"		N- 14 (79.20-80.60) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray;				

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80					Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subrounded gravel; Fine to coarse sand; (Gravel Alluvium)	**gravel; Fine to coarse sand; (Gravel Alluvium)**			
	N15	50	26-50/3"		N- 15 (83.70-84.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown to multicolored; Low to medium plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Quartzite clasts; (Lower Troutdale Formation)	**83.70 - 88.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown to multicolored; Low to medium plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Quartzite clasts; (Lower Troutdale Formation)**		Approx. 500 gallons of drilling mud loss, poor circulation, and caving between 85 and 129 feet.	
85									
	N16	100	50/1st 2"		N- 16 (89.30-89.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown to multicolored; Low to medium plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Quartzite clasts; (Lower Troutdale Formation)	**88.00 - 129.00 GRAVEL with some silt and sand to Silty GRAVEL with some sand, with cobbles and possible boulders; GP-GM/GM; Brown to multicolored; Low to medium plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Quartzite clasts; Poor recovery in some samples; (Lower Troutdale Formation)**			
90									
95									
100	N17	50	50/1st 2"		N- 17 (99.80-100.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown; Low to medium plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; (Lower Troutdale Formation)				
105									
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N18	50	50/1st 2"		N- 18 (110.30-110.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown; Low to medium plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; (Lower Troutdale Formation)				
115									
120	N19	0	50/1st 2"		N- 19 (119.70-119.90) No Recovery				
125									
	N20	50	50/1st 2"		N- 20 (128.80-129.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown; Low to medium plasticity fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Lower Troutdale Formation)	**129.00 End of hole**			
130									
135									
140									

Material Description: SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-12A**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,388**	Easting: **~ 349,391**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #9 (Hammer Efficiency = 87.4%)**		Driller **Western States/Raymond**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **David S. Jacobson**	Ground Elev. **~ -51 ft.**
Start Date **August 16, 2021**	End Date **August 18, 2021**	Total Depth **76.50 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
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B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
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Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
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HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 9.00 Sandy GRAVEL with trace silt, with cobbles and possible boulders; GP; Gray; Nonplastic fines; Wet; Very loose; Fine to coarse, subangular gravel; Fine to coarse sand; (Fill)**		Borehole drilled from barge using mud rotary drilling technique (5-inch hole); all depths are reported in feet below mudline; 6-inch ID steel casing installed to 50 feet below mudline.	
5	N1	17	1-1-0		N- 1 (5.00-6.50) Sandy GRAVEL with trace silt; GP; Gray; Nonplastic fines; Wet; Very loose; Fine the coarse, subangular gravel; Fine to coarse sand; Poor recovery; (Fill)				
	N2	22	4-4-3		N- 2 (7.50-9.00) Sandy GRAVEL with trace silt, with cobbles and possible boulders; GP; Gray; Nonplastic fines; Wet; Loose; Fine the coarse, subangular gravel; Fine to coarse sand; (Fill)				
10	N3	100	2-3-1	28	N- 3 (10.00-11.50) SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)	**9.00 - 22.00 SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)**		N3: 2% fines.	
	N4	39	2-2-3	28	N- 4 (12.50-14.00) SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)				
15	N5	33	4-3-4	29	N- 5 (15.00-16.50) SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)				
	N6	44	2-2-2	27	N- 6 (17.50-19.00) SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)			Wood fragments observed in drill cuttings at 17 feet.	
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N7	100	2-2-4	28	N- 7 (20.00-21.50) SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Wet; Loose; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)				
						22.00 - 38.00 SAND with trace silt; SP; Gray; Nonplastic fines; Wet; Very loose to medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)			
25	N8	100	1-1-1	38	N- 8 (25.00-26.50) SAND with trace silt; SP; Gray; Nonplastic fines; Wet; Very loose; Fine to medium sand; Micaceous; (Sand Alluvium)			N8: 2% fines.	
30	N9	33	3-3-3	32	N- 9 (30.00-31.50) SAND with trace silt; SP; Gray; Nonplastic fines; Wet; Loose; Fine to medium sand; Micaceous; (Sand Alluvium)				
35	N10	44	4-6-7	38	N- 10 (35.00-36.50) SAND with trace silt; SP; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)				
						38.00 - 48.00 SAND with trace silt; SP; Gray; Nonplastic fines; Wet; Loose to medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)			
40	N11	67	4-4-6	40	N- 11 (40.00-41.50) SAND with trace silt; SP; Gray; Nonplastic fines; Wet; Loose to medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)				
45	N12	72	7-8-6	38	N- 12 (45.00-46.50) SAND with trace silt; SP; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)			N12: 5% fines.	
						48.00 - 54.00 SAND with some silt; SP-SM; Gray and brown; Nonplastic fines; Moist to wet;			
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N13	78	5-7-9	37	N- 13 (50.00-51.50) SAND with some silt; SP-SM; Gray and brown; Nonplastic fines; Moist to wet; Medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)	**Medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)**			
55	N14	56	10-22-31	21	N- 14 (55.00-56.50) SAND with some silt and gravel; SP-SM; Gray and brown; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Micaceous; (Sand Alluvium)	**54.00 - 57.00 SAND with some silt and gravel; SP-SM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Micaceous; (Sand Alluvium)**			
60	N15	22	9-10-18		N- 15 (60.00-61.50) Sandy GRAVEL with trace silt, with cobbles and possible boulders; GP; Gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**57.00 - 68.00 Sandy GRAVEL with trace silt, with cobbles and possible boulders; GP; Gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**		Driller notes caving gravel conditions at 63 feet.	
65	N16	28	10-10-11		N- 16 (65.00-66.50) Sandy GRAVEL with trace silt, with cobbles and possible boulders; GP; Gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)				
70	N17	22	16-13-14		N- 17 (70.00-71.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**68.00 - 76.50 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Nonplastic fines; Wet; Medium dense to very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**		Driller notes borehole instability at 70 feet.	
75	N18	39	32-40-21		N- 18 (75.00-76.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)				
						76.50 End of hole Barge spuds bent overnight and conductor casing was askew in hole. Borehole abandoned.			
80									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

		Hole No.	**B-13**
Project **Earthquake Ready Burnside Bridge**	Purpose **Burnside Bridge**	E.A. No.	**N/A**
Highway **Burnside Street**	County **Multnomah**	Key No.	**N/A**
Hole Location Northing: **~ 172,378**	Easting: **~ 349,522**	Start Card No.	**N/A**
Equipment **CME-75 Truck Rig #9 (Hammer Efficiency = 87.4%)**	Driller **Western States/Raymond**	Bridge No.	**00511**
Project Geologist **Cody K. Sorensen, CEG**	Recorder **Kevin J. Cowell**	Ground Elev.	**~ -48 ft.**
Start Date **July 28, 2021**	End Date **August 3, 2021** / Total Depth **160.10 ft**	Tube Height	**N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 3.30 SAND with some silt and gravel; SP-SM; Gray; Nonplastic fines; Wet; Medium stiff; Fine to medium, subrounded gravel; Fine to coarse sand; (Sand Alluvium)**		Borehole drilled from barge using mud rotary drilling technique (5-inch hole); all depths are reported in feet below mudline; 6-inch ID steel casing installed to 35 feet below mudline; OYO suspension logging performed from 37 to 138 feet.	
	N1a	100	2-3-1	22	N- 1a (2.50-3.30) SAND with some silt and trace gravel; SP-SM; Gray; Nonplastic fines; Wet; Loose; Fine to medium, subrounded gravel; Fine to coarse sand; (Sand Alluvium)				
	N1b			77	N- 1b (3.30-4.00) SILT with trace to some sand; ML; Gray; Low plasticity; Wet; Medium stiff; Fine sand; (Fine-grained Alluvium)	**3.30 - 4.50 SILT with trace to some sand; ML; Gray; Low plasticity; Wet; Medium stiff; (Fine-grained Alluvium)**			
5	N2	100	2-1-2	27	N- 2 (5.00-6.50) Silty SAND with some gravel; SM; Gray; Nonplastic fines; Wet; Very loose; Fine, subrounded gravel; Fine to medium sand; (Sand Alluvium)	**4.50 - 7.00 Silty SAND with some gravel; SM; Gray; Nonplastic fines; Wet; Very loose; Fine, subrounded gravel; Fine to medium sand; (Sand Alluvium)**			
	N3	100	1-3-3	54	N- 3 (7.50-9.00) Sandy SILT; ML; Gray; Nonplastic; Moist to wet; Loose; Fine to medium sand; Pockets of SILT (ML); Trace wood fragments; (Sand/Silt Alluvium)			N3: 51% fines.	
10	N4	100	0-0-1	36	N- 4 (10.00-11.50) Silty SAND with some gravel; SM; Gray; Nonplastic fines; Wet; Very loose; Fine to medium, angular to subrounded gravel; Fine to medium sand; Trace wood fragments; (Sand Alluvium)	**7.00 - 9.50 Sandy SILT; ML; Gray; Nonplastic; Moist to wet; Loose; Fine to medium sand; Pockets of SILT (ML); Trace wood fragments; (Sand/Silt Alluvium)**		N4: 15% gravel, 72% sand, 13% fines.	
	N5	77	5-4-6	28	N- 5 (12.50-14.00) Silty SAND with trace gravel; SM; Gray; Nonplastic fines; Wet; Loose to medium dense; Fine to medium, subangular to subrounded gravel; Fine to medium sand; (Sand Alluvium)	**9.50 - 14.50 Silty SAND with trace to some gravel; SM; Gray; Nonplastic fines; Wet; Very loose to loose; Fine to medium, subangular to subrounded gravel; Fine to medium sand; Trace wood fragments; (Sand Alluvium)**			
15	N6	87	3-4-6	30	N- 6 (15.00-16.50) SAND with trace silt; SP; Gray; Nonplastic fines; Wet; Loose to medium dense; Fine to medium sand; (Sand Alluvium)			N6: 4% fines.	
	N7	100	4-5-5	32	N- 7 (17.50-19.00) SAND with some silt; SP-SM; Gray; Nonplastic fines; Wet; Loose to medium dense; Fine to medium sand; (Sand Alluvium)	**14.50 - 33.00 SAND with trace silt to SAND with some silt; SP/SP-SM; Gray;**			
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N8	100	2-4-4	38	N- 8 (20.00-21.50) SAND with some silt; SP-SM; Gray; Nonplastic fines; Wet; Loose; Fine to medium sand; (Sand Alluvium)	**Nonplastic fines; Wet; Loose to medium dense; Fine to medium sand; (Sand Alluvium)**			
	U1	75			U- 1 (23.00-25.00) SAND with some silt; SP-SM; Gray; Nonplastic fines; Wet; Loose; Fine to medium sand; (Sand Alluvium)				
25	N9	87	5-5-3	36	N- 9 (25.00-26.50) SAND with some silt and trace gravel; SP-SM; Gray; Nonplastic fines; Wet; Loose; Fine subrounded gravel; Fine to medium sand; (Sand Alluvium)			Borehole collapsed at 25 feet after sample N9.	
30	N10	100	5-6-7	44	N- 10 (30.00-31.50) SAND with some silt; SP-SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)			Smooth drilling at 30 feet.	
35	N11	100	5-4-3	39	N- 11 (35.00-36.50) Silty SAND; SM; Gray; Nonplastic to low plasticity fines; Wet; Loose; Fine to medium sand; Interbedded with SILT (ML); (Sand Alluvium)	**33.00 - 40.00 Silty SAND; SM; Gray; Nonplastic to low plasticity fines; Wet; Loose; Fine to medium sand; Interbedded with SILT (ML); (Sand Alluvium)**		N11: 22% fines.	
	U2	85			U- 2 (38.00-40.00) Silty SAND; SM; Gray; Nonplastic to low plasticity fines; Wet; Loose; Fine to medium sand; Interbedded with SILT (ML); (Sand Alluvium)				
40	N12	100	5-6-8	28	N- 12 (40.00-41.50) SAND with some silt; SP-SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; (Sand Alluvium)	**40.00 - 53.50 SAND with some silt with trace gravel; SP-SM; Gray; Nonplastic fines; Moist to wet; Medium dense; Fine, subrounded gravel; Fine to medium sand; (Sand Alluvium)**		N12: 1% gravel, 92% sand, 7% fines.	
45	N13	57	8-7-7		N- 13 (45.00-46.50) SAND with some silt with trace gravel; SP-SM; Gray; Nonplastic fines; Moist to wet; Medium dense; Fine, subrounded gravel; Fine to medium sand; (Sand Alluvium)				
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N14	73	6-4-7	31	N- 14 (50.00-51.50) SAND with some silt; SP-SM; Gray; Nonplastic fines; Moist to wet; Medium dense; Fine to medium sand; (Sand Alluvium)			N14: 6% fines.	
55	N15	87	18-26-30	13	N- 15 (55.00-56.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Multicolored clasts; (Gravel Alluvium)	**53.50 - 62.50 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic fines; Wet; Medium dense to very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Multicolored clasts; (Gravel Alluvium)**		Gravel inferred from drill action at 53.5 feet.	
60	N16	53	18-13-17	16	N- 16 (60.00-61.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic fines; Wet; Medium dense to dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Multicolored clasts; (Gravel Alluvium)				
65	N17	100	28-18-28		N- 17 (65.00-66.50) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray with multicolored clasts; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Multicolored clasts; (Gravel Alluvium)	**62.50 - 73.00 Silty GRAVEL with some sand to Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray with multicolored clasts; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Approx. 200 gallons of drilling mud loss from 60 to 65 feet.	
70	N18	80	25-23-20		N- 18 (70.00-71.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; Multicolored clasts; (Gravel Alluvium)				
75	N19	60	30-29-50/5"		N- 19 (75.00-76.40) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; (Gravel Alluvium)	**73.00 - 88.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Dense to very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; (Gravel Alluvium)**			
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N20	50	27-40-43	11	N- 20 (80.00-81.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)			N20: 5% fines.	
								Very hard drilling at 83 feet.	
85	N21	47	24-26-23		N- 21 (85.00-86.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)				
						88.00 - 97.50 Sandy GRAVEL with some silt to Silty GRAVEL with some sand, with cobbles and possible boulders; GP-GM/GM; Brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; Cobbles inferred; (Lower Troutdale Formation)			
90	N22	100	50/1st 5"		N- 22 (90.00-90.40) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; Cobbles inferred; (Lower Troutdale)				
95	N23	100	50/1st 3"		N- 23 (95.00-95.30) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; Cobbles inferred; (Lower Troutdale)				
						97.50 - 102.50 GRAVEL with some sand and silt, with cobbles and possible boulders; GP-GM; Dark green-gray; Nonplastic fines; wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; Quartzite clasts; Poor recovery; (Lower Troutdale Formation)			
100	N24	100	50/1st 0.5"		N- 24 (100.00-100.00) GRAVEL with some sand and silt, with cobbles and possible boulders; GP-GM; Dark green-gray; Nonplastic fines; Dry-moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; Quartzite clasts; (Lower Troutdale)				
						102.50 - 160.10 Sandy GRAVEL with some silt to Silty GRAVEL with some sand, with cobbles and possible boulders; GP-GM/GM; Dark green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Quartzite clasts; Poor			
105									
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N25	100	50/1st 2"		N- 25 (110.00-110.20) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Quartzite clasts; (Lower Troutdale)	**recovery; Stratified with 3- to 4-foot sand or silt interbeds from 145 to 160 feet, based on drill action; (Lower Troutdale Formation)**			
115									
120									
	N26	100	50/1st 2"		N- 26 (122.00-122.20) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; Granite clasts; Cemented sands; (Lower Troutdale)				
125									
130	N27	100	50/1st 2"		N- 27 (130.00-130.20) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Green-gray to brown; Nonplastic fines; Most; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; (Lower Troutdale)				
135									
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	N28	100	50/1st 2.5"		N- 28 (140.00-140.20) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; Granite clasts; (Lower Troutdale)				
145									
150	N29	0	50/1st 2"		N- 29 (150.00-150.20) No Recovery				
155								Approximate 3- to 4-foot thick interbeds beds of sand or silt inferred from drill action from 145 feet to bottom of borehole.	
160	N30	50	50/1st 1"		N- 30 (160.00-160.10) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Blue-gray to green-gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Lower Troutdale)	**160.10** **End of hole**			
165									
170									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-14**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,404**	Easting: **~ 349,688**		Start Card No. **N/A**
Equipment **Viper Specialty Drill Rig (Cathead Hammer)**		Driller **Salisbury & Associates, Inc./Caleb**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Shervin J. & Kevin C.**	Ground Elev. **~ 16 ft.**
Start Date **November 15, 2021**	End Date **November 18, 2021**	Total Depth **130.10 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

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0						**0.00 - 4.50 GRAVEL with some silt and sand; GP-GM; Brown and dark gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular gravel; Fine to coarse sand; (Fill)**		Borehole advanced using casing advancer drilling technique (4-inch hole).	
	N1	20	11-7-40		N- 1 (2.50-4.00) GRAVEL with some silt and sand; GP-GM; Brown and dark gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular gravel; Fine to coarse sand; Poor recovery; (Fill)				
5	N2	25	2-22-9	31	N- 2 (5.00-6.50) Silty GRAVEL with some sand; GM; Dark gray; Nonplastic fines; Wet; Dense; Fine, subangular to subrounded gravel; Fine to coarse sand; Trace organics; Trace concrete fragments; (Fill)	**4.50 - 9.50 Silty GRAVEL with some sand; GM; Dark gray; Nonplastic fines; Wet; Dense; Fine, subangular to subrounded gravel; Fine to coarse sand; Trace organics; Trace concrete fragments; Slight iron oxide staining; (Fill)**		N2: 60% gravel, 27% sand, 13% fines.	
	N3	53	18-22-14		N- 3 (7.50-9.00) Silty GRAVEL with some sand; GM; Dark gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; (Fill)				
10	N4	58	2-1-0	38	N- 4 (10.00-11.50) SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Very loose; Fine to medium sand; (Sand/Silt Alluvium)	**9.50 - 12.00 SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Very loose; Fine to medium sand; (Sand/Silt Alluvium)**		N4: 1% gravel, 88% sand, 11% fines.	
	N5	61	1-1-1	45	N- 5 (12.50-14.00) Silty SAND; SM; Dark gray; Nonplastic to low plasticity fines; Wet; Very loose; Fine to coarse sand; Stratified with interbeds Silty CLAY (CL); (Sand/Silt Alluvium)	**12.00 - 14.50 Silty SAND; SM; Dark gray; Nonplastic to low plasticity fines; Wet; Very loose; Fine to coarse sand; Stratified with interbeds Silty CLAY (CL); (Sand/Silt Alluvium)**		N5: 42% fines.	
15	N6	33	1-1-0	40	N- 6 (15.00-16.50) SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Very loose; Fine to coarse sand; (Sand/Silt Alluvium)	**14.50 - 19.50 SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Very loose to loose; Fine to coarse sand; Micaceous; Stratified with interbeds of SILT**		N6: 2% gravel, 89% sand, 9% fines.	
	N7	100	1-2-4	36	N- 7 (17.50-19.00) SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Loose; Fine to coarse sand; Micaceous; Stratified with interbeds of SILT (ML); (Sand/Silt Alluvium)			N7: 9% fines.	
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N8	89	1-0-1	45	N- 8 (20.00-21.50) Silty SAND; SM; Dark gray; Nonplastic to low plasticity fines; Wet; Very loose; Fine to medium sand; Micaceous; Stratified with interbeds of Clayey SILT (MH); (Sand/Silt Alluvium)	**(ML); (Sand/Silt Alluvium)**		N8: 53% sand, 47% fines.	
						19.50 - 22.50 Silty SAND; SM; Dark gray; Nonplastic to low plasticity fines; Wet; Very loose to loose; Fine to medium sand; Micaceous; Stratified with interbeds of Clayey SILT (MH); (Sand/Silt Alluvium)			
25	N9	78	1-1-1	49	N- 9 (25.00-26.50) Sandy SILT; ML; Dark gray; Nonplastic; Moist to wet; Very loose; Fine sand; Micaceous; (Sand/Silt Alluvium)	**22.50 - 32.50 Sandy SILT; ML; Dark gray; Nonplastic to low plasticity; Moist to wet; Very loose/Very soft to soft; Fine sand; Micaceous; (Sand/Silt Alluvium)**		Atterberg Limits N9: LL=35, PL=35, PI=0; 55% fines.	
30	N10	81	1-0-1	51	N- 10 (30.00-31.50) Sandy SILT; ML; Dark gray; Low plasticity; Moist; Very soft; Fine sand; Micaceous; (Sand/Silt Alluvium)			Atterberg Limits N10: LL=41, PL=35, PI=6.	
						32.50 - 37.50 Silty SAND; SM; Dark gray; Nonplastic to low plasticity fines; Moist; Loose; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			
35	N11	96	2-1-5	45	N- 11 (35.00-36.50) Silty SAND; SM; Dark gray; Nonplastic to low plasticity fines; Moist; Loose; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			N11: 57% sand, 43% fines.	
						37.50 - 40.75 SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Loose; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			
40	N12a	100	2-2-2	40	N- 12a (40.00-40.75) SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Loose; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			N12a: 10% fines.	
	N12b				N- 12b (40.75-41.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Soft to medium stiff; Fine sand; Micaceous; (Sand/Silt Alluvium)	**40.75 - 43.00 Sandy SILT; ML; Gray; Low plasticity; Wet; Soft to medium stiff; Fine sand; Micaceous; (Sand/Silt Alluvium)**			
						43.00 - 47.50 Silty SAND; SM; Dark gray; Nonplastic fines; Wet; Very loose; Fine sand; Micaceous; Stratified with 1- to 4-inch interbeds of SILT (ML); (Sand/Silt Alluvium)			
45	N13	94	1-2-1	44	N- 13 (45.00-46.50) Silty SAND; SM; Dark gray; Nonplastic fines; Wet; Very loose; Fine sand; Micaceous; Stratified with 1- to 4-inch interbeds of SILT (ML); (Sand/Silt Alluvium)			N13: 51% sand, 49% fines.	
						47.50 - 53.00 Sandy SILT; ML; Dark gray; Nonplastic to low plasticity; Wet; Loose/medium stiff;			
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N14	75	2-2-3	45	N- 14 (50.00-51.50) Sandy SILT; ML; Dark gray; Nonplastic to low plasticity; Wet; Loose/Medium stiff; Fine sand; Micaceous; Stratified with 1- to 4-inch interbeds of SILT (ML); (Sand/Silt Alluvium)	**Fine sand; Micaceous; Stratified with 1- to 4-inch interbeds of SILT (ML); (Sand/Silt Alluvium)**		N14: 58% fines.
55						**53.00 - 85.00 SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Fine to medium sand; Micaceous; *Sand heave in casing during sampling; (Sand Alluvium)**		Sand heave of up to 10 feet observed in sands from 53 to 96 feet below ground surface. SPT N-values in this zone are not representative as samples were taken in heaved soils within casing.
60								
65	N15	100		41	N- 15 (65.00-66.50) SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Wet; Fine to medium sand; Micaceous; *Sand heave in casing; (Sand Alluvium)			N15: 9% fines.
70	N16	100		41	N- 16 (70.00-71.50) SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Moist; Fine to medium sand; Micaceous; *Sand heave in casing; (Sand Alluvium)			N16: 6% fines.
75								
80								

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N17	0			N- 17 (80.00-81.50) No Recovery				
85						**85.00 - 95.00 SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Fine to medium sand; Micaceous; *Sand heave in casing during sampling; (Sand Alluvium)**			
90	N18	100		45	N- 18 (90.00-91.50) SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Fine to medium sand; Micaceous; *Sand heave in casing; (Sand Alluvium)			N18: 96% sand, 4% fines.	
95						**95.00 - 105.00 SILT with trace sand; ML; Dark gray; Low plasticity; Wet; Medium stiff; Fine sand; Micaceous; (Fine-grained Alluvium)**			
100	N19	83	2-2-4	48	N- 19 (100.00-101.50) SILT with trace sand; ML; Dark gray; Low plasticity; Wet; Medium stiff; Fine sand; Micaceous; (Fine-grained Alluvium)			N19: 90% fines.	
105						**105.00 - 125.00 SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Fine to medium sand; Micaceous; *Sand heave in casing during sampling; (Sand Alluvium)**			
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N20	100		45	N- 20 (110.00-111.50) SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Fine to medium sand; Micaceous; *Sand heave in casing; (Sand Alluvium)			N20: 5% fines.	
115									
120	N21	100		37	N- 21 (120.00-121.50) SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Fine to medium sand; Micaceous; *Sand heave in casing; (Sand Alluvium)			N21: 1% fines.	
125						**125.00 - 130.10 Sandy GRAVEL with trace silt; GP; Dark gray; based on drill action and cuttings; *Sand heave in casing during sampling; (Gravel Alluvium)**		Gravel encountered at approx. 125 feet based on drill action and cuttings. At 128.6 feet, driller indicates drill rig unable to advance the borehole further in the gravel. Borehole terminated after sample N22.	
	N22	67		35	N- 22 (128.60-130.10) *Sand heave in casing, sample not representative of actual material; Recovered only sand heave in sample; (Gravel Alluvium)			N22: 95% sand, 5% fines. *Not representative	
130						**130.10 End of hole Refusal Borehole terminated**			
135									
140									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

		Hole No.	**B-15**
Project **Earthquake Ready Burnside Bridge**	Purpose **Burnside Bridge**	E.A. No.	**N/A**
Highway **Burnside Street**	County **Multnomah**	Key No.	**N/A**
Hole Location Northing: **~ 172,292**	Easting: **~ 349,728**	Start Card No.	**N/A**
Equipment **CME-75 Truck Rig #9 (Hammer Efficiency = 87.4%)**	Driller **Western States/Raymond**	Bridge No.	**00511**
Project Geologist **Cody K. Sorensen, CEG**	Recorder **David S. Jacobson**	Ground Elev.	**~ 39 ft.**
Start Date **September 12, 2021**	End Date **September 15, 2021** / Total Depth **215.00 ft**	Tube Height	**N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 1.00 Portland Cement Concrete; (Fill)**		Borehole advanced using hollow-stem auger drilling technique (8-inch hole) to 25 feet; 6-inch ID steel casing installed to 25 feet; OYO suspension logging performed from 25 to 203 feet.	
	N1	56	6-4-4		N- 1 (2.50-4.00) Silty SAND with some gravel; SM; Gray-brown mottled; Nonplastic to low plasticity fines; Moist; Loose; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; (Fill)	**1.00 - 4.50 Silty SAND with some gravel; SM; Gray-brown mottled; Nonplastic to low plasticity fines; Moist; Loose; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; (Fill)**			
5	N2	72	8-13-17		N- 2 (5.00-6.50) Sandy SILT with some gravel; ML; Gray-brown mottled; Nonplastic; Moist; Medium dense to dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Micaceous; Few asphalt/concrete fragments; Trace organics; (Fill)	**4.50 - 9.50 Sandy SILT with trace to some gravel; ML; Gray-brown mottled to brown; Nonplastic; Moist; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; Few asphalt and concrete fragments; Trace organics; (Fill)**			
	N3	78	6-8-11		N- 3 (7.50-9.00) Sandy SILT with trace gravel; ML; Brown; Nonplastic; Moist; Medium dense; Fine to coarse, subangular gravel; Fine sand; Micaceous; (Fill)				
10	N4	89	6-13-17		N- 4 (10.00-11.50) SILT with some sand; ML; Brown mottled; Nonplastic; Moist; Medium dense to dense; Fine sand; Micaceous; (Fill)	**9.50 - 14.50 SILT with some sand and trace gravel; ML: Brown and gray mottled; Nonplastic to low plasticity; Moist; Medium dense to dense/Very stiff; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Micaceous; Slight iron oxide staining; Trace brick fragments and organics; (Fill)**			
	N5	89	9-13-16		N- 5 (12.50-14.00) SILT with some sand and trace gravel; ML; Brown and gray; Low plasticity; Moist; Very stiff; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Micaceous; Slight iron oxide staining; Trace brick fragments and organics; (Fill)				
15	N6	89	9-10-8		N- 6 (15.00-16.50) Gravelly silty SAND; SM; Brown and gray; Low plasticity fines; Moist; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine sand; Micaceous; Trace organics and wood debris; (Fill)				
	N7	56	7-7-7		N- 7 (17.50-19.00) Silty GRAVEL with some sand; GM; Gray-brown mottled; Low plasticity fines; Moist; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Micaceous; Trace organics and wood debris; (Fill)	**14.50 - 17.00 Silty GRAVEL with trace sand; GM; Gray-brown mottled; Nonplastic fines;**			
20									

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20	N8	50	5-6-6		N- 8 (20.00-21.50) Gravelly SAND with trace silt; SP; Gray; Nonplastic fines; Moist; Medium dense; Fine to coarse, subangular to rounded gravel; Fine to medium sand; (Fill)	**Moist; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Micaceous; Trace organics and wood debris; (Fill)**			
25	N9	67	5-7-7	11	N- 9 (25.00-26.50) Silty SAND; SM; Gray; Nonplastic fines; Moist; Medium dense; Fine to medium sand; (Fill)	**17.00 - 19.50 Silty GRAVEL with some sand; GM; Gray-brown mottled; Low plasticity fines; Moist; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Micaceous; Trace organics and wood debris; (Fill)**		Switched to open-hole mud rotary technique (5-inch hole) at 25 feet. N9: 13% fines.	
30	N10	67	6-8-6	26	N- 10 (30.00-31.50) Gravelly silty SAND; SM; Gray and brown; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Fill)	**19.50 - 23.00 Gravelly SAND with trace silt; SP; Gray; Nonplastic fines; Moist; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; (Fill)**		N10: 13% fines.	
35	N11	100	1-1-2	41	N- 11 (35.00-36.50) Sandy SILT; ML; Gray-brown mottled; Low plasticity; Wet; Soft; Fine sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)	**23.00 - 28.00 Silty SAND; SM; Gray; Nonplastic fines; Moist; Medium dense; Fine to medium sand; (Fill)**		Atterberg Limits N11: LL=36, PL=32, PI=4; 60% fines.	
	U1	50		43	U- 1 (38.00-40.00) Sandy SILT; ML; Gray; Nonplastic to low plasticity; Wet; Fine sand; Micaceous; (Sand/Silt Alluvium)	**28.00 - 33.00 Gravelly silty SAND; SM; Gray and brown; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Fill)**		Atterberg Limits U1a: LL=NP, PL=NP, PI=NP; 51% fines.	
	U1a				U- 1a (38.00-39.00)				
	U1b			42	U- 1b (39.00-40.00)			Atterberg Limits U1b: LL=36, PL=30, PI=6.	
40	N12	100	1-2-1	40	N- 12 (40.00-41.50) Sandy SILT; ML; Gray; Nonplastic to low plasticity; Moist; Very loose/Soft; Fine sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)	**33.00 - 63.00 Sandy SILT to Silty SAND; ML, ML/SM; Gray and gray-brown mottled; Nonplastic to low plasticity; Moist to wet; Soft/Very loose to loose; Fine sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)**		N12: 58% fines.	
45	N13	100	1-2-2	46	N- 13 (45.00-46.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Loose; Fine sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)			Atterberg Limits N13: LL=NP, PL=NP, PI=NP; 62% fines.	
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N14	100	2-2-2	44	N- 14 (50.00-51.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Loose; Fine sand; Micaceous; Interbedded with Sandy SAND (SM); (Sand/Silt Alluvium)			N14: 50% fines.	
55	N15	100	1-4-3	40	N- 15 (55.00-56.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Loose; Fine sand; Micaceous; Few interbeds of Silty SAND (SM); (Sand/Silt Alluvium)			Atterberg Limits N15: LL=33, PL=32, PI=1; 56% fines.	
	U2	75			U- 2 (58.00-60.00) Sandy SILT; ML; Gray; Nonplastic; Wet; Fine sand; Micaceous; (Sand/Silt Alluvium)				
60	N16	100	1-4-6	39	N- 16 (60.00-61.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Loose to medium dense; Fine sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)			Atterberg Limits N16: LL=NP, PL=NP, PI=NP; 64% fines.	
						63.00 - 93.00 Silty SAND; SM; Gray; Nonplastic fines; Wet; Very loose to medium dense; Fine to medium sand; Micaceous; Interbeds of SILT with some sand (ML), Sandy SILT (ML), and SAND with some silt (SP-SM); (Sand/Silt Alluvium)		
65	N17	100	5-5-6	38	N- 17 (65.00-66.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; Trace interbeds of SILT with some sand (ML); Trace organics; (Sand/Silt Alluvium)			N17: 30% fines.	
70	N18	89	3-6-5	39	N- 18 (70.00-71.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; Few interbeds of Sandy SILT (ML); (Sand/Silt Alluvium)			N18: 53% sand, 47% fines.	
75	N19	89	4-5-4	44	N- 19 (75.00-76.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			N19: 34% fines.	
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N20	100	3-4-4	34	N- 20 (80.00-81.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose; Fine sand; Micaceous; Interbedded with SILT with some sand and Sandy SILT (ML); (Sand/Silt Alluvium)			Atterberg Limits N20: LL=NP, PL=NP, PI=NP; 44% fines.	
	U3	100		36	U- 3 (83.00-85.00) Silty SAND; SM; Gray; Nonplastic fines; Wet; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			Atterberg Limits U3: LL=NP, PL=NP, PI=NP.	
85	N21	100	1-0-0	41	N- 21 (85.00-86.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Very loose; Fine sand; Micaceous; Few interbeds of SAND with some silt (SP-SM); (Sand/Silt Alluvium)			N21: 31% fines.	
90	N22	89	6-6-8	39	N- 22 (90.00-91.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			N22: 28% fines.	
95	N23	100	0-4-3	39	N- 23 (95.00-96.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Fine sand; Micaceous; Trace organics: Driller dropped rods into borehole, *SPT N-value not representative of actual material.; (Sand/Silt Alluvium)	**93.00 - 98.00 Sandy SILT; ML; Gray; Low plasticity; Wet; Fine sand; Micaceous; Trace organics; (Sand/Silt Alluvium)**		Atterberg Limits N23: LL=41, PL=35, PI=6; 67% fines. Driller dropped rods into borehole during sampling of N23, SPT N-value not representative of actual material.	
100	N24	100	2-7-8	39	N- 24 (100.00-101.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; Some interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)	**98.00 - 108.00 Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; Trace interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)**		N24: 44% fines.	
105	N25	78	7-6-8	40	N- 25 (105.00-106.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; Trace interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)			N25: 34% fines.	
110						**108.00 - 113.00 SILT with some sand; ML; Gray; Low plasticity; Wet; Medium stiff to stiff;**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N26	100	3-3-5	45	N- 26 (110.00-111.50) SILT with some sand; ML; Gray; Low plasticity; Wet; Medium stiff to stiff; Fine sand; Micaceous; Trace organics; Few interbeds of Silty SAND (SM); (Fine-grained Alluvium)	**Fine sand; Micaceous; Trace organics; Few interbeds of Silty SAND (SM); (Fine-grained Alluvium)**		Atterberg Limits N26: LL=40, PL=34, PI=6; 74% fines.	
115	N27	100	1-2-6	41	N- 27 (115.00-116.50) Sandy SILT; ML; Gray; Nonplastic to low plasticity; Wet; Loose/Medium stiff to stiff; Fine sand; Micaceous; Trace organics; Few interbeds of Silty SAND (SM); (Sand/Silt Alluvium)	**113.00 - 123.00 Sandy SILT; ML; Gray; Low plasticity; Wet; Medium stiff to very stiff; Fine sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)**		N27:67% fines.	
120	N28	100	0-5-11	42	N- 28 (120.00-121.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Very stiff; Fine sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)			Atterberg Limits N28: LL=39, PL=33, PI=6; 64% fines.	
125	N29	100	2-3-6	45	N- 29 (125.00-126.50) SILT with some sand; ML; Gray; Low plasticity; Wet; Stiff; Fine sand; Micaceous; Trace interbeds of Silty SAND (SM); (Fine-grained Alluvium)	**123.00 - 128.00 SILT with some sand; ML; Gray; Low plasticity; Wet; Stiff; Fine sand; Micaceous; Trace interbeds of Silty SAND (SM); (Fine-grained Alluvium)**		N29: 73% fines.	
130	N30	100	5-3-7	40	N- 30 (130.00-131.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose to medium dense; Fine to medium sand; Micaceous; Interbedded with SILT with some sand (ML); (Sand/Silt Alluvium)	**128.00 - 138.00 Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose to medium dense; Fine to medium sand; Micaceous; Interbedded with SILT with some sand (ML); (Sand/Silt Alluvium)**		N30: 48% fines.	
135	N31	78	4-4-4	40	N- 31 (135.00-136.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose; Fine to medium sand; Micaceous; Interbedded with SILT with some sand (ML); (Sand/Silt Alluvium)			N31: 42% fines.	
140						**138.00 - 149.00 Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to**		Driller notes increasing sand content at 138 feet.	

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	N32	67	5-7-7	36	N- 32 (140.00-141.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)	**medium sand; Micaceous; (Sand Alluvium)**		N32: 14% fines.	
145	N33	89	10-13-12	35	N- 33 (145.00-146.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)			N33: 26% fines.	
150	N34	50	9-16-18		N- 34 (150.00-151.50) Gravelly silty SAND; SM; Gray; Nonplastic fines; Moist; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)	**149.00 - 152.00 Gravelly silty SAND; SM; Gray; Nonplastic fines; Moist; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)**		Driller notes coarse sand at 149 feet.	
155						**152.00 - 170.75 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
160	N35	6	29-23-25		N- 35 (160.00-161.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Poor recovery; (Gravel Alluvium)				
165								Driller notes intermittent sand lenses at 165 feet.	
170									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
170	N36a	67	28-19-13		N- 36a (170.00-170.75) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)			Driller notes loose gravel-type drill action from 170-175 feet.	
	N36b				N- 36b (170.75-171.50) SAND with some silt and trace gravel; SP-SM; Gray and brown; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Sand Alluvium)	**170.75 - 172.00 SAND with some silt and trace gravel; SP-SM; Gray and brown; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Sand Alluvium)**			
175						**172.00 - 184.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Driller notes harder drilling at 178 feet.	
180	N37	50	41-27-21		N- 37 (180.00-181.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)				
185						**184.00 - 215.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Inferred from drill action and cuttings; (Lower Troutdale Formation)**		Driller notes very hard drilling at 184 feet, and approximately 50 gallons drilling mud loss. Borehole advanced from 184 to 215 feet with no sampling for suspension logging.	
190									
195									
200									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
200					SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.				
205									
210									
215						**215.00 End of hole**			
220									
225									
230									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

		Hole No.	**B-16**
Project **Earthquake Ready Burnside Bridge**	Purpose **Burnside Bridge**	E.A. No.	**N/A**
Highway **Burnside Street**	County **Multnomah**	Key No.	**N/A**
Hole Location Northing: **~ 172,490** Easting: **~ 349,814**		Start Card No.	**N/A**
Equipment **CME-75 Truck Rig #9 (Hammer Efficiency = 87.4%)**	Driller **Western States/Raymond**	Bridge No.	**00511**
Project Geologist **Cody K. Sorensen, CEG**	Recorder **David S. Jacobson**	Ground Elev.	**~ 31 ft.**
Start Date **August 27, 2021** End Date **September 1, 2021**	Total Depth **210.10 ft**	Tube Height	**N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 4.50 GRAVEL, inferred from drill action and cuttings; (Fill)**		Borehole advanced using hollow-stem auger drilling technique (8-inch hole) to 25 feet; OYO suspension logging performed from 19 to 198 feet. Driller indicates coarse gravel in upper 2 feet.	
	N1	0	6-7-7		N- 1 (2.50-4.00) No Recovery				
5	N2	67	4-5-6	22	N- 2 (5.00-6.50) SILT with trace sand; ML; Brown; Low plasticity; Moist; Stiff; Fine sand; Few brick and concrete fragments; Disturbed texture; (Fill)	**4.50 - 7.00 SILT with trace sand; ML; Brown; Low plasticity; Moist; Stiff; Fine sand; Few brick and concrete fragments; Disturbed texture; (Fill)**			
	N3	44	2-5-7	24	N- 3 (7.50-9.00) SILT with some sand and gravel; ML; Brown; Nonplastic to low plasticity; Moist; Medium dense/Stiff; Fine to coarse, subangular gravel; Fine sand; Trace brick and concrete fragments; Micaceous; Disturbed texture; (Fill)	**7.00 - 12.00 SILT with some sand and gravel to SILT with some sand; ML; Brown mottled; Nonplastic to low plasticity; Moist; Medium dense/Soft to stiff; Fine to coarse, subangular gravel; Fine to coarse sand; Trace to few brick and concrete fragments; Disturbed texture; (Fill)**		Smooth drilling with some gravel at 7 feet.	
10	N4	78	2-1-3	30	N- 4 (10.00-11.50) SILT with some sand; ML; Brown mottled; Low plasticity; Moist; Soft to medium stiff; Fine to medium sand; Micaceous; Few brick fragments; Disturbed texture; (Fill)				
	N5	39	6-7-12	24	N- 5 (12.50-14.00) Silty CLAY with some sand and gravel; CL; Brown and gray mottled; Low to medium plasticity; Moist; Very stiff; Fine to coarse, subangular to rounded gravel; Fine to medium sand; Trace brick fragments; Micaceous; Disturbed texture; (Fill)	**12.00 - 14.50 Silty CLAY with some sand and gravel; CL; Brown and gray mottled; Low to medium plasticity; Moist; Very stiff; Fine to coarse, subangular to rounded gravel; Fine to medium sand; Trace brick fragments; Micaceous; Disturbed texture; (Fill)**		Driller indicates increasing gravel content at 12 feet.	
15	N6	22	6-7-7		N- 6 (15.00-16.50) Clayey GRAVEL with some sand; GC; Brown and gray mottled; Low to medium plasticity fines; Moist; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; Trace brick fragments; (Fill)				
	N7	11	1-1-3		N- 7 (17.50-19.00) Recovered wood fragments and organics			Wood in cuttings at 17 feet.	
20						**14.50 - 19.00**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N8	56	4-4-6	37	N- 8 (20.00-21.50) Sandy SILT; ML; Gray; Low plasticity; Moist; Stiff; Fine to medium sand; Micaceous; Trace organics; (Sand/Silt Alluvium)	**Clayey GRAVEL with some sand; GC; Brown and gray mottled; Low to medium plasticity fines; Moist; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; Trace brick fragments; Recovered wood fragments and organics from 17 to 19 feet.; (Fill)**		N8: 69% fines. ▽	
								Switched to open-hole mud rotary technique (5-inch hole) at 25 feet.	
25	U1	0			U- 1 (25.00-27.00) No Recovery			9/30/21 ▽	
	N9	89	1-2-1	46	N- 9 (27.00-28.50) Sandy SILT; ML; Brown and gray; Nonplastic; Moist; Very loose; Fine sand; Micaceous; Trace interbeds of Silty SAND (SM); (Sand/Silt Alluvium)	**19.00 - 40.75 Sandy SILT; ML; Gray and brown; Nonplastic to low plasticity; Very loose to loose/Soft to stiff; Moist to wet; Fine to medium sand; Micaceous; Trace organics; Trace to few interbeds of Silty SAND (SM); (Sand/Silt Alluvium)**		Atterberg Limits N9: LL=NP, PL=NP, PI=NP; 62% fines.	
30	N10	89	1-2-1	46	N- 10 (30.00-31.50) Sandy SILT; ML; Gray; Low plasticity; Moist; Soft; Fine sand; Micaceous; Some interbeds of Silty SAND (SM); (Sand/Silt Alluvium)			Atterberg Limits N10: LL=40, PL=34, PI=6; 57% fines.	
35	U2	100		40	U- 2 (35.00-37.00) Sandy SILT; ML; Gray; Nonplastic; Moist; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			Atterberg Limits U2: LL=NP, PL=NP, PI=NP.	
	N11	78	3-3-3	46	N- 11 (37.00-38.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Loose; Fine to medium sand; Micaceous; Few interbeds of Sandy SILT (ML); (Sand/Silt Alluvium)			N11: 51% fines.	
40	N12a	100	3-6-6	43	N- 12a (40.00-40.75) Sandy SILT; ML; Gray; Nonplastic; Moist; Medium dense; Fine sand; Micaceous; (Sand/Silt Alluvium)			N12a: 69% fines.	
	N12b			42	N- 12b (40.75-41.50) Silty SAND; SM; Gray and brown; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**40.75 - 53.00 Silty SAND; SM; Gray and brown; Nonplastic fines; Moist to wet; Loose to medium dense; fine to medium sand; Interbedded with 3- to 4-inch interbeds of Sandy SILT to SILT with some sand (ML); (Sand/Silt Alluvium)**		N12b: 37% fines.	
45	N13	100	6-3-3	42	N- 13 (45.00-46.50) Silty SAND; SM; Gray; Nonplastic fines; Moist; Loose; Fine sand; Micaceous; Interbedded with 4-inch thick interbeds of Sandy SILT (ML); (Sand/Silt Alluvium)			Atterberg Limits N13: LL=NP, PL=NP, PI=NP; 43% fines.	
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N14	78	3-3-2	42	N- 14 (50.00-51.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose; Fine to medium sand; Micaceous; Interbedded with 3-inch thick interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)			N14: 40% fines.	
55	N15	100	0-0-4	48	N- 15 (55.00-56.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Soft to medium stiff; Fine sand; Micaceous; Interbedded with 1- to 2-inch thick interbeds of Silty SAND (SM); (Sand/Silt Alluvium)	**53.00 - 58.00 Sandy SILT; ML; Gray; Low plasticity; Wet; Soft to medium stiff; Fine sand; Micaceous; Interbedded with 1- to 2-inch thick interbeds of Silty SAND (SM); (Sand/Silt Alluvium)**		Atterberg Limits N15: LL=45, PL=42, PI=3; 56% fines. Geokon 4500S-350kPa vibrating wire piezometer (S/N=2136467) installed at 55 feet below ground surface.	
60	U3	75			U- 3 (60.00-62.00) Silty SAND; SM; Gray; Nonplastic fines; Wet; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**58.00 - 64.00 Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)**			
	N16	100	3-4-7	39	N- 16 (62.00-63.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			N16: 71% sand, 29% fines.	
65	N17	100	0-0-5	49	N- 17 (65.00-66.50) SILT with some sand; ML; Gray; Low plasticity; Wet; Medium stiff; Fine sand; Micaceous; Interbedded with 1- to 2-inch thick interbeds of Silty SAND (SM); (Sand/Silt Alluvium)	**64.00 - 68.00 SILT with some sand; ML; Gray; Low plasticity; Wet; Medium stiff; Fine sand; Micaceous; Interbedded with 1- to 2-inch thick interbeds of Silty SAND (SM); (Sand/Silt Alluvium)**		Atterberg Limits N17: LL=46, PL=36, PI=10; 70% fines.	
70	N18	89	6-5-5	39	N- 18 (70.00-71.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose to medium dense; Fine to medium sand; Micaceous; Few interbeds of Sandy SILT (ML); (Sand/Silt Alluvium)	**68.00 - 83.00 Silty SAND; SM; Gray; Nonplastic fines; Moist to wet; Loose to medium dense; Fine to medium sand; Interbedded with Sandy SILT (ML); (Sand/Silt Alluvium)**		N18: 17% fines.	
75	N19	67	5-5-6	35	N- 19 (75.00-76.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			N19: 21% fines.	
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N20	78	2-2-6	45	N- 20 (80.00-81.50) Silty SAND; SM; Gray; Nonplastic fines; Moist; Loose; Fine to medium sand; Micaceous; Interbedded with Sandy SILT (ML); (Sand/Silt Alluvium)			N20: 47% fines.	
						83.00 - 88.00 Sandy SILT; ML; Gray; Low plasticity; Moist; Medium stiff to stiff; Fine sand; Micaceous; Trace organics; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)			
85	N21	100	2-4-4	46	N- 21 (85.00-86.50) Sandy SILT; ML; Gray; Low plasticity; Moist; Medium stiff to stiff; Fine sand; Micaceous; Trace organics; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)			Atterberg Limits N21: LL=45, PL=37, PI=8; 52% fines.	
						88.00 - 103.00 Silty SAND; SM; Gray; Nonplastic to low plasticity fines; Moist; Loose to medium dense; Fine to medium sand; Micaceous; Trace organics; Interbedded with Sandy SILT (ML); (Sand/Silt Alluvium)			
90	N22	100	6-5-5	39	N- 22 (90.00-91.50) Silty SAND; SM; Gray; Nonplastic fines; Moist; Loose to medium dense; Fine to medium sand; Micaceous; Trace organics; Interbedded with Sandy SILT (ML); (Sand/Silt Alluvium)			N22: 44% fines.	
95	N23	100	6-3-6	37	N- 23 (95.00-96.50) Silty SAND; SM; Gray; Nonplastic to low plasticity fines; Moist; Loose; Fine sand; Micaceous; Interbedded with Sandy SILT (ML); (Sand/Silt Alluvium)			N23: 28% fines.	
100	N24	100	7-8-9	38	N- 24 (100.00-101.50) Silty SAND; SM; Gray; Nonplastic fines; Moist; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			N24: 16% fines.	
						103.00 - 108.00 Sandy SILT; ML; Gray; Low plasticity; Moist; Medium stiff; Fine sand; Micaceous; Interbedded with 1- to 2-inch thick interbeds of Silty SAND (SM); (Sand/Silt Alluvium)			
105	N25	100	4-1-6	41	N- 25 (105.00-106.50) Sandy SILT; ML; Gray; Low plasticity; Moist; Medium stiff; Fine sand; Micaceous; Interbedded with 1- to 2-inch thick interbeds of Silty SAND (SM); (Sand/Silt Alluvium)			Atterberg Limits N25: LL=47, PL=38, PI=9; 60% fines.	
						108.00 - 114.00 Silty SAND; SM; Gray; Nonplastic fines; Moist to wet; Loose; Fine to			
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	U4	100			U- 4 (110.00-112.00) Silty SAND; SM; Gray; Nonplastic fines; Moist to wet; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**medium sand; Micaceous; Trace organics; Interbedded with SILT with trace sand (ML); (Sand/Silt Alluvium)**			
	N26	89	4-3-6	41	N- 26 (112.00-113.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose; Fine to medium sand; Micaceous; Trace organics; Interbedded with SILT with trace sand (ML); (Sand/Silt Alluvium)			N26: 28% fines.	
115	N27	100	6-9-10	37	N- 27 (115.00-116.50) Sandy SILT; ML; Gray; Nonplastic; Moist; Medium dense; Fine sand; Micaceous; (Sand/Silt Alluvium)	**114.00 - 123.00 Sandy SILT; ML; Gray; Nonplastic; Moist; Medium dense; Fine to medium sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)**		N27: 63% fines. Driller indicates coarse sand to fine gravel at 118 feet.	
120	N28	100	6-7-8	39	N- 28 (120.00-121.50) Sandy SILT; ML; Gray; Nonplastic; Moist; Medium dense; Fine to medium sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)			N28: 66% fines.	
125	N29	100	5-6-8	40	N- 29 (125.00-126.50) SILT with some sand; ML; Gray; Low plasticity; Moist; Stiff; Fine to coarse sand; Micaceous; (Fine-grained Alluvium)	**123.00 - 128.00 SILT with some sand; ML; Gray; Low plasticity; Moist; Stiff; Fine to coarse sand; Micaceous; (Fine-grained Alluvium)**		Atterberg Limits N29: LL=42, PL=34, PI=8; 75% fines.	
130	N30	100	9-12-13	29	N- 30 (130.00-131.50) Silty SAND; SM; Gray; Nonplastic fines; Moist; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**128.00 - 133.00 Silty SAND; SM; Gray; Nonplastic fines; Moist; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)**		Atterberg Limits N30: LL=NP, PL=NP, PI=NP; 35% fines.	
135	N31	67	4-5-15	35	N- 31 (135.00-136.50) Sandy SILT; ML; Gray; Nonplastic to low plasticity; Moist; Medium dense/Very stiff; Fine to medium sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)	**133.00 - 144.00 Sandy SILT; ML; Gray; Nonplastic to low plasticity; Moist; Medium dense/Medium stiff to very stiff; Fine to medium sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)**		N31: 50% fines.	
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	N32	56	6-4-4	37	N- 32 (140.00-141.50) Sandy SILT; ML; Gray; Low plasticity; Moist; Medium stiff to stiff; Fine to medium sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)			N32: 62% fines.	
145	N33	33	29-27-27		N- 33 (145.00-146.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**144.00 - 153.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark gray and brown; Nonplastic fines; wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
150	N34	35	32-37-50/5"		N- 34 (150.00-151.40) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)				
155	N35	47	30-28-50/5"		N- 35 (155.00-156.40) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxidation and staining; (Gravel Alluvium)	**153.00 - 158.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; (Gravel Alluvium)**			
160	N36	33	15-26-25		N- 36 (160.00-161.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)	**158.00 - 163.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
165	N37	50	34-27-29		N- 37 (165.00-166.50) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)	**163.00 - 167.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Driller indicates harder material at 167 feet.	
170						**167.00 - 173.00 Sandy silty GRAVEL, with cobbles and possible boulders;**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
170	N38	100	50/1st 2"		N- 38 (170.00-170.20) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Blue-green, gray-green, green-black, and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; Micas adhered to gravel clasts; Dark green-gray to green-black staining of gravel clasts; (Lower Troutdale Formation)	**GM; Blue-green, gray-green, green-black, and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; Micas adhered to gravel clasts; Dark green-gray to green-black staining of gravel clasts; (Lower Troutdale Formation)**			
175	N39	100	50-50/3"		N- 39 (175.00-175.75) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, gray, and black; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	**173.00 - 193.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, gray, and black; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)**			
180	N40	100	50/1st 2"		N- 40 (180.00-180.20) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, gray, and black; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)				
185	N41	0	50/1st 2"		N- 41 (185.00-185.20) No Recovery				
190	N42	0	50/1st 2"		N- 42 (190.00-190.20) No Recovery	**193.00 - 204.50 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Blue-green, green-gray, to yellow-brown, brown, tan, black, and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Lower Troutdale Formation)**			
195	N43	100	50/1st 1"		N- 43 (195.00-195.10) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Blue-green, green-gray, and gray-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Lower Troutdale Formation)				
200									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
200	N44	100	50/1st 2"		N- 44 (200.00-200.20) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, gray, black, and tan; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Lower Troutdale Formation)				
205	N45	100	35-44-50/5"		N- 45 (205.00-206.40) SAND with some silt; SP-SM; Yellow to yellow-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; (Lower Troutdale Formation)	**204.50 - 207.00 SAND with some silt; SP-SM; Yellow to yellow-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; (Lower Troutdale Formation)**			
210	N46	100	50/1st 1"		N- 46 (210.00-210.10) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Yellow-brown, brown, gray, and black; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	**207.00 - 210.10 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Yellow-brown, brown, gray, and black; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)**			
215						**210.10 End of hole**			
220									
225									
230									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-17**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,470**	Easting: **~ 350,069**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #9 (Hammer Efficiency = 78.4%)**		Driller **Western States/Brad**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Seth C. Sonnier & David S. Jacobson**	Ground Elev. **~ 34 ft.**
Start Date **August 23, 2021**	End Date **August 25, 2021**	Total Depth **195.00 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 0.33 Asphalt Concrete; (Fill)**		Borehole advanced using hollow-stem auger drilling technique (10-inch hole) to 25 feet; OYO suspension logging performed from 20 to 183 feet.	
						0.33 - 0.83 Base Aggregate; (Fill)			
	N1	33	19-21-20		N- 1 (2.50-4.00) Gravelly silty SAND, with cobbles; SM; Multicolored; Nonplastic fines; Moist; Dense; Fine to coarse, subangular gravel; Fine to coarse sand; Asphalt fragments; (Fill)	**0.83 - 4.50 Gravelly silty SAND, with cobbles; SM; Multicolored; Nonplastic fines; Moist; Dense; Fine to coarse, subangular gravel; Fine to coarse sand; Asphalt fragments; (Fill)**		Cobbles in upper 5 feet.	
5	N2	100	5-6-20		N- 2 (5.00-6.50) Gravelly SILT with some sand with cobbles; ML; Multicolored; Medium plasticity; Moist; Very stiff; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Brick/mortar fragments; Trace organics; Disturbed texture; (Fill)				
						4.50 - 7.00 Gravelly SILT with some sand, with cobbles; ML; Multicolored; Low plasticity; Moist; Very stiff; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Brick/mortar fragments; Trace organics; Disturbed texture; (Fill)			
	N3	100	2-3-4	32	N- 3 (7.50-9.00) SILT with some sand and some gravel; ML; Brown; Low to medium plasticity; Moist; Medium stiff; Fine to coarse, subrounded gravel; Fine to coarse sand; Micaceous; Disturbed texture; (Fill)				
10	N4	33	4-6-10		N- 4 (10.00-11.50) SILT with some sand and trace gravel; ML; Brown; Low plasticity; Moist; Very stiff; Fine to coarse, subrounded gravel; Fine to coarse sand; Brick fragments; Disturbed texture; (Fill)				
	N5	100	4-2-2	32	N- 5 (12.50-14.00) Silty CLAY with some sand and trace gravel; CL; Blue-gray; Medium plasticity; Moist; Soft to medium stiff; Fine to coarse, subrounded gravel; Fine to coarse sand; Trace organics - charred fragments; Trace brick fragments; (Fill)	**7.00 - 12.00 SILT with some sand and trace to some gravel; ML; Blue-gray; Medium plasticity; Moist; Soft to medium stiff; Fine to coarse, subrounded gravel; Fine to coarse sand; Trace organics - charred fragments; Trace brick fragments; (Fill)**			
15	N6	67	2-1-2	40	N- 6 (15.00-16.50) Silty CLAY with some sand and trace gravel; CL; Blue-gray; Medium plasticity; Moist; Soft; Fine to coarse, subrounded gravel; Fine to coarse sand; Trace organics - charred fragments; Trace brick fragments; (Fill)				
	N7	100	1-1-1	47	N- 7 (17.50-19.00) Clayey SILT; MH; Blue-gray; Medium plasticity; Moist to wet; Very soft to soft; Micaceous; (Fine-grained Alluvium)	**12.00 - 17.00 Silty CLAY with some sand and trace gravel; CL; Blue-gray; Medium plasticity; Moist; Soft to**		Atterberg Limits N7: LL=60, PL=36, PI=24; 97% fines.	
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N8	100	0-0-0	49	N- 8 (20.00-21.50) Clayey SILT; MH; Blue-gray; Medium plasticity; Moist to wet; Very soft to soft; Micaceous; (Fine-grained Alluvium)	**medium stiff; Fine to coarse, subrounded gravel; Fine to coarse sand; Trace organics, charred fragments; Trace brick fragments; (Fill)**		N8: 98% fines. 8/23/21	
	U1	100		48	U- 1 (23.00-25.00) SILT with some sand; ML; Brown mottled; Low to medium plasticity; Wet; Fine sand; Micaceous; Slight to moderate iron oxide staining; (Fine-grained Alluvium)	**17.00 - 22.00 Clayey SILT; MH; Blue-gray; Medium plasticity; Moist to wet; Very soft to soft; Micaceous; (Fine-grained Alluvium)**		Atterberg Limits U1a: LL=49, PL=32, PI=17; Dry Density U1a: 73 pcf; 22% sand, 78% fines. Atterberg Limits U1b: LL=34, PL=25, PI=9. Switched to open-hole mud rotary technique (5-inch hole) at 25 feet. Atterberg Limits N9: LL=46, PL=35, PI=11; 96% fines.	
	U1a				U- 1a (23.00-24.00) Sample split for lab testing.				
	U1b			50	U- 1b (24.00-25.00)				
25	N9	100	1-0-1	50	N- 9 (25.00-26.50) SILT; ML; Brown mottled; Low plasticity; Wet; Very soft; Micaceous; Slight to moderate iron oxide staining; (Fine-grained Alluvium)	**22.00 - 37.00 SILT to SILT with some sand; ML; Brown mottled to gray; Low to medium plasticity; Moist to wet; Very soft to soft; Fine sand; Micaceous; Trace organics; Slight to moderate iron oxide staining; (Fine-grained Alluvium)**			
30	N10	100	0-0-0	45	N- 10 (30.00-31.50) SILT with trace sand; ML; Brown mottled; Low plasticity; Moist; Very soft; Fine sand; Micaceous; Slight to moderate iron oxide staining; (Fine-grained Alluvium)			N10: 86% fines.	
35	N11	100	0-0-1	45	N- 11 (35.00-36.50) SILT with trace sand; ML; Gray; Low plasticity; Moist; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)			N11: 94% fines.	
						37.00 - 42.00 Silty SAND; SM; Gray; Low plasticity fines; Moist; Fine sand; Micaceous; (Sand/Silt Alluvium)			
40	U2	100		41	U- 2 (40.00-42.00) Silty SAND; SM; Gray; Low plasticity fines; Moist; Fine sand; Micaceous; (Fine-grained Alluvium)			Dry Density U2a: 79 pcf; 2% gravel, 77% sand, 21% fines. Atterberg Limits U2b: LL=36, PL=26, PI=9.	
	U2a				U- 2a (40.00-41.00) Sample split for lab testing.				
	U2b			45	U- 2b (41.00-42.00)				
	N12	100	1-1-3	47	N- 12 (42.00-43.50) SILT with trace sand; ML; Gray; Low plasticity; Moist; Soft to medium stiff; Fine sand; Micaceous; (Fine-grained Alluvium)	**42.00 - 60.40 SILT to SILT with some sand; ML; Gray; Nonplastic to low plasticity; Moist; Very loose/Very soft to medium stiff; Micaceous; Trace organics; (Fine-grained Alluvium)**		Atterberg Limits N12: LL=48, PL=37, PI=11; 92% fines.	
45	N13	100	0-0-0	53	N- 13 (45.00-46.50) SILT; ML; Gray; Low plasticity; Moist; Very soft; Micaceous; Trace organics; (Fine-grained Alluvium)			N13: 97% fines.	
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N14	100	1-1-2	44	N- 14 (50.00-51.50) SILT with some sand; ML; Gray; Nonplastic; Moist; Very loose; Fine sand; Micaceous; Trace organics; (Fine-grained Alluvium)			Atterberg Limits N14: LL=NP, PL=NP, PI=NP; 77% fines.	
55	N15	100	0-0-1	44	N- 15 (55.00-56.50) SILT with trace sand; ML; Gray; Low plasticity; Moist; Very soft; Fine sand; Micaceous; Trace organics; Interbedded with SILT with some sand (ML); (Fine-grained Alluvium)			N15: 90% fines.	
60	N16a	100	0-4-3	49	N- 16a (60.00-60.40) SILT with trace sand; ML; Gray; Low plasticity; Moist; Medium stiff; Fine sand; Micaceous; Trace organics; Interbedded with SILT with some sand (ML); (Fine-grained Alluvium)			Driller notes interbedded sand and silt. N16a: 90% fines. N16b: 48% fines.	
	N16b			41	N- 16b (60.40-61.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose; Fine sand; Micaceous; Trace organics; (Sand/Silt Alluvium)	**60.40 - 63.50 Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose; Fine sand; Micaceous; Trace organics; (Sand/Silt Alluvium)**			
65	N17	100	0-1-5	47	N- 17 (65.00-66.50) SILT with trace sand; ML; Gray; Nonplastic to low plasticity; Wet; Loose/Medium stiff; Fine sand; Micaceous; Trace organics; (Fine-grained Alluvium)	**63.50 - 68.50 SILT with trace sand; ML; Gray; Nonplastic to low plasticity; Wet; Loose/Medium stiff; Fine sand; Micaceous; Trace organics; (Fine-grained Alluvium)**		N17: 89% fines.	
70	N18	67	4-2-4	48	N- 18 (70.00-71.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose; Fine sand; Micaceous; Trace organics; (Sand/Silt Alluvium)	**68.50 - 73.50 Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose; Fine sand; Micaceous; Trace organics; (Sand/Silt Alluvium)**		N18: 43% fines.	
75	N19	100	1-0-0	50	N- 19 (75.00-76.50) SILT with trace sand; ML; Gray; Nonplastic; Moist to wet; Very loose; Fine sand; Micaceous; Trace organics; Interbedded with Sandy SILT (ML); (Fine-grained Alluvium)	**73.50 - 82.00 SILT with trace to some sand; ML; Gray; Nonplastic; Moist to wet; Very loose; Fine sand; Micaceous; Trace organics; Interbedded with Sandy SILT (ML); (Fine-grained Alluvium)**		Atterberg Limits N19: LL=39, PL=38, PI=1; 89% fines.	
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	U3	100		39	U- 3 (80.00-82.00) SILT with some sand; ML; Gray; Nonplastic; Moist; Fine sand; Micaceous; (Sand/Silt Alluvium)			Dry Density U3a: 80 pcf; 27% sand, 73% fines.	
	U3a				U- 3a (80.00-81.00) Sample split for lab testing.				
	U3b			39	U- 3b (81.00-82.00)			Atterberg Limits U3b: LL=NP, PL=NP, PI=NP.	
	N20	100	3-6-11	33	N- 20 (82.00-83.50) Silty SAND; SM; Gray; Nonplastic fines; Moist to wet; Medium dense; Fine to medium sand; (Sand/Silt Alluvium)	**82.00 - 84.25 Silty SAND; SM; Gray; Nonplastic fines; Moist; Fine sand; Micaceous; (Sand/Silt Alluvium)**		N20: 24% fines.	
85	N21	100	2-0-6	48	N- 21 (85.00-86.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Loose; Fine sand; Micaceous; (Sand/Silt Alluvium)	**84.25 - 88.50 Sandy SILT; ML; Gray; Nonplastic; Wet; Loose; Fine sand; Micaceous; (Sand/Silt Alluvium)**		N21: 63% fines.	
90	N22	78	8-8-11	32	N- 22 (90.00-91.50) Silty SAND; SM; Gray; Nonplastic fines; Moist to wet; Medium dense; Fine to medium sand; (Sand/Silt Alluvium)	**88.50 - 98.50 Silty SAND; SM; Gray; Nonplastic fines; Moist to wet; Loose to medium dense; Fine to medium sand; (Sand/Silt Alluvium)**		N22: 18% fines.	
95	N23	78	4-2-7	45	N- 23 (95.00-96.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose; Fine to medium sand; (Sand/Silt Alluvium)			N23: 40% fines.	
100	N24	89	1-0-0	48	N- 24 (100.00-101.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Very loose; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**98.50 - 101.50 Sandy SILT; ML; Gray; Nonplastic; Wet; Very loose; Fine sand; Micaceous; (Sand/Silt Alluvium)**		N24: 31% sand, 69% fines.	
	U4	100		37	U- 4 (101.50-103.50) Silty SAND; SM; Gray; Nonplastic fines; Moist; Fine sand; Micaceous; (Sand/Silt Alluvium)	**101.50 - 103.50 Silty SAND; SM; Gray; Nonplastic fines; Moist; Fine sand; Micaceous; (Sand/Silt Alluvium)**		Approximately 250 gallons drilling mud loss between 100-130 feet.	
	U4a				U- 4a (101.50-102.50) Sample split for lab testing.			Dry Density U4a: 78 pcf; 60% sand, 40% fines.	
	U4b			46	U- 4b (102.50-103.50)			Atterberg Limits U4b: LL=NP, PL=NP, PI=NP.	
	N25	100	12-18-22	39	N- 25 (103.50-105.00) Sandy SILT; ML; Gray; Nonplastic; Moist to wet; Dense; Fine to medium sand; Micaceous; Interbedded with SILT with some sand (ML) and Silty SAND (SM); (Sand/Silt Alluvium)	**103.50 - 118.50 Sandy SILT; ML; Gray; Nonplastic to low plasticity; Moist to wet; Medium dense to dense/Stiff; Fine to medium sand; Micaceous; Trace organics; Interbedded with SILT with some sand (ML) and Silty SAND (SM); (Sand/Silt Alluvium)**		Atterberg Limits N25: LL=35, PL=33, PI=2; 54% fines.	
105									
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N26	100	5-1-10	41	N- 26 (110.00-111.50) Sandy SILT; ML; Gray; Nonplastic to low plasticity; Moist to wet; Medium dense/Stiff; Fine to medium sand; Micaceous; Interbedded with 4-inch thick layer Silty SAND (SM); (Sand/Silt Alluvium)			N26: 57% fines.	
115	N27	67	6-7-12	44	N- 27 (115.00-116.50) Sandy SILT; ML; Gray; Nonplastic; Moist to wet; Medium dense; Fine to medium sand; Micaceous; Trace organics; (Sand/Silt Alluvium)			N27: 42% fines.	
						118.50 - 130.75 Silty SAND; SM; Brown to gray; Nonplastic fines; Moist to wet; Medium dense to dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			
120	N28	67	7-9-13	40	N- 28 (120.00-121.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			N28: 28% fines.	
125	N29	78	17-21-19	28	N- 29 (125.00-126.50) Silty SAND; SM; Gray; Nonplastic fines; Moist; Dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			N29: 14% fines.	
								6- to 12-inch thick gravel interbeds from 127 to 135 feet based on drill action.	
130	N30a	44	16-11-9		N- 30a (130.00-130.75) Silty SAND; SM; Brown; Nonplastic fines; Moist; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)				
	N30b			38	N- 30b (130.75-131.50) SILT with some sand; ML; Gray; Nonplastic; Moist; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**130.75 - 148.00 SILT with some sand to Sandy SILT; ML; Gray; Nonplastic to low plasticity; Moist to wet; Medium dense/Stiff to very stiff; Fine to medium sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)**		N30b: 71% fines.	
135	N31	89	7-5-10	47	N- 31 (135.00-136.50) SILT with some sand; ML; Gray; Nonplastic to low plasticity; Moist to wet; Medium dense/Stiff to very stiff; Fine sand; Micaceous; Interbedded with Sandy SILT (ML); (Sand/Silt Alluvium)			N31: 76% fines.	
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	N32	100	5-4-15	40	N- 32 (140.00-141.50) Sandy SILT; ML; Gray; Nonplastic to low plasticity; Moist to wet; Medium dense/Very stiff; Fine to medium sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)			Atterberg Limits N32: LL=38, PL=34, PI=4; 59% fines.	
145	N33	100	1-10-10	43	N- 33 (145.00-146.50) Sandy SILT; ML; Gray; Nonplastic to low plasticity; Moist to wet; Medium dense/Very stiff; Fine to medium sand; Micaceous; Interbedded with 2- to 4-inch thick layers Silty SAND (SM); (Sand/Silt Alluvium)			N33: 62% fines.	
						148.00 - 157.50 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand Micaceous; Slight iron oxide staining; (Gravel Alluvium)		Driller notes very hard drilling at 148 feet.	
150	N34	80	50/1st 5"		N- 34 (150.00-150.40) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)				
155	N35	100	50/1st 5"		N- 35 (155.00-155.40) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Gravel Alluvium)				
						157.50 - 162.50 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Gravel Alluvium)			
160	N36	73	48-50/5"		N- 36 (160.00-160.90) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Gravel Alluvium)				
						162.50 - 167.50 SAND with some silt and trace gravel, with possible cobbles; SP-SM; Brown; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Sand Alluvium)			
165	N37	72	15-16-16		N- 37 (165.00-166.50) SAND with some silt and trace gravel; SP-SM; Brown; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Sand Alluvium)				
						167.50 - 183.00 Sandy silty GRAVEL to Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray		Hard drilling at 167.5 feet.	
170									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
170	N38	100	50/1st 2"		N- 38 (170.00-170.20) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray; Nonplastic fines; Wet; Very dense; Fine to coarse, angular to subrounded gravel; Recovered only basalt fragments from possible cobble; (Gravel Alluvium)	**and brown; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; Micaceous; (Gravel Alluvium)**			
175	N39	80	50/1st 5"		N- 39 (175.00-175.40) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; Micaceous; (Gravel Alluvium)				
180	N40	100	48-50/5"		N- 40 (180.00-180.90) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Slight iron oxide staining; (Gravel Alluvium)				
						183.00 - 195.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; Micaceous; Weak cementation; (Lower Troutdale Formation)			
185	N41	100	39-41-50/4"		N- 41 (185.00-186.40) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray, yellow-brown, orange-brown, and brown; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Slight iron oxide staining; Micas adhered to gravel clasts; Weak cementation; (Lower Troutdale Formation)				
190	N42	100	50/1st 1"		N- 42 (190.00-190.10) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, angular gravel; Sample primarily rock fragments from possible cobble; (Lower Troutdale Formation)			Cobbles at 191 to 192 feet below ground surface. Approximately 30 gallons drilling mud loss. Cobbles at 194 feet. Lost drililng mud circulation. Circulation regained before reaching 195 feet, lost 250 gallons drilling mud.	
195	N43	0	50/1st 0"		N- 43 (195.00-195.00) No Recovery	**195.00 End of hole**			
200									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

		Hole No.	**B-18**
Project **Earthquake Ready Burnside Bridge**	Purpose **Burnside Bridge**	E.A. No.	**N/A**
Highway **Burnside Street**	County **Multnomah**	Key No.	**N/A**
Hole Location Northing: **~ 172,371** Easting: **~ 350,239**		Start Card No.	**N/A**
Equipment **CME-75 Truck Rig #9 (Hammer Efficiency = 87.4%)**	Driller **Western States/Raymond**	Bridge No.	**00511**
Project Geologist **Cody K. Sorensen, CEG**	Recorder **Kyle T. Romney**	Ground Elev.	**~ 34 ft.**
Start Date **August 23, 2021**	End Date **August 26, 2021** Total Depth **185.20 ft**	Tube Height	**N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 3.20 Sandy GRAVEL with some silt; GP-GM; Dark gray-brown; Nonplastic fines; Moist; Medium dense; Fine to coarse, angular to subrounded gravel; Fine to coarse sand; (Fill)**		Borehole advanced using hollow-stem auger drilling technique (8-inch hole) to 25 feet.	
	N1a	100	8-7-6		N- 1a (2.50-3.20) Sandy GRAVEL with some silt; GP-GM; Dark gray-brown; Nonplastic fines; Moist; Medium dense; Fine to coarse, angular to subrounded gravel; Fine to coarse sand; (Fill)				
	N1b				N- 1b (3.20-4.00) Silty CLAY with trace sand; CL; Gray; Low plasticity; Moist; Stiff; Fine sand; Trace organics; (Fill)				
5						**3.20 - 4.50 Silty CLAY with trace sand; CL; Gray; Low plasticity; Moist; Stiff; Fine sand; Trace organics; (Fill)**			
	N2a	100	8-1-1		N- 2a (5.00-5.80) SAND with some silt and gravel; SP-SM; Black; Nonplastic fines; Moist; Very loose; Fine to coarse sand; (Fill)				
	N2b				N- 2b (5.80-6.50) Silty CLAY with trace sand; CL; Blue-green to gray; Low plasticity; Moist; Soft; Fine sand; Few organics; (Fill)				
						4.50 - 5.80 SAND with some silt and gravel; SP-SM; Black; Nonplastic fines; Moist; Very loose; Fine to coarse sand; (Fill)			
	N3a	100	1-0-1		N- 3a (7.50-8.20) Silty SAND; SM; Black; Nonplastic fines; Moist; Very loose; Fine to coarse sand; (Fill)				
	N3b				N- 3b (8.20-9.00) Silty SAND with some organics; SM; Gray; Nonplastic to low plasticity fines; Moist; Very loose; Fine to coarse sand; Numerous organics and wood debris; (Fill)				
10	N4	100	0-0-1	58	N- 4 (10.00-11.50) Silty SAND with some organics; SM; Gray; Nonplastic to low plasticity fines; Moist; Very loose; Fine to coarse sand; Numerous organics and wood debris; (Fill)	**5.80 - 7.00 Silty CLAY with trace sand; CL; Blue-green to gray; Low plasticity; Moist; Soft; Fine sand; Few organics; (Fill)**			
	N5	100	0-1-1	70	N- 5 (12.50-14.00) Silty SAND with some organics; SM; Gray; Nonplastic to low plasticity fines; Moist; Very loose; Fine to coarse sand; Some to numerous organics and wood debris; (Fill)	**7.00 - 8.20 Silty SAND; SM; Black; Nonplastic fines; Moist; Very loose; Fine to coarse sand; (Fill)**			
15	N6	100	1-1-1	73	N- 6 (15.00-16.50) Silty SAND with some organics; SM; Gray; Nonplastic to low plasticity fines; Moist; Very loose; Fine to coarse sand; Some to numerous organics and wood debris; (Fill)	**8.20 - 19.50 Silty SAND with some organics; SM; Gray; Nonplastic to low plasticity fines; Moist; Very loose; Fine too coarse sand; Some to numerous organics and wood debris; (Fill)**		N6: 38% fines.	
	N7	100	1-2-1	55	N- 7 (17.50-19.00) Silty SAND with some organics; SM; Gray; Nonplastic to low plasticity fines; Moist; Very loose; Fine to coarse sand; Some to numerous organics and wood debris; (Fill)				
20						**19.50 - 22.50**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N8	100	2-1-1	45	N- 8 (20.00-21.50) SILT; ML; Light gray; Low plasticity; Moist; Soft; Few organics and wood debris; Wood fragment at 20.8 ft; (Fine-grained Alluvium)	**SILT; ML; Light gray; Low plasticity; Moist; Soft; Few organics and wood debris; Wood fragment at 20.8 ft; (Fine-grained Alluvium)**			
						22.50 - 37.00 Organic CLAY to Organic CLAY with trace sand; OH; Light gray and brown-gray; High plasticity; Moist; Soft; Fine sand; Micaceous; Some to numerous organics and wood debris; (Fine-grained Alluvium)		
25	N9	100	2-2-2	93	N- 9 (25.00-26.50) Organic CLAY with trace sand; OH; Light gray; High plasticity; Moist; Soft; Fine sand; Micaceous; Some organics and wood debris; (Fine-grained Alluvium)			Switched to open-hole mud rotary technique (5-inch hole) at 25 feet. N9: 94% fines.	
	U1	0			U- 1 (28.00-30.00) No Recovery				
30	N10	100	0-2-1	87	N- 10 (30.00-31.50) Organic CLAY; OH; Brown-gray; High plasticity; Moist; Soft; Micaceous; Some organics and wood debris; (Fine-grained Alluvium)			N10: 96% fines.	
35	N11	100	0-0-2	105	N- 11 (35.00-36.50) Organic CLAY; OH; Brown-gray; High plasticity; Moist; Soft; Micaceous; Some organics and wood debris; (Fine-grained Alluvium)			Atterberg Limits N11: LL=120, PL=77, PI=43; 96% fines.	
						37.00 - 40.00 Organic SILT with some sand; OL; Brown-gray; Low plasticity; Moist; Fine sand; Micaceous; Some to numerous organics and wood debris; (Fine-grained Alluvium)			
	U2	100		103	U- 2 (38.00-40.00) Organic SILT with some sand; OL; Brown-gray; Low plasticity; Moist; Fine sand; Micaceous; (Fine-grained Alluvium)			Dry Density U2a: 40 pcf; 2% gravel, 26% sand, 72% fines. Atterberg Limits U2b: LL=45, PL=38, PI=7.	
	U2a								
	U2b			51	U- 2a (38.00-39.00) Sample split for lab testing. U- 2b (39.00-40.00)				
40	N12	100	0-2-3	94	N- 12 (40.00-41.50) Organic CLAY with trace sand; OH; Brown-gray; High plasticity; Moist; Medium stiff; Fine sand; Some to numerous organics; (Fine-grained Alluvium)			Atterberg Limits N12: LL=130, PL=75, PI=55; 89% fines.	
						40.00 - 43.00 Organic CLAY with trace sand; OH; Brown-gray; High plasticity; Moist; Medium stiff; Fine sand; Micaceous; Some to numerous organics and wood debris; (Fine-grained Alluvium)			
45	N13a	100	2-2-2	26	N- 13a (45.00-46.00) Sandy silty CLAY to Sandy silty CLAY with trace gravel; CL; Blue to light gray; Low plasticity; Wet; Soft to medium stiff; Fine, rounded gravel; Fine sand; Trace organics; (Fine-grained Alluvium)			N13a: 55% fines.	
						43.00 - 46.00 Sandy silty CLAY to Sandy silty CLAY with trace gravel; CL; Blue to light gray; Low plasticity; Wet; Soft to medium stiff; Fine rounded gravel; Fine sand; Trace organics; (Fine-grained			
	N13b			110	N- 13b (46.00-46.50) Organic SILT with trace sand; OL; Brown-gray; Low plasticity; Moist; Soft to medium stiff; Fine sand; Micaceous; Numerous organics; (Fine-grained Alluvium)				
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N14	80	3-3-2	33	N- 14 (50.00-51.50) Sandy SILT to Sandy SILT with trace gravel; ML; Blue to light gray; Low plasticity; Wet; Medium stiff; Fine to coarse, rounded gravel; Fine sand; Micaceous; Trace organics; (Sand/Silt Alluvium)	**Alluvium)** **46.00 - 48.00** **Organic SILT with trace sand; OL; Brown-gray; Low plasticity; Moist; Soft to medium stiff; Fine sand; Numerous organics; (Fine-grained Alluvium)**		N14: 67% fines.	
55	N15	100	5-4-5	35	N- 15 (55.00-56.50) Sandy SILT to Sandy SILT with trace gravel; ML; Gray; Low plasticity; Moist; Stiff; Fine to coarse, rounded gravel; Fine sand; Micaceous; Few organics; (Sand/Silt Alluvium)	**48.00 - 58.50** **Sandy SILT to Sandy SILT with trace gravel; ML; Blue gray, light gray, and gray; Low plasticity; Moist to wet; Medium stiff to stiff; Fine to coarse, rounded gravel; Fine sand; Micaceous; Trace to few organics; (Sand/Silt Alluvium)**		Atterberg Limits N15: LL=38, PL=27, PI=11. Drill chatter at 58.5 feet.	
60	N16	33	10-8-8		N- 16 (60.00-61.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown and gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**58.50 - 73.00** **Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown and gray; Nonplastic fines; Wet; Loose to medium dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**			
65	N17	13	6-5-5		N- 17 (65.00-66.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown and gray; Nonplastic fines; Wet; Loose to medium dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Poor recovery; (Gravel Alluvium)				
70	N18	13	7-6-8		N- 18 (70.00-71.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown and gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Poor recovery; (Gravel Alluvium)				
75	N19	33	14-12-20		N- 19 (75.00-76.50) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, and gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**73.00 - 77.00** **Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, and gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)** **77.00 - 79.00** **Sand interbed; inferred from drill action; (Sand**		Driller noted a sand interbed from 77 to 79 feet.	
80									

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80	N20	13	10-24-24		N- 20 (80.00-81.50) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark gray and brown; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Poor recovery; (Gravel Alluvium)	**Alluvium)** **79.00 - 88.00** **Sandy silty GRAVEL, with cobbles and possible boulders; GM; Tan-brown, brown, dark gray, and gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**			
85	N21	20	12-14-23		N- 21 (85.00-86.50) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Tan-brown, brown, and gray; Nonplastic fines; Wet; Dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Poor recovery; (Gravel Alluvium)				
						88.00 - 98.00 **Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray, brown, red-brown, and tan; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Slight iron oxide staining; (Lower Troutdale Formation)**		Harder drilling at 88 feet.	
90	N22	100	50/1st 5"		N- 22 (90.00-90.40) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray, brown, red-brown, and tan; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Slight iron oxide staining; (Lower Troutdale Formation)				
95	N23	67	50/1st 3"		N- 23 (95.00-95.30) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray, brown, red-brown, and tan; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Slight iron oxide staining; (Lower Troutdale Formation)				
						98.00 - 108.00 **Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Red-brown, brown, tan-brown, and gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)**			
100	N24	89	48-50/4"		N- 24 (100.00-100.80) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Red-brown, brown, tan-brown, and gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)				
105	N25	100	50/1st 4"		N- 25 (105.00-105.30) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Red-brown, brown, tan-brown, and gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)				
						108.00 - 123.00 **Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark**			
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N26	100	50/1st 2"		N- 26 (110.00-110.20) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray, green-black, and brown; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**gray, green-black, and brown; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; (Lower Troutdale Formation)**			
115	N27	100	50/1st 1"		N- 27 (115.00-115.10) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray, green-black, and brown; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; (Lower Troutdale Formation)				
120	N28	100	50/1st 1"		N- 28 (120.00-120.10) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray, green-black, and brown; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; (Lower Troutdale Formation)				
125	N29	100	50/1st 5"		N- 29 (125.00-125.40) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, tan-brown, brown, dark gray, and gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	**123.00 - 138.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, tan-brown, brown, dark gray, and gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; Micas and sand adhered to gravel clasts in samples; (Lower Troutdale Formation)**			
130	N30	100	50/1st 2"		N- 30 (130.00-130.20) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, tan-brown, brown, dark gray, and gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)				
135	N31	100	50/1st 1"		N- 31 (135.00-135.10) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, tan-brown, brown, dark gray, and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; (Lower Troutdale Formation)	**138.00 - 153.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM;**			
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	N32	50	50/1st 2"		N- 32 (140.00-140.20) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark gray, gray, and brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	**Dark gray, gray, and brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Occasional zones of weak cementation; Micaceous; (Lower Troutdale Formation)**			
145	N33	100	50/1st 2"		N- 33 (145.00-145.20) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark gray, gray, and brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
150	N34	0	50/1st 2"		N- 34 (150.00-150.20) No Recovery				
						153.00 - 173.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray, green-black, gray, and dark brown; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)			
155	N35	100	50/1st 2"		N- 35 (155.00-155.20) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray, green-black, gray, and dark brown; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
160	N36	0	50/1st 1"		N- 36 (160.00-160.10) No Recovery				
165	N37	0	50/1st 1"		N- 37 (165.00-165.10) No Recovery				
170									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
170	N38	0	50/1st 1"		N- 38 (170.00-170.10) No Recovery				
175	N39	100	50/1st 3"		N- 39 (175.00-175.30) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark green-gray to green-black, and dark gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	**173.00 - 185.20 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark green-gray to green-black and dark gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)**			
180	N40	100	50/1st 1"		N- 40 (180.00-180.10) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark green-gray to green-black, and dark gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)				
185	N41	100	50/1st 2"		N- 41 (185.00-185.20) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Dark green-gray to green-black, and dark gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Weak cementation; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	**185.20 End of hole**			
190									
195									
200									

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

		Hole No.	**B-19**
Project **Earthquake Ready Burnside Bridge**	Purpose **Burnside Bridge**	E.A. No.	**N/A**
Highway **Burnside Street**	County **Multnomah**	Key No.	**N/A**
Hole Location Northing: **~ 172,503**	Easting: **~ 350,466**	Start Card No.	**N/A**
Equipment **CME-75 Truck Rig #9 (Hammer Efficiency = 87.4%)**	Driller **Western States/Raymond**	Bridge No.	**00511**
Project Geologist **Cody K. Sorensen, CEG**	Recorder **David S. Jacobson**	Ground Elev.	**~ 50 ft.**
Start Date **September 7, 2021**	End Date **September 8, 2021** / Total Depth **85.10 ft**	Tube Height	**N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 0.20 Asphalt Concrete; (Fill)**		Borehole vacuum excavated to 8.3 feet due to nearby utilities.	
						0.20 - 0.60 Portland Cement Concrete; (Fill)			
						0.60 - 12.70 Sandy silty GRAVEL; GM; Gray and brown; Nonplastic fines; Moist; Medium dense to very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Trace concrete fragments; 0.6 to 8.5 feet based on observation during vacuum excavation; (Fill)			
5									
10	N1	89	25-36-31		N- 1 (10.00-11.50) Sandy silty GRAVEL; GM; Gray and brown; Nonplastic fines; Moist; Very dense; Fine to coarse, angular to subrounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Trace concrete fragments; (Fill)			Borehole advanced using hollow-stem auger drilling technique (8-inch hole) from 8.3 feet to 25 feet.	
	N2a	100	5-12-16		N- 2a (12.50-12.70) Sandy silty GRAVEL; GM; Gray and brown; Nonplastic fines; Moist; Medium dense; Fine to coarse, angular to subrounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Trace concrete fragments; (Fill)				
	N2b				N- 2b (12.70-14.00) SAND with trace silt; SP; Gray; Nonplastic fines; Moist; Medium dense; Fine to medium sand; Micaceous; (Fill)	**12.70 - 17.00 SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Moist; Medium dense to dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Micaceous; (Fill)**			
15	N3	100	11-16-19		N- 3 (15.00-16.50) SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Moist; Dense; Fine to coarse, subangular to subrounded gravel; Fine to medium sand; Micaceous; (Fill)				
	N4	100	10-15-15		N- 4 (17.50-19.00) SAND with some silt; SP-SM; Gray; Nonplastic fines; Moist; Medium dense to dense; Fine to medium sand; Micaceous; (Fill)	**17.00 - 23.00 SAND with some silt; SP-SM; Gray; Nonplastic fines; Moist; Medium dense to dense; Fine to medium sand;**		Driller notes gravel lens at 18 feet.	
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N5	100	13-19-24	7	N- 5 (20.00-21.50) SAND with some silt; SP-SM; Gray; Nonplastic fines; Moist; Dense; Fine to medium sand; Micaceous; (Fill)	**Micaceous; (Fill)**		N5: 10% fines.	
25	N6	100	13-16-18	16	N- 6 (25.00-26.50) Silty SAND with trace gravel; SM; Gray and brown; Nonplastic fines; Moist; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)	**23.00 - 27.00 Silty SAND with trace gravel; SM; Gray and brown; Nonplastic fines; Moist; Dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)**		Switched to open-hole mud rotary technique (5-inch hole) at 25 feet.	
30	N7	100	49-32-37	13	N- 7 (30.00-31.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Slight iron oxide staining; (Gravel Alluvium)	**27.00 - 38.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Slight iron oxide staining; (Gravel Alluvium)**		Lost drilling mud circulation at 27 feet. Approximately 120 gallons drilling mud loss.	
35	N8	67	25-24-46		N- 8 (35.00-36.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Slight iron oxide staining; (Gravel Alluvium)				
40	N9	100	50/1st 3"		N- 9 (40.00-40.25) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**38.00 - 43.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Moist to wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**			
45	N10	100	50/1st 2"		N- 10 (45.00-45.20) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, gray, and dark brown; Nonplastic to low plasticity fines; Moist to wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	**43.00 - 73.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, gray and dark brown; Nonplastic to low plasticity fines; Moist to wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to**			
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N11	67	50/1st 3"		N- 11 (50.00-50.25) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, gray, and dark brown; Nonplastic to low plasticity fines; Moist to wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Weak cementation; (Lower Troutdale Formation)	**gravel clasts; Zones of weak cementation; (Lower Troutdale Formation)**			
55	N12	50	50/1st 2"		N- 12 (55.00-55.20) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, gray, and dark brown; Nonplastic to low plasticity fines; Moist to wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)				
60	N13	0	50/1st 1"		N- 13 (60.00-60.10) No Recovery				
65	N14	0	50/1st 0"		N- 14 (65.00-65.00) No Recovery				
70	N15	0	50/1st 1"		N- 15 (70.00-70.10) No Recovery				
75	N16	100	50/1st 3"		N- 16 (75.00-75.25) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Yellow-brown, brown, gray, tan, and dark brown; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Micas adhered to gravel clasts; (Lower Troutdale Formation)	**73.00 - 79.67 Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Yellow-brown, brown, gray, tan and dark brown; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Micas adhered to gravel clasts in**			
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N17a	100	19-50/4"	31	N- 17a (80.00-80.70) Silty SAND; SM; Yellow-brown to tan-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; (Lower Troutdale Formation)	**samples; (Lower Troutdale Formation)**		N17a: 25% fines.	
	N17b				N- 17b (80.70-80.80) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, dark brown, and gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**79.67 - 80.70 Silty SAND; SM; Yellow-brown to tan-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; (Lower Troutdale Formation)**			
85	N18	100	50/1st 1"		N- 18 (85.00-85.10) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, dark brown, and gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**80.70 - 85.10 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, dark brown and gray; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
90						**85.10 End of hole**			
95									
100									
105									
110									

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Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-20**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,430**	Easting: **~ 350,598**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #9 (Hammer Efficiency = 87.4%)**		Driller **Western States/Raymond**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **David S. Jacobson**	Ground Elev. **~ 65 ft.**
Start Date **September 9, 2021**	End Date **September 10, 2021**	Total Depth **41.50 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 0.20 Asphalt Concrete; (Fill)**		Vacuum excavated to a depth of 5 feet below ground surface where an old cobblestone road was encountered	
						0.20 - 1.10 Portland Cement Concrete; (Fill)			
						1.10 - 5.00 Silty SAND with gravel; Based on observation during vacuum excavation; (Fill)			
5						**5.00 - 5.50 GRAVEL; Based on observation during vacuum excavation; (Fill)**		Cored through old cobblestone road.	
								Switched to open-hole mud rotary technique (5-inch hole) at 6.5 feet.	
						5.50 - 6.00 Old Cobblestone Road; (Fill)			
						6.00 - 6.50 Portland Cement Concrete; (Fill)			
10	N1	78	2-2-4	41	N- 1 (10.00-11.50) SILT with trace sand; ML; Brown; Low plasticity; Moist; Medium stiff; Fine sand; Micaceous; Catastrophic Flood Deposits - Fine-grained Facies	**6.50 - 13.00 SILT with trace sand; ML; Brown; Low plasticity; Moist; Medium stiff; Fine sand; Micaceous; (Catastrophic Flood Deposits - Fine-Grained Facies)**		Atterberg Limits N1: LL=39, PL=29, PI=10.	
						13.00 - 19.50 Silty SAND; SM; Brown; Nonplastic fines; Moist; Loose; Fine sand; Micaceous; (Catastrophic Flood Deposits - Fine-Grained Facies)			
15	N2	100	4-2-2	39	N- 2 (15.00-16.50) SILT with some sand; ML; Brown; Nonplastic; Moist; Loose; Fine sand; Micaceous; Catastrophic Flood Deposits - Fine-grained Facies			Atterberg Limits N2: LL=NP, PL=NP, PI=NP.	
	U1	75			U- 1 (18.00-19.50) SILT with some sand; ML; Brown; Nonplastic; Moist; Loose; Fine sand; Micaceous; Catastrophic Flood Deposits - Fine-grained Facies				
20	N3	67	16-26-43	11	N- 3 (19.50-21.00) Silty GRAVEL with some sand, with	**19.50 - 25.00**		N3: 14% fines.	

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20					cobbles and possible boulders; GM; Brown and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; Catastrophic Flood Deposits - Channel Facies	**Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Brown and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Slight iron oxide staining; (Catastrophic Flood Deposits - Channel Facies)**			
25	N4	83	10-11-18	23	N- 4 (25.00-26.50) Silty SAND; SM; Brown; Nonplastic fines; Moist; Medium dense; Fine sand; Micaceous; Catastrophic Flood Deposits - Channel Facies	**25.00 - 27.00 Silty SAND; SM; Brown; Nonplastic fines; Moist; Medium dense; Fine to medium sand; Micaceous; (Catastrophic Flood Deposits - Channel Facies)**		N4: 27% fines.	
30	N5	78	14-12-13	19	N- 5 (30.00-31.50) Silty SAND with trace gravel; SM; Gray and brown; Nonplastic fines; Moist; Medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Catastrophic Flood Deposits - Channel Facies	**27.00 - 33.00 Silty SAND with trace gravel; SM; Gray and brown; Nonplastic fines; Moist; Medium dense; Fine to coarse, subrounded gravel; Fine to coarse sand; (Catastrophic Flood Deposits - Channel Facies)**		N5: 14% fines.	
35						**33.00 - 41.50 GRAVEL with some silt with trace sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to rounded gravel; Coarse sand; (Catastrophic Flood Deposits - Channel Facies)**		Driller notes layered sand and gravel	
40	N6	0	9-10-9		N- 6 (40.00-41.50) GRAVEL with some silt with trace sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Wet; Medium dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Catastrophic Flood Deposits - Channel Facies			No recovery with SPT. Sample recovered using 3-inch sampler.	
						41.50 End of hole			
45									
50									

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-21**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,546**	Easting: **~ 348,222**		Start Card No. **N/A**
Equipment **GeoProbe 7822DT #8 (Hammer Efficiency = 85%)**		Driller **Western States**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Christine M. & Shervin J.**	Ground Elev. **~ 31 ft.**
Start Date **November 8, 2021**	End Date **November 10, 2021**	Total Depth **120.10 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

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HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 0.60 Portland Cement Concrete; (Fill)**		Borehole advanced using direct push technique (2.25-inch hole) to 25 feet.	
						0.60 - 0.90 Base Aggregate; (Fill)			
						0.90 - 13.00 SILT with trace sand; ML; Brown; Low plasticity; Moist; Medium stiff; Fine sand; Trace rootlets; (Fill)			
5	N1	100	2-3-4	34	N- 1 (5.00-6.50) SILT with trace sand; ML; Brown; Low plasticity; Moist; Medium stiff; Fine sand; Trace rootlets; (Fill)				
10	N2	100	1-3-2	37	N- 2 (10.00-11.50) SILT with trace sand; ML; Brown; Low plasticity; Moist; Medium stiff; Fine sand; Trace rootlets; (Fill)			Atterberg Limits N2: LL=39, PL=27, PI=12.	
						13.00 - 23.00 SILT with trace sand; ML; Brown; Nonplastic to low plasticity; Moist to wet; Very loose to loose/Soft; Fine sand; Micaceous; Trace rootlets; (Fine-grained Alluvium)			
15	N3	100	2-1-2	39	N- 3 (15.00-16.50) SILT with trace sand; ML; Brown; Low plasticity; Moist; Soft; Fine sand; Trace rootlets; (Fine-grained Alluvium)				
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N4	100	2-1-3	33	N- 4 (20.00-21.50) SILT with some sand; ML; Brown; Nonplastic; Wet; Very loose to loose; Fine sand; Micaceous; (Fine-grained Alluvium)			Atterberg Limits N4: LL=27, PL=27, PI=0.	
25	N5	60	31-28-33		N- 5 (25.00-26.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**23.00 - 28.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic to low plasticity fines; Moist; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Switched to open-hole mud rotary technique (5-inch hole) at 25 feet. Difficult drilling below 25 feet, borehole caving.	
30	N6	40	19-13-20		N- 6 (30.00-31.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Moist; Dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**28.00 - 48.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Moist; Dense to very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Drilling mud loss and borehole caving at 30 feet.	
35	N7	40	27-29-30		N- 7 (35.00-36.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)			Driller added Baroid to the drilling mud at 35 feet to attempt to stabilize borehole.	
40	N8	27	35-21-17		N- 8 (40.00-41.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Moist; Dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)				
45	N9	40	32-14-15		N- 9 (45.00-46.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Moist; Medium dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)				
50						**48.00 - 53.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Orange-brown,**		Driller indicated harder material at 48 feet.	

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N10	53	29-39-50/4"		N- 10 (50.00-51.30) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Orange-brown, red-brown, and brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**red-brown, and brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**			
						53.00 - 63.00 SAND with some silt; SP-SM; Yellow-brown and orange-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; Slight iron oxide staining; (Upper Troutdale Formation)		
55	N11	80	23-27-36	25	N- 11 (55.00-56.50) SAND with some silt; SP-SM; Yellow-brown and orange-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; Slight iron oxide staining; (Upper Troutdale Formation)			N11: 89% sand, 11% fines.	
60	N12	80	21-28-36	22	N- 12 (60.00-61.50) SAND with some silt; SP-SM; Yellow-brown and orange-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; Slight iron oxide staining; (Upper Troutdale Formation)			N12: 9% fines.	
						63.00 - 73.00 SAND with some silt to SAND with some silt and trace gravel; SP-SM; Yellow-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Upper Troutdale Formation)		
65	N13	80	31-28-36	19	N- 13 (65.00-66.50) SAND with some silt and trace gravel; SP-SM; Yellow-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Upper Troutdale Formation)			N13: 10% fines.	
70	N14	67	19-26-33	23	N- 14 (70.00-71.50) SAND with some silt; SP-SM; Yellow-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; (Upper Troutdale Formation)			N14: 90% sand, 10% fines.	
						73.00 - 83.00 SAND with some silt; SP-SM; Red-brown and yellow-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; Slight iron oxide staining; (Upper Troutdale Formation)		
75	N15	80	28-34-45	24	N- 15 (75.00-76.50) SAND with some silt; SP-SM; Red-brown and yellow-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; Slight iron oxide staining; (Upper Troutdale Formation)			N15: 11% fines.	
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N16	73	28-34-50/5"	25	N- 16 (80.00-81.40) SAND with some silt; SP-SM; Red-brown and yellow-brown; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; Slight iron oxide staining; (Upper Troutdale Formation)			N16: 10% fines.	
85	N17	60	20-40-50/1"	22	N- 17 (85.00-86.10) SAND with some silt and trace gravel; SP-SM; Red-brown and yellow-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; Slight iron oxide staining; (Upper Troutdale Formation)	**83.00 - 98.00 SAND with some silt and trace gravel; SP-SM; Red-brown and yellow-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; Slight iron oxide staining; Micas and sand adhered to gravel clasts; (Upper Troutdale Formation)**		N17: 5% gravel, 86% sand, 9% fines. Drill chatter between 86 and 88 feet, gravel inferred.	
90	N18	53	26-50/4"	22	N- 18 (90.00-90.80) SAND with some silt and trace gravel; SP-SM; Red-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Upper Troutdale Formation)			N18: 8% fines.	
95	N19	33	28-50/4"	25	N- 19 (95.00-95.50) SAND with some silt and trace gravel; SP-SM; Red-brown; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; Micas and sand adhered to gravel clasts; (Upper Troutdale Formation)			N19: 11% fines.	
100	N20	7	50/1st 1"		N- 20 (100.00-100.10) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, red-brown, and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Poor recovery; (Lower Troutdale Formation)	**98.00 - 120.10 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, red-brown, and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
105	N21	7	50/1st 1"		N- 21 (105.00-105.10) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, red-brown, and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Poor recovery; (Lower Troutdale Formation)				
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N22	0	50/1st 1"		N- 22 (110.00-110.10) No Recovery				
115									
120	N23	7	50/1st 1"		N- 23 (120.00-120.10) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, red-brown, and gray; Nonplastic fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Poor recovery; (Lower Troutdale Formation)	**120.10 End of hole**			
125									
130									
135									
140									

SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin.
ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-22**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,566**	Easting: **~ 348,513**		Start Card No. **N/A**
Equipment **GeoProbe 8150LS Tracked Sonic Rig**		Driller **Western States**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Kyle R. & Christine M. Maher**	Ground Elev. **~ 33 ft.**
Start Date **November 9, 2021**	End Date **November 11, 2021**	Total Depth **150.00 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil: Driving Resistance / Rock: Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0					SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.	**0.00 - 0.90 Asphalt Concrete; (Fill)**		Borehole vacuum excavated to 10 feet due to nearby utilities.	
						0.90 - 8.50 Sandy GRAVEL with boulders; Based on observations during vacuum excavation; (Fill)			
5									
10	S1	70			S- 1 (10.00-20.00) Silty CLAY; CL; Brown; Medium plasticity; Moist; Micaceous; (Fine-grained Alluvium)	**8.50 - 24.00 Silty CLAY; CL; Brown; Medium plasticity; Moist; Micaceous; (Fine-grained Alluvium)**		Borehole drilled using rotary sonic drilling technique below 10 feet (6-inch hole). Atterberg Limits S1: LL=41, PL=25, PI=16; 98% fines	
15									
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	S2 S2a	100			S- 2 (20.00-30.00) S- 2a (20.00-24.00) Silty CLAY; CL; Brown; Medium plasticity; Moist; Micaceous; (Fine-grained Alluvium)				
	S2b				S- 2b (24.00-30.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**24.00 - 44.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**			
25									
30	S3	100			S- 3 (30.00-50.00)				
	S3a				S- 3a (30.00-44.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)			S3a: 57% gravel, 29% sand, 13% fines.	
35									
40									
	S3b				S- 3b (44.00-50.00) SILT; ML; Gray to brown; Low plasticity; Moist; Slight iron oxide staining; Micaceous; (Fine-grained Alluvium)	**44.00 - 50.00 SILT; ML; Gray to brown; Low plasticity; Moist; Slight iron oxidation; Micaceous; (Fine-grained Alluvium)**		S3b: 1% sand, 99% fines.	
45									
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	S4	100			S- 4 (50.00-70.00) S- 4a (50.00-56.00) Gravelly SAND with some silt; SP-SM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)	**50.00 - 56.00 Gravelly SAND with some silt; SP-SM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)**		S4a: 42% gravel, 52% sand, 6% fines.	
	S4a								
55									
	S4b				S- 4b (56.00-59.00) SAND with trace silt and gravel; SP; Brown; Nonplastic fines; Moist; Fine, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Sand Alluvium)	**56.00 - 59.00 SAND with trace silt and gravel; SP; Brown; Nonplastic fines; Moist; Fine, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Sand Alluvium)**			
	S4c				S- 4c (59.00-63.00) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**59.00 - 63.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**			
60									
	S4d				S- 4d (63.00-67.00) SAND with some silt; SP-SM; Yellow-brown and tan-brown; Nonplastic fines; Moist; Fine to medium sand; Micaceous; (Upper Troutdale Formation)	**63.00 - 70.00 SAND with some silt to SAND with some silt and gravel; SP-SM; Yellow-brown and tan-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Upper Troutdale Formation)**		S4d: 95% sand, 5% fines.	
65									
	S4e				S- 4e (67.00-70.00) SAND with some silt and gravel; SP-SM; Yellow-brown and tan-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Upper Troutdale Formation)				
70	S5	100			S- 5 (70.00-90.00) (Lower Troutdale Formation)				
	S5a				S- 5a (70.00-78.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Sand and micas adhered to gravel clasts; (Lower Troutdale Formation)	**70.00 - 78.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Sand and micas adhered to gravel clasts; (Lower Troutdale Formation)**			
75									
	S5b				S- 5b (78.00-90.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Yellow-brown and gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**78.00 - 92.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM;**			
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80						**Yellow-brown and gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
85									
90	S6	100			S- 6 (90.00-100.00)				
	S6a				S- 6a (90.00-92.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Yellow-brown and gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)			S6a: 60% gravel, 26% sand, 14% fines.	
	S6b				S- 6b (92.00-94.00) Clayey SILT; MH; Gray; Medium plasticity; Moist; Micaceous; (Lower Troutdale Formation)	**92.00 - 94.00 Clayey SILT; MH; Gray; Medium plasticity; Moist; Micaceous; (Lower Troutdale Formation)**		Atterberg Limits S6b: LL=66, PL=39, PI=27; 96% fines.	
	S6c				S- 6c (94.00-100.00) Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Brown and gray; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**94.00 - 108.00 Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Brown and gray; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
95									
100	S7	100			S- 7 (100.00-104.00) Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Brown and gray; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)			S7: 65% gravel, 22% sand, 13% fines.	
	S8	100			S- 8 (104.00-110.00)				
	S8a				S- 8a (104.00-108.00) Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Brown and gray; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
105									
	S8b				S- 8b (108.00-110.00) Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Brown and gray; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Weak cementation; (Lower Troutdale Formation)	**108.00 - 116.00 Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Brown**			
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	S9	100			S- 9 (110.00-120.00) S- 9a (110.00-116.00) Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Brown and gray; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Weak cementation; (Lower Troutdale Formation)	**and gray; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Weak cementation; (Lower Troutdale Formation)**			
	S9a								
115									
	S9b				S- 9b (116.00-120.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray to dark green-black; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining of gravel clasts; (Lower Troutdale Formation)	**116.00 - 130.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray to dark green-black; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining of gravel clasts; (Lower Troutdale Formation)**		S9b: 61% gravel, 27% sand, 12% fines.	
120	S10	100			S- 10 (120.00-130.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray to dark green-black; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining of gravel clasts; (Lower Troutdale Formation)				
125									
130	S11	100			S- 11 (130.00-140.00) S- 11a (130.00-138.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**130.00 - 150.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**		S11a: 75% gravel, 20% sand, 5% fines.	
	S11a								
135									
	S11b				S- 11b (138.00-140.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	S12	100			S- 12 (140.00-150.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic to low plasticity fines; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)			Driller added water to core barrel to release sample S12 from the core barrel.	
145									
150						**150.00 End of hole**			
155									
160									
165									
170									

SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin.
ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.



10 – 15 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

SONIC CORE PHOTOS
BORING B-22

January 2022 102636-009

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15 – 20 FEET

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20 – 25 FEET

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25 – 30 FEET

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30 – 35.5 FEET

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35.5 – 40 FEET

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40 – 46 FEET

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46 – 50 FEET

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BORING B-22

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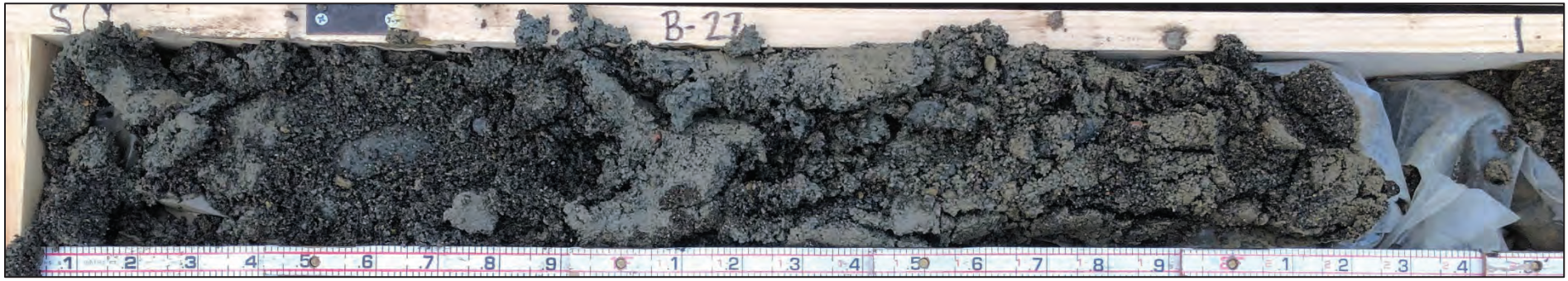



50 – 56 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

SONIC CORE PHOTOS
BORING B-22

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56 – 60 FEET

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60 – 65 FEET

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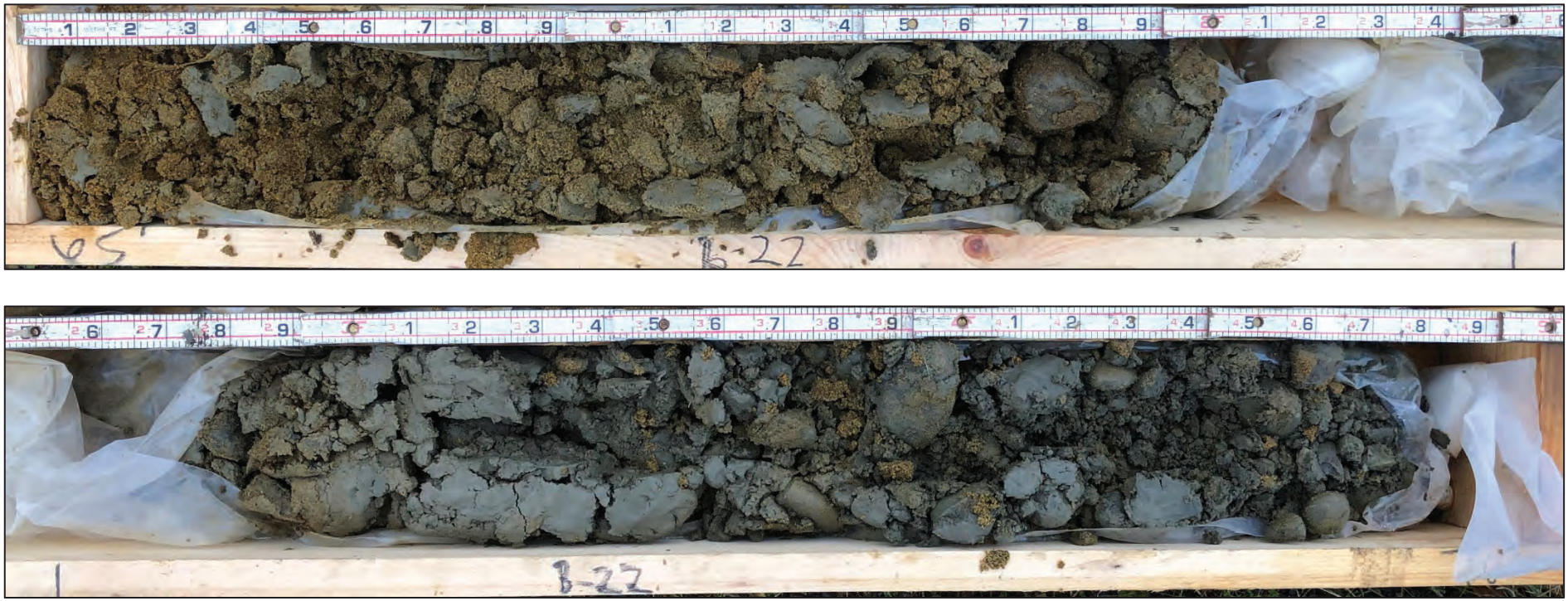

65 – 70 FEET

Earthquake Ready Burnside Bridge
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SONIC CORE PHOTOS
BORING B-22

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70 – 75 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

SONIC CORE PHOTOS
BORING B-22

January 2022 102636-009

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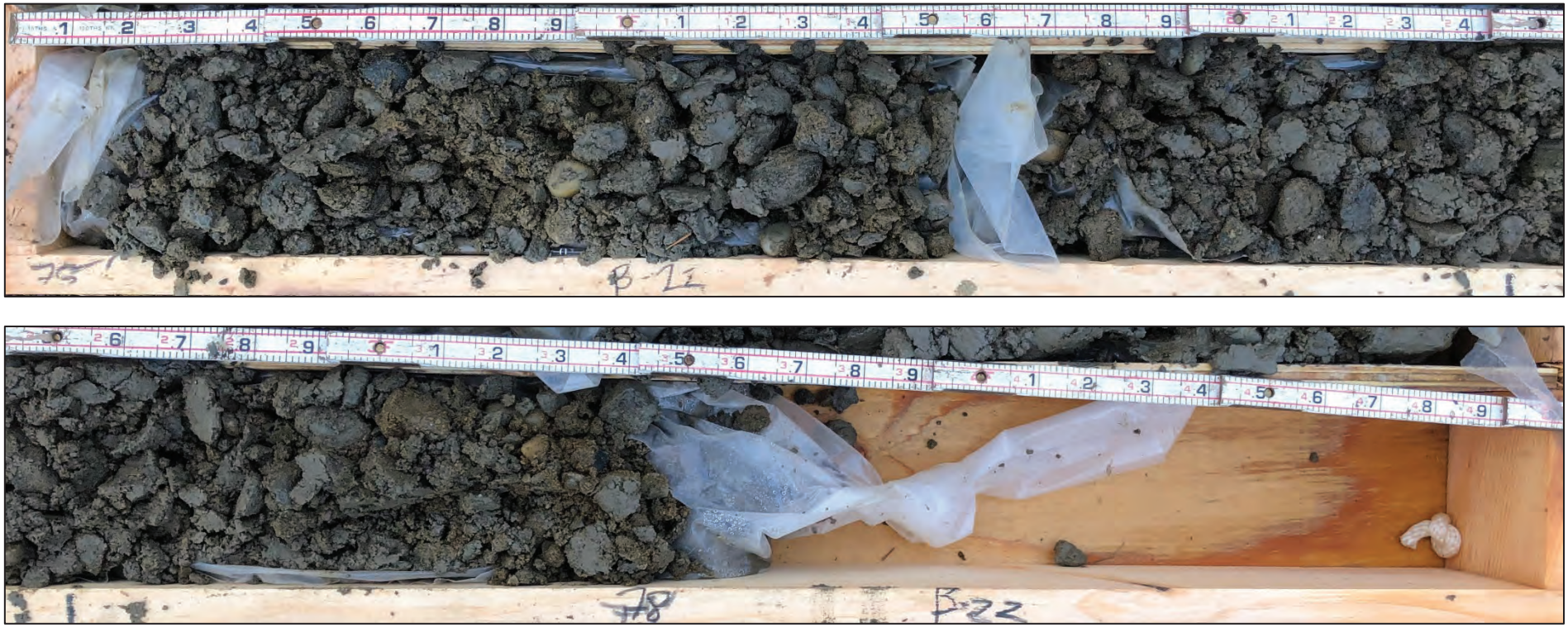

75 – 78 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

SONIC CORE PHOTOS
BORING B-22

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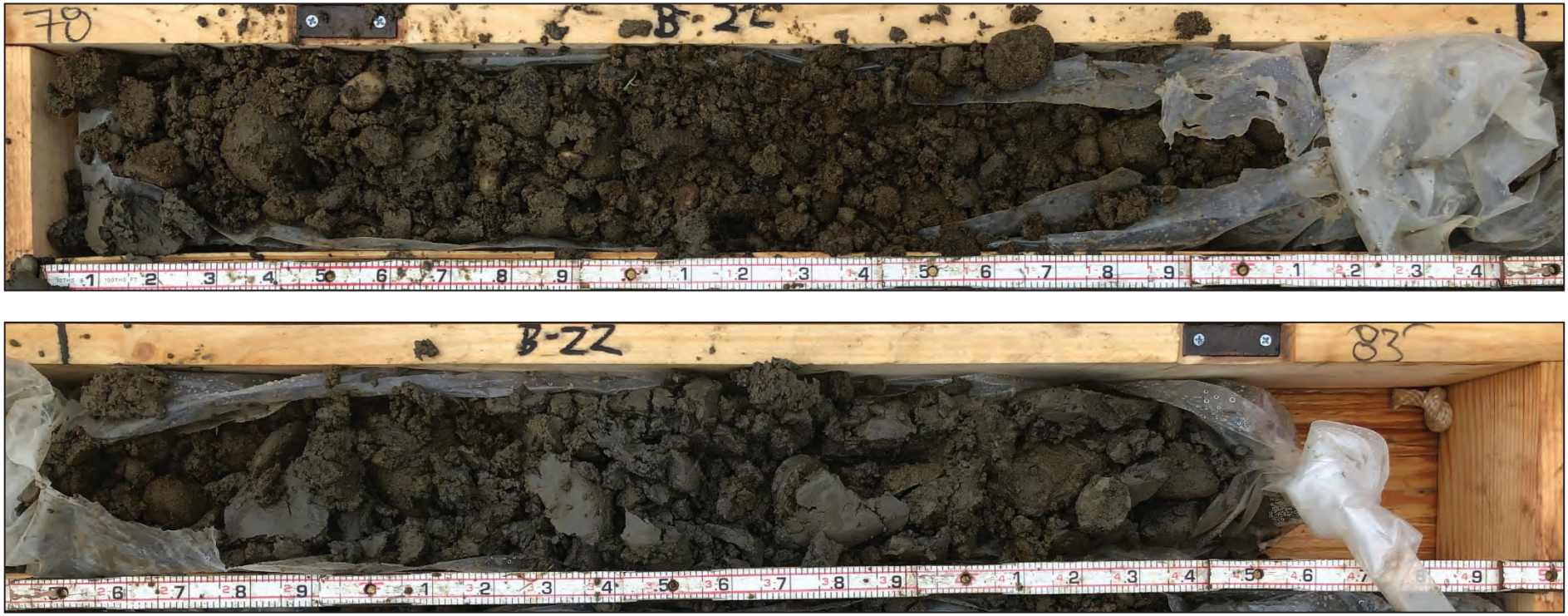

78 – 83 FEET

Earthquake Ready Burnside Bridge
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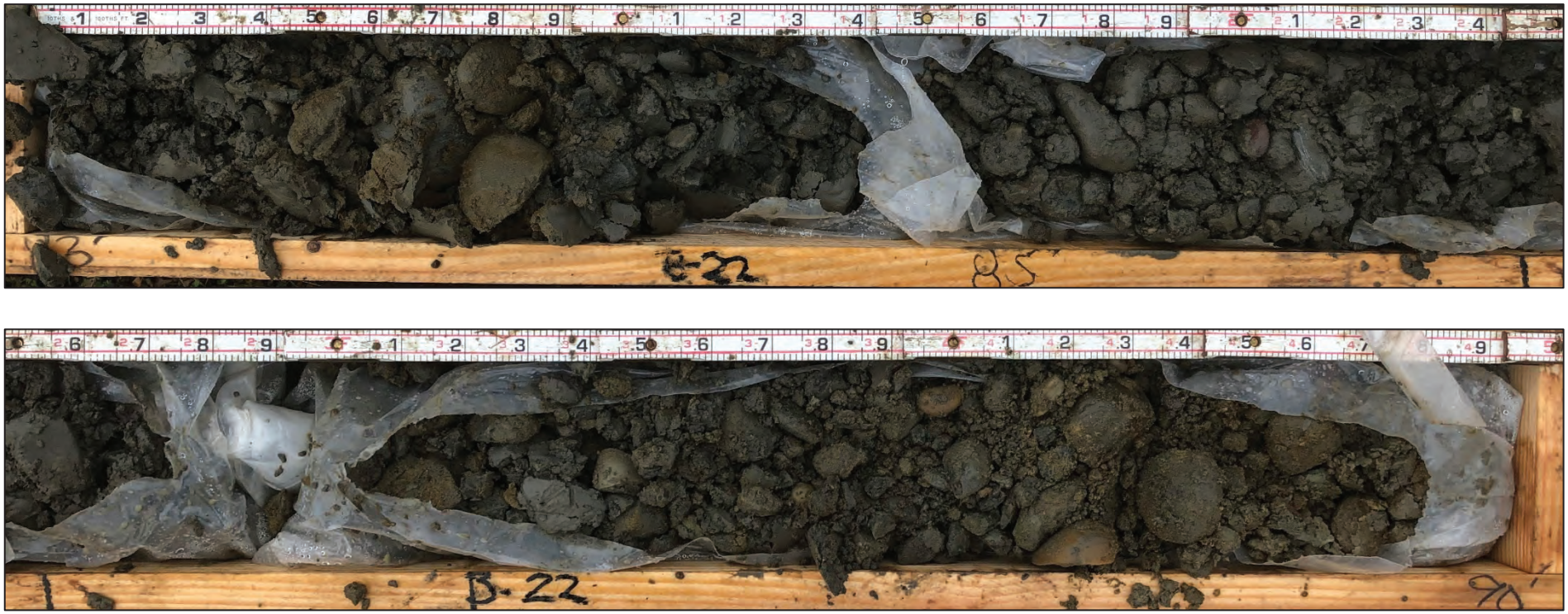

83 – 90 FEET

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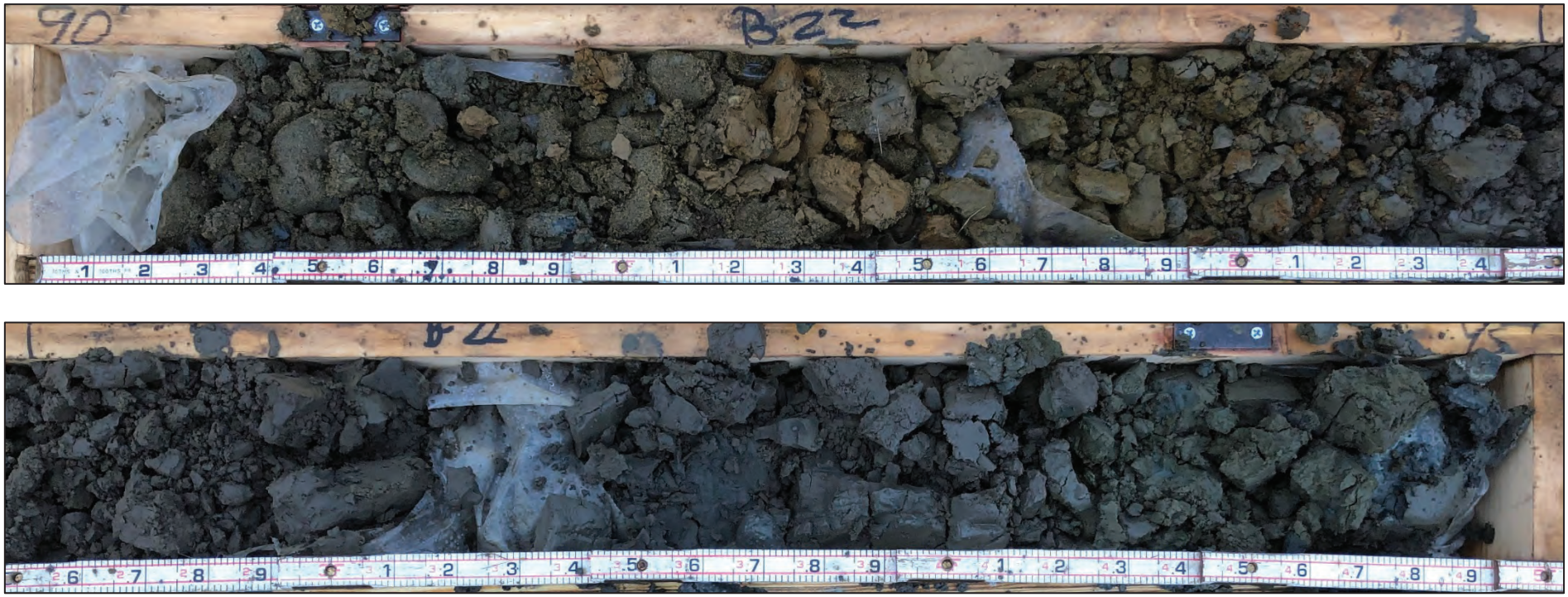

90 – 95 FEET

Earthquake Ready Burnside Bridge
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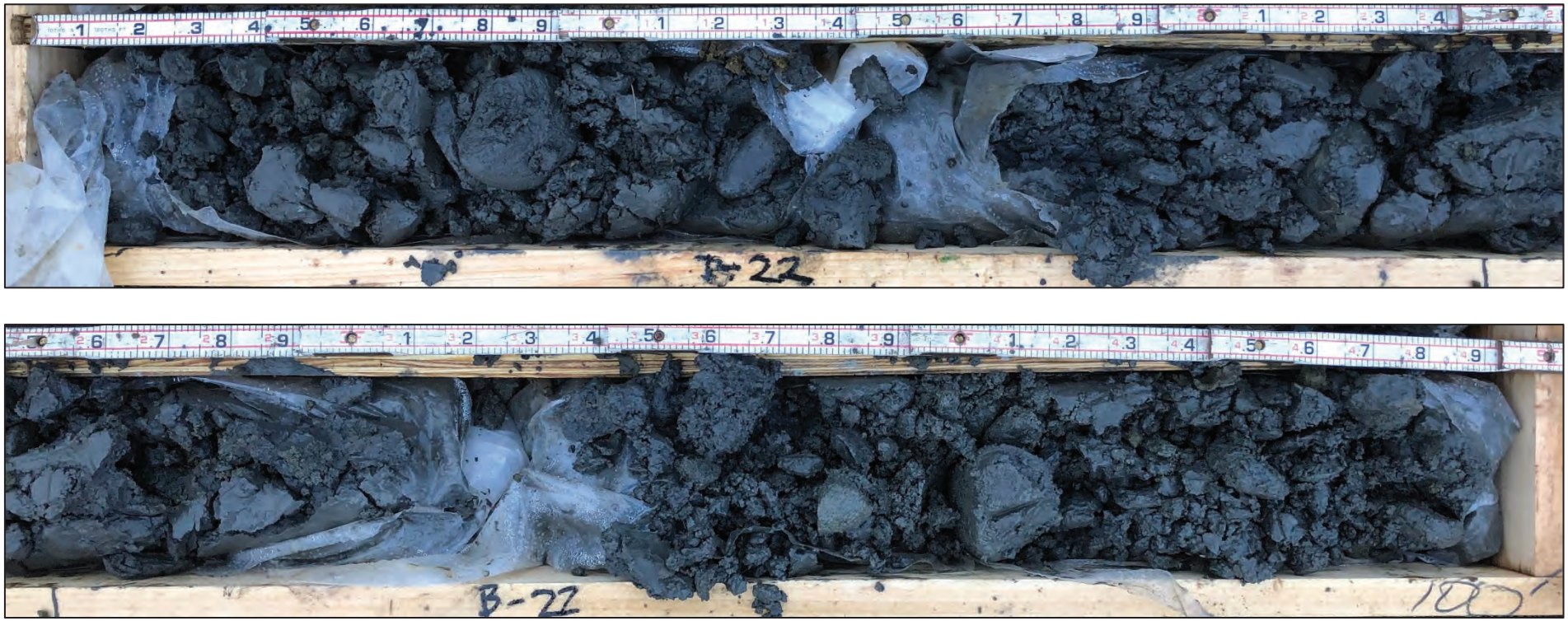

95 – 100 FEET

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100 – 104 FEET

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104 – 108 FEET

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108 – 112 FEET

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112 – 116 FEET

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116 – 120 FEET

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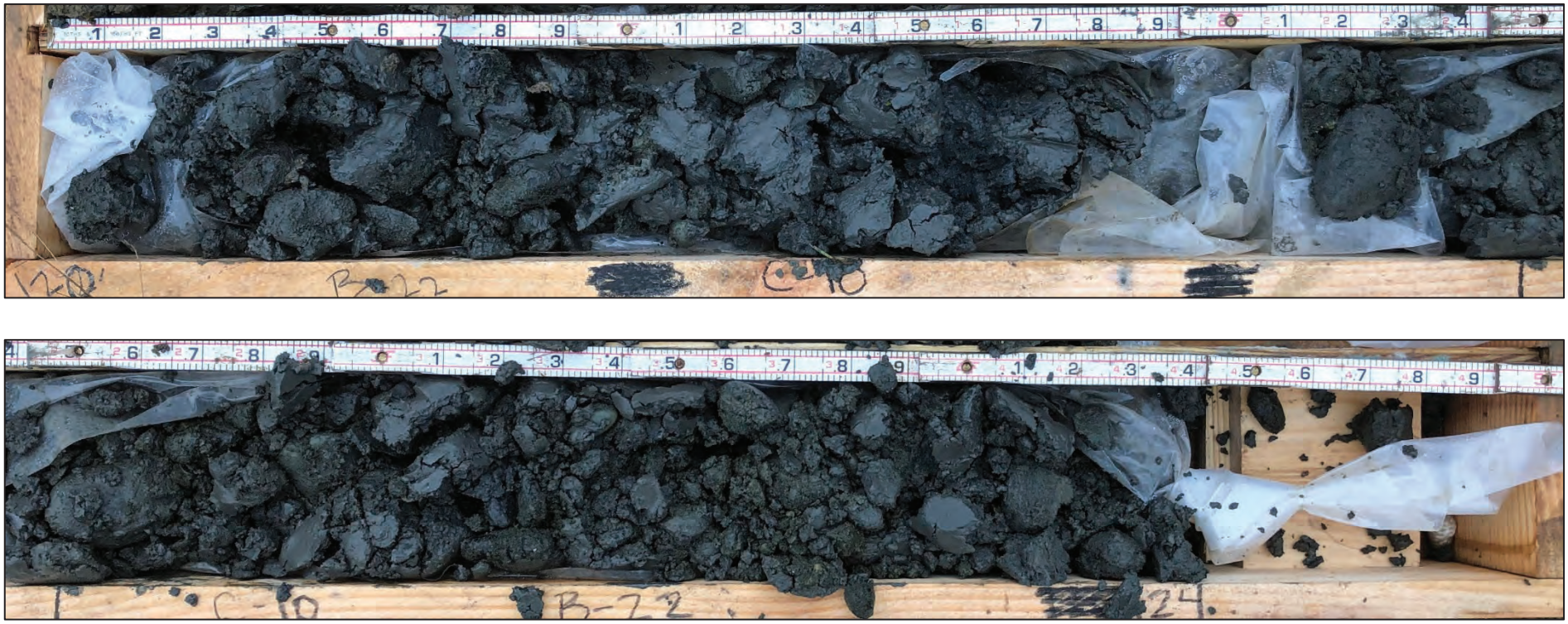

120 – 124 FEET

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124 – 128 FEET

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128 – 130 FEET

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130 – 134.3 FEET

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134.3 – 138 FEET

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138 – 140 FEET

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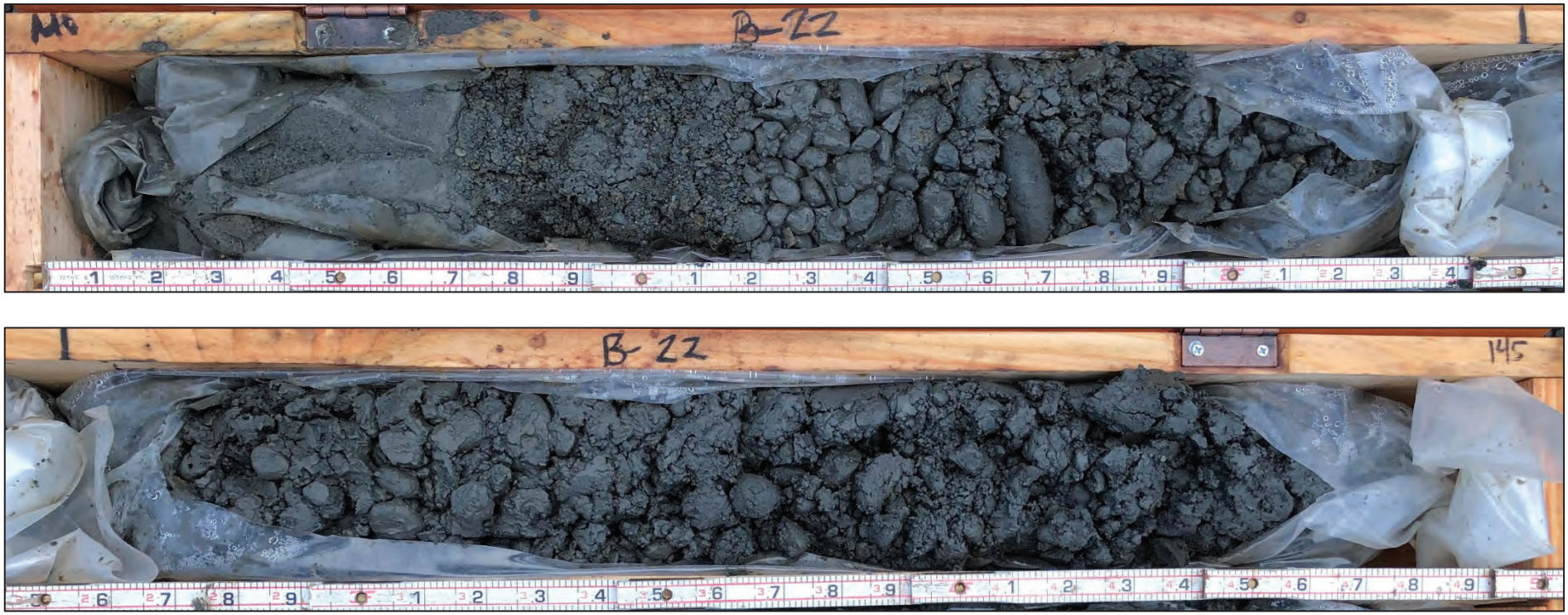

140 – 145 FEET

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145 – 150 FEET

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-23**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,467**	Easting: **~ 348,580**		Start Card No. **N/A**
Equipment **GeoProbe 8150LS Tracked Sonic Rig**		Driller **Western States/Adonis**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Kevin J. Cowell & Kyle T. Romney**	Ground Elev. **~ 34 ft.**
Start Date **November 2, 2021**	End Date **November 5, 2021**	Total Depth **140.00 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil Driving Resistance / Rock Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 0.50 Asphalt Concrete; (Fill)**		Borehole vacuum excavated to 6 feet due to nearby utilities.	
						0.50 - 6.00 Sandy GRAVEL, with cobbles; GP; Brown to gray; Based on observations during vacuum excavation.; (Fill)			
5									
	S1	29			S- 1 (6.00-20.00) Poor recovery S- 1a (6.00-8.00) Silty GRAVEL with some sand, with possible cobbles; GM; Brown; Low plasticity fines; Moist; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Fill)	**6.00 - 8.00 Silty GRAVEL with some sand, with possible cobbles; GM; Brown; Low plasticity fines; Moist; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Fill)**		Borehole drilled using rotary sonic drilling technique below 6 feet (6-inch hole). S1a: 37% gravel, 22% sand, 41% fines.	
	S1a								
	S1b				S- 1b (8.00-10.00) SILT with some sand; ML; Gray; Nonplastic to low plasticity; Moist; Fine sand; Micaceous; (Fill)				
10								Poor recovery of sample S1, cobble may have blocked bit.	
						8.00 - 20.00 SILT with some sand; ML; Gray; Nonplastic to low plasticity; Moist; Fine sand; Micaceous; (Fill)			
15									
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	S2	100			S- 2 (20.00-30.00) S- 2a (20.00-25.00) Sandy SILT; ML; Brown; Nonplastic to low plasticity; Wet; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**20.00 - 25.00 Sandy SILT; ML; Brown; Nonplastic to low plasticity; Wet; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)**			
	S2a								
25	S2b				S- 2b (25.00-28.00) Silty SAND with trace gravel; SM; Brown; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**25.00 - 28.00 Silty SAND with trace gravel; SM; Brown; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)**			
	S2c				S- 2c (28.00-30.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Brown; Nonplastic fines; Moist; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)	**28.00 - 30.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Brown; Nonplastic fines; Moist; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**		S2c: 52% gravel, 30% sand, 18% fines.	
30	S3	100			S- 3 (30.00-50.00) S- 3a (30.00-31.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Moist; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**30.00 - 45.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**			
	S3a								
	S3b				S- 3b (31.00-32.50) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)				
	S3c				S- 3c (32.50-45.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)			S3c: 75% gravel, 20% sand, 5% fines.	
35									
40								Borehole sloughing and caving at 40 feet.	
45	S3d				S- 3d (45.00-50.00) Silty CLAY; CL; Brown; Medium plasticity; Moist; Slight iron oxide staining; Micaceous; (Fine-grained Alluvium)	**45.00 - 50.00 Silty CLAY; CL; Brown; Medium plasticity; Moist; Slight iron oxide staining; Micaceous; (Fine-grained Alluvium)**		Atterberg Limits S3d: LL=49, PL=27, PI=22.	
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	S4	100			S- 4 (50.00-60.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**50.00 - 63.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**		S4: 68% gravel, 24% sand, 8% fines.	
55									
60	S5	100			S- 5 (60.00-77.00)				
	S5a				S- 5a (60.00-63.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)				
	S5b				S- 5b (63.00-77.00) SAND with some silt; SP-SM; Yellow-brown to tan-brown; Nonplastic fines; Moist; Fine to medium sand; Micaceous; (Upper Troutdale Formation)	**63.00 - 77.00 SAND with some silt; SP-SM; Yellow-brown to tan-brown; Nonplastic fines; Moist; Fine to medium sand; Micaceous; (Upper Troutdale Formation)**		S5b: 89% sand, 11% fines.	
65									
70									
75									
	S6	100			S- 6 (77.00-90.10)				
	S6a				S- 6a (77.00-82.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown and gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**77.00 - 82.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown and gray; Nonplastic fines;**			
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80						**Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
	S6b				S- 6b (82.00-86.50) Gravelly SAND with some silt; SP-SM; Brown to gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Lower Troutdale Formation)	**82.00 - 86.50 Gravelly SAND with some silt; SP-SM; Brown to gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**		S6b: 45% gravel, 48% sand, 7% fines.	
85									
	S6d				S- 6d (86.50-88.50) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**86.50 - 88.50 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
	S6e				S- 6e (88.50-90.10) Gravelly silty SAND; SM; Brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Lower Troutdale Formation)	**88.50 - 90.10 Gravelly silty SAND; SM; Brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Lower Troutdale Formation)**			
90	S7	100			S- 7 (90.10-100.00)				
	S7a				S- 7a (90.10-92.00) SILT with trace sand; ML; Gray; Low plasticity; Moist; Fine sand; Micaceous; (Lower Troutdale Formation)	**90.10 - 94.00 SILT with trace sand; ML; Low plasticity; Moist; Fine sand; Micaceous; (Lower Troutdale Formation)**		S7a: 7% sand, 93% fines.	
	S7b				S- 7b (92.00-94.00) SILT with trace sand; ML; Brown; Low plasticity; Moist; Fine sand; Micaceous; (Lower Troutdale Formation)	**94.00 - 102.50 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
	S7c				S- 7c (94.00-100.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)			S7c: 57% gravel, 24% sand, 19% fines.	
95									
100	S8	100			S- 8 (100.00-117.00)				
	S8a				S- 8a (100.00-102.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
	S8b				S- 8b (102.50-105.00) Silty SAND with some gravel; SM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Lower Troutdale Formation)	**102.50 - 105.00 Silty SAND with some gravel; SM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Lower Troutdale Formation)**			
105	S8c				S- 8c (105.00-117.00) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**105.00 - 127.50 Sandy GRAVEL with some silt, with cobbles and possible**			
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110						**boulders; GP-GM; Gray; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
115									
	S9	100			S- 9 (117.00-130.00)				
	S9a				S- 9a (117.00-125.00) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)			S9a: 64% gravel, 31% sand, 5% fines.	
120									
125	S9c				S- 9c (125.00-127.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
	S9d				S- 9d (127.50-130.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**127.50 - 140.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
130	S10	100			S- 10 (130.00-140.00)				
	S10a				S- 10a (130.00-140.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
135									
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140						**140.00** **End of hole**			
145									
150									
155									
160									
165									
170									



6 – 10 FEET

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20 – 25 FEET

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25 – 30 FEET

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30 – 35 FEET

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35 – 39 FEET

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39 – 44 FEET

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44 – 47 FEET

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47 – 50 FEET

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50 – 53.5 FEET

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53.5 – 57.5 FEET

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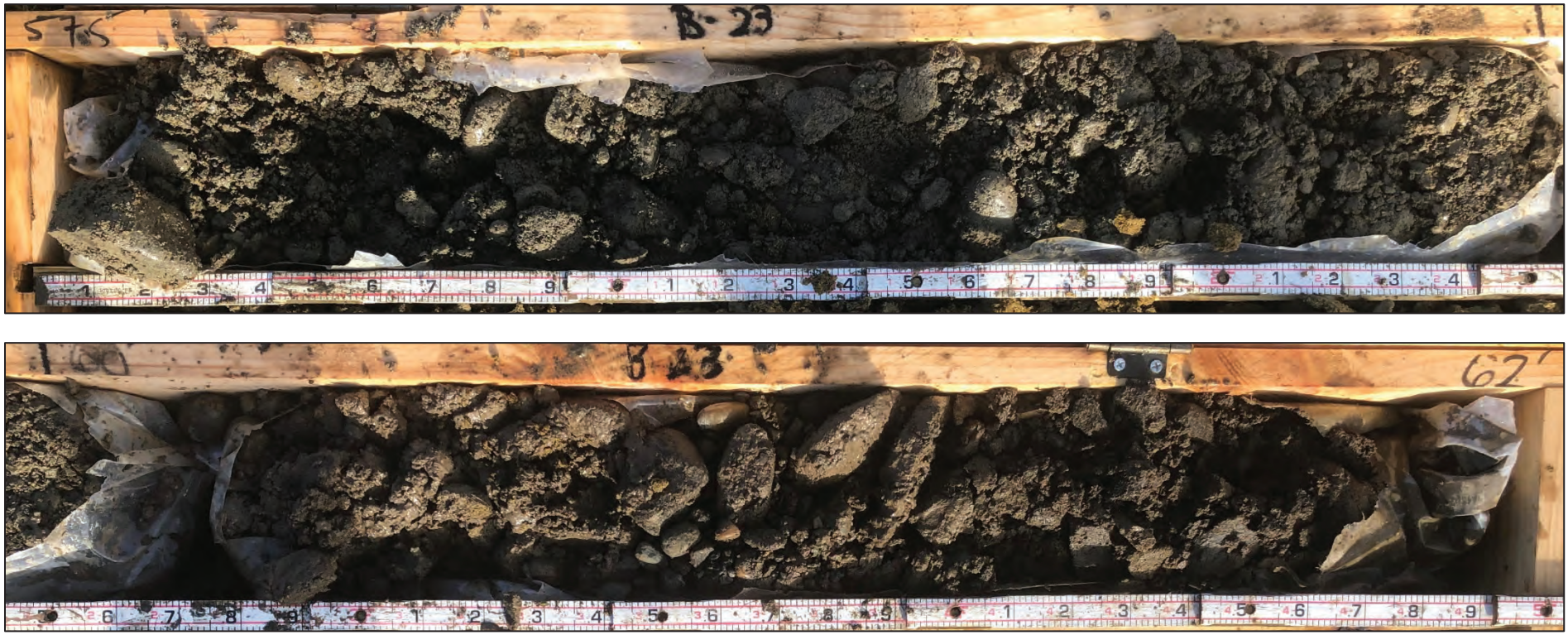

57.5 – 62 FEET

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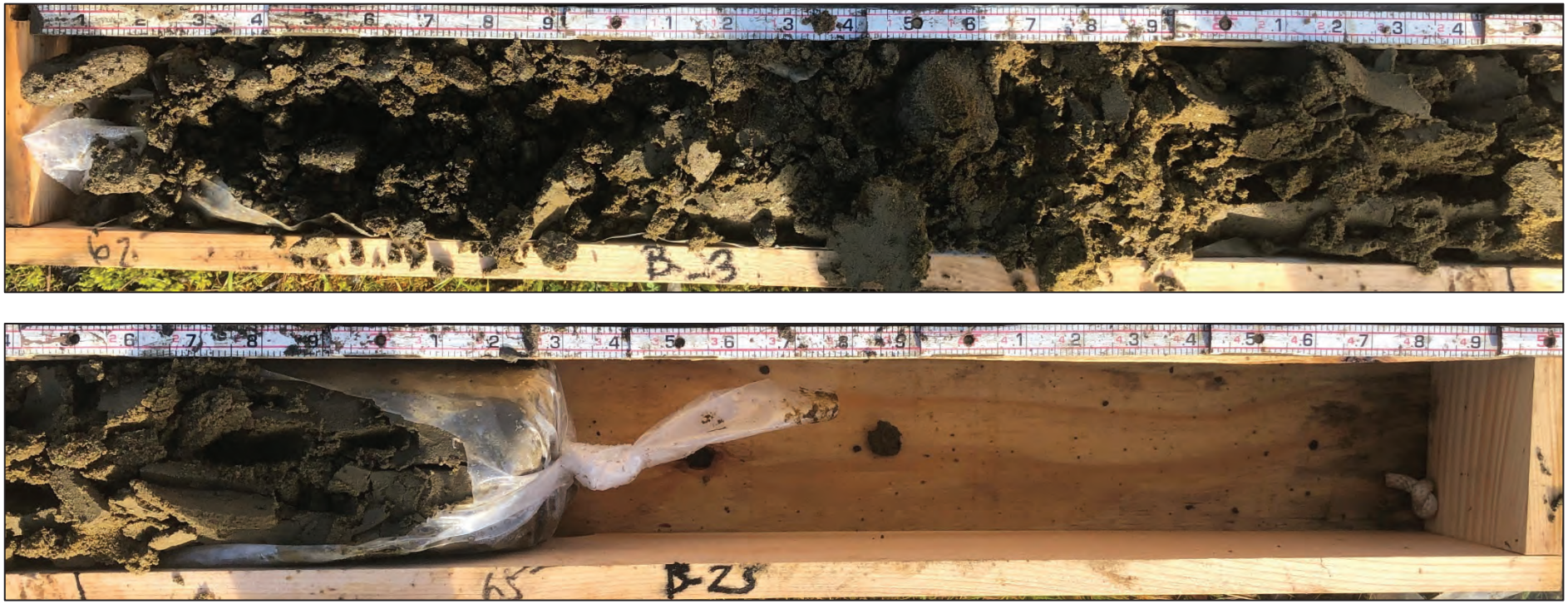

62 – 65 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

SONIC CORE PHOTOS
BORING B-23

January 2022 102636-009

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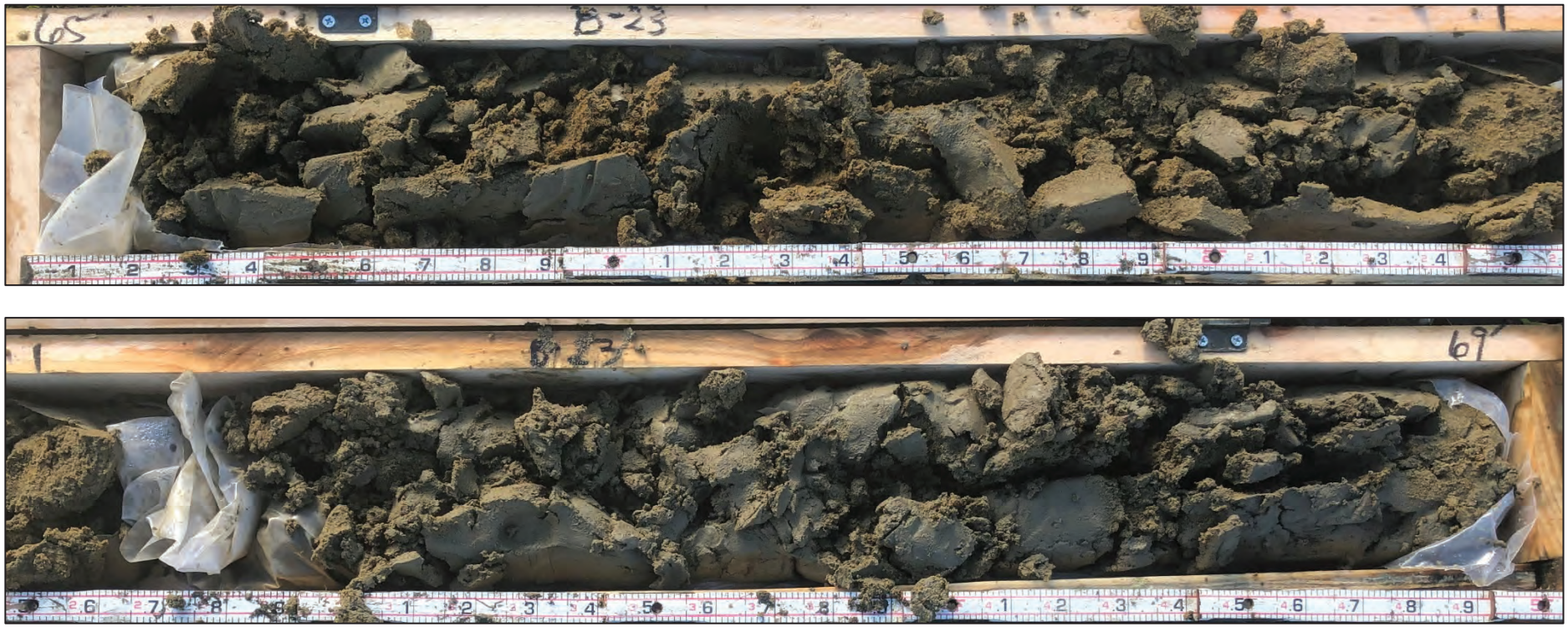

65 – 69 FEET

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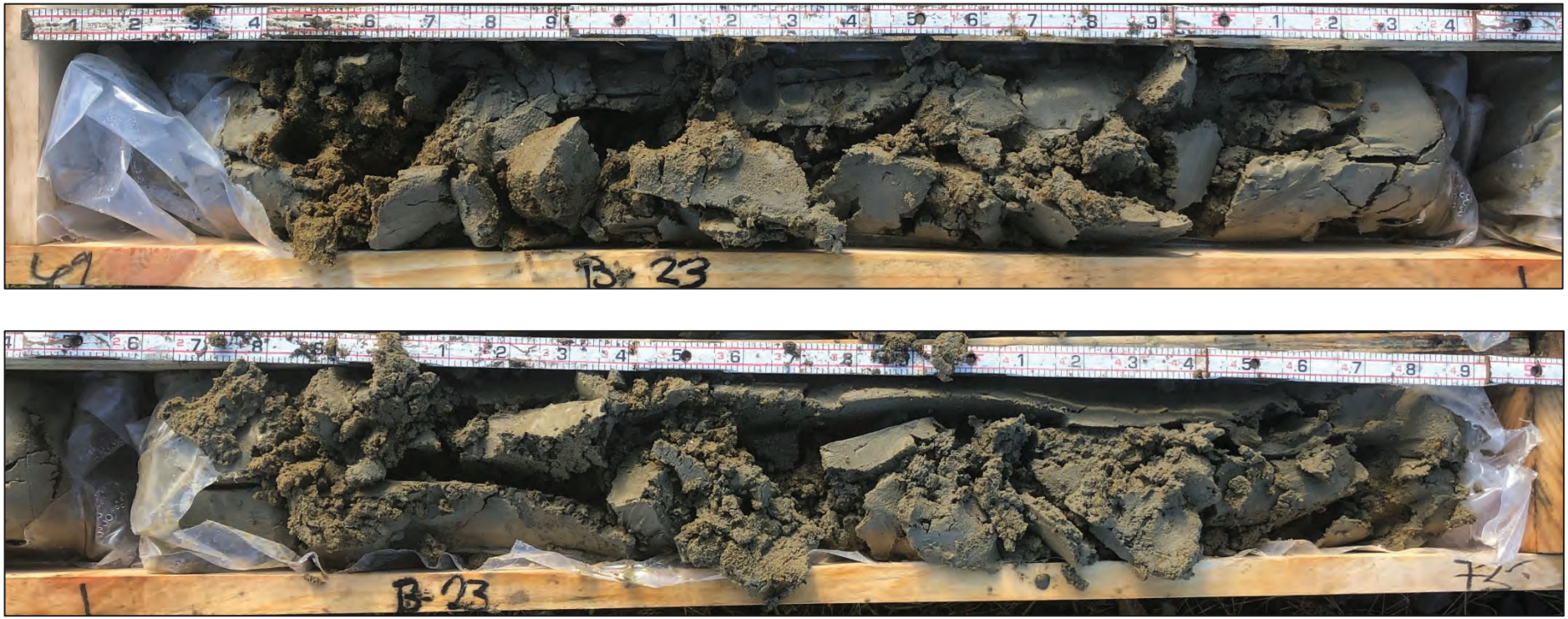

69 – 73 FEET

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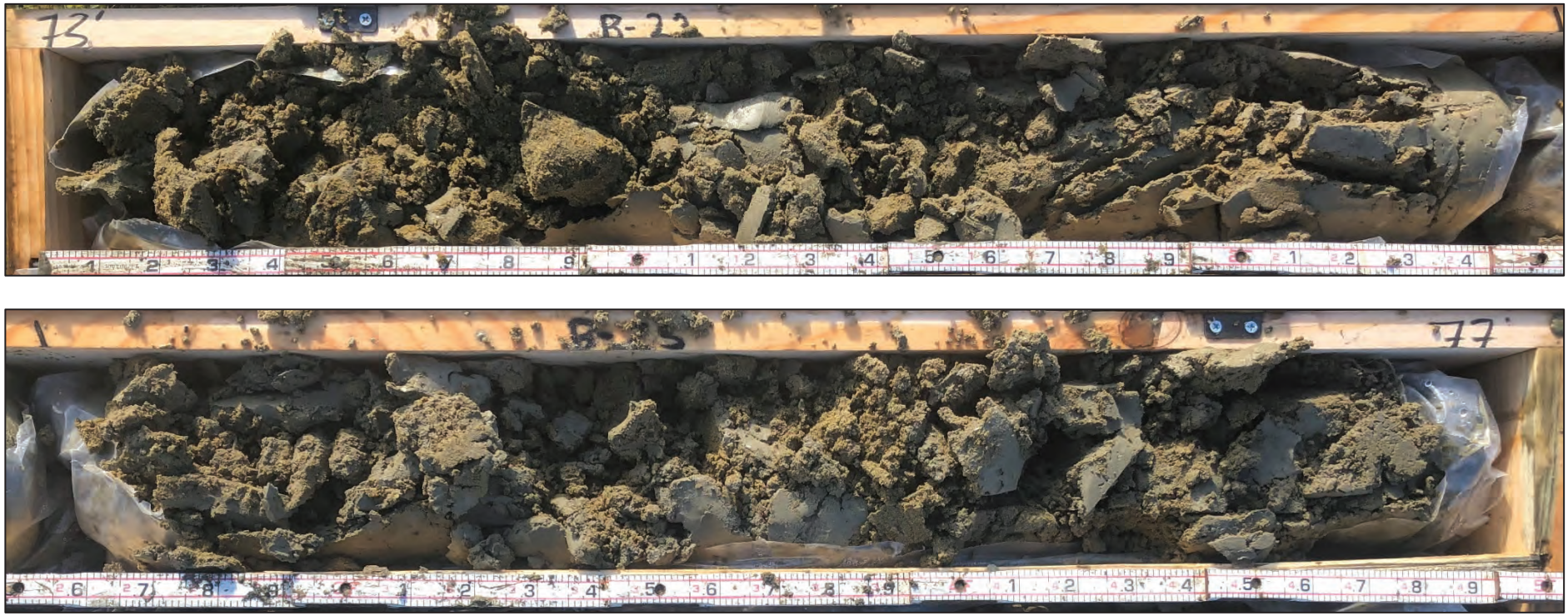

73 – 77 FEET

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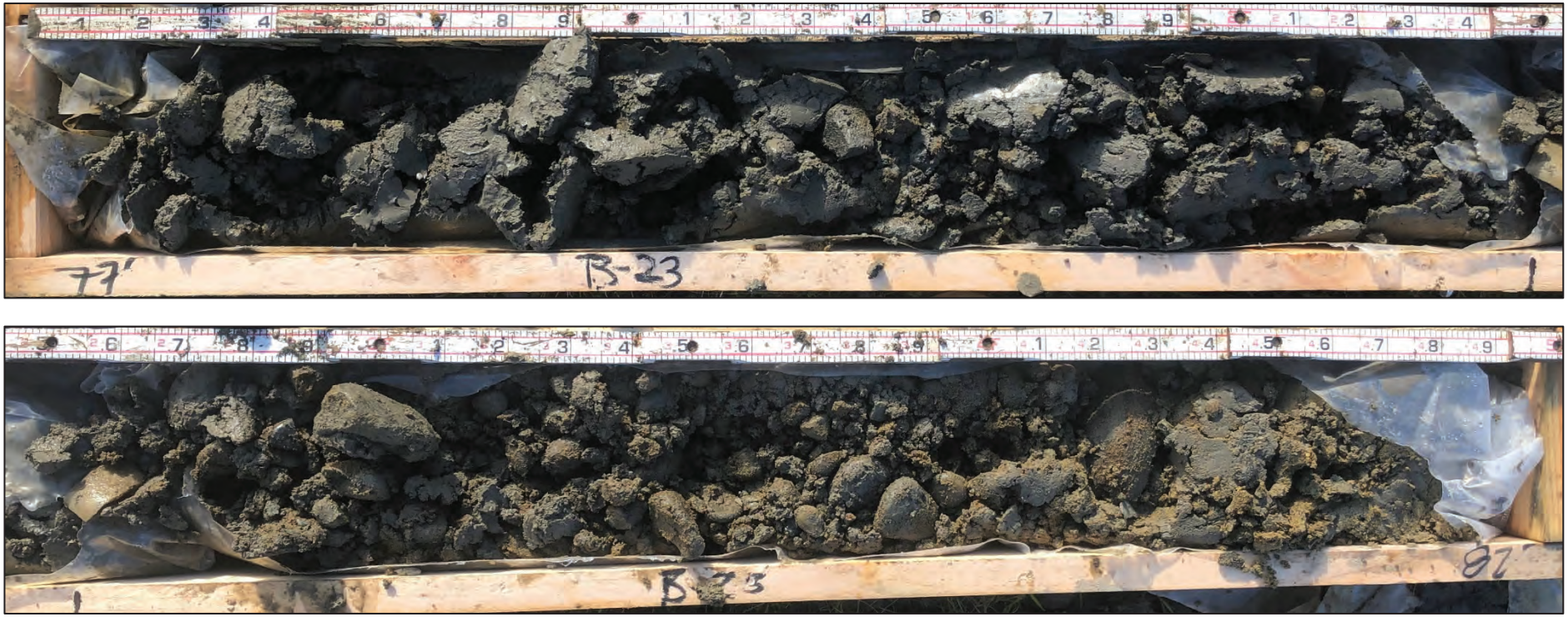

77 – 82 FEET

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82 – 86.5 FEET

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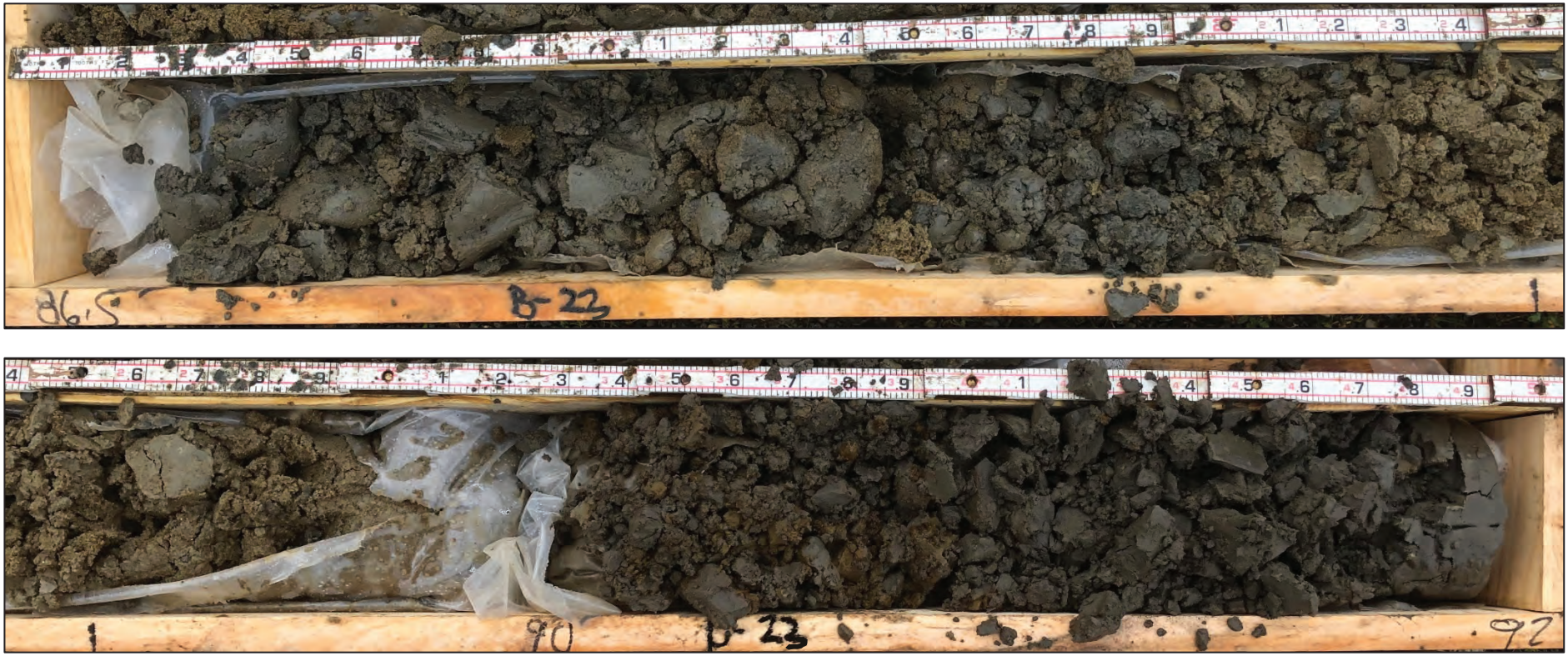

86.5 – 92 FEET

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92 – 96 FEET

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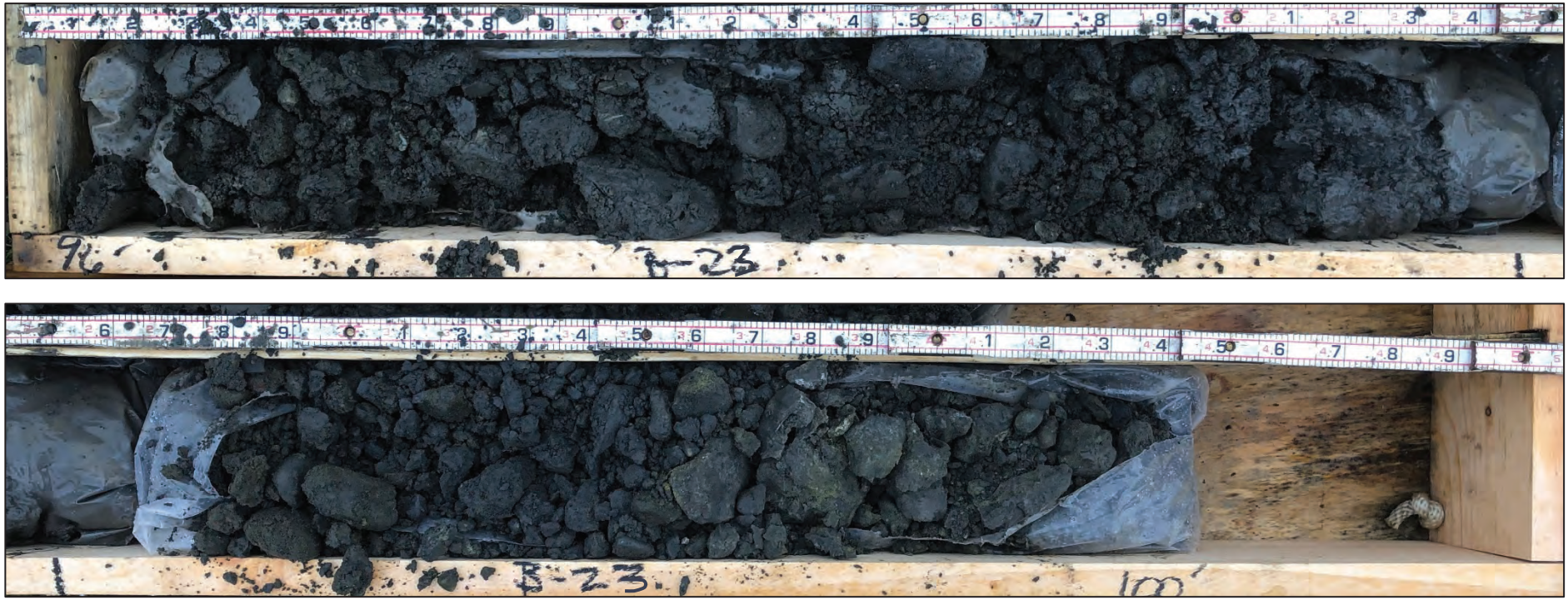

96 – 100 FEET

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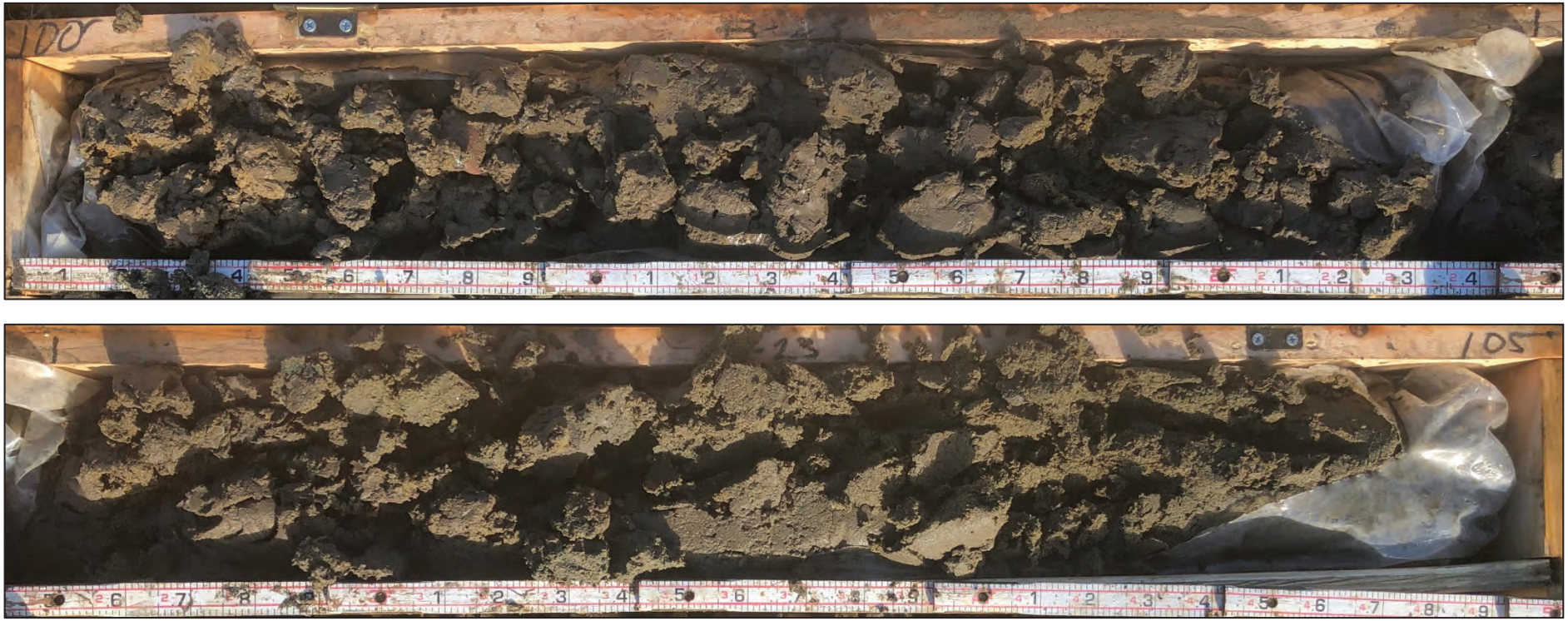

100 – 105 FEET

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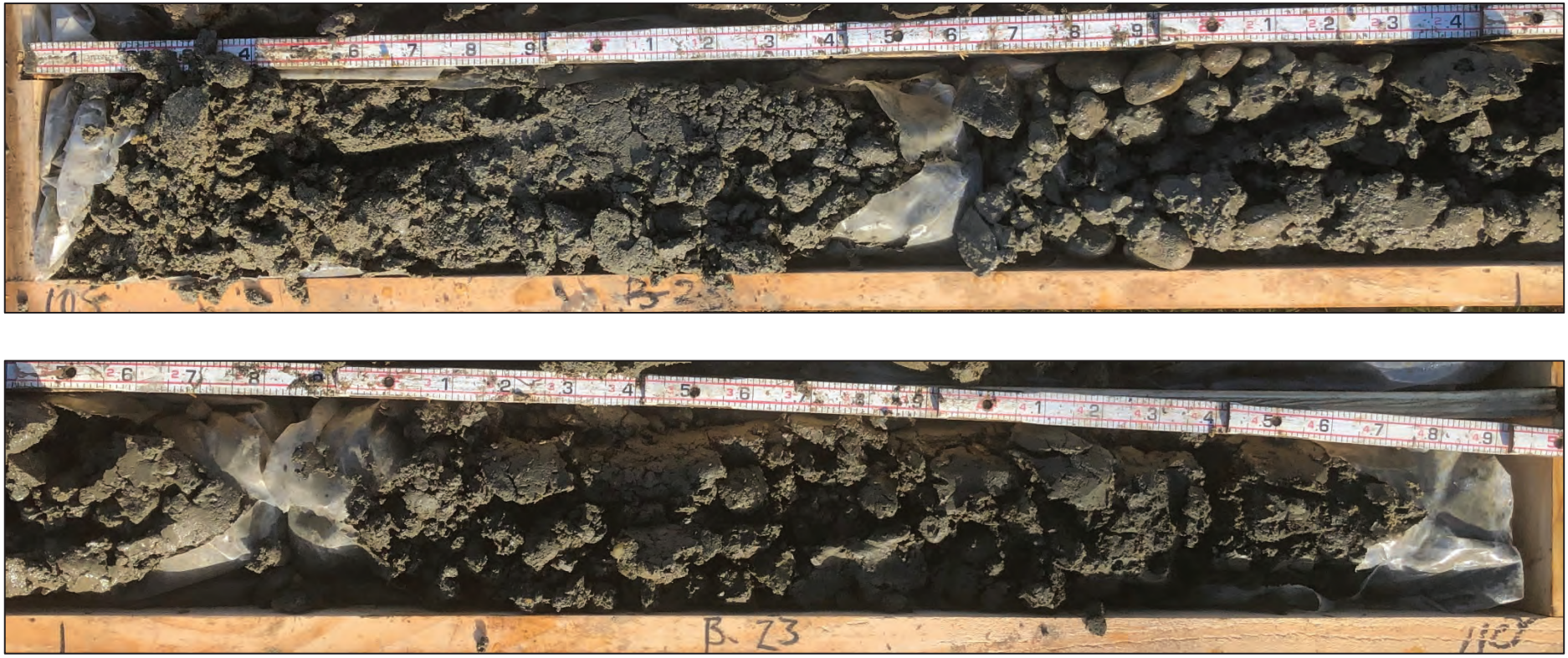

105 – 110 FEET

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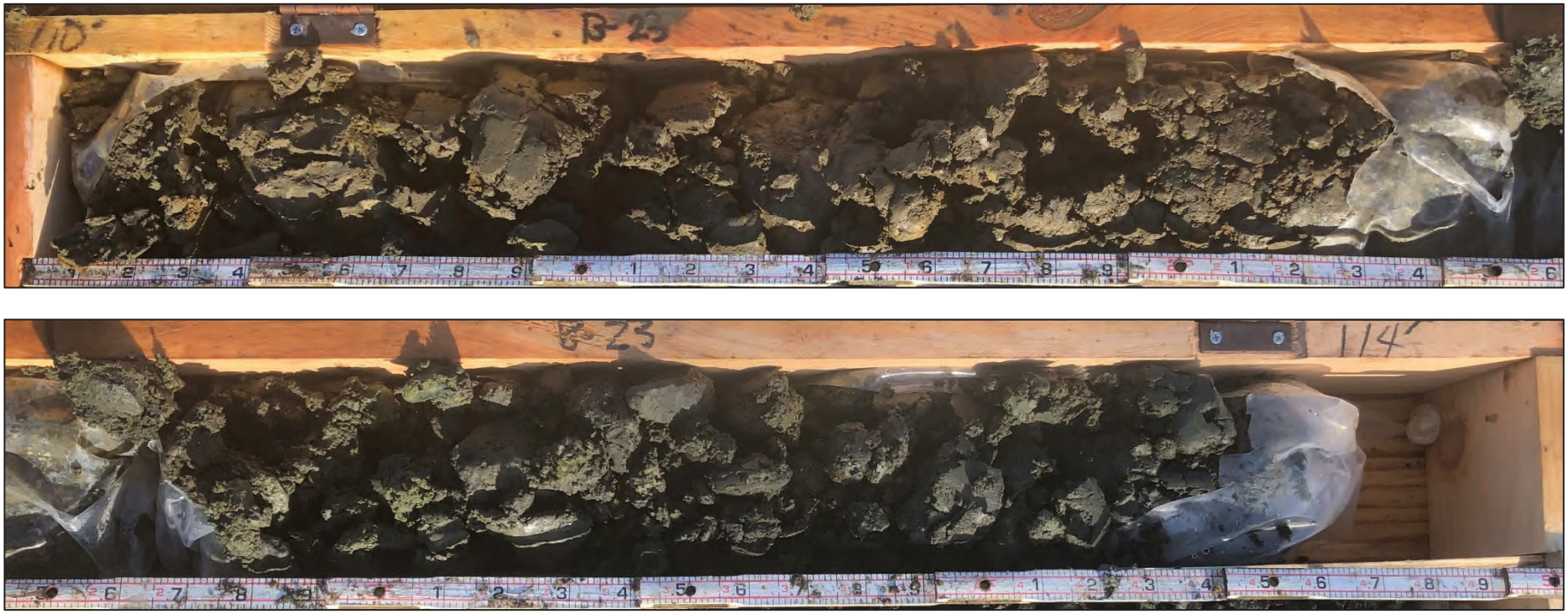

110 – 114 FEET

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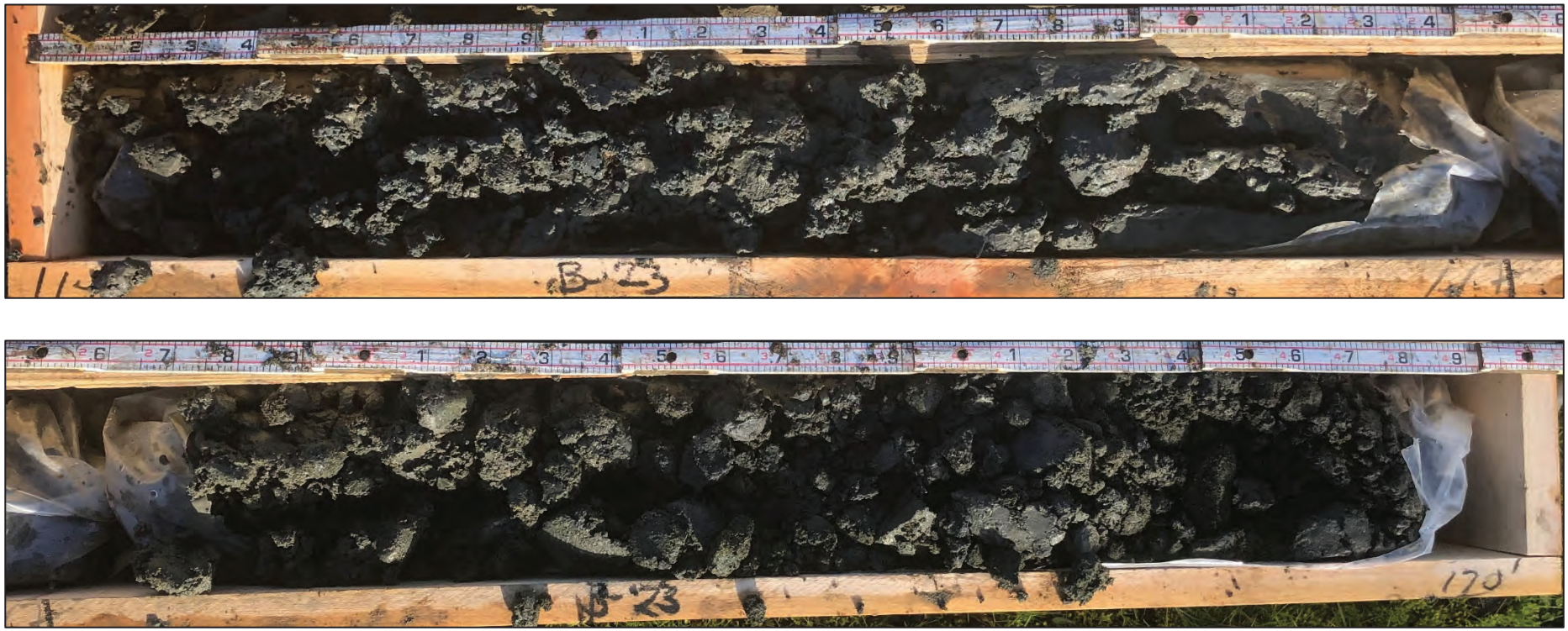

114 – 120 FEET

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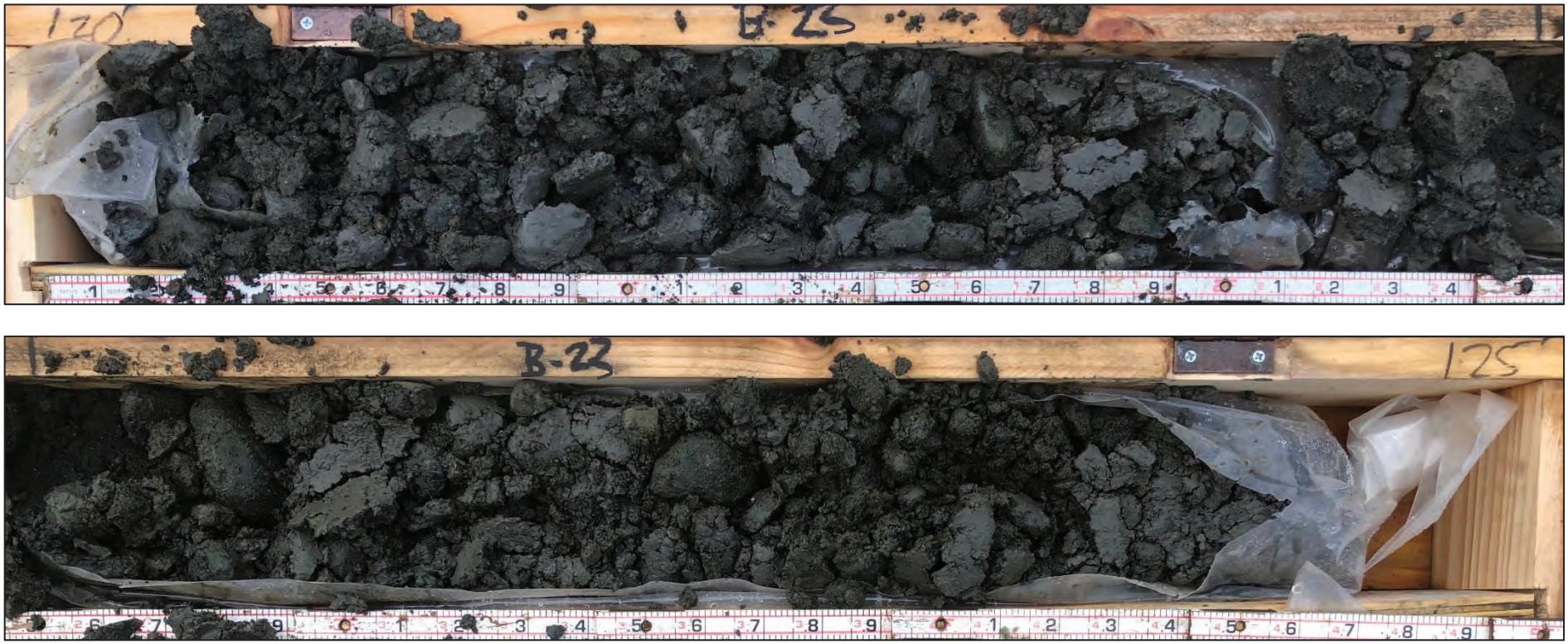

120 – 125 FEET

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125 – 130 FEET

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130 – 135 FEET

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135 – 140 FEET

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-24**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,566**	Easting: **~ 349,045**		Start Card No. **N/A**
Equipment **GeoProbe 8150LS Tracked Sonic Rig**		Driller **Western States/Joe**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Lauren S. & Veronica B.**	Ground Elev. **~ -54 ft.**
Start Date **September 8, 2021**	End Date **September 14, 2021**	Total Depth **160.00 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil: Driving Resistance / Rock: Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0	S1	27			S- 1 (0.00-10.00) Gravelly SAND with some silt; SP-SM; Gray; Nonplastic to low plasticity fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Poor recovery; (Sand Alluvium)	**0.00 - 10.00 Gravelly SAND with some silt; SP-SM; Gray; Nonplastic to low plasticity fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)**		Borehole drilled from barge using rotary sonic drilling technique (6-inch hole); all depths are reported in feet below mudline.	
10	S2	37			S- 2 (10.00-15.00) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic to low plasticity fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)	**10.00 - 15.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic to low plasticity fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**		S2: 53% gravel, 48% sand, 5% fines.	
15	S3	100			S- 3 (15.00-20.00)	**15.00 - 20.00 SAND with some silt; SP-SM; Gray; Nonplastic fines; Moist; Fine to coarse sand; (Sand Alluvium)**			
	S3a				S- 3a (15.00-18.00) SAND with some silt; SP-SM; Gray; Nonplastic fines; Moist; Fine to coarse sand; (Sand Alluvium)				
	S3b				S- 3b (18.00-20.00) SAND with some silt; SP-SM; Gray; Nonplastic fines; Moist; Fine to coarse sand; (Sand Alluvium)				
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	S4	18			S- 4 (20.00-30.00) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Damp; Fine to coarse, rounded gravel; Fine to coarse sand; Silt and sand washed out of sample during drilling; Poor recovery; (Gravel Alluvium)	**20.00 - 30.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Damp; Fine to coarse, rounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
25									
30	S5	41			S- 5 (30.00-40.00)				
	S5a				S- 5a (30.00-33.00) Gravelly silty SAND; SM; Gray; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand/Silt Alluvium)	**30.00 - 33.00 Gravelly silty SAND; SM; Gray; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand/Silt Alluvium)**			
	S5b				S- 5b (33.00-40.00) Silty SAND; SM; Gray; Low plasticity fines; Moist; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**33.00 - 40.00 Silty SAND; SM; Gray; Low plasticity fines; Moist; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)**		Atterberg Limits S5a: LL=34, PL=26, PI=8; 59% sand, 41% fines.	
35									
40	S6	100			S- 6 (40.00-50.00)				
	S6a				S- 6a (40.00-42.00) Gravelly SAND with some silt; SP-SM; Gray and brown; Nonplastic fines; Moist; Fine to coarse, subrounded gravel; Fine to coarse sand; (Sand Alluvium)	**40.00 - 42.00 Gravelly SAND with some silt; SP-SM; Gray and brown; Nonplastic fines; Moist; Fine to coarse, subrounded gravel; Fine to coarse sand; (Sand Alluvium)**			
	S6b				S- 6b (42.00-50.00) Silty SAND; SM; Gray and brown; Nonplastic to low plasticity fines; Moist; Fine to medium sand; Micaceous; Stratified with 1- to 2-inch thick interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)	**42.00 - 57.50 Silty SAND to Clayey SAND; SM/SC; Gray and brown; Nonplastic to low plasticity fines; Moist; Fine to medium sand; Stratified with 1- to 2-inch interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)**		S6b: 30% fines.	
45									
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	S7	100			S- 7 (50.00-60.00) S- 7a (50.00-57.50) Silty SAND to Clayey SAND; SM/SC; Gray to brown; Low plasticity fines; Moist; Fine to medium sand; Micaceous; Stratified with 1- to 2-inch thick interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)			Atterberg Limits S7a: LL=32, PL=22, PI=10; 24% fines.	
	S7a								
55									
	S7b				S- 7b (57.50-60.00) Silty SAND with some gravel; SM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)	**57.50 - 60.00 Silty SAND with some gravel; SM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded gravel; Fine to coarse sand; Micaceous; (Sand/Silt Alluvium)**			
60	S8	100			S- 8 (60.00-70.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray and brown; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Slight iron oxide staining; (Lower Troutdale Formation)	**60.00 - 70.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray and brown; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Slight iron oxide staining; (Lower Troutdale Formation)**		S8: 48% gravel, 37% sand, 15% fines.	
65									
70	S9	87			S- 9 (70.00-75.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray to brown; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)	**70.00 - 75.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray to brown; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)**			
75	S10	100			S- 10 (75.00-80.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray and brown; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)	**75.00 - 80.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray and brown; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to**		S10: 59% gravel, 28% sand, 13% fines.	
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	S11	100			S- 11 (80.00-87.50) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Yellow-brown, brown, green-gray, gray, and dark gray; Low to medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	**rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)**			
						80.00 - 90.00 Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Yellow-brown, brown, green-gray, gray, and dark gray; Low to medium plasticity fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)		
85									
	S12	100			S- 12 (87.50-90.00) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Yellow-brown, brown, green-gray, gray, and dark gray; Low plasticity fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Sand and fines washed out of sample during drilling; (Lower Troutdale Formation)				
90	S13	100			S- 13 (90.00-97.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, green-gray, gray, and dark gray; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Dark green staining of gravel clasts; (Lower Troutdale Formation)	**90.00 - 100.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, gray-green, gray, and dark gray; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Dark green staining of gravel clasts; (Lower Troutdale Formation)**		S13: 48% gravel, 34% sand, 17% fines.	
95									
	S14	100			S- 14 (97.00-100.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, green-gray, gray, and dark gray; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Dark green staining of gravel clasts; (Lower Troutdale Formation)				
100	S15	100			S- 15 (100.00-105.00)	**100.00 - 105.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray, green-gray, and dark gray; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
	S15a				S- 15a (100.00-104.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray, green-gray, and dark gray; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
	S15b				S- 15b (104.50-105.00) Cobble				
105	S16	100			S- 16 (105.00-110.00)				
	S16a				S- 16a (105.00-107.50) Silty SAND; SM; Yellow-brown and brown; Nonplastic fines; Moist; Fine to medium sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)	**105.00 - 107.50 Silty SAND; SM; Yellow-brown and brown; Nonplastic fines; Moist; Fine to medium sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)**			
	S16b				S- 16b (107.50-110.00) GRAVEL with trace silt and sand, with cobbles and possible boulders; GP; Yellow-brown, brown, and gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**107.50 - 115.00**			
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	S17	100			S- 17 (110.00-115.00)	**GRAVEL with trace silt and sand, with cobbles and possible boulders; GP; Yellow-brown, brown, and gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
	S17a				S- 17a (110.00-113.00) GRAVEL with trace silt and sand, with cobbles and possible boulders; GP; Yellow-brown, brown, and gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
	S17b				S- 17b (113.00-115.00) GRAVEL with trace silt and sand, with cobbles and possible boulders; GP; Yellow-brown, brown, and gray; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)			S17b: 84% gravel, 13% sand, 3% fines.	
115	S18	100			S- 18 (115.00-120.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, and gray; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**115.00 - 120.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, and gray; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
120	S19	100			S- 19 (120.00-130.00)				
	S19a				S- 19a (120.00-128.00) CLAY with trace sand; CH; Blue-gray to brown; High plasticity; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)	**120.00 - 128.00 CLAY with trace sand; CH; Blue-gray to brown; High plasticity; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)**		Atterberg Limits S19a: LL=77, PL=34, PI=43.	
125									
	S19b				S- 19b (128.00-130.00) Silty SAND; SM; Gray; Nonplastic to low plasticity fines; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)	**128.00 - 160.00 Silty SAND; SM; Gray to brown; Nonplastic to low plasticity fines; Moist; Fine to medium sand; Micaceous; No to few interbeds of SILT with some sand (ML); (Sandy River Mudstone)**			
130	S20	100			S- 20 (130.00-140.00) Silty SAND; SM; Gray; Nonplastic to low plasticity fines; Moist; Fine to medium sand; Micaceous; Few interbeds of SILT with some sand (ML); (Sandy River Mudstone)				
135									
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	S21	100			S- 21 (140.00-150.00) Silty SAND; SM; Gray; Nonplastic fines; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)			S21: 15% fines.	
145									
150	S22	100			S- 22 (150.00-160.00)				
	S22a				S- 22a (150.00-155.00) Silty SAND; SM; Gray to brown; Nonplastic fines; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)				
155	S22b				S- 22b (155.00-160.00) Silty SAND; SM; Gray; Nonplastic to low plasticity fines; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)				
160						**160.00 End of hole**			
165									
170									



0 – 10 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

SONIC CORE PHOTOS
BORING B-24

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10 – 15 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

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15 – 20 FEET

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20 – 25 FEET

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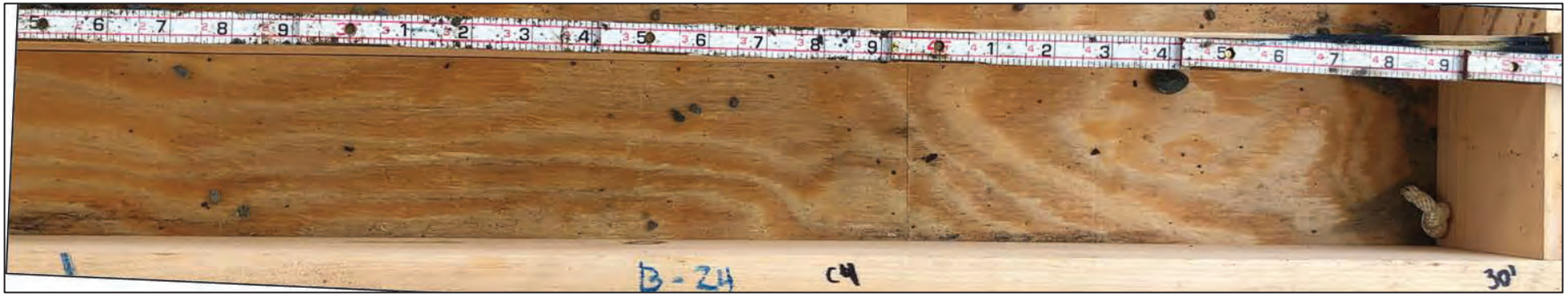

25 – 30 FEET

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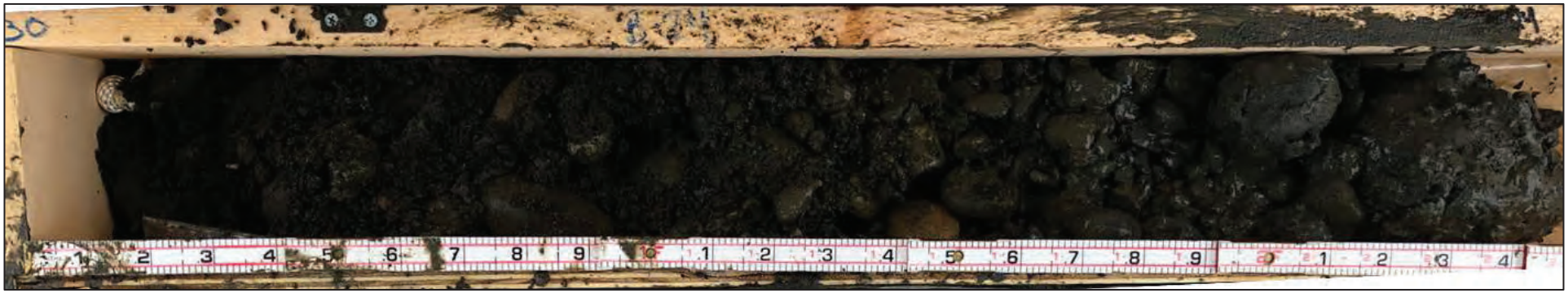

30 – 35 FEET

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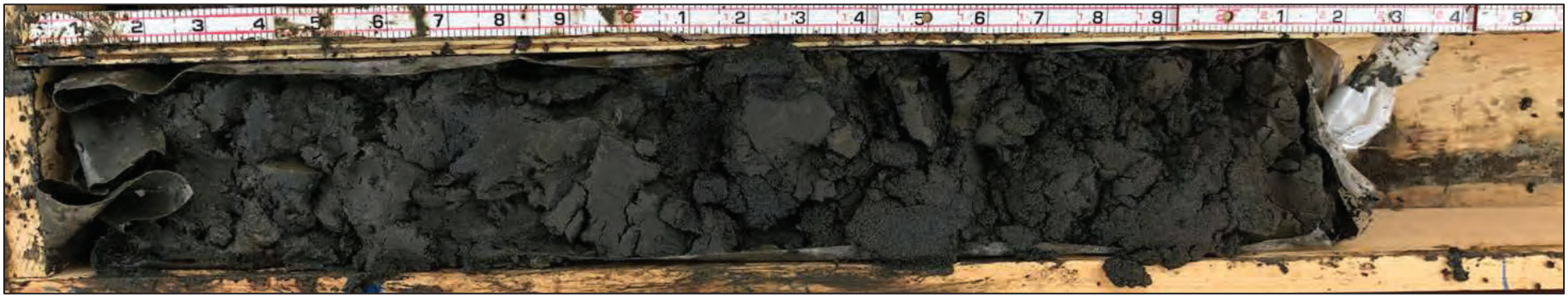

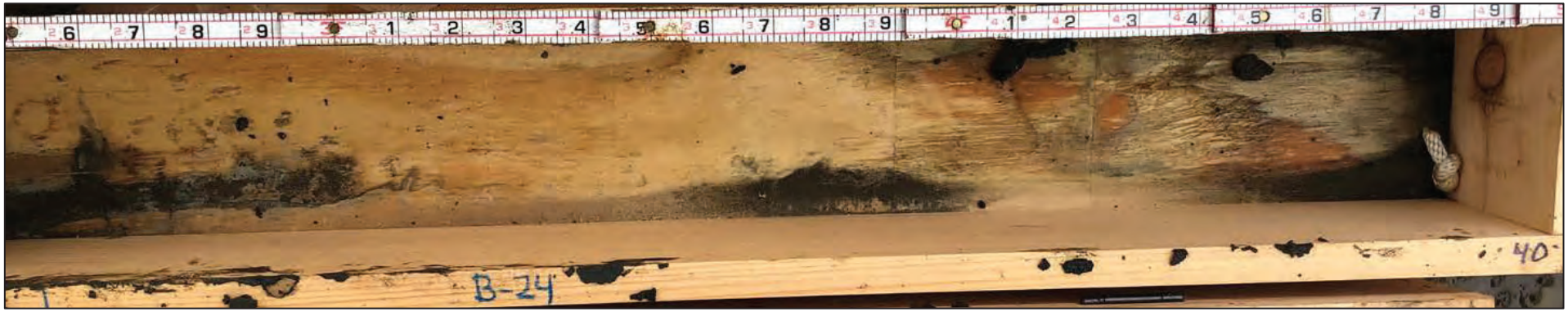

35 – 40 FEET

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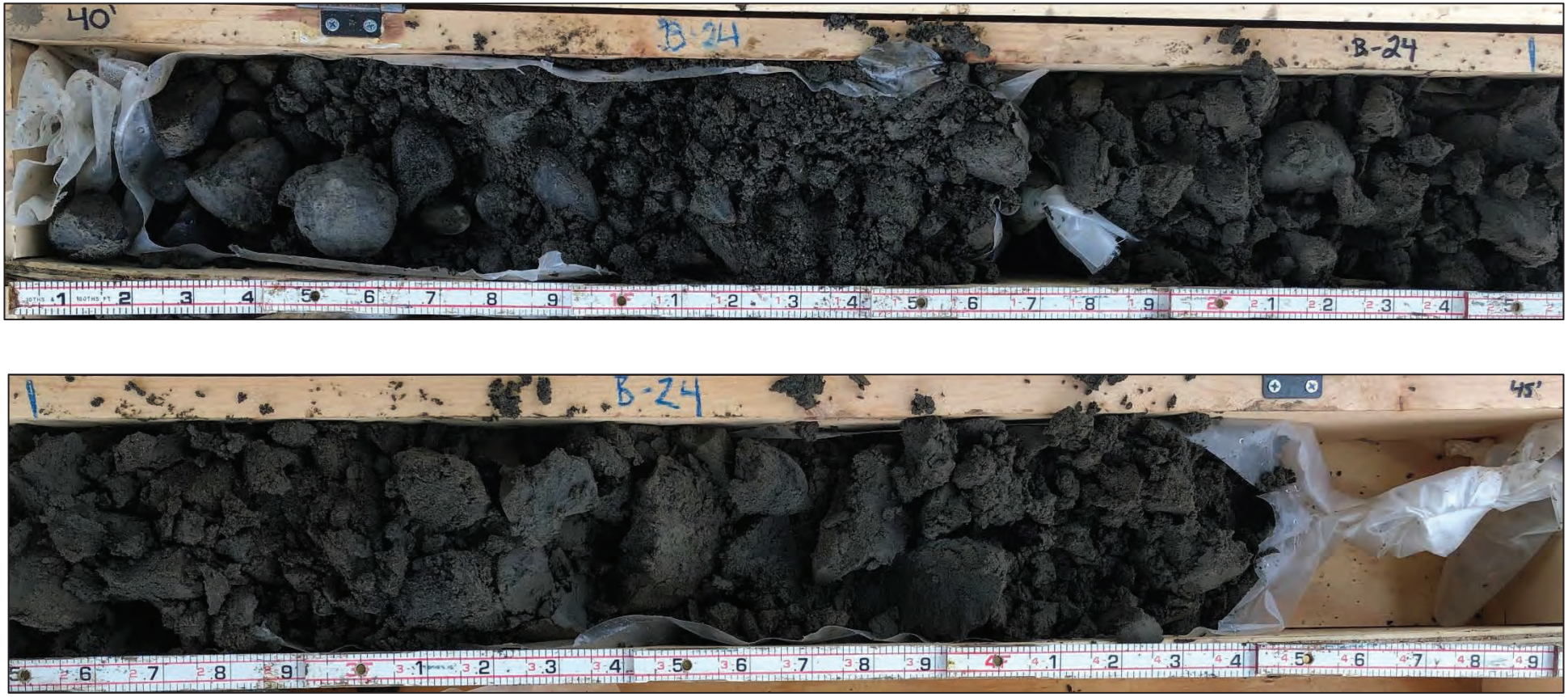

40 – 45 FEET

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45 – 50 FEET

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50 – 55 FEET

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55 – 60 FEET

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60 – 65 FEET

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65 – 70 FEET

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70 – 75 FEET

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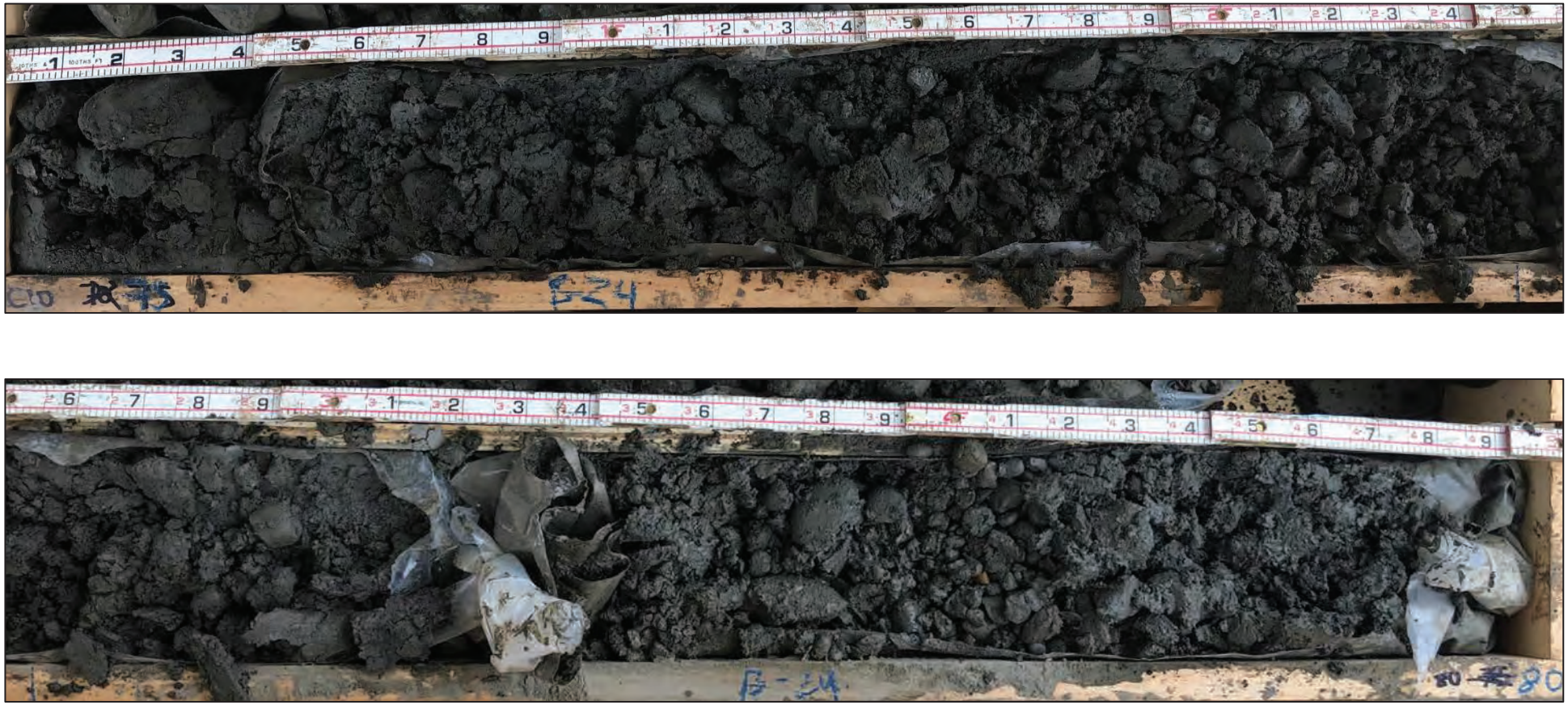

75 – 80 FEET

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80 – 85 FEET

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85 – 87.5 FEET

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87.5 – 90 FEET

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90 – 93.5 FEET

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93.5 – 97 FEET

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97 – 100 FEET

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100 – 105 FEET

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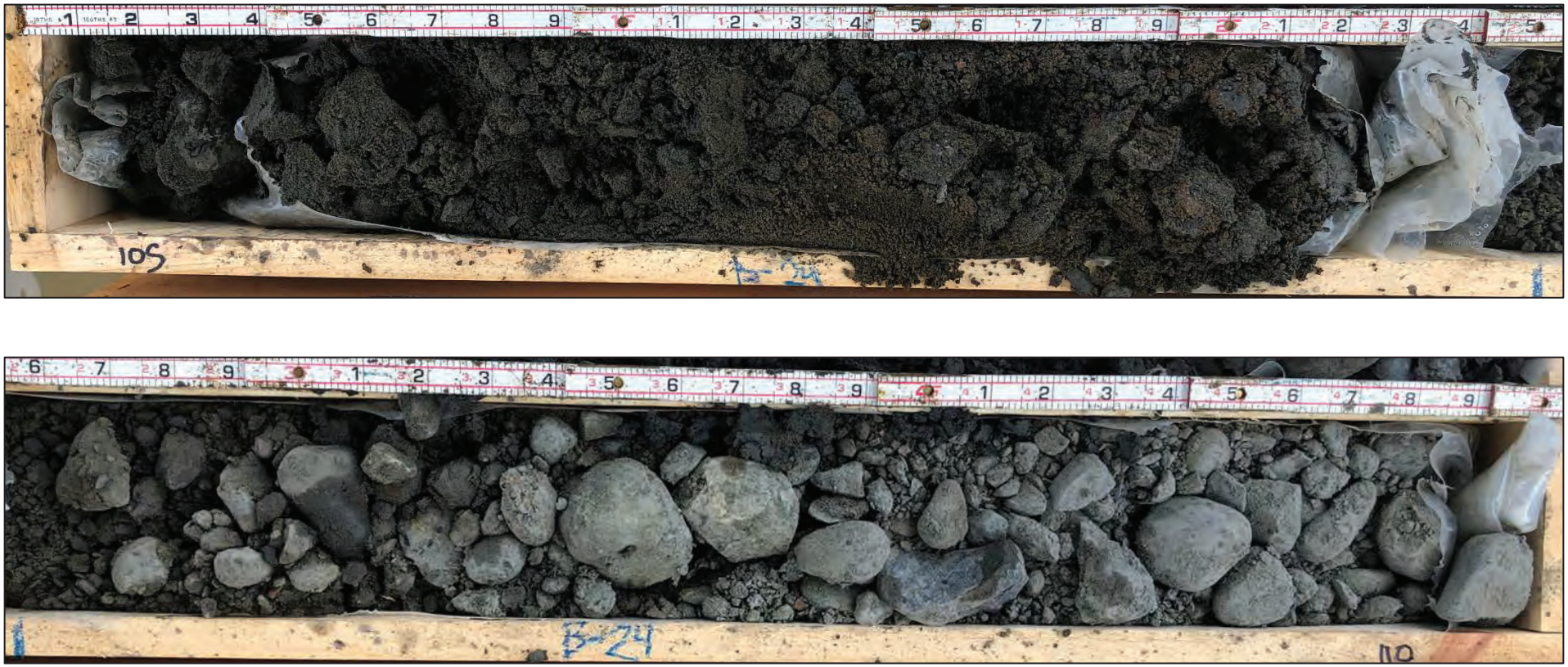

105 – 110 FEET

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110 – 115 FEET

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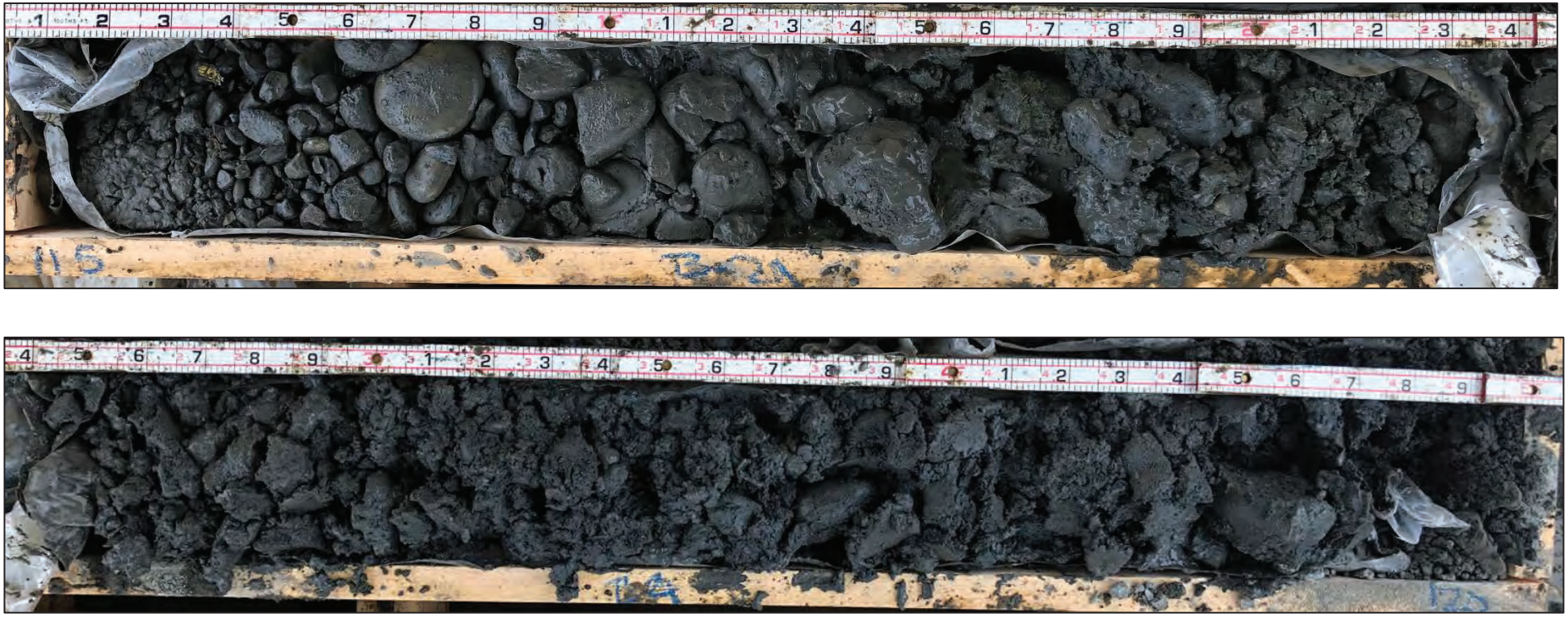

115 – 120 FEET

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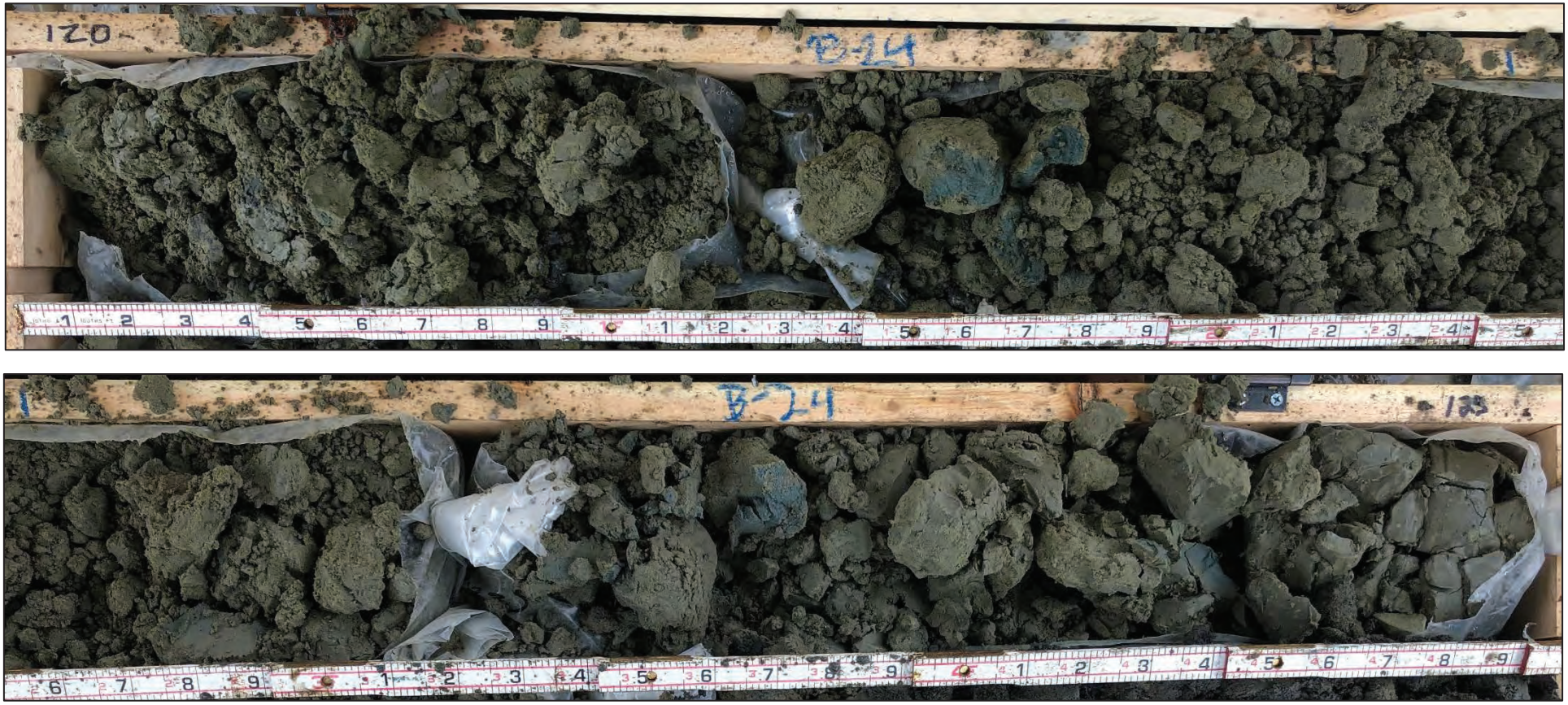

120 – 125 FEET

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125 – 130 FEET

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130 – 135 FEET

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135 – 140 FEET

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140 – 145 FEET

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145 – 150 FEET

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150 – 155 FEET

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155 – 160 FEET

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-25**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,407**	Easting: **~ 349,007**		Start Card No. **N/A**
Equipment **GeoProbe 8150LS Tracked Sonic Rig**		Driller **Western States**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Lauren S. & Veronica B.**	Ground Elev. **~ -49 ft.**
Start Date **September 20, 2021**	End Date **September 22, 2021**	Total Depth **165.00 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil Driving Resistance / Rock Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0	S1	33			S- 1 (0.00-4.00) SAND with some silt and gravel; SP-SM; Gray and brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)	**0.00 - 14.00 SAND with some silt and gravel; SP-SM; Gray and brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)**		Borehole drilled from barge using rotary sonic drilling technique (6-inch hole); all depths are reported in feet below mudline.	
	S2	46			S- 2 (4.00-14.00) SAND with some silt and gravel; SP-SM; Gray and brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)				
5									
10									
	S3	30			S- 3 (14.00-24.00) Gravelly SAND with some silt to SAND with some silt and gravel; SP-SM; Gray and brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)	**14.00 - 24.00 Gravelly SAND with some silt to SAND with some silt and gravel; SP-SM; Gray and brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)**		S3: 47% gravel, 47% sand, 6% fines.	
15									
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20									
	S4	67			S- 4 (24.00-34.00)	**24.00 - 28.00**			
	S4a				S- 4a (24.00-28.00) Sandy GRAVEL with some silt; GP-GM; Gray and brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**Sandy GRAVEL with some silt; GP-GM; Gray and brown; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
25									
	S4b				S- 4b (28.00-34.00) Silty SAND; SM; Gray; Nonplastic fines; Moist; Fine to medium sand; Micaceous; Trace wood fragments and organics; (Sand/Silt Alluvium)	**28.00 - 44.00 Silty SAND to Silty SAND with some gravel; SM; Gray, brown, and dark gray; Nonplastic to low plasticity fines; Moist to wet; Fine to coarse sand; Micaceous; No to trace wood fragments and organics; (Sand/Silt Alluvium)**			
30									
	S5	75			S- 5 (34.00-44.00)				
	S5a				S- 5a (34.00-36.00) Silty SAND with some gravel; SM; Brown and gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Sand/Silt Alluvium)				
35									
	S5b				S- 5b (36.00-44.00) Silty SAND; SM; Dark gray; Nonplastic to low plasticity fines; Moist to wet; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			S5b: 16% fines.	
40									
	S6	45			S- 6 (44.00-54.00)	**44.00 - 49.00**		S6a: 52% gravel, 30% sand, 18% fines.	
	S6a				S- 6a (44.00-49.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
45									
	S6b				S- 6b (49.00-51.00) Silty CLAY with some sand; CL; Gray; Low to medium plasticity; Moist; Fine to medium sand; Micaceous; (Upper Troutdale Formation)	**49.00 - 51.00 Silty CLAY with some**		Atterberg Limits S6b: LL=29, PL=19, PI=10.	
50									

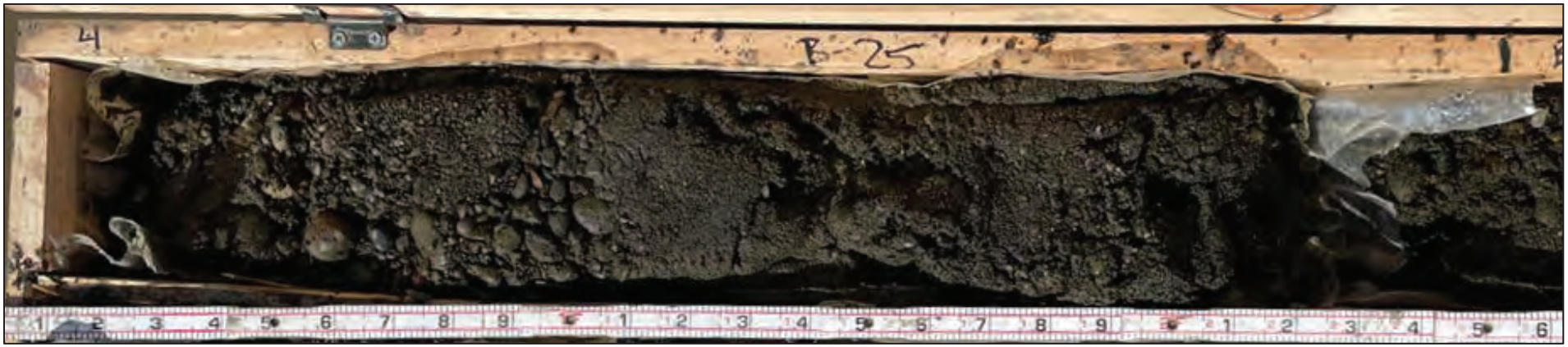
Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description
50						**sand; CL; Gray; Low to medium plasticity; Moist; Fine to medium sand; Micaceous; (Upper Troutdale Formation)**
	S6c				S- 6c (51.00-54.00) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray-brown and blue-brown; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)	**51.00 - 54.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray-brown and blue-brown; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)**
	S7	100			S- 7 (54.00-64.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray, green-gray, and brown; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	**54.00 - 68.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray, green-gray, and brown; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)**
55						
60						
	S8	94			S- 8 (64.00-72.00)	
	S8a				S- 8a (64.00-68.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray, green-gray, and brown; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	
65						
	S8b				S- 8b (68.00-70.50) Silty SAND; SM; Gray to brown; Nonplastic fines; Moist; Fine to medium sand; Micaceous; (Lower Troutdale Formation)	**68.00 - 70.50 Silty SAND; SM; Gray to brown; Nonplastic fines; Moist; Fine to medium sand; Micaceous; (Lower Troutdale Formation)**
70						**70.50 - 84.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, green-gray, and gray; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)**
	S9	100			S- 9 (70.50-74.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, and gray; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	
	S10	100			S- 10 (74.00-84.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, and gray; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	
75						
80						

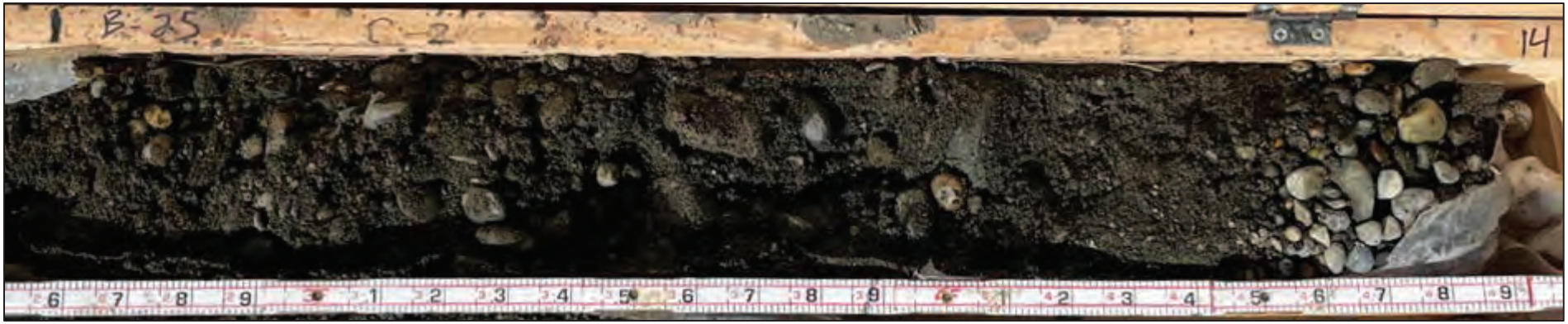
Graphic Log | Drilling Methods, Size and Remarks / Water Level/ Date | Backfill/ Instrumentation

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80									
	S11	100			S- 11 (84.00-94.00) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, green-gray, and gray; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	**84.00 - 94.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, green-gray, and gray; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Foramtion)**		S11: 57% gravel, 33% sand, 11% fines.	
85									
90									
	S12	100			S- 12 (94.00-104.00)	**94.00 - 98.00 Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Tan-brown, gray-brown, and dark gray; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
	S12a				S- 12a (94.00-98.00) Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Tan-brown, gray-brown, and dark gray; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
95									
	S12b				S- 12b (98.00-104.00) CLAY with trace sand; CH; Blue-gray to yellow-brown; Medium plasticity; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)	**98.00 - 104.00 CLAY with trace sand; CH; Blue-gray to yellow-brown; Medium plasticity; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)**			
100									
	S13	100			S- 13 (104.00-114.00) Sandy silty CLAY; CL; Blue-gray to gray-brown; Low to medium plasticity; Moist; Fine to medium sand; Micaceous; Some interbeds of Silty SAND (SM) and Clayey SAND (SC); (Sandy River Mudstone)	**104.00 - 114.00 Sandy silty CLAY; CL; Blue-gray to gray-brown; Low to medium plasticity; Moist; Fine to medium sand; Micaceous; Some interbeds of Silty SAND (SM) and Clayey SAND (SC); (Sandy River Mudstone)**		Atterberg Limits S13: LL=47, PL=27, PI=20.	
105									
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110									
	S14	100			S- 14 (114.00-124.00) Silty CLAY with some sand; CL; Red-brown, yellow-brown, and blue-gray; Medium plasticity; Moist; Fine to medium sand; Few interbeds of Clayey SAND (SC); (Sandy River Mudstone)	**114.00 - 138.50 Silty CLAY with some sand; CL; Red-brown, yellow-brown, blue-gray, and gray; Medium plasticity; Moist; Fine to medium sand; Micaceous; No to few interbeds of Clayey SAND (SC) and Silty SAND (SM); Occasional zones of weak cementation; (Sandy River Mudstone)**			
115									
120									
	S15	100			S- 15 (124.00-134.00) Silty CLAY with some sand; CL; Red-brown, yellow-brown, and blue-gray; Medium plasticity; Moist; Fine to medium sand; Micaceous; Occasional zones of weak cementation; (Sandy River Mudstone)				
125									
130									
	S16	100			S- 16 (134.00-144.00)				
	S16a				S- 16a (134.00-138.50) Silty CLAY with some sand; CL; Gray; Medium plasticity; Moist; Fine sand; Micaceous; Stratified with 2- to 4-inch thick interbeds of Silty SAND (SM); (Sandy River Mudstone)				
135									
	S16b				S- 16b (138.50-144.00) SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Moist; Fine to coarse sand; Micaceous; (Sandy River Mudstone)	**138.50 - 152.20 SAND with some silt; SP-SM; Dark gray;**		Atterberg Limits S16b: LL=NP, PL=NP, PI=NP.	
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140						**Nonplastic fines; Moist; Fine to coarse sand; Micaceous; (Sandy River Mudstone)**			
	S17	100			S- 17 (144.00-154.00)				
	S17a				S- 17a (144.00-152.20) SAND with some silt; SP-SM; Dark gray; Nonplastic fines; Moist; Fine to coarse sand; Micaceous; (Sandy River Mudstone)			S17a: 8% fines.	
145									
150									
	S17b				S- 17b (152.20-152.90) Sandy silty CLAY; CL; Gray; Medium plasticity; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)	**152.20 - 152.90 Sandy silty CLAY; CL; Gray; Medium plasticity; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)**			
	S17c				S- 17c (152.90-154.00) Silty SAND; SM; Dark blue-gray; Nonplastic fines; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)				
	S18	100			S- 18 (154.00-159.00) Silty SAND; SM; Dark blue-gray; Nonplastic fines; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)	**152.90 - 159.00 Silty SAND; SM; Dark blue-gray and blue-gray; Nonplastic fines; Moist; Fine to coarse sand; Micaceous; (Sandy River Mudstone)**			
155									
	S19	100			S- 19 (159.00-163.50) SAND with trace silt; SP; Dark blue-gray; Nonplastic fines; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)	**159.00 - 165.00 SAND with trace silt; SP; Dark blue-gray to blue-gray; Nonplastic fines; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)**		S19: 5% fines.	
160									
	S20	100			S- 20 (163.50-165.00) SAND with some silt; SP-SM; Blue-gray; Nonplastic fines; Moist; Fine to coarse sand; Micaceous; (Sandy River Mudstone)				
165						**165.00 End of hole**			
170									





4 – 14 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

SONIC CORE PHOTOS
BORING B-25

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14 – 24 FEET

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24 – 29 FEET

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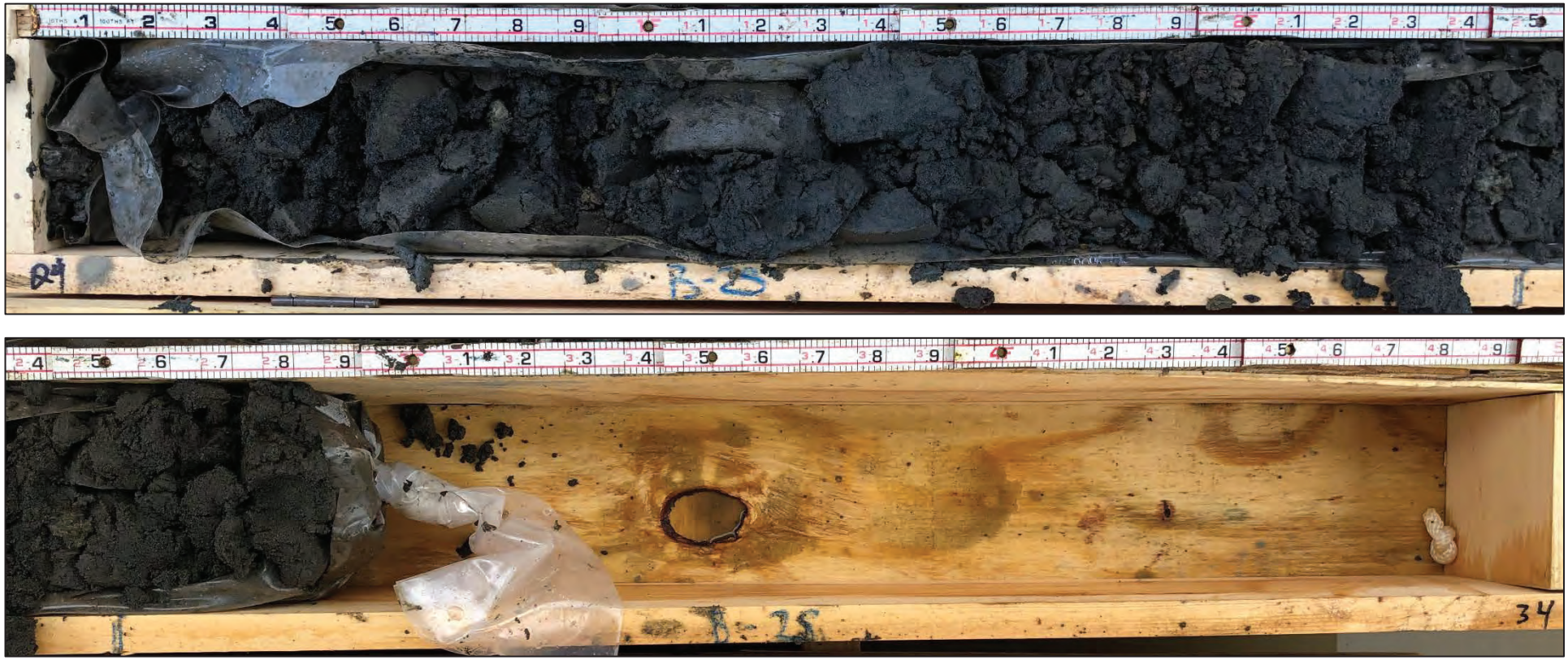

29 – 34 FEET

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34 – 39 FEET

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39 – 44 FEET

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44 – 49 FEET

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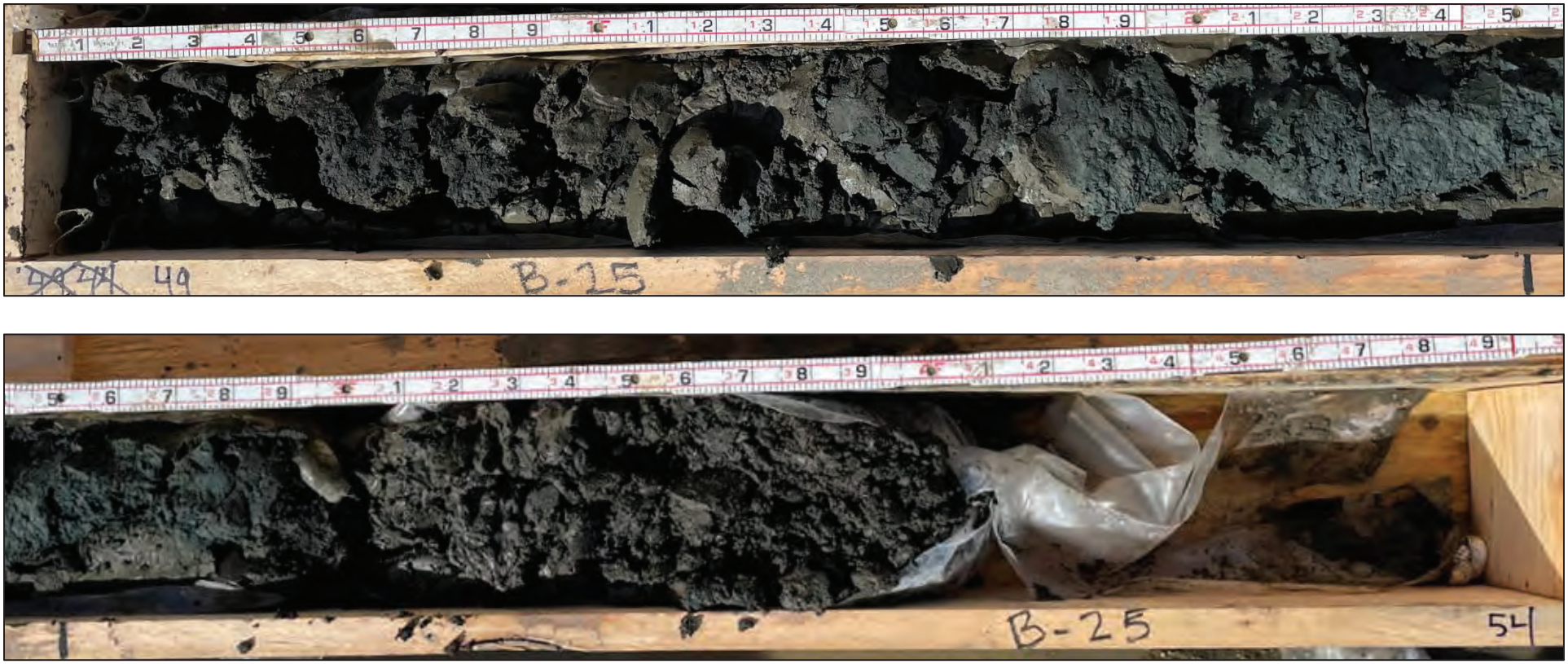

49 – 54 FEET

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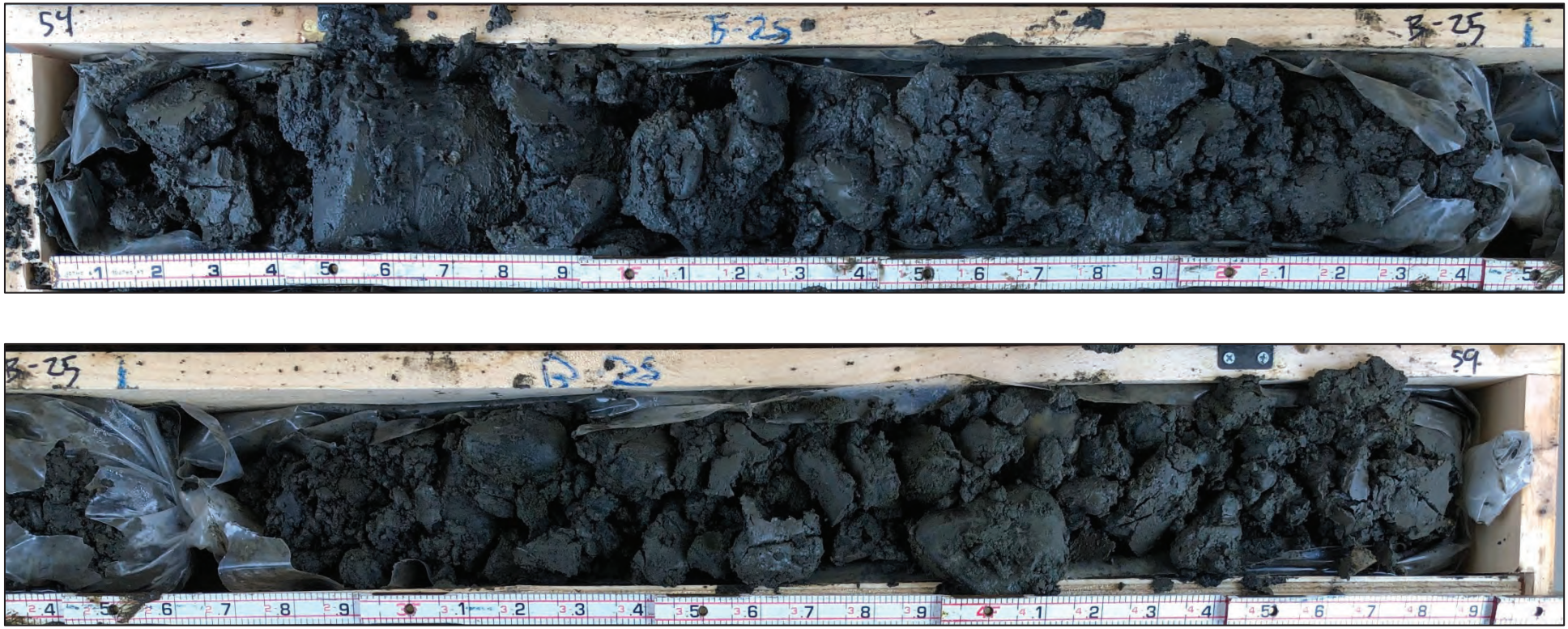

54 – 59 FEET

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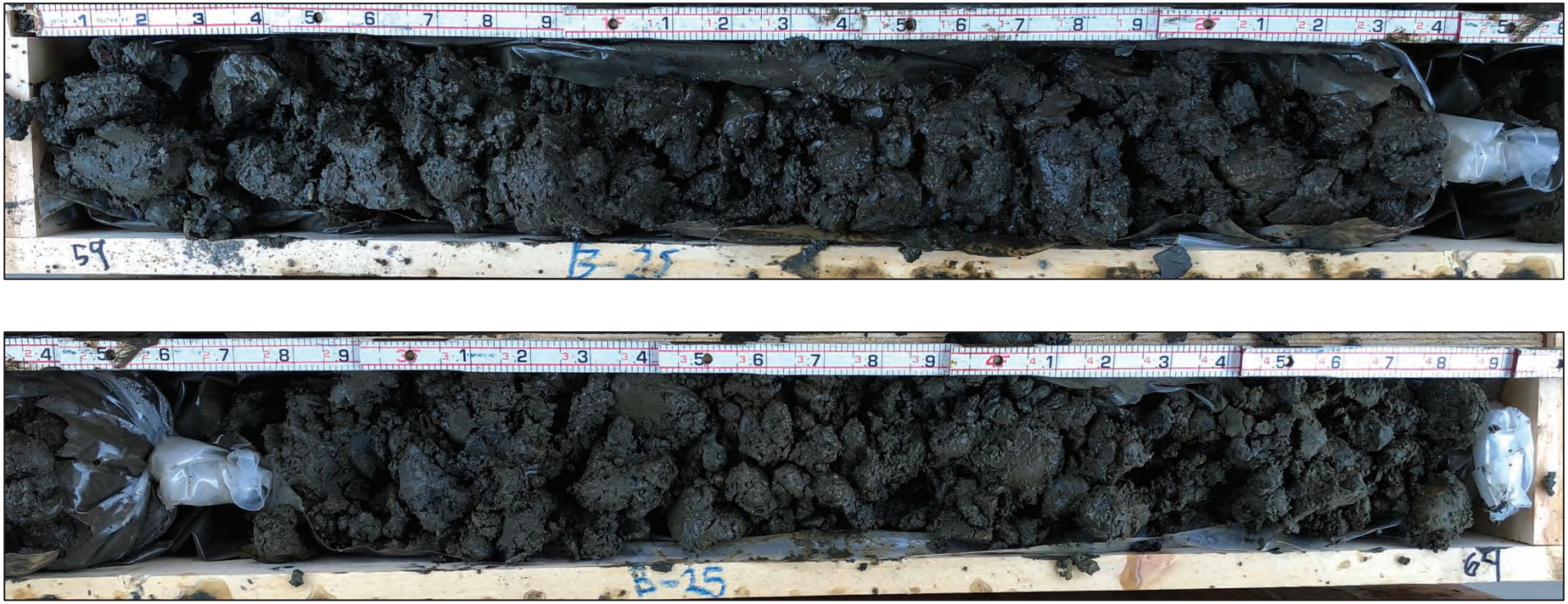

59 – 64 FEET

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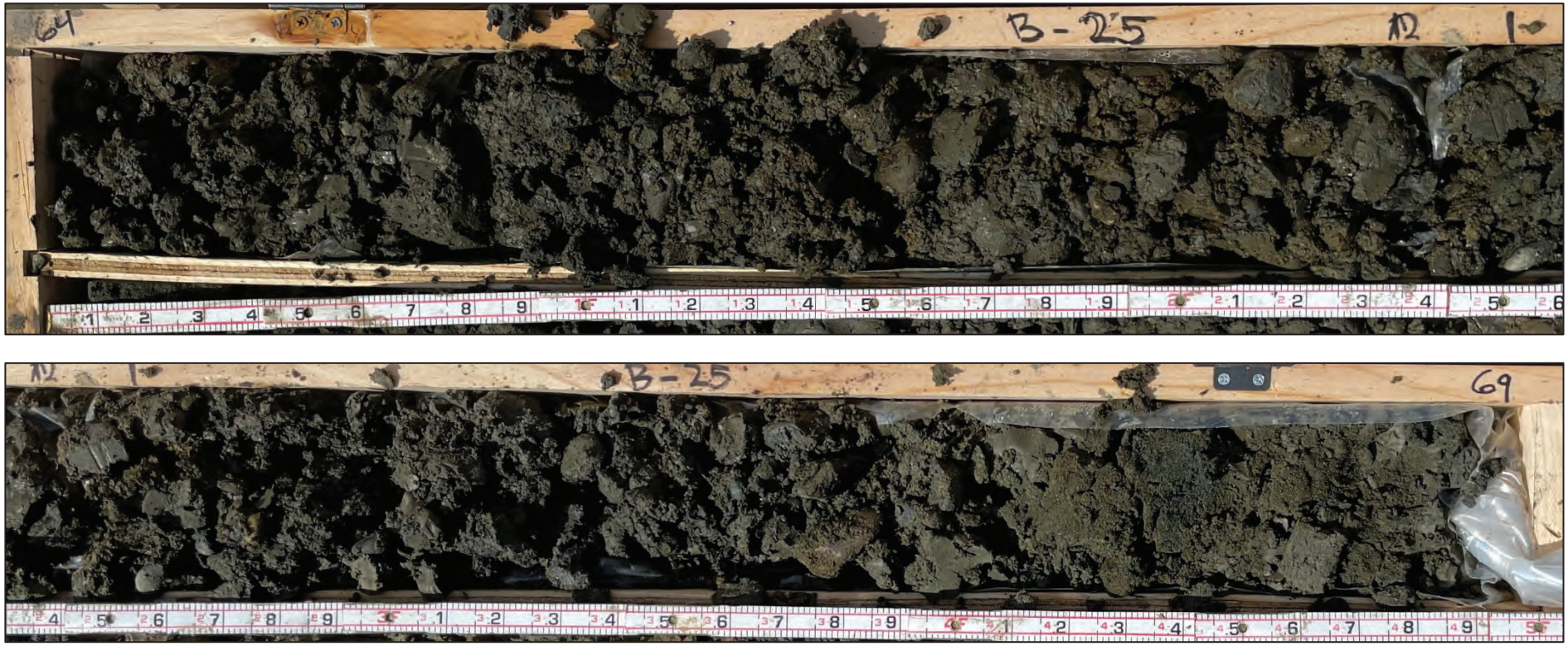

64 – 69 FEET

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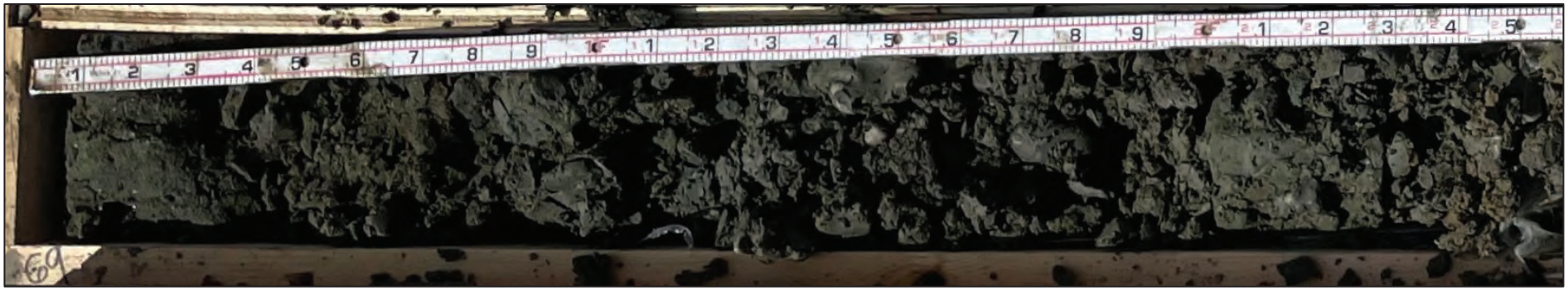

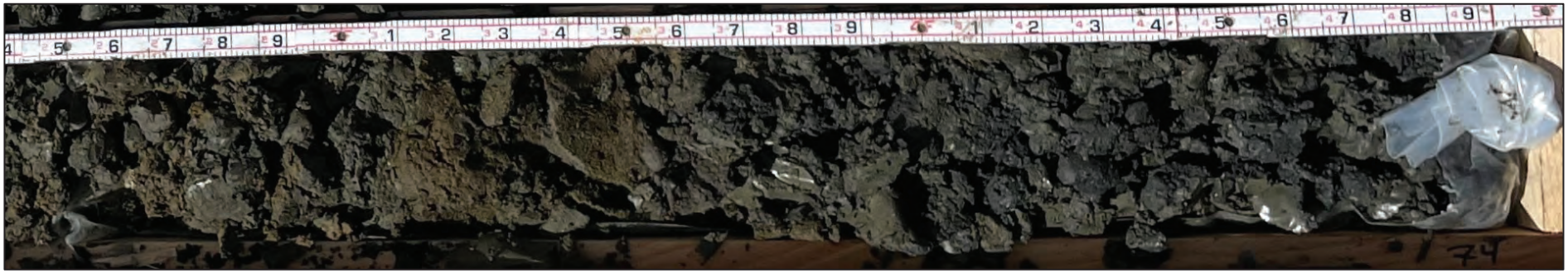

69 – 74 FEET

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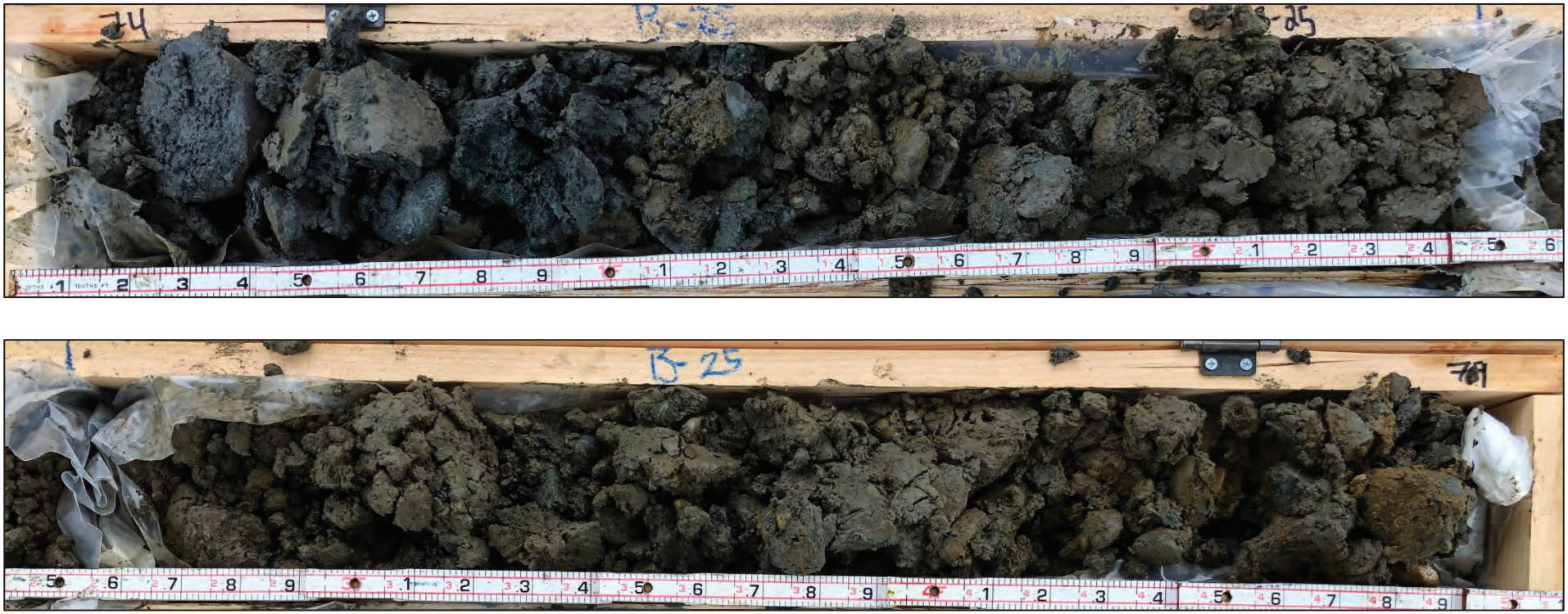

74 – 79 FEET

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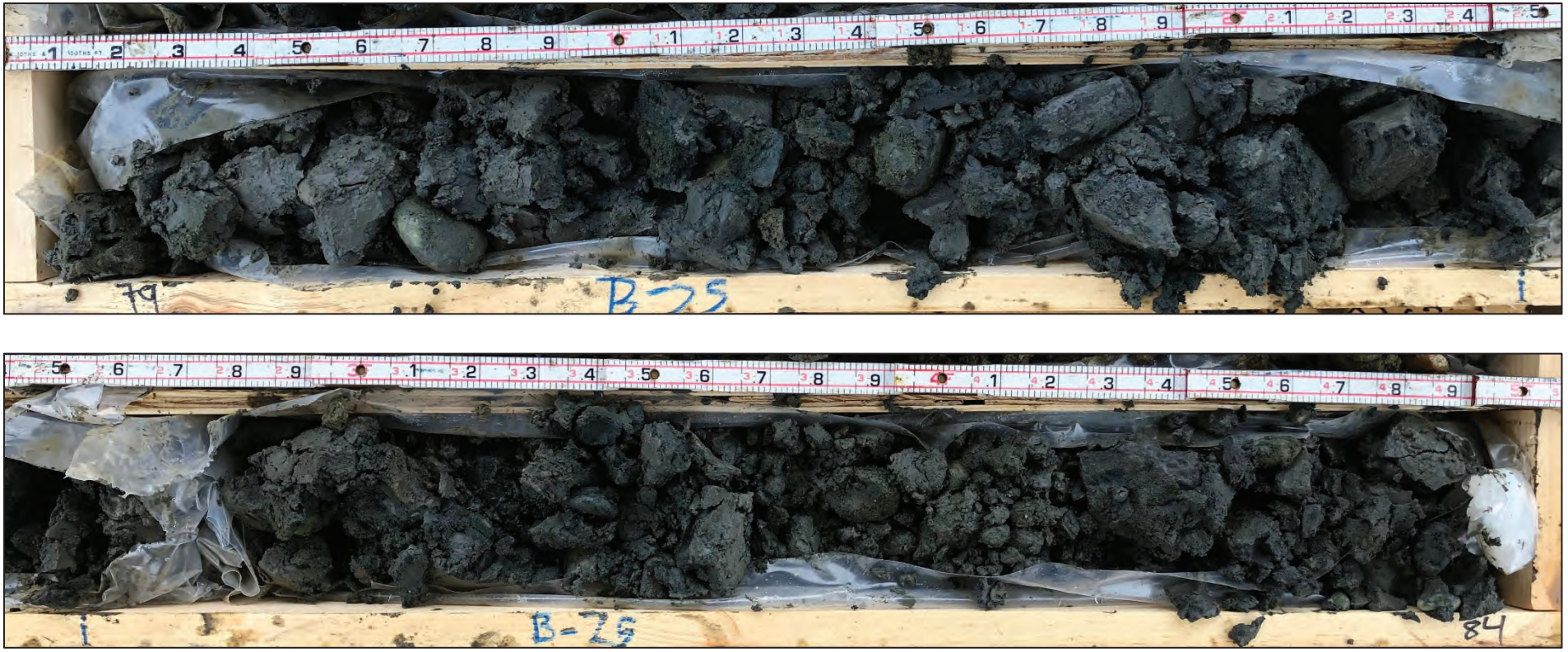

79 – 84 FEET

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84 – 89 FEET

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89 – 94 FEET

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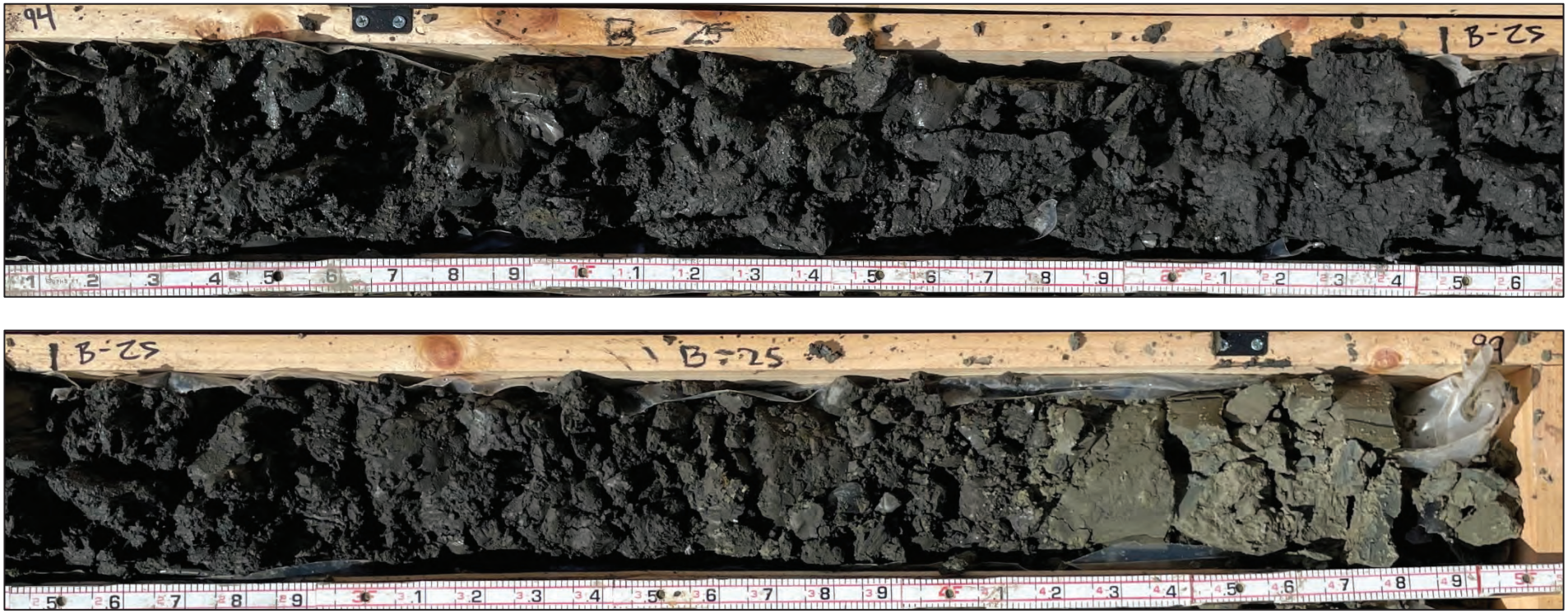

94 – 99 FEET

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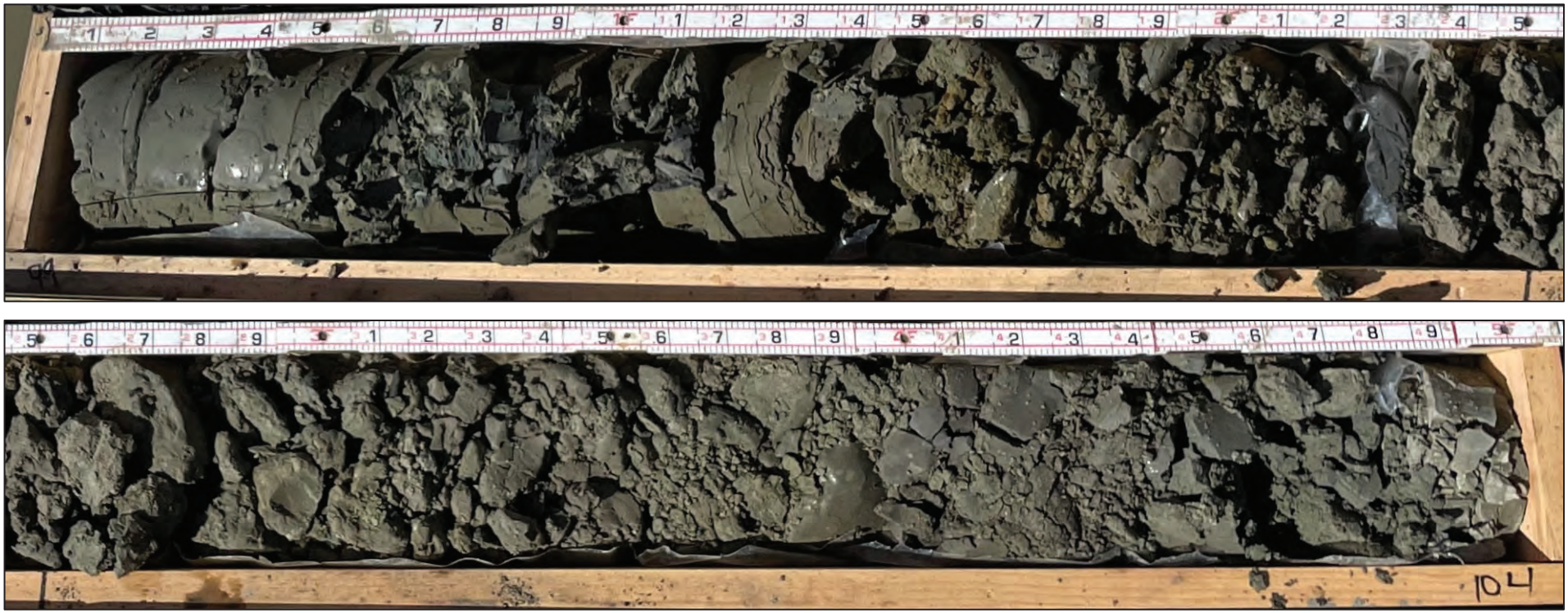

99 – 104 FEET

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104 – 109 FEET

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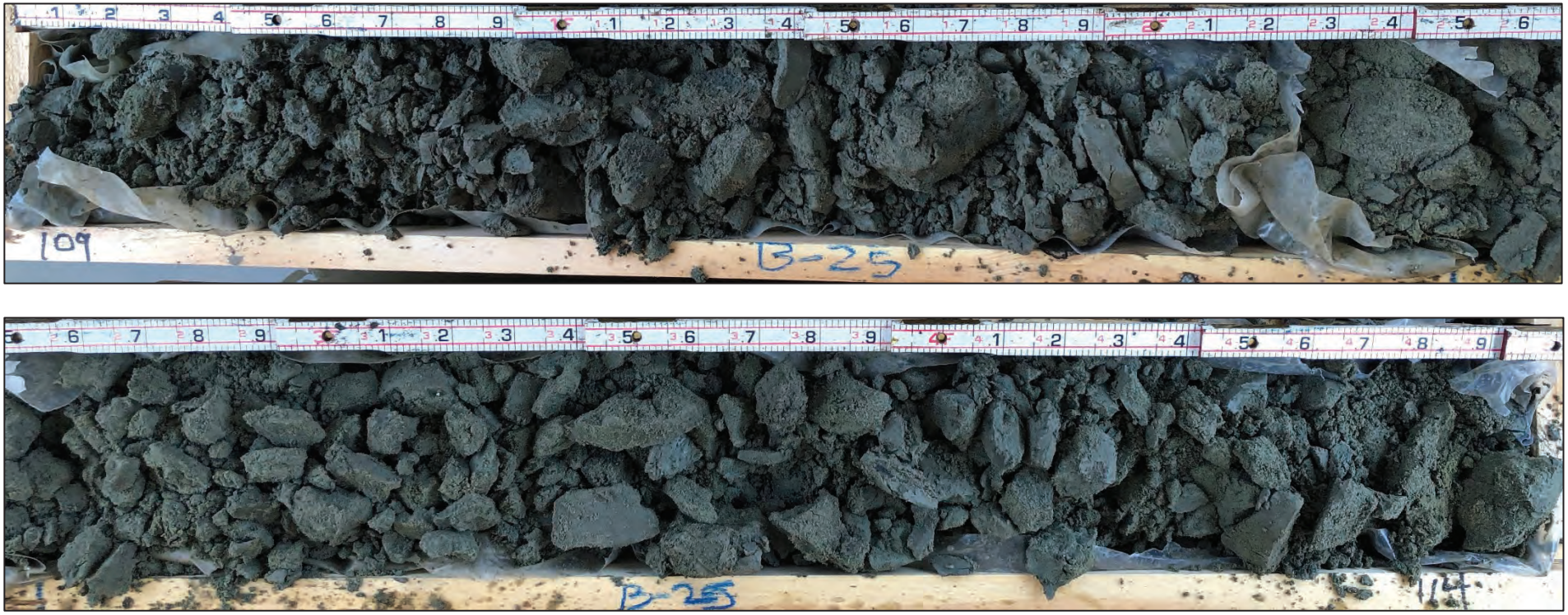

109 – 114 FEET

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114 – 119 FEET

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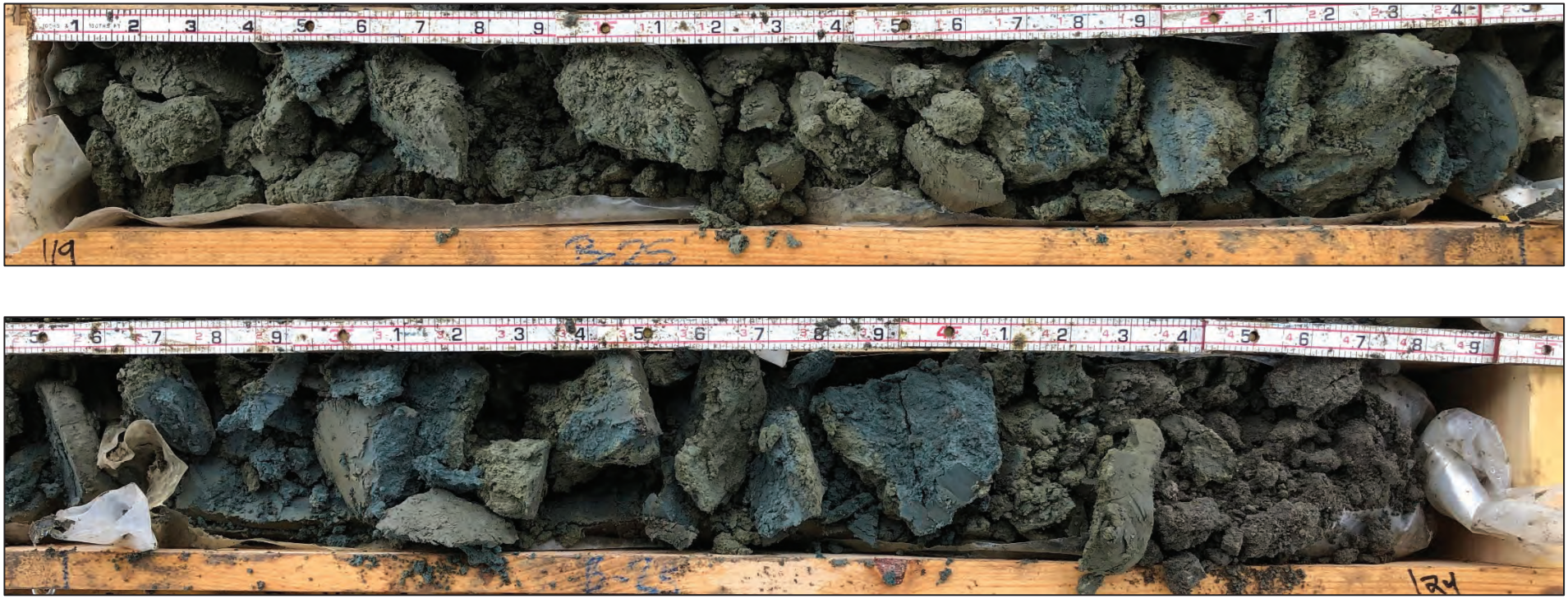

119 – 124 FEET

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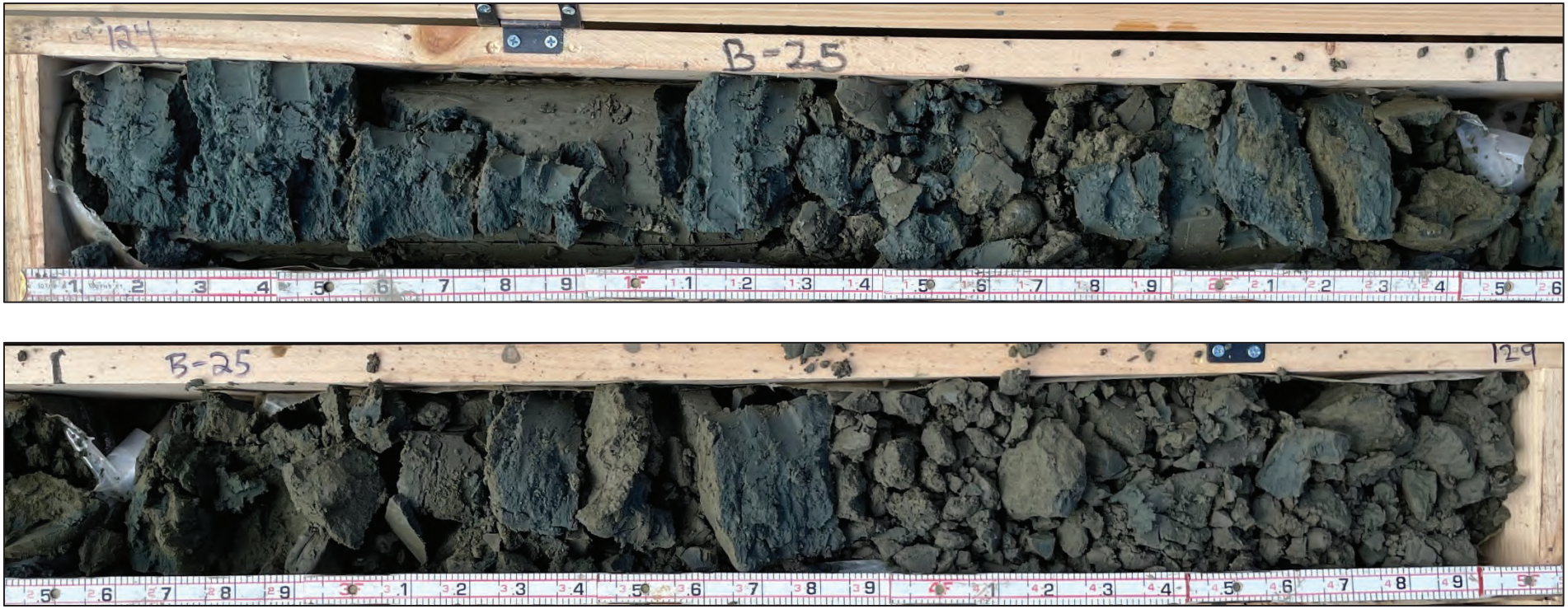

124 – 129 FEET

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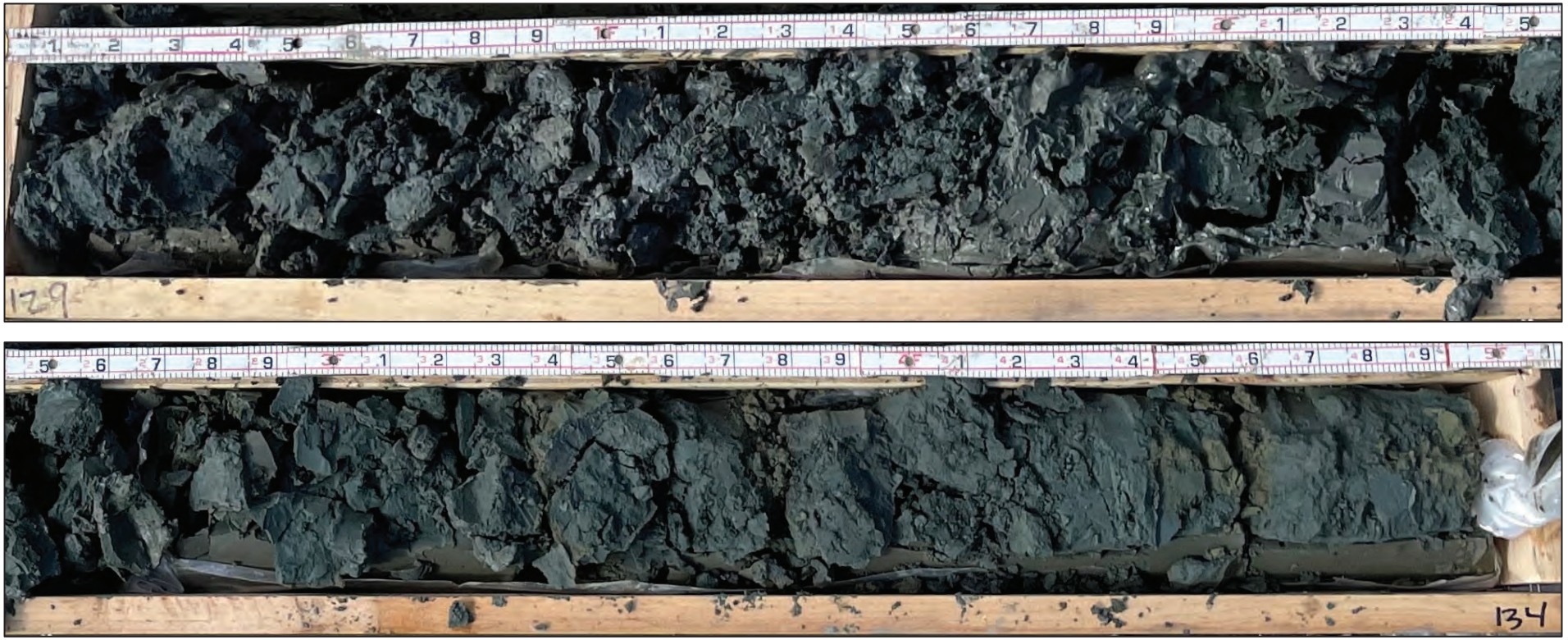

129 – 134 FEET

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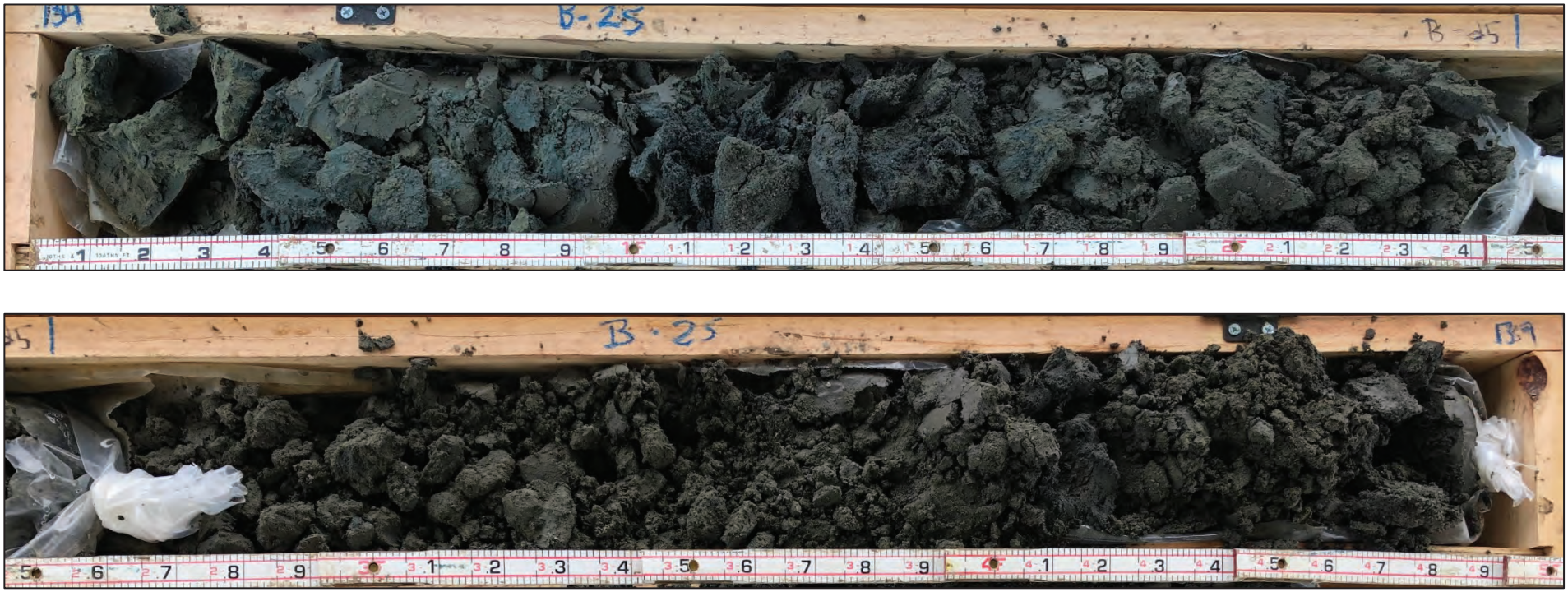

134 – 139 FEET

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139 – 144 FEET

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144 – 149 FEET

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149 – 154 FEET

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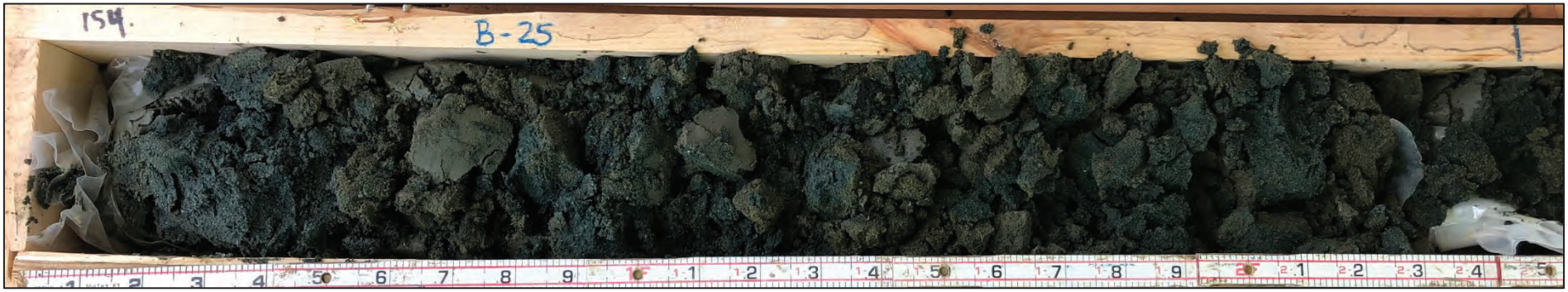



154 – 159 FEET

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159 – 163.5 FEET

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163.5 – 165 FEET

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-26**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,511**	Easting: **~ 349,102**		Start Card No. **N/A**
Equipment **GeoProbe 8150LS Tracked Sonic Rig**		Driller **Western States**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Lauren S. & Veronica B.**	Ground Elev. **~ -36 ft.**
Start Date **September 14, 2021**	End Date **September 17, 2021**	Total Depth **158.00 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil: Driving Resistance / Rock: Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0	S1	100			S- 1 (0.00-8.00) S- 1a (0.00-3.00) Silty SAND; SM; Gray; Nonplastic fines; Moist; Fine to medium sand; Few wood fragments; (Fill)	**0.00 - 18.00 Silty SAND to Silty SAND with some gravel, with cobbles; SM; Gray; Nonplastic fines; Moist; Fine to coarse, angular to subrounded gravel; Fine to coarse sand; Few to mostly wood and log fragments; (Fill)**		Borehole drilled from barge using rotary sonic drilling technique (6-inch hole); all depths are reported in feet below mudline.	
	S1a								
	S1b				S- 1b (3.00-8.00) Wood log, oriented vertically; Possible pile; (Fill)				
5									
	S2	20			S- 2 (8.00-18.00) Silty SAND with some gravel, with cobbles; SM; Gray; Nonplastic fines; Moist; Fine to coarse, angular to subrounded gravel; Fine to coarse sand; Numerous wood fragments; Poor recovery; (Fill)				
10									
15									
	S3	85			S- 3 (18.00-28.00)				
	S3a				S- 3a (18.00-23.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Moist to wet; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Trace organics; (Gravel Alluvium)	**18.00 - 23.50 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM;**			
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20						**Gray and brown; Nonplastic fines; Moist to wet; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Trace organics; (Gravel Alluvium)**			
	S3b				S- 3b (23.50-28.00) SAND with some silt; SP-SM; Gray; Nonplastic fines; Moist; Fine to coarse sand; Trace organics; (Sand Alluvium)	**23.50 - 33.00 SAND with some silt to Gravelly SAND with some silt; SP-SM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Trace organics; (Sand Alluvium)**			
25									
	S4	90			S- 4 (28.00-38.00)				
	S4a				S- 4a (28.00-30.00) Gravelly SAND with some silt; SP-SM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)				
30	S4b				S- 4b (30.00-33.00) SAND with some silt and gravel; SP-SM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)				
	S4c				S- 4c (33.00-38.00) Sandy GRAVEL with some silt; GP-GM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded gravel; Fine to coarse sand; (Sand/Silt Alluvium)	**33.00 - 38.00 Sandy GRAVEL with some silt; GP-GM; Nonplastic fines; Moist; Fine to coarse, subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**		S4c: 52% gravel, 40% sand, 8% fines.	
35									
	S5	90			S- 5 (38.00-48.00)				
	S5a				S- 5a (38.00-46.00) Silty SAND with some gravel; SM; Gray; Nonplastic fines; Moist; Fine, subrounded to rounded gravel; Fine to coarse sand; (Sand/Silt Alluvium)	**38.00 - 48.00 Silty SAND with trace to some gravel; SM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand/Silt Alluvium)**			
40									
45	S5b				S- 5b (46.00-47.50) Silty SAND with some gravel; SM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand/Silt Alluvium)				
	S5c				S- 5c (47.50-48.00) Silty SAND with some gravel; SM; Gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Sand and fines washed away during drilling; (Sand/Silt Alluvium)				
	S6	20			S- 6 (48.00-58.00) GRAVEL with some sand and trace silt, with cobbles and possible boulders; GW; Gray; Nonplastic fines; Moist; Fine to coarse, subangular to	**48.00 - 58.00 GRAVEL with some sand and trace silt, with cobbles and possible boulders;**		S6: 73% gravel, 24% sand, 3% fines.	
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50					rounded gravel; Fine to coarse sand; Poor recovery; (Gravel Alluvium)	**GW; Gray; Nonplastic fines; Moist; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
55									
	S7	75			S- 7 (58.00-68.00)				
	S7a				S- 7a (58.00-63.00) Silty SAND; SM; Dark gray; Nonplastic fines; Moist; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**58.00 - 63.00 Silty SAND; SM; Dark gray; Nonplastic fines; Moist; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)**			
60									
	S7b				S- 7b (63.00-68.00) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray and green-gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**63.00 - 68.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray and green-gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**			
65									
	S8	100			S- 8 (68.00-78.00)				
	S8a				S- 8a (68.00-70.50) Silty SAND; SM; Gray; Nonplastic to low plasticity fines; Moist; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**68.00 - 70.50 Silty SAND; SM; Gray; Nonplastic to low plasticity fines; Moist; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)**			
70									
	S8b				S- 8b (70.50-78.00) Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Yellow-brown, tan-brown, brown, and gray; Low to medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)	**70.50 - 78.00 Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Yellow-brown, tan-brown, brown, and gray; Low to medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Slight iron oxide staining; (Lower Troutdale Formation)**		S8b: 56% gravel, 30% sand, 14% fines.	
75									
	S9	100			S- 9 (78.00-88.00)				
	S9a				S- 9a (78.00-83.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, and gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**78.00 - 88.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM;**		S9a: 7% fines.	
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80						**Yellow-brown, brown and gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
	S9b				S- 9b (83.50-88.00) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown, brown, and gray; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
85									
	S10	100			S- 10 (88.00-98.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, green-gray, and gray; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)	**88.00 - 118.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, green-gray, and gray; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Some micas and sand adhered to gravel clasts; (Lower Troutdale Formation)**			
90									
95									
	S11	100			S- 11 (98.00-103.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, green-gray, and gray; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
100									
	S12	100			S- 12 (103.00-108.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, green-gray, and gray; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)				
105									
	S13	100			S- 13 (108.00-118.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, green-gray, and gray; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)				
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110									
115									
120	S14	100			S- 14 (118.00-128.00) GRAVEL with some clay and sand, with cobbles and possible boulders; GP-GC; Dark green-gray, gray, and dark green-black; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Dark green-black staining of gravel clasts; (Lower Troutdale Formation)	**118.00 - 138.00 GRAVEL with some clay and sand, with cobbles and possible boulders; GP-GC; Dark green-gray, gray, and dark green-black; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Some dark green-black staining on gravel clasts; Some micas and sand adhered to gravel clasts; (Lower Troutdale Formation)**			
125	S15	100			S- 15 (128.00-133.00) GRAVEL with some clay and sand, with cobbles and possible boulders; GP-GC; Dark green-gray, gray, and dark green-black; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining of gravel clasts; (Lower Troutdale Formation)			S15: 71% gravel, 19% sand, 10% fines.	
130	S16	100			S- 16 (133.00-138.00) GRAVEL with some clay and sand, with cobbles and possible boulders; GP-GC; Dark green-gray, gray, and dark green-black; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)				
135	S17	100			S- 17 (138.00-148.00)				
140	S17a				S- 17a (138.00-140.50) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Green-gray and gray; Low to medium plasticity; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts;	**138.00 - 140.50 Sandy clayey GRAVEL, with cobbles and possible boulders; GC;**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140					(Lower Troutdale Formation)	**Green-gray and gray; Low to medium plasticity; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)**			
	S17b				S- 17b (140.50-148.00) Clayey SILT with trace sand; MH; Blue-gray to gray-brown; High plasticity; Moist; Fine sand; Micaceous; (Sandy River Mudstone)	**140.50 - 151.00 Clayey SILT with trace sand; MH; Blue-gray to gray-brown; High plasticity; Moist; Fine sand; Micaceous; (Sandy River Mudstone)**		Atterberg Limits S17b: LL=76, PL=38, PI=38.	
145									
	S18	100			S- 18 (148.00-151.00) Clayey SILT with trace sand; MH; Blue-gray to gray-brown; High plasticity; Moist; Fine sand; Micaceous; (Sandy River Mudstone)				
150									
	S19	100			S- 19 (151.00-158.00) Silty SAND; SM; Dark gray, green-gray, and brown; Low plasticity fines; Moist; Fine to coarse sand; Micaceous; (Sandy River Mudstone)	**151.00 - 158.00 Silty SAND; SM; Dark gray, green-gray, and brown; Low plasticity fines; Moist; Fine to coarse sand; Micaceous; (Sandy River Mudstone)**			
155									
						158.00 End of hole			
160									
165									
170									



0 – 3 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

SONIC CORE PHOTOS
BORING B-26

January 2022 102636-009

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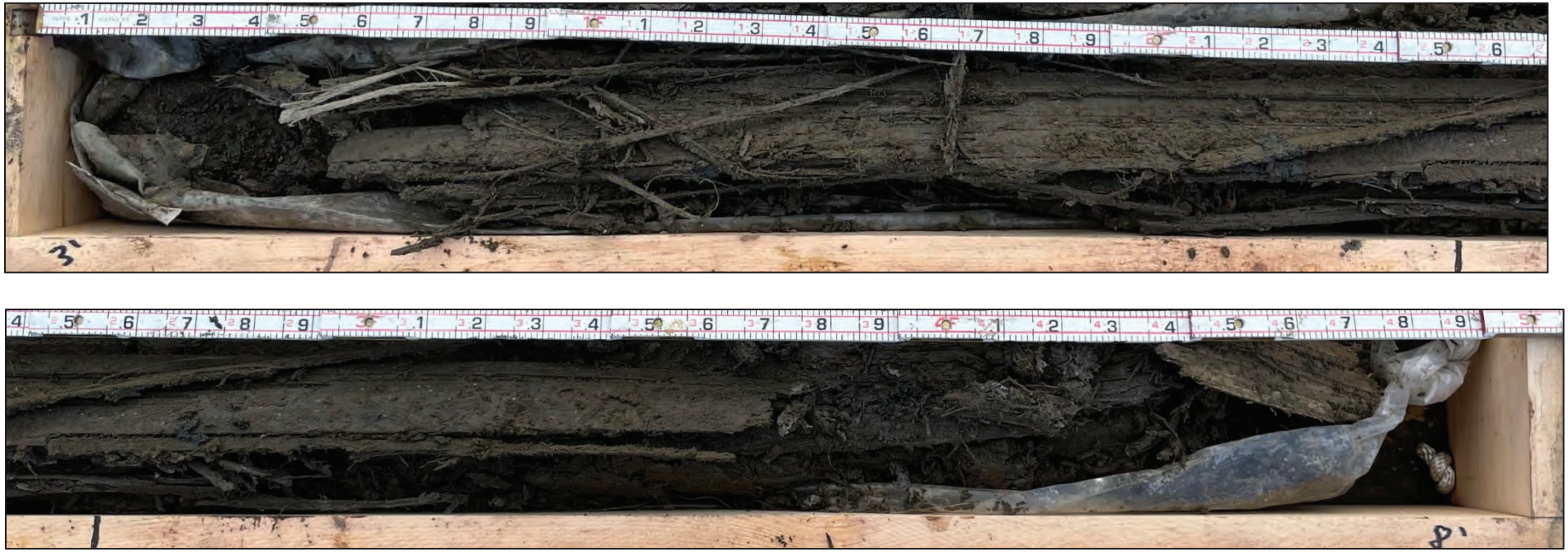

3 – 8 FEET

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8 – 18 FEET

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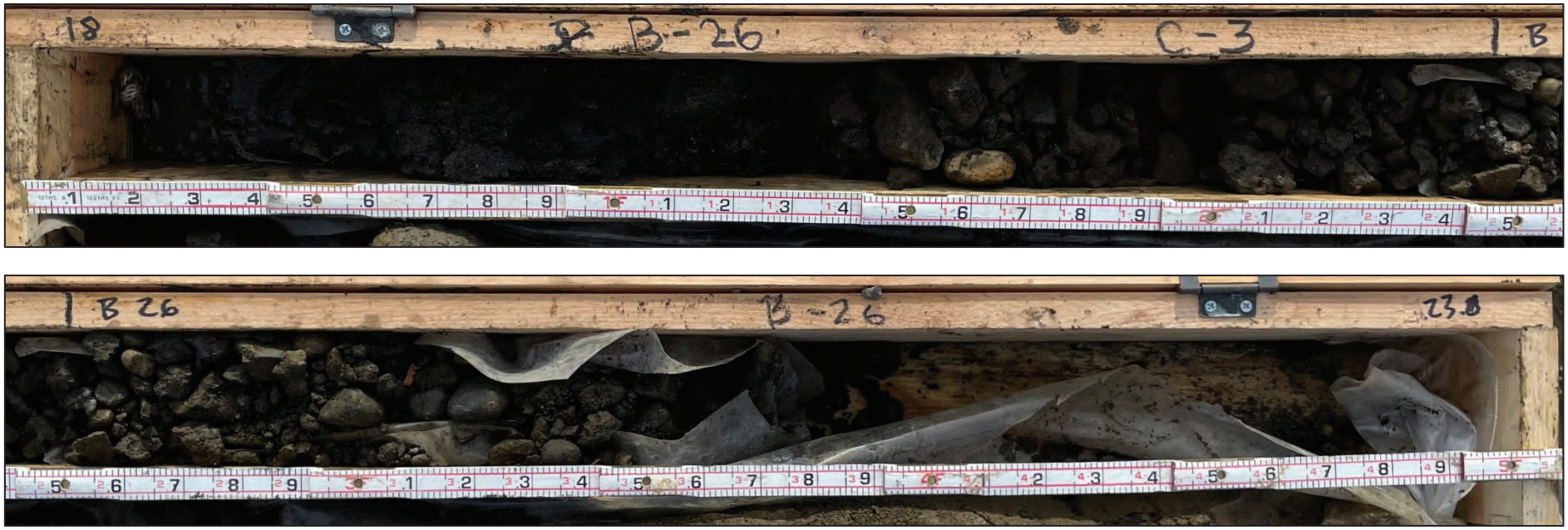

18 – 23 FEET

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23 – 28 FEET

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28 – 33.5 FEET

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33.5 – 38 FEET

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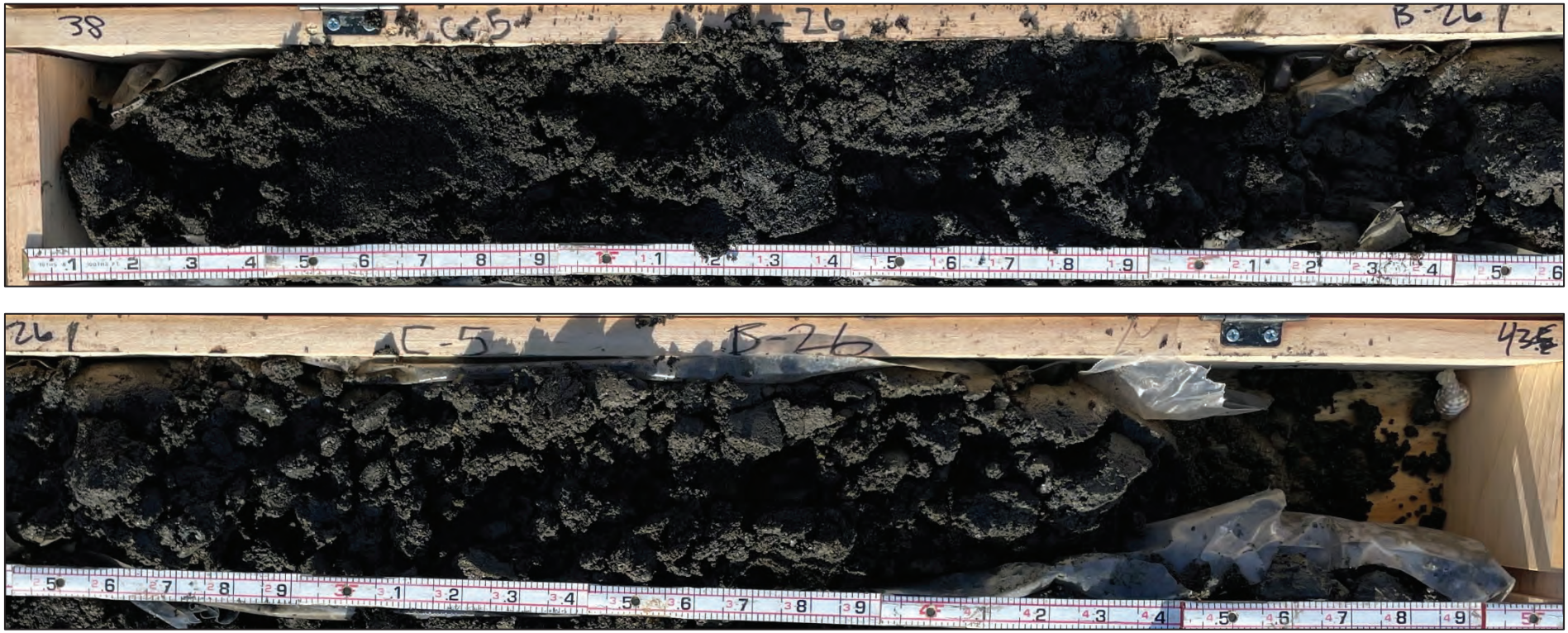

38 – 43 FEET

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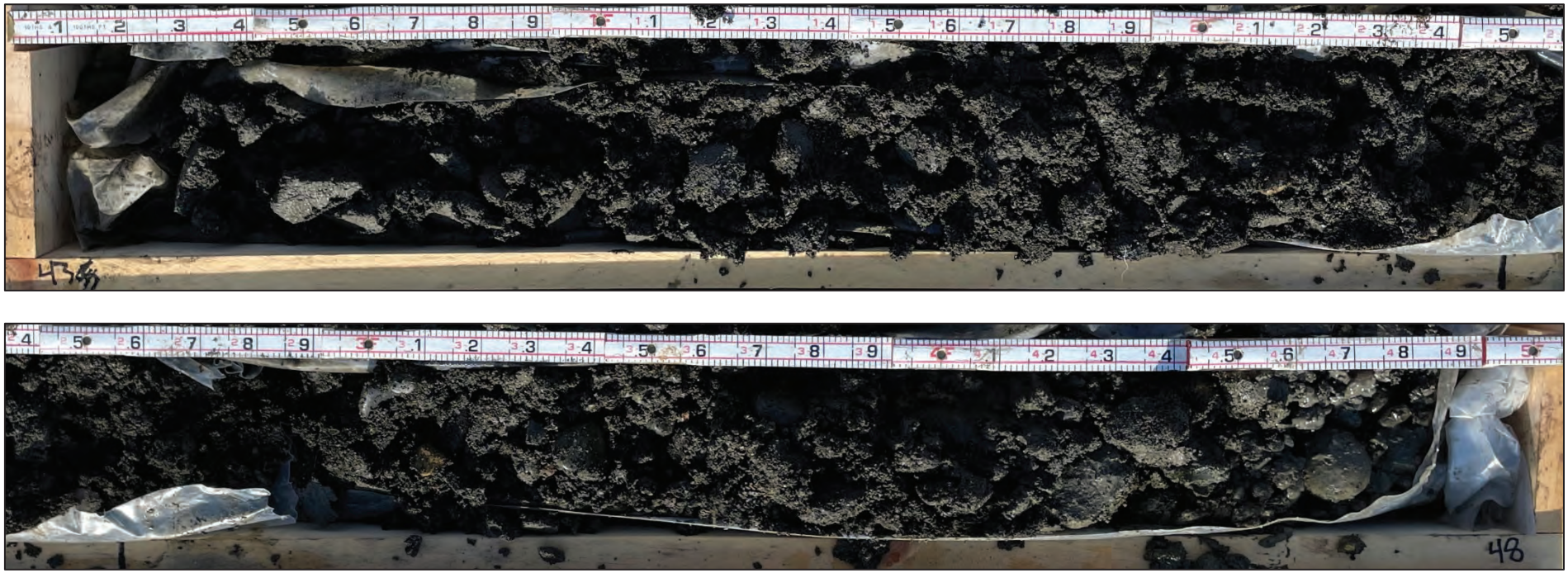

43 – 48 FEET

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48 – 58 FEET

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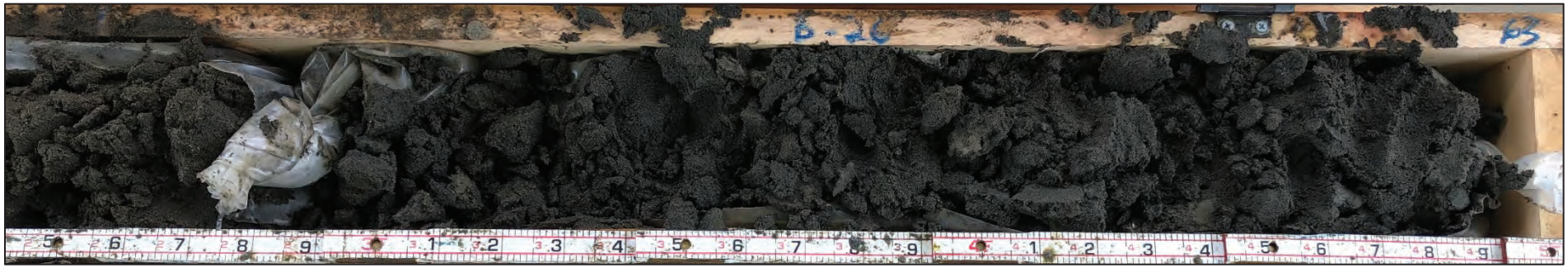

58 – 63 FEET

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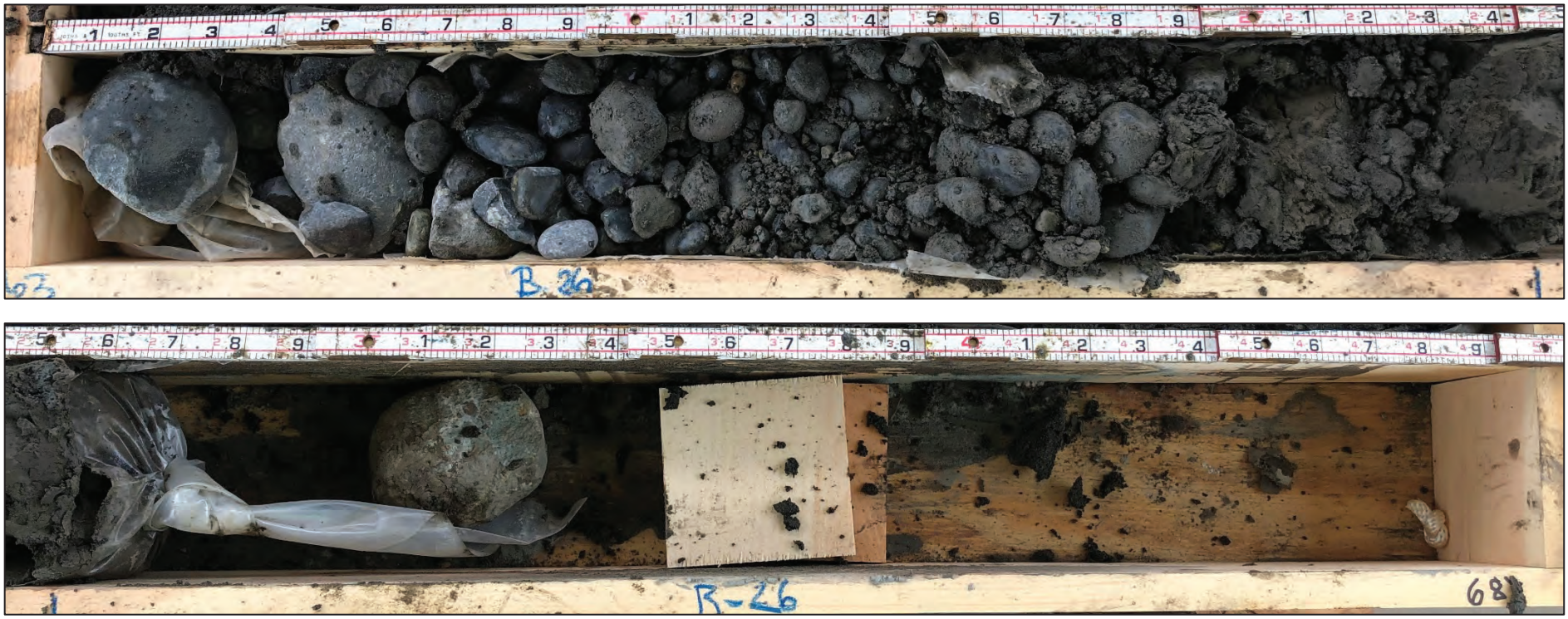

63 – 68 FEET

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68 – 73 FEET

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73 – 78 FEET

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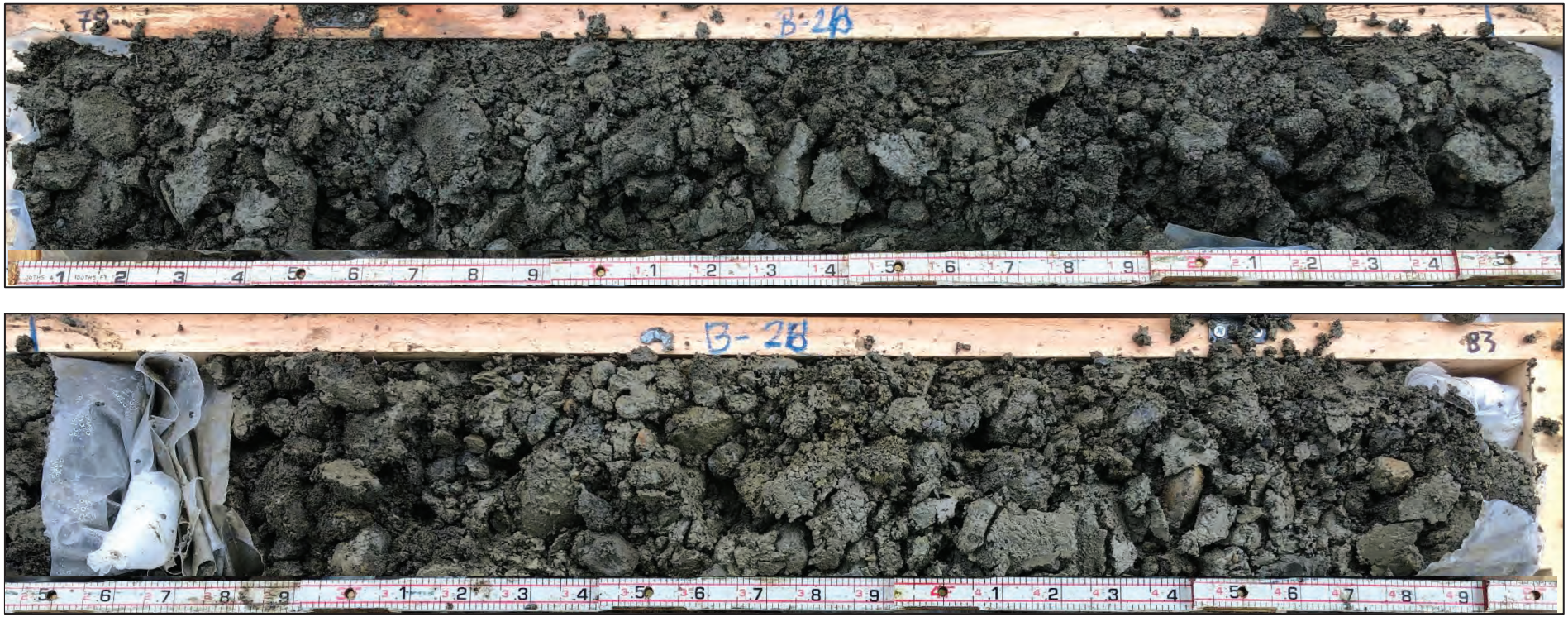

78 – 83 FEET

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83 – 88 FEET

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88 – 93 FEET

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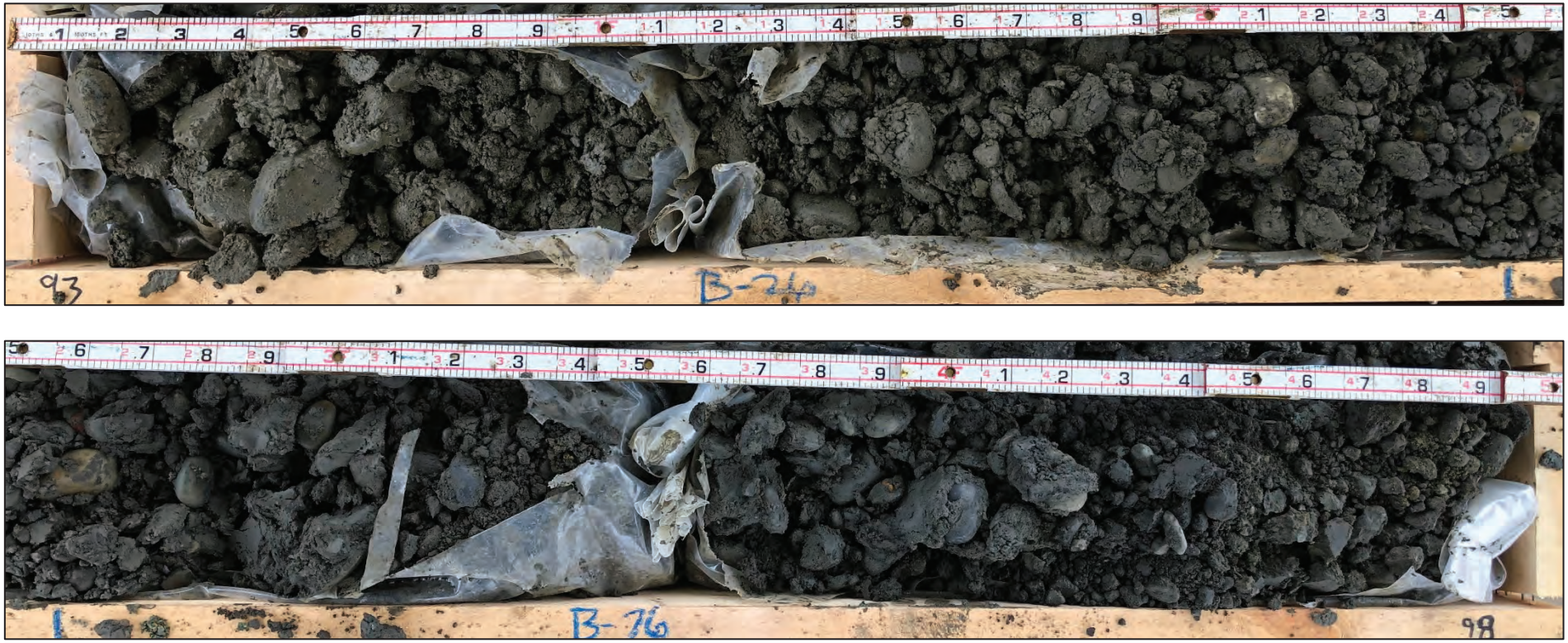

93 – 98 FEET

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98 – 103 FEET

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103 – 108 FEET

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108 – 113 FEET

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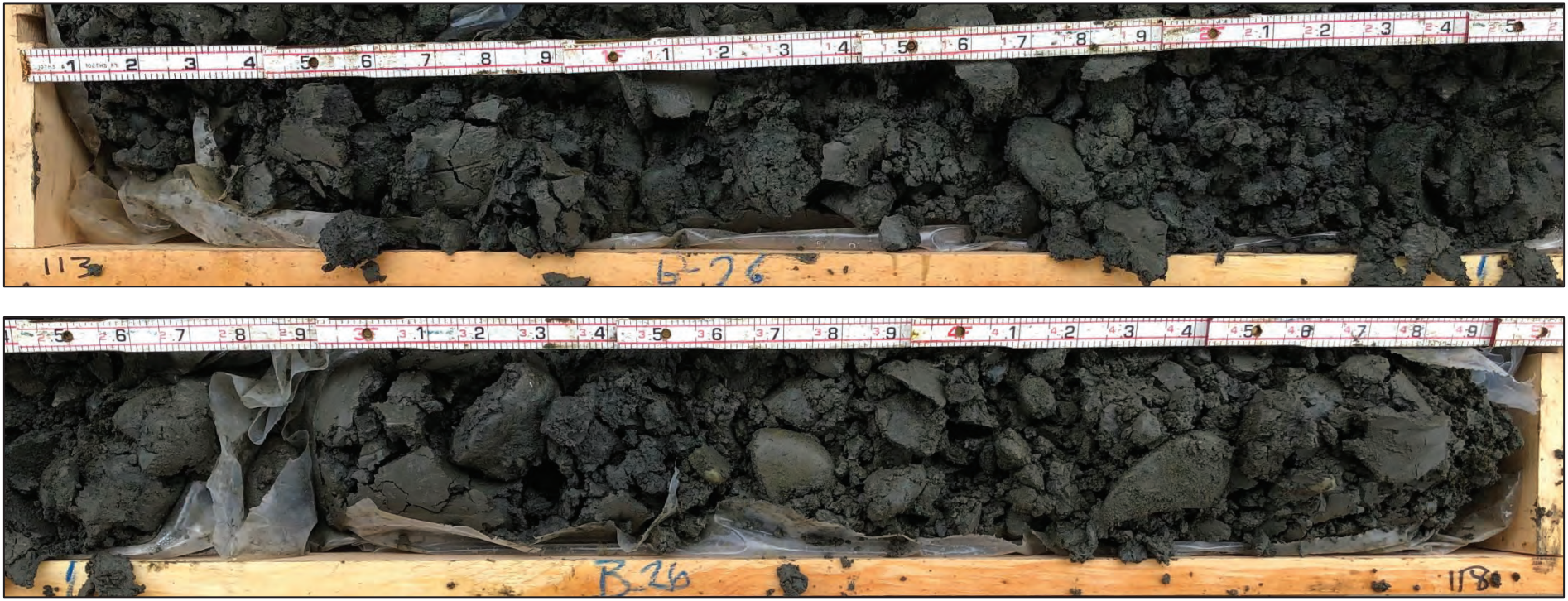

113 – 118 FEET

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118 – 123 FEET

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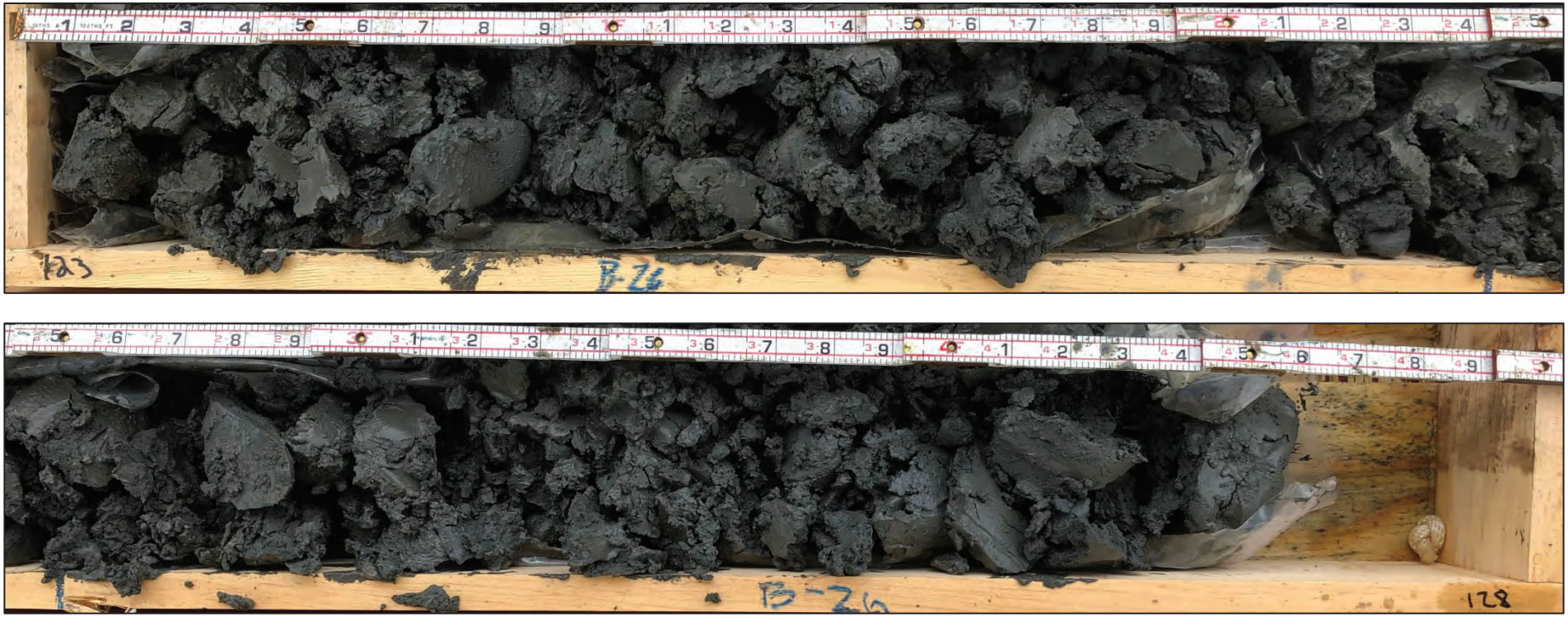

123 – 128 FEET

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128 – 133 FEET

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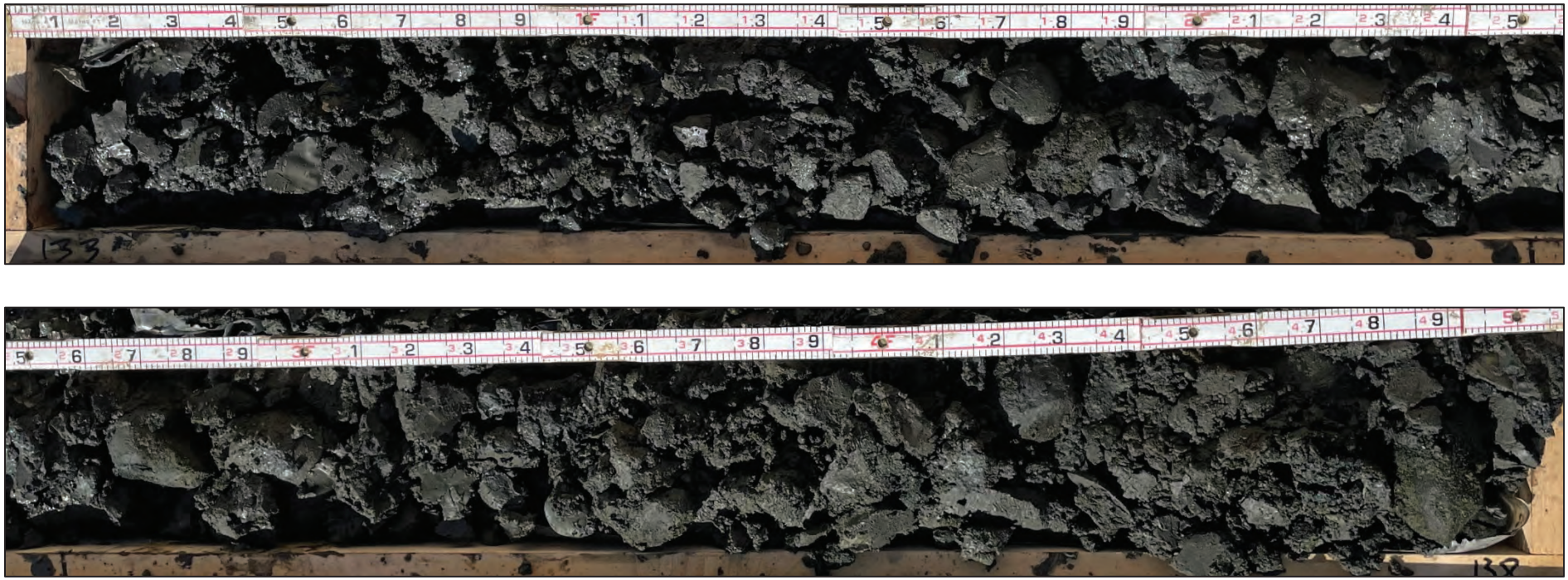

133 – 138 FEET

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138 – 143 FEET

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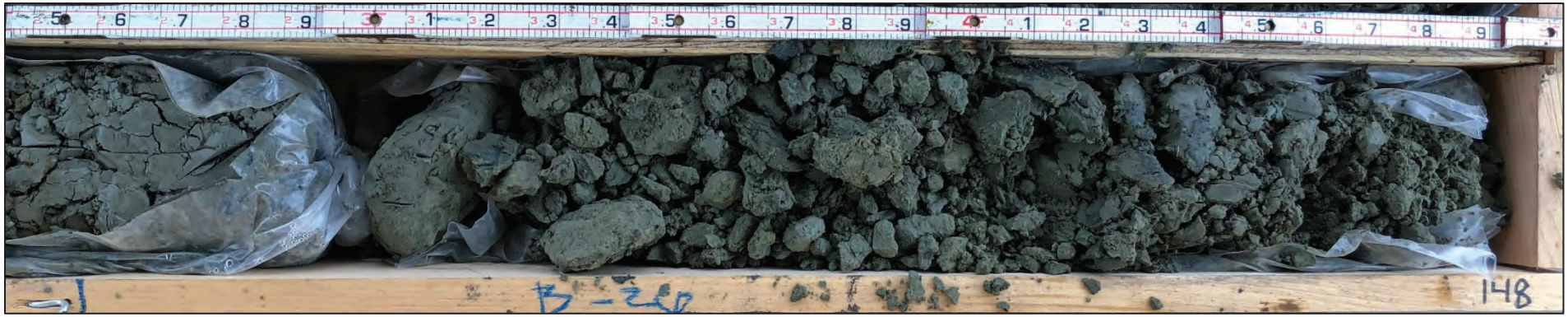

143 – 148 FEET

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148 – 153 FEET

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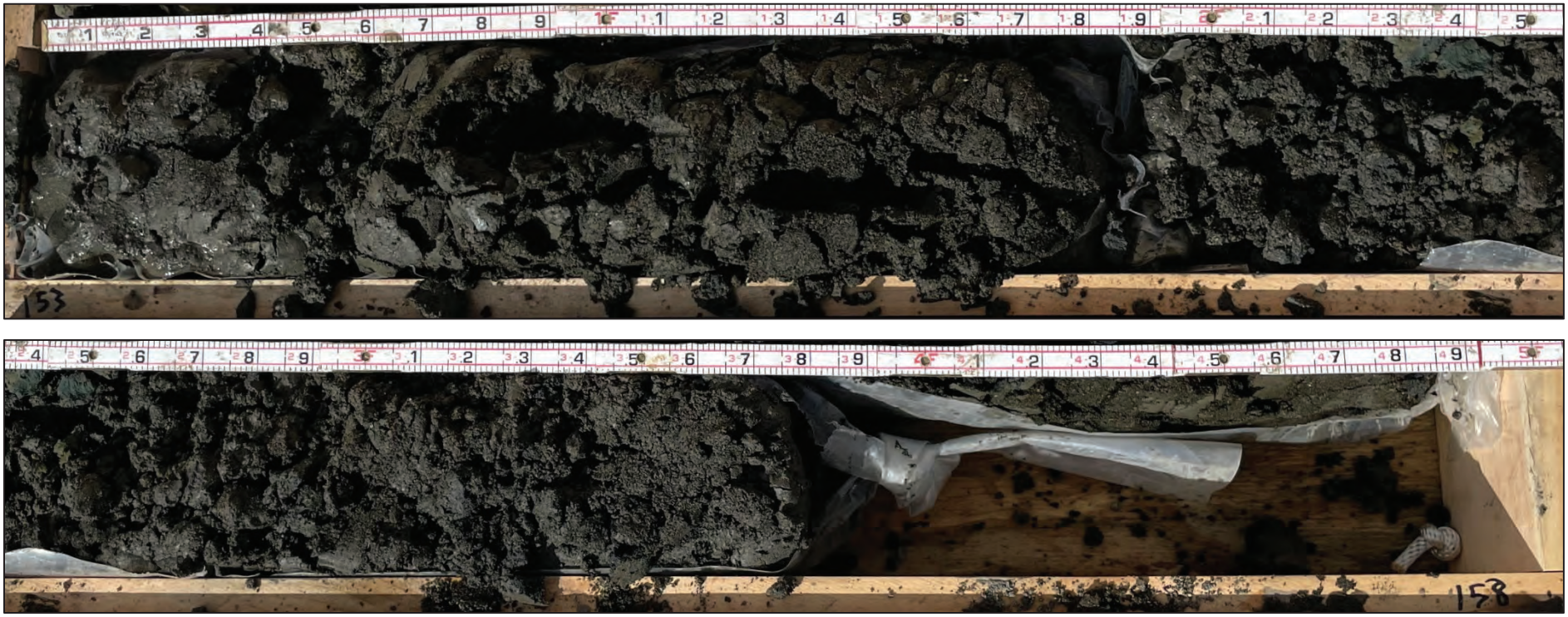

153 – 158 FEET

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

		Hole No.	**B-27**
Project **Earthquake Ready Burnside Bridge**	Purpose **Burnside Bridge**	E.A. No.	**N/A**
Highway **Burnside Street**	County **Multnomah**	Key No.	**N/A**
Hole Location Northing: **~ 172,371**	Easting: **~ 349,058**	Start Card No.	**N/A**
Equipment **CME-75 Truck Rig #5 (Hammer Efficiency = 80.8%)**	Driller **Western States/Adonis**	Bridge No.	**00511**
Project Geologist **Cody K. Sorensen, CEG**	Recorder **Veronica C. Biesiada**	Ground Elev.	**~ -32 ft.**
Start Date **August 5, 2021**	End Date **August 10, 2021** / Total Depth **178.80 ft**	Tube Height	**N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 7.00 Silty SAND with trace gravel; SM; Dark gray; Nonplastic fines; Wet; Very loose; Fine, subrounded to rounded gravel; Fine to medium sand; Micaceous; Trace organics and wood debris; (Sand Alluvium)**		Borehole drilled from barge using mud rotary drilling technique (5-inch hole); all depths are reported in feet below mudline; 6-inch ID steel casing installed to 62 feet below mudline; OYO suspension logging performed from 70 to 165 feet.	
5	N1	40	0-0-0		N- 1 (5.20-6.70) Silty SAND with trace gravel; SM; Dark gray; Nonplastic fines; Wet; Very loose; Fine, subrounded to rounded gravel; Fine to medium sand; Micaceous; Trace organics and wood debris; (Sand Alluvium)				
	N2	100	18-5-9	26	N- 2 (7.90-9.40) SAND with some silt and gravel; SP-SM; Dark gray; Nonplastic fines; Wet; Medium dense; Fine, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Sand Alluvium)	**7.00 - 9.50 SAND with some silt and gravel; SP-SM; Dark gray; Nonplastic fines; Wet; Medium dense; Fine, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Sand Alluvium)**			
10	N3	80	3-4-6	19	N- 3 (10.50-12.00) Gravelly SAND with trace silt; SP; Gray; Nonplastic fines; Wet; Loose to medium dense; Fine, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)	**9.50 - 12.50 Gravelly SAND with trace silt; SP; Gray; Nonplastic fines; Wet; Loose to medium dense; Fine, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)**		N3: 2% fines. Approximately 240 gallons of drilling mud loss from 11 to 18 feet.	
	N4	40	25-27-26		N- 4 (13.30-14.80) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)				
15	N5	33	8-4-5		N- 5 (15.90-17.40) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Loose; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**12.50 - 18.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Loose to very dense; Fine to coarse, subrounded to rounded gravel;**			
	N6	87	12-8-4	26	N- 6 (18.60-20.10) SAND with some silt and gravel; SP-SM; Brown and gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)			N6: 7% fines.	
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20						**Fine to coarse sand; (Gravel Alluvium)**			
	N7	67	3-3-5	24	N- 7 (21.10-22.60) SAND with some silt and gravel; SP-SM; Brown and gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)	**18.00 - 29.00 SAND with some silt and gravel; SP-SM; Brown, gray and dark gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)**			
25									
	N8	80	7-9-5	24	N- 8 (26.20-27.70) SAND with some silt and gravel; SP-SM; Dark gray; Nonplastic fines; Wet; Medium dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)				
30						**29.00 - 38.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Dense to very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**		Harder drilling at 29 feet.	
	N9	67	35-28-28		N- 9 (31.20-32.70) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)				
35									
	N10	60	22-21-10		N- 10 (35.80-37.30) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)				
40						**38.00 - 48.00 GRAVEL with some sand and trace silt, with cobbles and possible boulders; GP; Dark gray; Nonplastic fines; Moist to wet; Medium dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Approximately 850 gallons of drilling mud loss between 40 and 50 feet.	
	N11	20	11-16-13		N- 11 (40.40-41.90) GRAVEL with some sand and trace silt, with cobbles and possible boulders; GP; Dark gray; Nonplastic fines; Moist to wet; Medium dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Poor recovery; (Gravel Alluvium)				
	N12	13	12-11-7		N- 12 (44.20-45.70) GRAVEL with some sand and trace silt, with cobbles and possible boulders; GP; Dark gray; Nonplastic fines; Moist to wet; Medium dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Poor recovery; (Gravel Alluvium)				
45									
50						**48.00 - 53.50 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM;**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N13	20	13-6-12		N- 13 (50.10-51.60) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown and gray; Medium plasticity fines; Wet; Medium dense; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; Poor recovery; (Gravel Alluvium)	**Brown and gray; Medium plasticity fines; Wet; Medium dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**			
						53.50 - 58.00 Silty SAND with trace gravel; SM; Dark gray-brown; Nonplastic fines; Moist to wet; Medium dense; Fine, rounded gravel; Fine to medium sand; Micaceous; (Sand Alluvium)		Smoother drilling at 53.5 feet.	
55	N14	100	9-9-11	36	N- 14 (55.70-57.20) Silty SAND with trace gravel; SM; Dark gray-brown; Nonplastic fines; Moist to wet; Medium dense; Fine, rounded gravel; Fine to medium sand; Micaceous; (Sand Alluvium)			N14: 20% fines.	
						58.00 - 64.50 Silty SAND; SM; Gray; Nonplastic fines; Moist; Medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)			
60	N15	100	2-4-7	41	N- 15 (60.90-62.40) Silty SAND; SM; Gray; Nonplastic fines; Moist; Medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)				
						64.50 - 68.70 SILT with some sand; ML; Gray; Low plasticity; Moist; Very soft; Fine sand; Micaceous; Trace organics; (Sand/Silt Alluvium)			
65	N16	100	0-0-0	38	N- 16 (66.20-67.70) SILT with some sand; ML; Gray; Low plasticity; Moist; Very soft; Fine sand; Micaceous; Trace organics; (Sand/Silt Alluvium)			Atterberg Limits N16: LL=38, PL=29, PI=9.	
	U1	100			U- 1 (67.70-68.70) SILT with some sand; ML; Gray; Low plasticity; Moist; Very soft; Fine sand; Micaceous; (Sand/Silt Alluvium)			Shelby tube was only pushed 1 foot until refusal at 68.7 feet.	
	N17	100	27-50/3"		N- 17 (68.70-69.50) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Red-brown and gray-brown; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Gravel Alluvium)	**68.70 - 76.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Red-brown, gray-brown, brown, and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Gravel Alluvium)**			
70									
	N18	100	50/1st 5"		N- 18 (74.20-74.60) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Brown and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)				
75						**76.00 - 83.00 Clayey SILT with trace sand; MH; Gray to orange-brown; Medium plasticity; Moist; Hard; Fine sand; Micaceous; Stratified with some 2-inch thick interbeds of Silty SAND (SM);**		Smoother drilling at 76 feet.	
80	N19	100	12-21-25	36	N- 19 (79.40-80.90) Clayey SILT with trace sand; MH;			Atterberg Limits N19: LL=60, PL=44, PI=16.	

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80					Gray to orange-brown; Medium plasticity; Moist; Hard; Fine sand; Micaceous; Stratified with some 2-inch thick interbeds of Silty SAND (SM); (Upper Troutdale Formation)	**(Upper Troutdale Formation)**			
						83.00 - 88.50 SILT with some sand; ML; Gray; Low plasticity; Moist; Hard; Fine sand; Micaceous; Stratified with few 1/2-inch thick interbeds of Silty SAND (SM); (Upper Troutdale Formation)			
85	N20	100	7-11-22	40	N- 20 (84.50-86.00) SILT with some sand; ML; Gray; Low plasticity; Moist; Hard; Fine sand; Micaceous; Stratified with few 1/2-inch thick interbeds of Silty SAND (SM); (Upper Troutdale Formation)			Atterberg Limits N20: LL=44, PL=32, PI=12.	
						88.50 - 93.00 GRAVEL with some clay and some sand, with cobbles and possible boulders; GP-GC; Gray and dark green-black; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining of gravel clasts; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)		Harder drilling at 88.5 feet.	
90	N21	100	50/1st 3"		N- 21 (89.60-89.90) GRAVEL with some clay and some sand, with cobbles and possible boulders; GP-GC; Gray and dark green-black; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Dark green-black staining of gravel clasts; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)				
95	N22	67	50/1st 3"		N- 22 (95.00-95.30) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Red-brown, yellow-brown, brown, and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)	**93.00 - 108.00 Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Red-brown, yellow-brown, brown, and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)**			
100									
	N23	33	50/1st 3"		N- 23 (100.80-101.10) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Red-brown, yellow-brown, brown, and gray; Low plasticity fines; Moist; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Slight iron oxide staining; (Lower Troutdale Formation)				
105									
						108.00 - 115.00 Silty SAND; SM; Dark gray to black; Nonplastic fines; Moist; Very dense;		Smoother drilling at 108 feet.	
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110						**Fine to medium sand; Micaceous; (Sandy River Mudstone)**			
	N24	100	25-48-50	28	N- 24 (111.20-112.70) SAND with some silt; SP-SM; Dark gray to black; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; (Sandy River Mudstone)			N24: 12% fines.	
115						**115.00 - 130.00 Clayey SAND; SC; Green-gray; Low to medium plasticity fines; Moist; Very dense; Fine to medium sand; Micaceous; (Sandy River Mudstone)**			
120									
	N25	100	13-27-35	34	N- 25 (121.10-122.60) Clayey SAND; SC; Green-gray; Low to medium plasticity fines; Moist; Very dense; Fine to medium sand; Micaceous; (Sandy River Mudstone)			N25: 71% sand, 29% fines.	
125								Few interbeds of CLAY to Silty CLAY (CH/CL) between 115 and 135 feet, based on drill action and cuttings.	
130						**130.00 - 143.00 Silty SAND; SM; Green-gray; Low plasticity fines; Moist; Very dense; Fine to coarse sand; Micaceous; (Sandy River Mudstone)**			
135									
	N26	100	16-26-30	30	N- 26 (138.10-139.60) Silty SAND; SM; Green-gray; Low plasticity fines; Moist; Very dense; Fine to coarse sand; Micaceous; (Sandy River Mudstone)			N26: 18% fines.	
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140					SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.				
						143.00 - 155.00 Clayey SILT with trace sand; MH; Gray; Medium plasticity; Moist; Very stiff; Fine sand; Micaceous; (Sandy River Mudstone)			
145									
	N27	100	4-8-13	45	N- 27 (148.60-150.10) Clayey SILT with trace sand; MH; Gray; Medium plasticity; Moist; Very stiff; Fine sand; Micaceous; (Sandy River Mudstone)			Atterberg Limits N27: LL=63, PL=36, PI=27.	
150									
155						**155.00 - 165.00 Silty SAND; SM; Gray; Low plasticity fines; Moist; Very dense; Fine to medium sand; Micaceous; (Sandy River Mudstone)**		Pressuremeter Tests at 153.5 and 155 feet.	
160									
	N28	100	17-33-38	27	N- 28 (160.30-161.80) Silty SAND; SM; Gray; Low plasticity fines; Moist; Very dense; Fine to medium sand; Micaceous; (Sandy River Mudstone)			N28: 85% sand, 15% fines.	
165						**165.00 - 174.00 Silty SAND; SM; Gray; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; (Sandy River Mudstone)**			
170									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
170									
	N29	100	33-50/5"	31	N- 29 (171.00-171.90) Silty SAND; SM; Gray to dark gray; Nonplastic fines; Moist; Very dense; Fine to medium sand; Micaceous; (Sandy River Mudstone)				
						174.00 - 178.80 Silty SAND; SM; Gray to dark gray; Low plasticity fines; Moist; Very dense; Fine to medium sand; Micaceous; (Sandy River Mudstone)			
175									
	N30	100	29-50/5"	29	N- 30 (177.90-178.80) Silty SAND; SM; Gray to dark gray; Low plasticity fines; Moist; Very dense; Fine to medium sand; Micaceous; (Sandy River Mudstone)				
						178.80 End of hole			
180									
185									
190									
195									
200									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-28**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,556**	Easting: **~ 349,386**		Start Card No. **N/A**
Equipment **GeoProbe 8150LS Tracked Sonic Rig**		Driller **Western States/Joe**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Kyle T. Romney**	Ground Elev. **~ -61 ft.**
Start Date **October 19, 2021**	End Date **October 22, 2021**	Total Depth **136.40 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil: Driving Resistance / Rock: Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0	S1	50			S- 1 (0.00-24.40) S- 1a (0.00-8.50) SAND with some silt and trace gravel; SP-SM; Brown to gray; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to medium sand; (Sand Alluvium)	**0.00 - 8.50 SAND with some silt and trace gravel; SP-SM; Brown; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to medium sand; (Sand Alluvium)**		Borehole drilled from barge using rotary sonic drilling technique (6-inch hole); all depths are reported in feet below mudline.	
	S1a								
5									
	S1b				S- 1b (8.50-24.40) SAND with trace silt and gravel; SP; Brown and gray; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to medium sand; (Sand Alluvium)	**8.50 - 26.20 SAND with trace silt and gravel; SP; Brown and gray; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to medium sand; (Sand Alluvium)**		S1b: 4% fines.	
10									
15									
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20									
25	S2	50			S- 2 (24.40-45.00)				
	S2a				S- 2a (24.40-26.20) SAND with trace silt and gravel; SP; Brown and gray; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to medium sand; (Sand Alluvium)				
	S2b				S- 2b (26.20-27.50) Silty SAND; SM; Blue-gray; Low plasticity fines; Wet; Fine to medium sand; (Sand Alluvium)	**26.20 - 27.50 Silty SAND; SM; Blue-gray; Low plasticity fines; Wet; Fine to medium sand; (Sand Alluvium)**			
	S2c				S- 2c (27.50-29.70) SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Fine to coarse sand; Trace to some organics; (Sand Alluvium)	**27.50 - 29.70 SAND with trace silt; SP; Dark gray; Nonplastic fines; Wet; Fine to coarse sand; Trace to some organics; (Sand Alluvium)**			
30	S2d				S- 2d (29.70-45.00) Silty SAND; SM; Gray; Nonplastic fines; Wet; Fine to medium sand; Micaceous; (Sand Alluvium)	**29.70 - 45.00 Silty SAND; SM; Gray; Nonplastic fines; Wet; Fine to medium sand; Micaceous; (Sand Alluvium)**		S2d: 20% fines.	
35									
40									
45	S3	70			S- 3 (45.00-65.00)				
	S3a				S- 3a (45.00-47.50) SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to coarse sand; (Sand Alluvium)	**45.00 - 47.50 SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to coarse sand; (Sand Alluvium)**			
	S3b				S- 3b (47.50-65.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**47.50 - 68.00 GRAVEL with some silt and sand, with cobbles and possible**		S3b: 70% gravel, 25% sand, 6% fines.	
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50						**boulders; GP-GM; Gray; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
55									
60									
65	S4	100			S- 4 (65.00-84.00)				
	S4a				S- 4a (65.00-68.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)				
	S4b				S- 4b (68.00-84.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray to yellow-brown; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Zones of weak cementation; (Lower Troutdale Formation)	**68.00 - 84.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray to yellow-brown; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Zones of weak cementation; (Lower Troutdale Formation)**			
70									
75									
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80									
	S5	100			S- 5 (84.00-99.80) S- 5a (84.00-95.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray to yellow-brown; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Zones of weak cementation; Micaceous; (Lower Troutdale Formation)	**84.00 - 95.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray to yellow-brown; Nonplastic to low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Zones of weak cementation; Micaceous; (Lower Troutdale Formation)**		S5a: 73% gravel, 17% sand, 10% fines.	
	S5a								
85									
90									
95	S5b				S- 5b (95.00-99.80) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark gray; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**95.00 - 99.80 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark gray; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
100	S6	100			S- 6 (99.80-115.60) S- 6a (99.80-115.60) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray, brown and yellow-brown; Nonplastic to low plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**99.80 - 121.50 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray, brown, and yellow-brown; Nonplastic to low plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Occasional weakly cemented zones with micas and sand adhered to gravel clasts; (Lower Troutdale Formation)**			
	S6a								
105									
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110					SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.				
115	S7	100			S- 7 (115.60-136.40)				
	S7a				S- 7a (115.60-121.50) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray, brown and yellow-brown; Nonplastic to low plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)				
120	S7b				S- 7b (121.50-123.00) Silty SAND with some gravel; SM; Yellow-brown; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**121.50 - 123.00 Silty SAND with some gravel; SM; Yellow-brown; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**			
	S7c				S- 7c (123.00-131.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GW-GM; Brown to yellow-brown; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**123.00 - 131.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GW-GM; Brown to yellow-brown; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**		S7c: 63% gravel, 30% sand, 7% fines.	
125									
130	S7d				S- 7d (131.00-133.00) Silty SAND; SM; Yellow-brown; Nonplastic fines; Moist to wet; Fine to medium sand; Micaceous; (Lower Troutdale Formation)	**131.00 - 133.00 Silty SAND; SM; Yellow-brown; Nonplastic fines; Moist to wet; Fine to medium sand; Micaceous; (Lower Troutdale Formation)**			
	S7e				S- 7e (133.00-136.40) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark green-gray to yellow-brown; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**133.00 - 136.40 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Dark green-gray to yellow-brown; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower**			
135									
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140						**Troutdale Formation)**			
						136.40 **End of hole**			
145									
150									
155									
160									
165									
170									



0 – 5 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

SONIC CORE PHOTOS
BORING B-28

January 2022 102636-009

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5 – 12.5 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

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24.4 – 27.5 FEET

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27.5 – 32.5 FEET

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32.5 – 47.5 FEET

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47.5 – 53.5 FEET

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53.5 – 59 FEET

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65 – 69 FEET

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69 – 74.5 FEET

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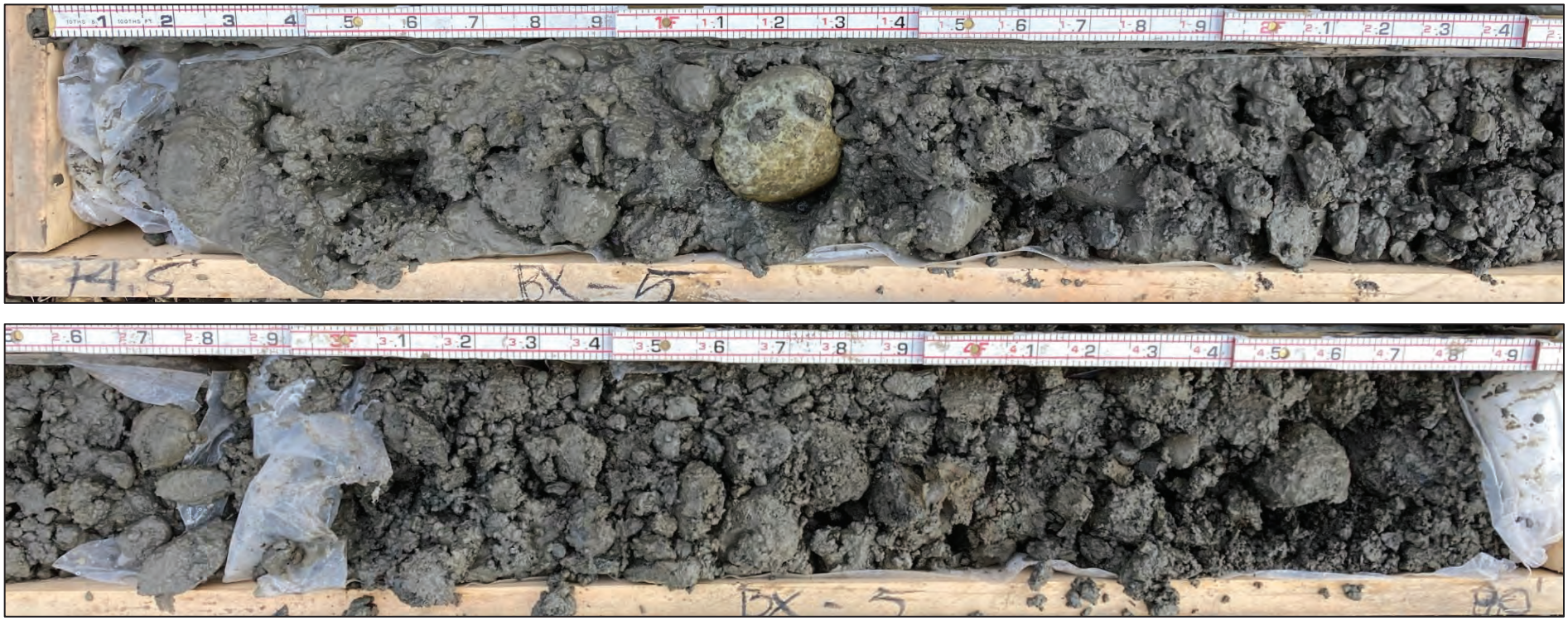

74.5 – 80 FEET

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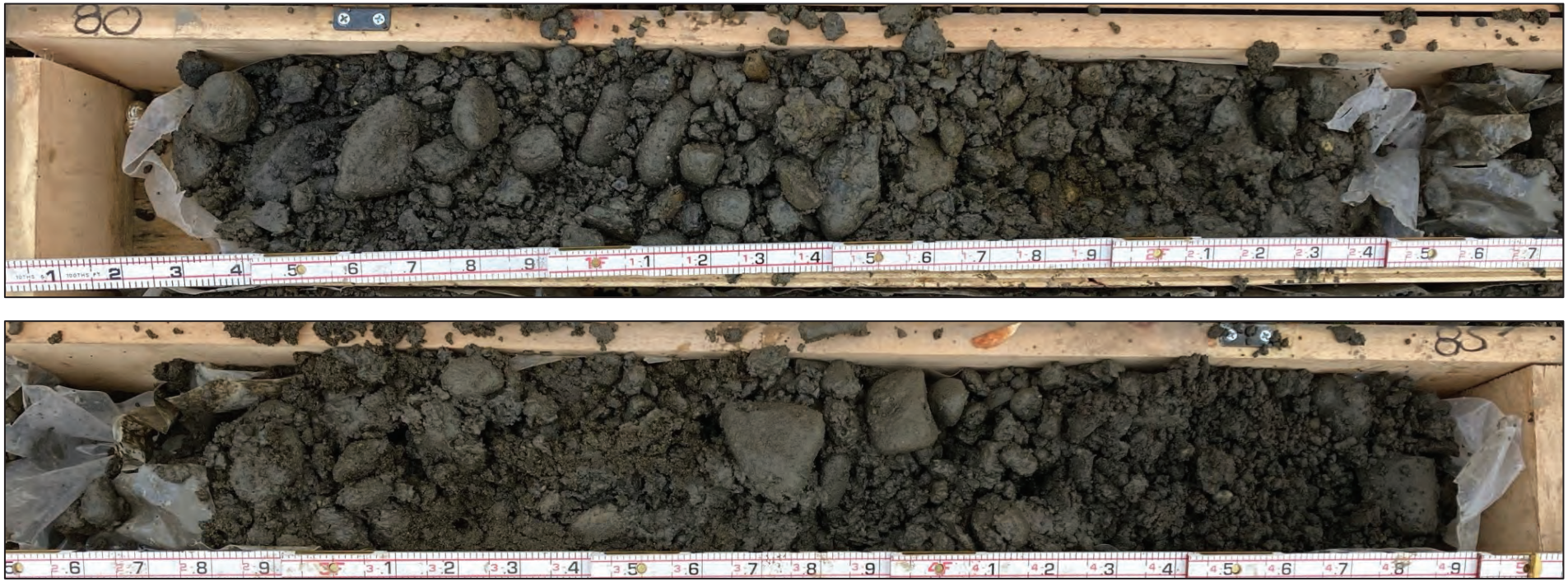

80 – 85 FEET

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85 – 88.5 FEET

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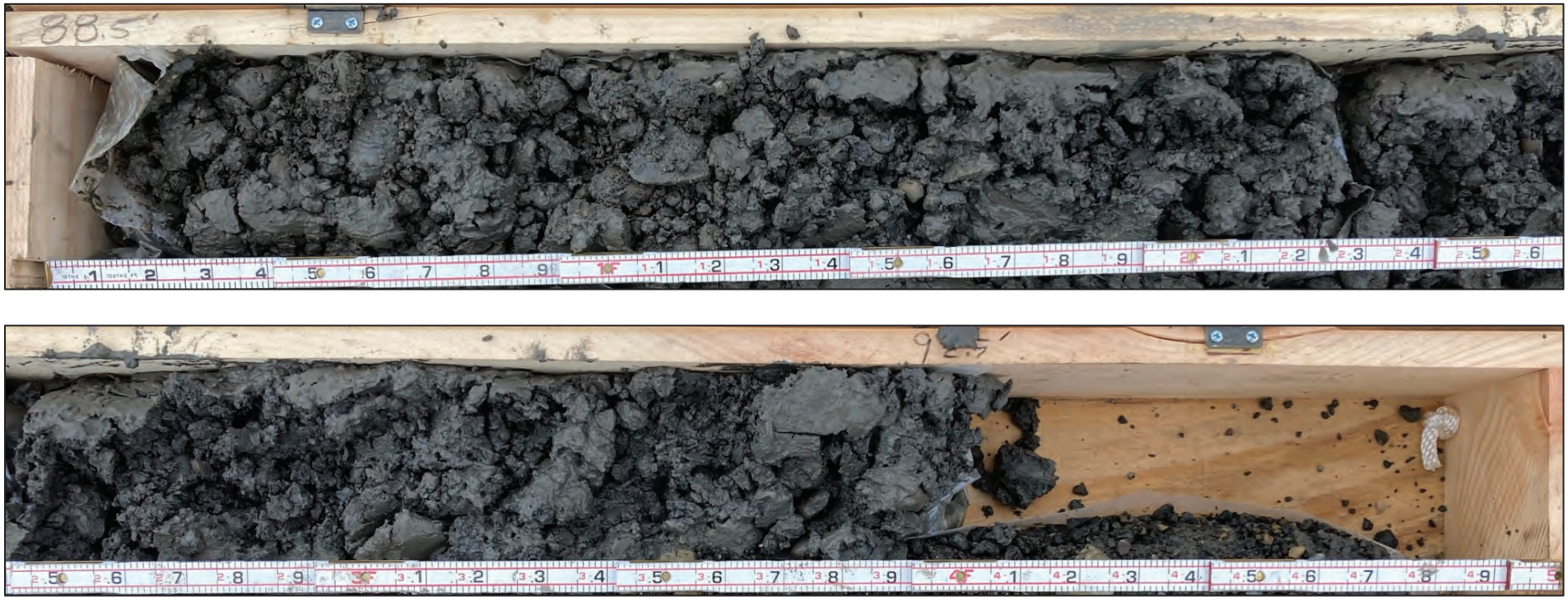

88.5 – 92.5 FEET

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92.5 – 97.5 FEET

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97.5 – 102 FEET

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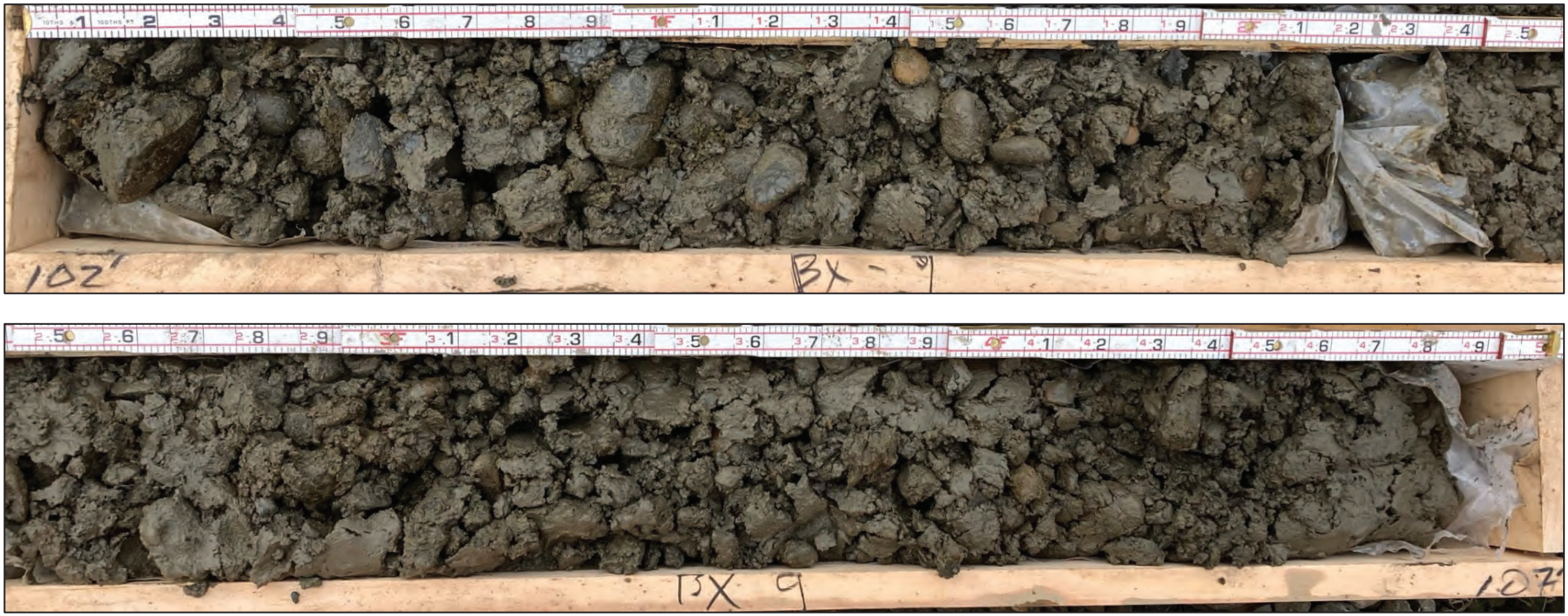

102 – 107 FEET

Earthquake Ready Burnside Bridge
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115 – 119 FEET

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119 – 123 FEET

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123 – 128 FEET

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128 – 133 FEET

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133 – 136.4 FEET

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-29**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,362**	Easting: **~ 349,316**		Start Card No. **N/A**
Equipment **GeoProbe 8150LS Tracked Sonic Rig**		Driller **Western States/Joe**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Kyle T. Romney**	Ground Elev. **~ -51 ft.**
Start Date **October 12, 2021**	End Date **October 14, 2021**	Total Depth **160.30 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil Driving Resistance / Rock Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0	S1	50			S- 1 (0.00-25.00) Poor recovery S- 1a (0.00-10.50) SAND with some silt and gravel; SP-SM; Dark gray; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to coarse sand; Metal fragments; (Fill)	**0.00 - 10.50 SAND with some silt and gravel; SP-SM; Dark gray; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to coarse sand; Metal fragments; (Fill)**		Borehole drilled from barge using rotary sonic drilling technique (6-inch hole); all depths are reported in feet below mudline.	
	S1a								
5									
10	S1b				S- 1b (10.50-25.00) SAND with trace silt and gravel; SP; Dark gray; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to medium sand; (Sand Alluvium)	**10.50 - 58.60 SAND with trace silt and gravel; SP; Dark gray; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to medium sand; (Sand Alluvium)**			
15									
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20									
25	S2	100			S- 2 (25.00-40.00) SAND with trace silt and gravel; SP; Dark gray; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to medium sand; (Sand Alluvium)			S2: 2% fines.	
30									
35									
40	S3	100			S- 3 (40.00-58.60) SAND with trace silt and gravel; SP; Dark gray; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to medium sand; (Sand Alluvium)			S3: 3% fines.	
45									
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50									
55									
	S4	100			S- 4 (58.60-80.00) (Gravel Alluvium)	**58.60 - 62.00**			
	S4a				S- 4a (58.60-62.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray to brown; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; (Gravel Alluvium)	**GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray to brown; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; (Gravel Alluvium)**			
60									
	S4b				S- 4b (62.00-65.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Low plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**62.00 - 65.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Low plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
65	S4c				S- 4c (65.00-76.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Brown to yellow brown; Low plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micas adhered to gravel and cobbles clasts; Zones of weak cementation; Mostly cobbles from 73.5 to 76 feet.; (Lower Troutdale Formation)	**65.00 - 76.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Brown to yellow-brown; Low plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micas adhered to gravel and cobbles clasts; Zones of weak cementation; Mostly cobbles from 73.5 to 76 feet; (Lower Troutdale Formation)**			
70									
75									
	S4d				S- 4d (76.00-80.00) Sandy GRAVEL with some silt, with cobbles and possible boulders; GW-GM; Gray; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Zones of weak cementation; (Lower Troutdale Formation)	**76.00 - 90.50 Sandy GRAVEL with some silt, with cobbles and possible boulders; GW-GM; Gray; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand;**		S4d: 61% gravel, 30% sand, 9% fines.	
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	S5	100			S- 5 (80.00-104.40) S- 5a (80.00-90.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Zones of weak cementation; (Lower Troutdale Formation)	**Zones of weak cementation; (Lower Troutdale Formation)**			
	S5a								
85									
90									
	S5b				S- 5b (90.50-94.00) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Gray; Medium plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)	**90.50 - 94.00 Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Gray; Medium plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)**			
	S5c				S- 5c (94.00-104.40) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray to yellow-brown; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)	**94.00 - 126.00 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray to yellow-brown; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)**			
95									
100									
	S6	100			S- 6 (104.40-115.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray to yellow-brown; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)				
105									
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110					SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.				
115	S7	100			S- 7 (115.00-121.50) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray to yellow-brown; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)				
120	S8	94			S- 8 (121.50-136.40)				
	S8a				S- 8a (121.50-126.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Gray to yellow-brown; Low plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)				
125	S8b				S- 8b (126.00-129.00) Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Dark gray; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)	**126.00 - 129.00 Clayey GRAVEL with some sand, with cobbles and possible boulders; GC; Dark gray; Medium plasticity fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Lower Troutdale Formation)**			
	S8c				S- 8c (129.00-135.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic to low plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Stratified with 4- to 6-inch interbeds of Clayey GRAVEL with some sand (GC); (Lower Troutdale Formation)	**129.00 - 138.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic to low plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Stratified with 4- to 6-inch interbeds of Clayey GRAVEL with some sand (GC); (Lower Troutdale Formation)**		S8c: 56% gravel, 25% sand, 19% fines.	
130									
135	S8d				S- 8d (135.50-136.40) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic to low plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Stratified with 4- to 6-inch interbeds of Clayey GRAVEL with some sand (GC); (Lower Troutdale Formation)				
	S9	100			S- 9 (136.40-150.00)				
	S9a				S- 9a (136.40-138.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic to low plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Stratified with 4- to 6-inch interbeds of Clayey GRAVEL with some sand (GC); (Lower Troutdale Formation)				
	S9b				S- 9b (138.00-140.00) CLAY with trace sand; CH; Blue;	**138.00 - 140.00 CLAY with trace sand; CH; Blue; High plasticity; Moist; Fine**		Atterberg Limits S9b: LL=61, PL=29, PI=32.	
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	S9c				High plasticity; Moist; Fine sand; Slight iron oxide staining; (Sandy River Mudstone) S- 9c (140.00-141.00) Silty SAND; SM; Blue-gray; Nonplastic to low plasticity fines; Moist; Fine to medium sand; (Sandy River Mudstone)	**sand; Slight iron oxide staining; (Sandy River Mudstone)**			
	S9d				S- 9d (141.00-150.00) Silty SAND; SM; Gray; Nonplastic fines; Moist; Fine to medium sand; (Sandy River Mudstone)	**140.00 - 141.00 Silty SAND; SM; Blue-gray; Nonplastic to low plasticity fines; Moist; Fine to medium sand; (Sandy River Mudstone)**			
145						**141.00 - 152.00 Silty SAND; SM; Gray; Nonplastic fines; Moist; Fine to medium sand; (Sandy River Mudstone)**			
150	S10	100			S- 10 (150.00-160.30)				
	S10a				S- 10a (150.00-152.00) Silty SAND; SM; Gray; Nonplastic fines; Moist; Fine to medium sand; (Sandy River Mudstone)				
	S10b				S- 10b (152.00-160.30) SAND with some silt; SP-SM; Blue-green; Nonplastic to low plasticity fines; Moist; Fine to medium sand; Micaceous; Stratified with 4- to 6-inch interbeds of Sandy SILT (ML); (Sandy River Mudstone)	**152.00 - 160.30 SAND with some silt; SP-SM; Blue-green; Nonplastic to low plasticity fines; Moist; Fine to medium sand; Micaceous; Stratified with 4- to 6-inch interbeds of Sandy SILT (ML); (Sandy River Mudstone)**		S10b: 6% fines.	
155									
160						**160.30 End of hole**			
165									
170									



0 – 2.5 FEET

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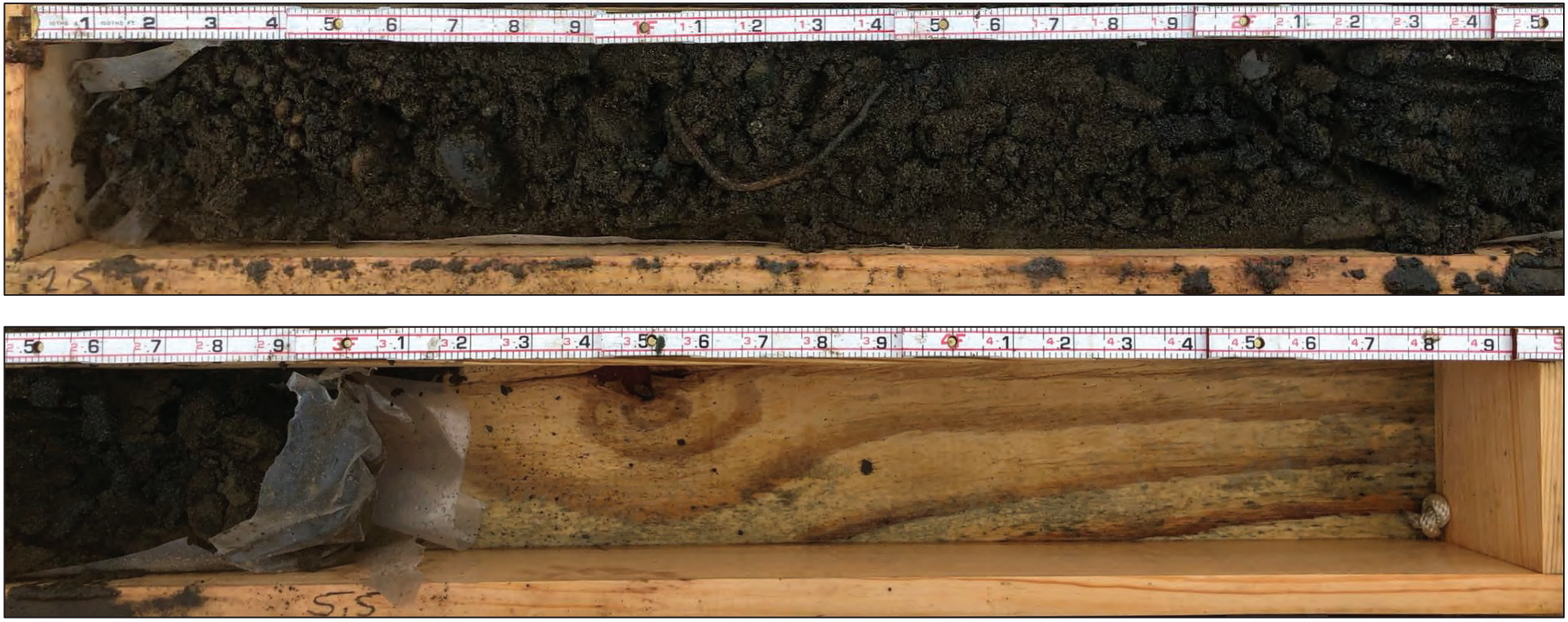

2.5 – 5.5 FEET

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5.5 – 9 FEET

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9 – 12 FEET

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19 – 22 FEET

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22 – 26.5 FEET

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26.5 – 30.5 FEET

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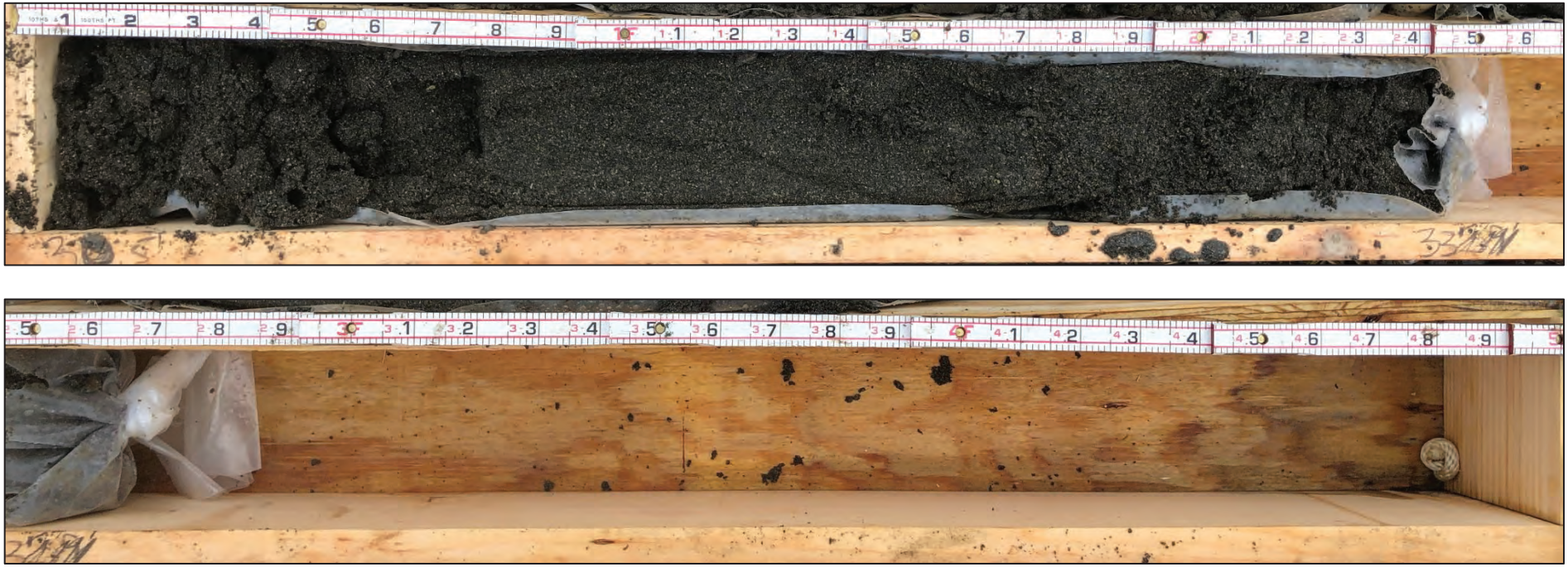

30.5 – 33 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

SONIC CORE PHOTOS
BORING B-29

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33 – 38 FEET

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38 – 42 FEET

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42 – 47 FEET

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47 – 52 FEET

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52 – 57 FEET

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57 – 62 FEET

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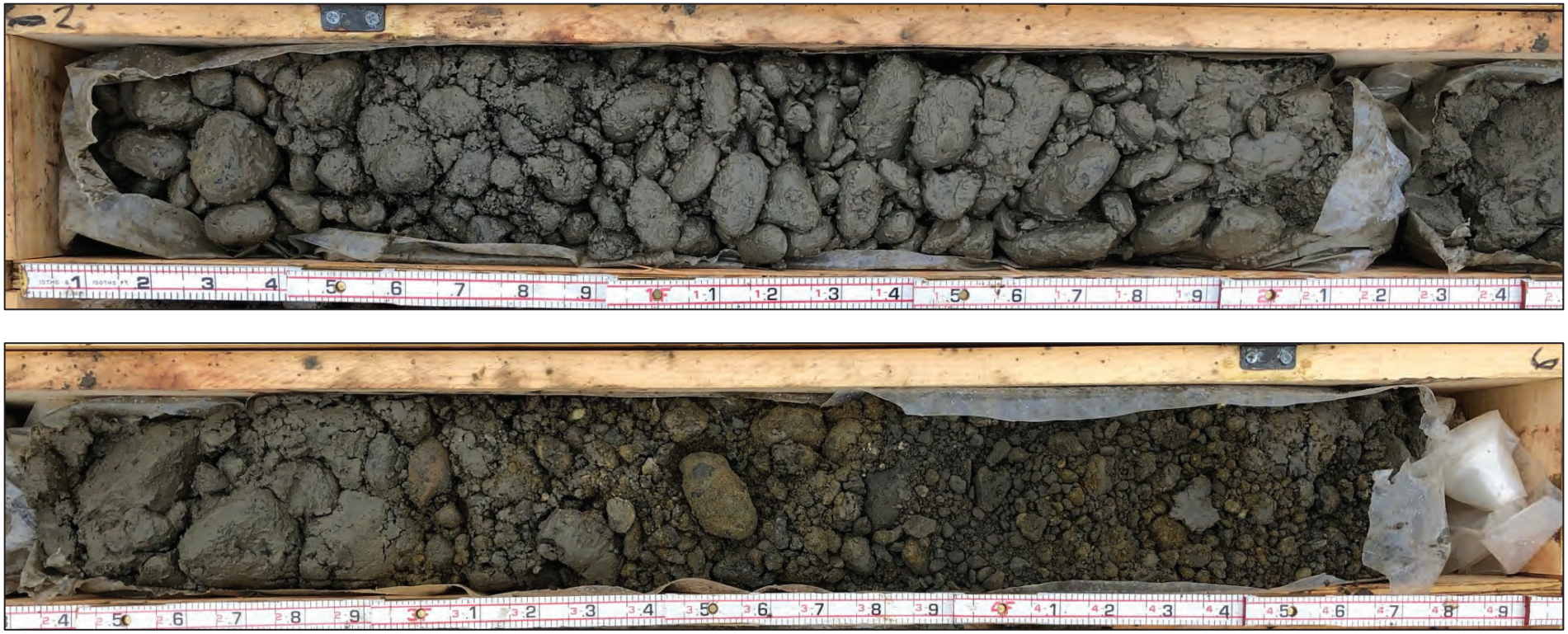

62 – 67 FEET

Earthquake Ready Burnside Bridge
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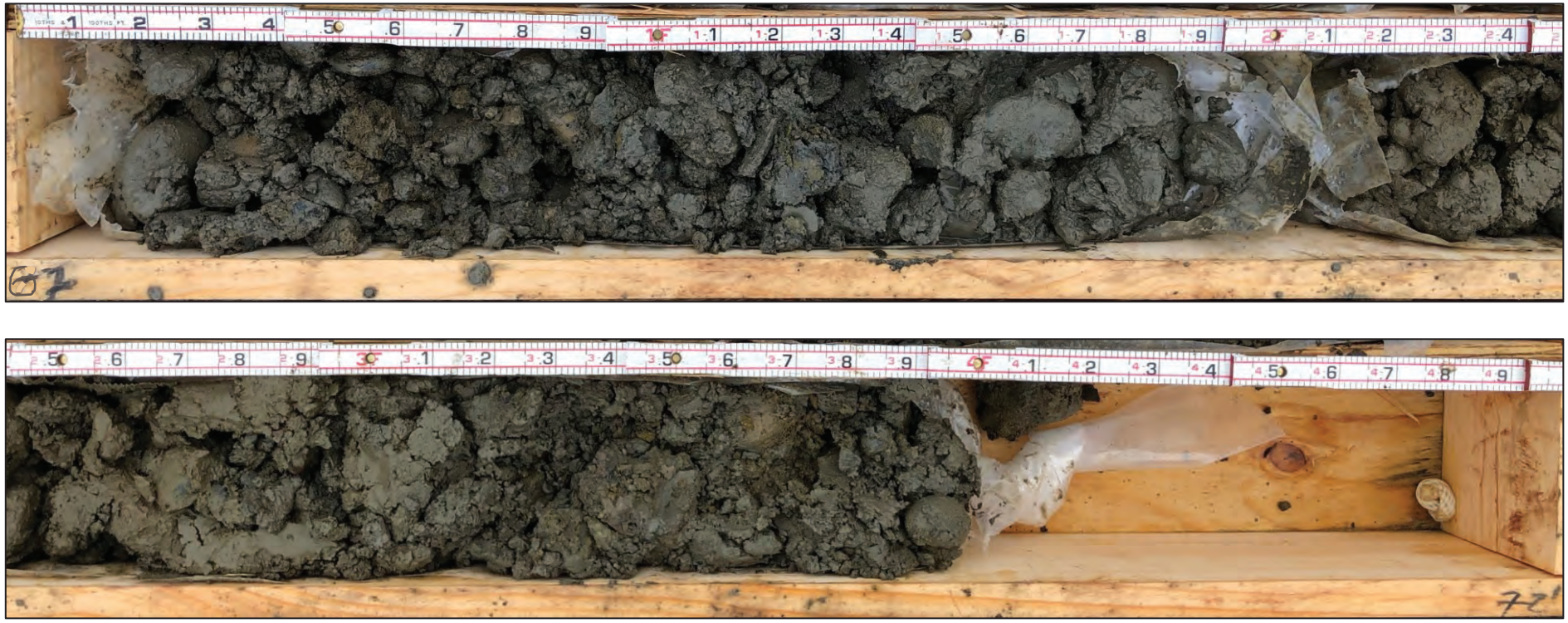

67 – 72 FEET

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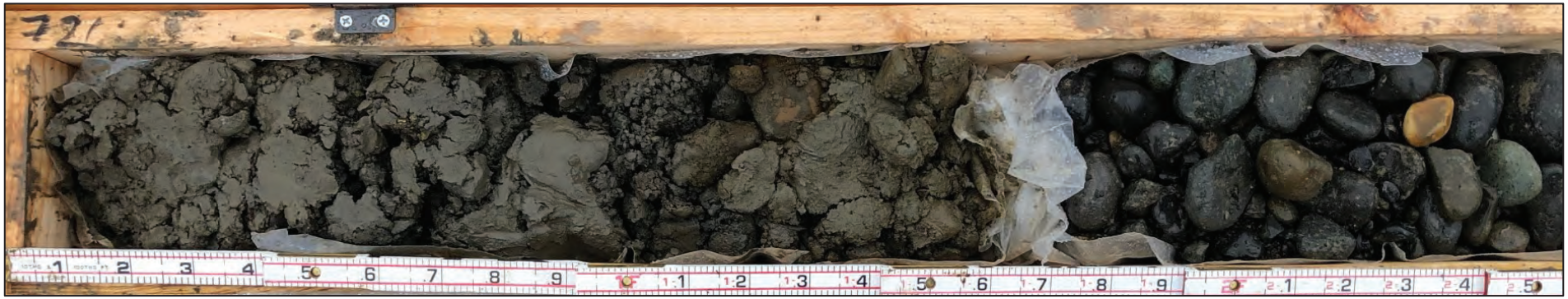



72 – 77 FEET

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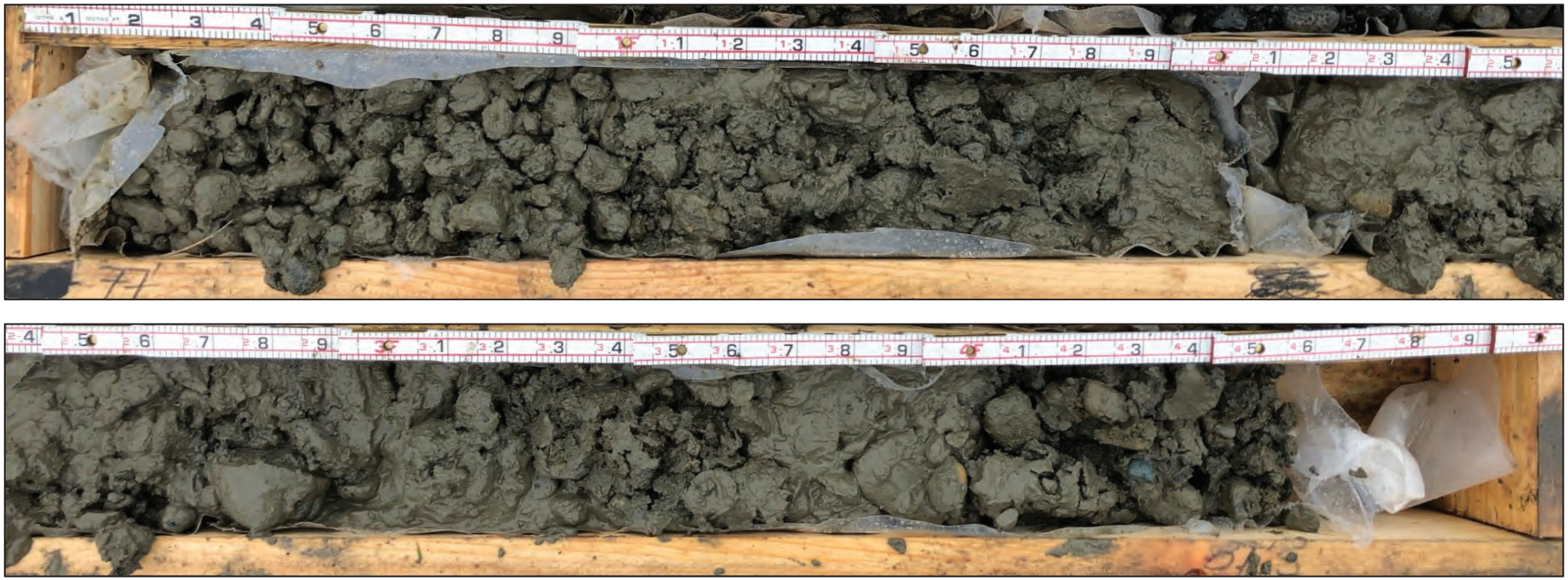

77 – 81.5 FEET

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81.5 – 86 FEET

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86 – 91 FEET

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91 – 95.5 FEET

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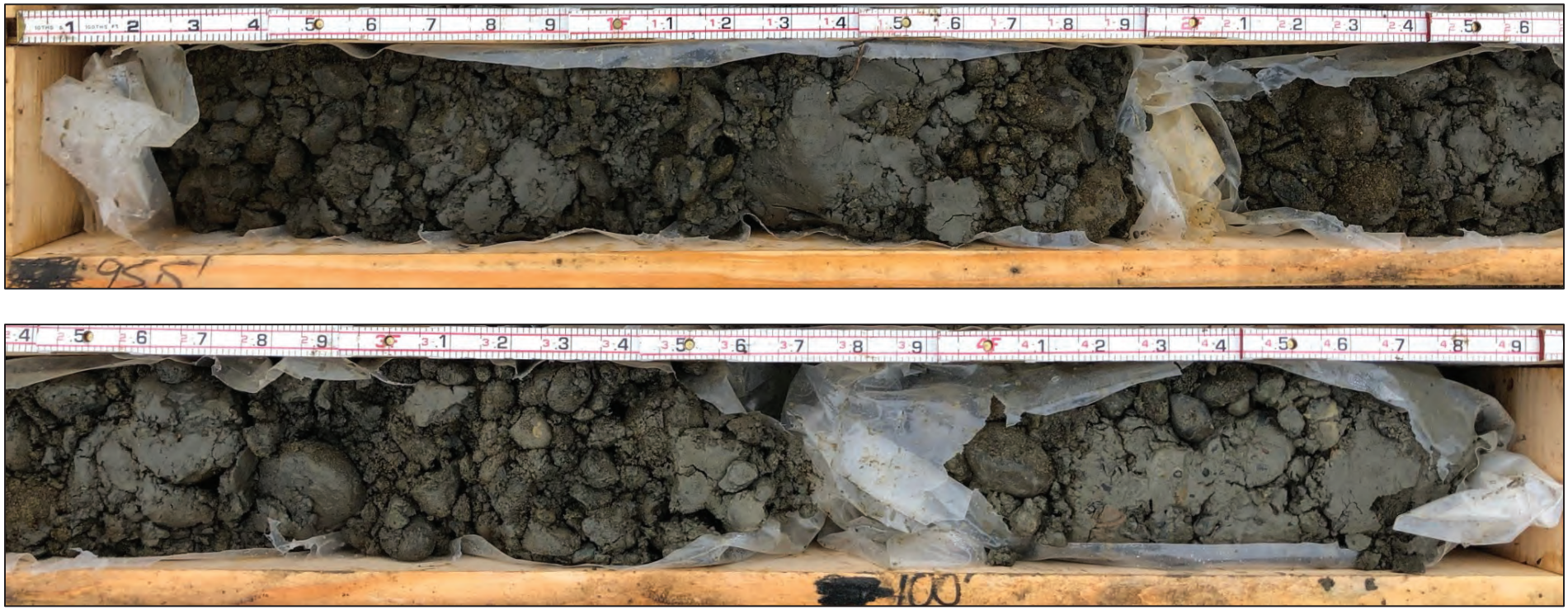

95.5 – 100 FEET

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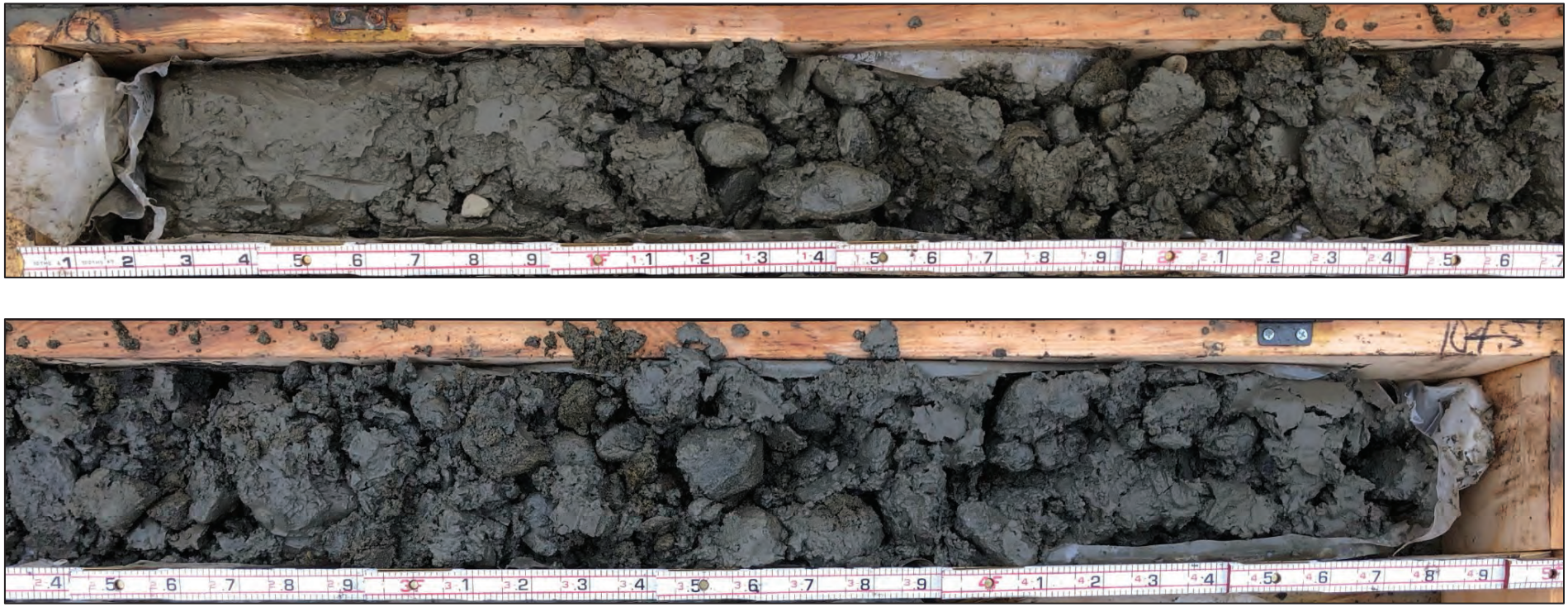

100 – 104.5 FEET

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104.5 – 108 FEET

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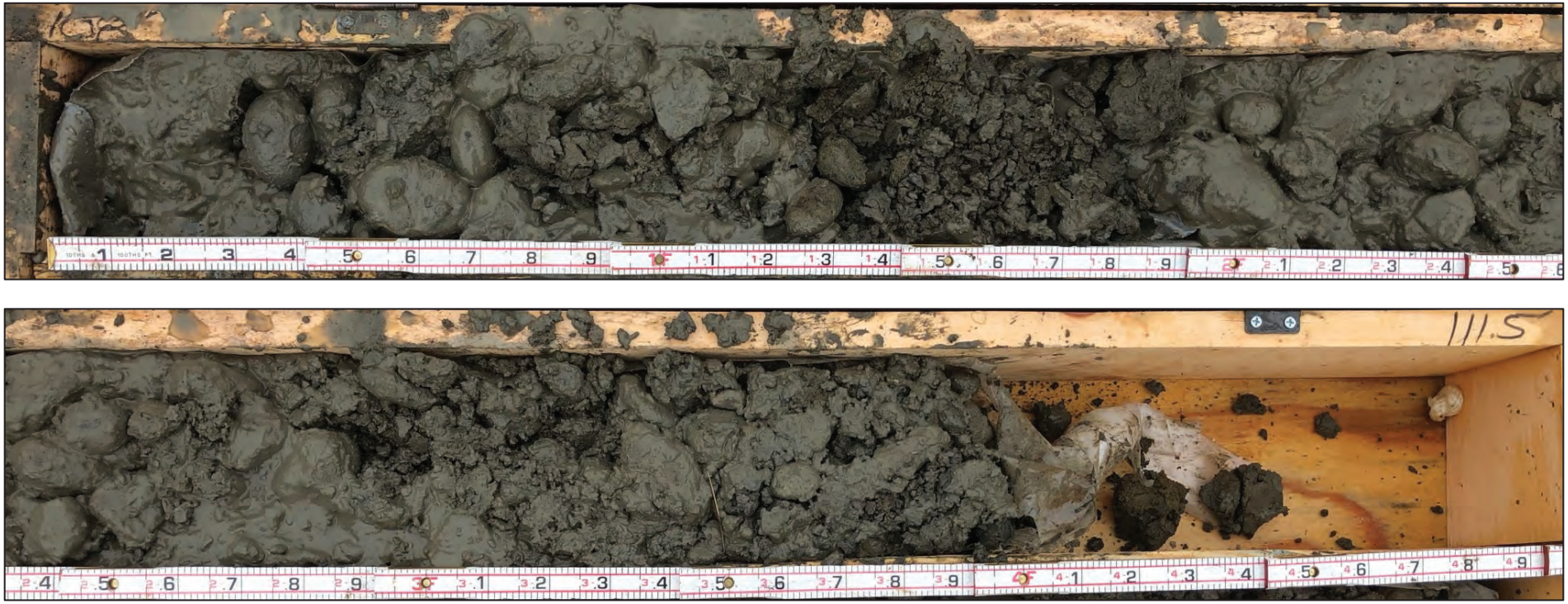

108 – 111.5 FEET

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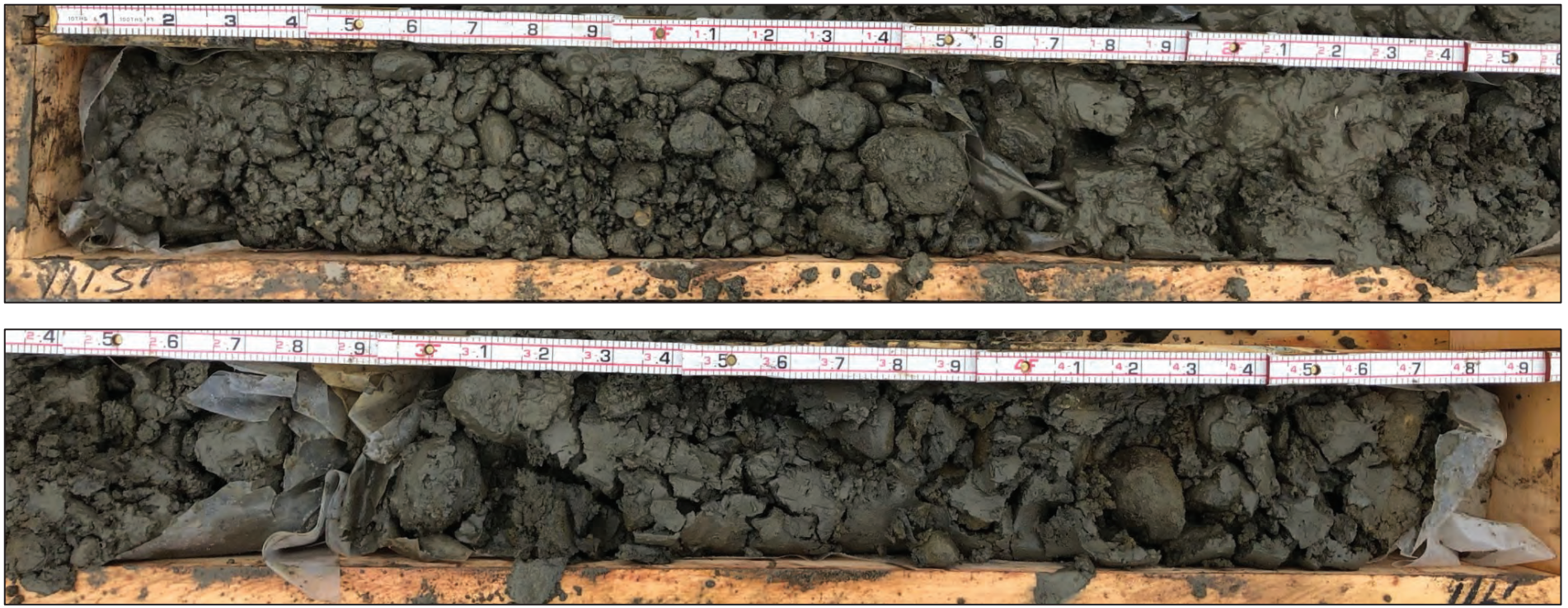

111.5 – 116 FEET

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116 – 120 FEET

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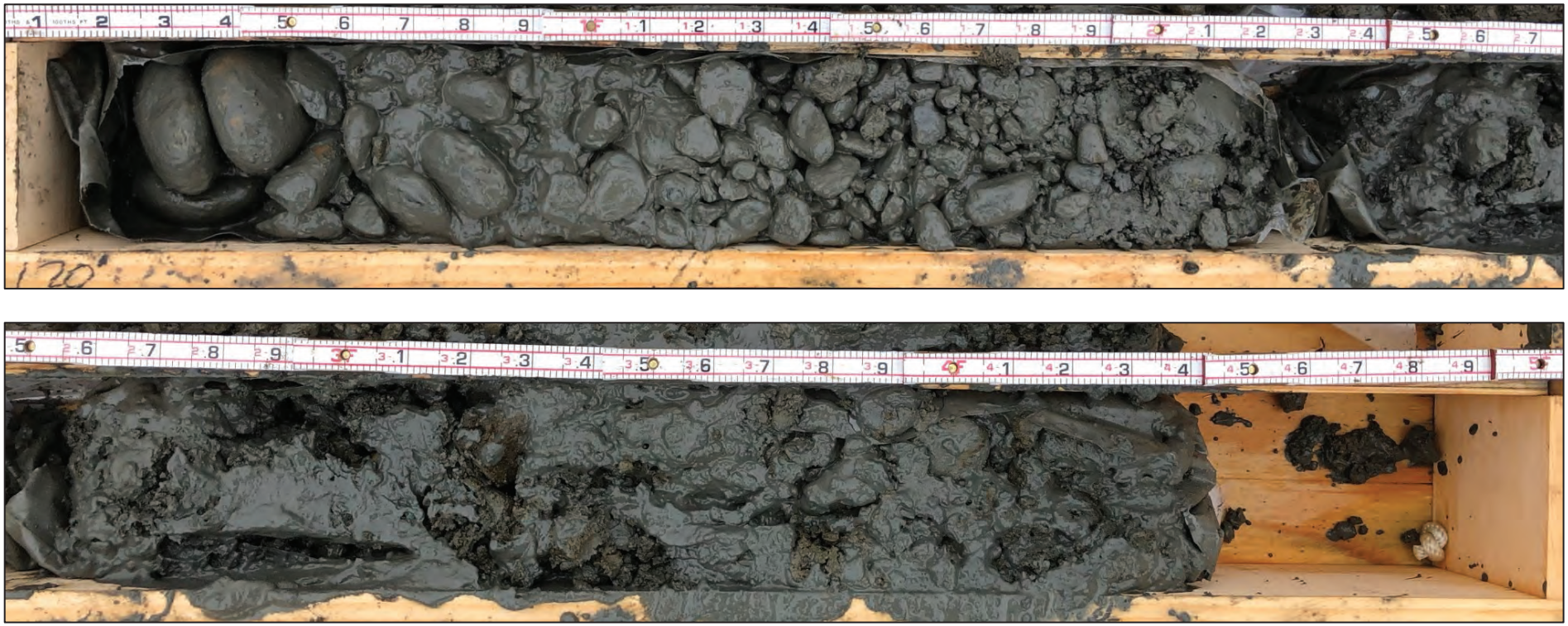

120 – 124 FEET

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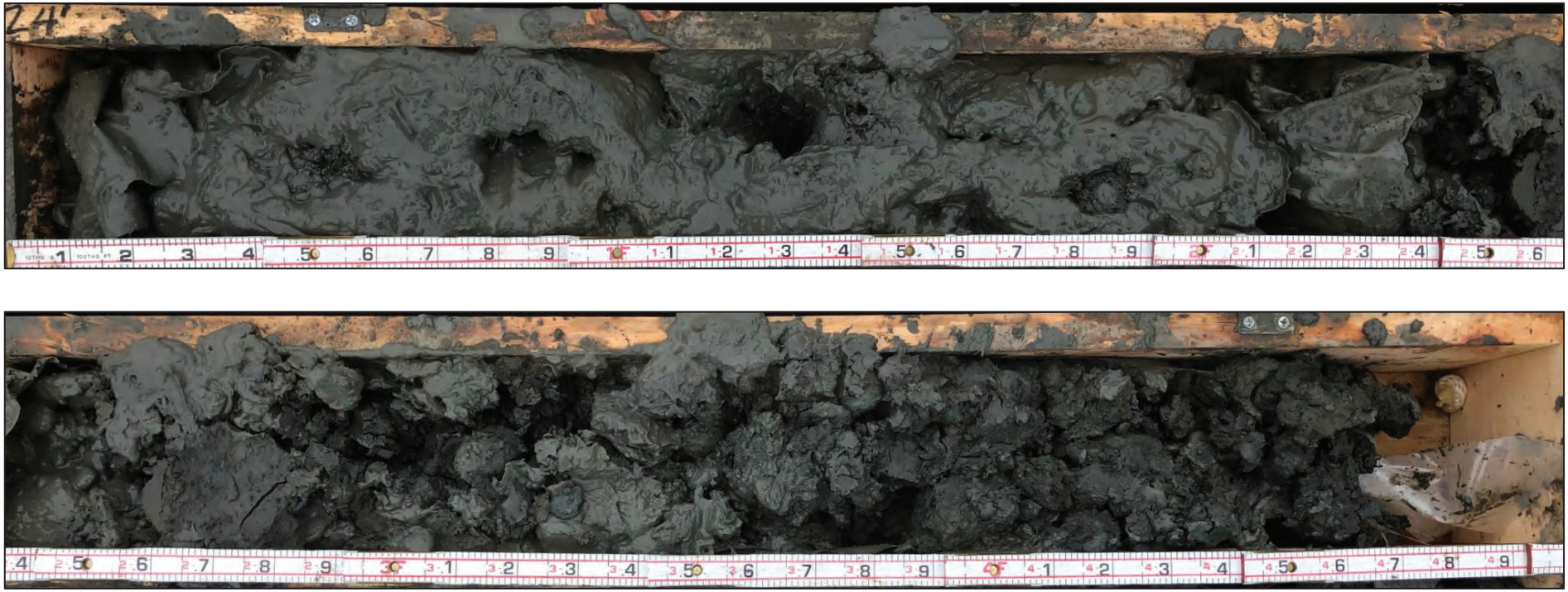

124 – 127 FEET

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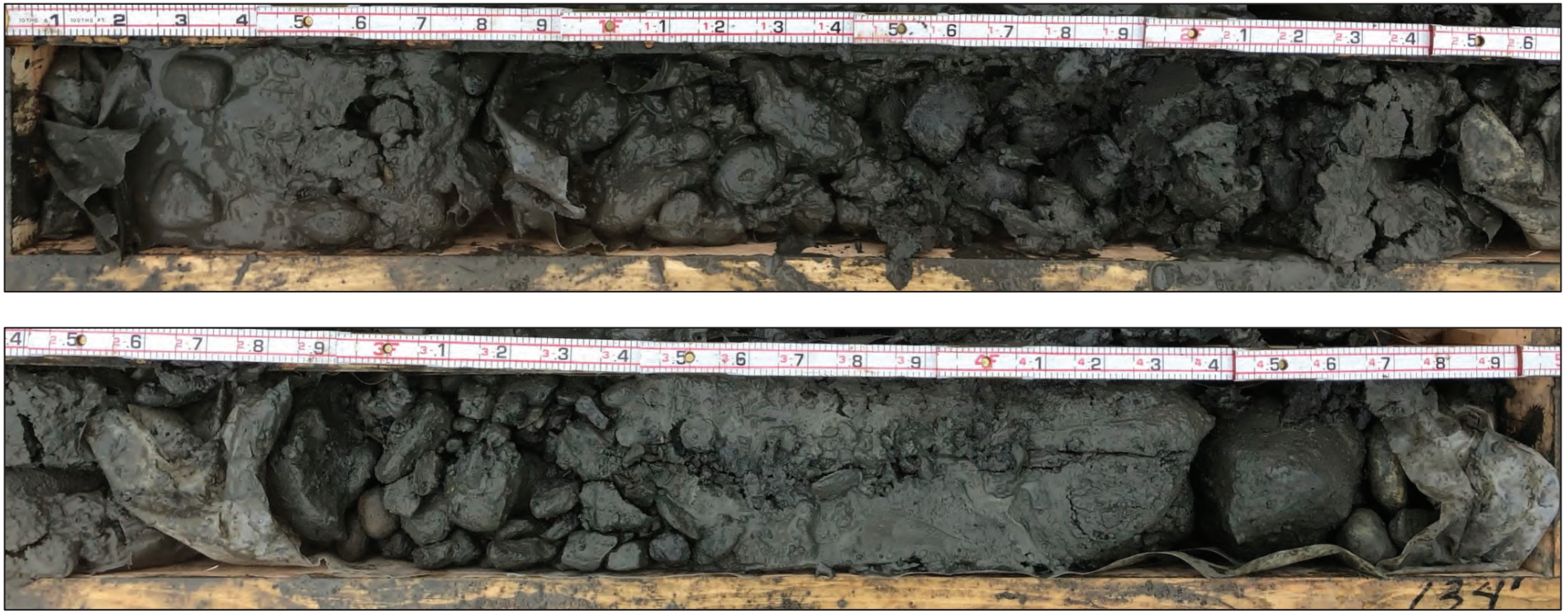

127 – 134 FEET

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138 – 142 FEET

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142 – 146 FEET

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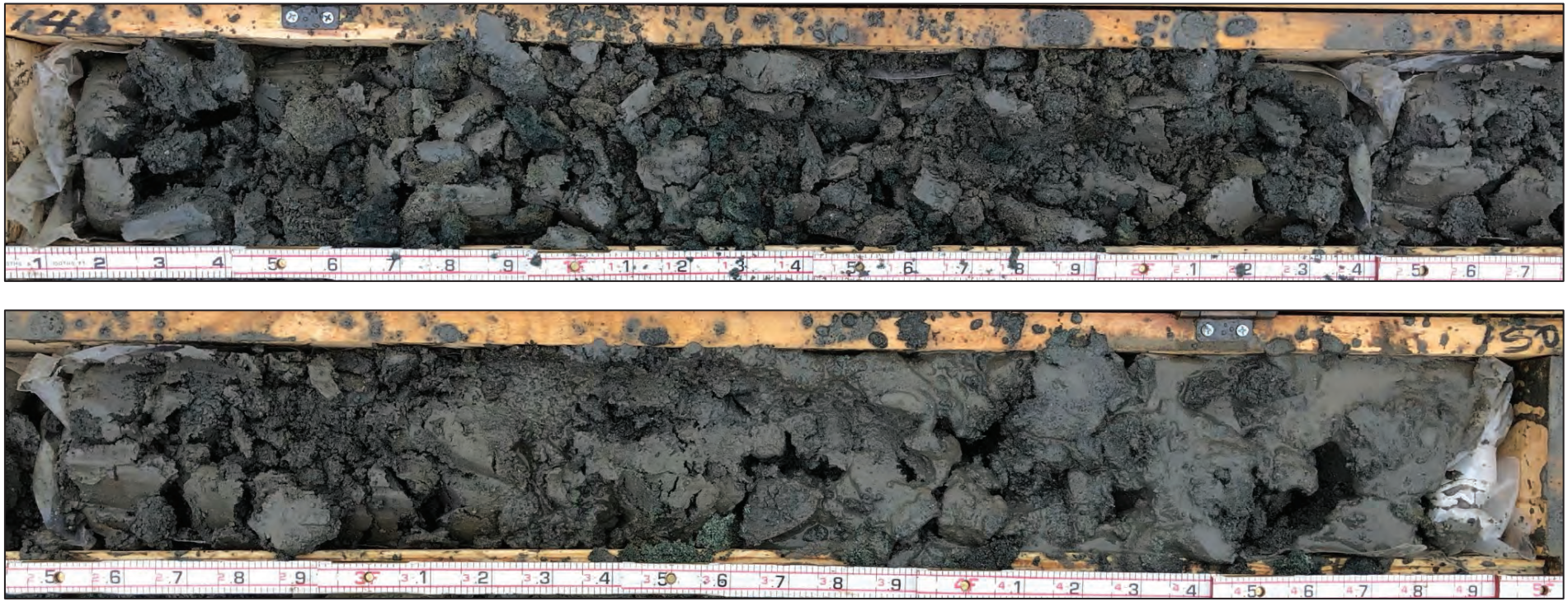

146 – 150 FEET

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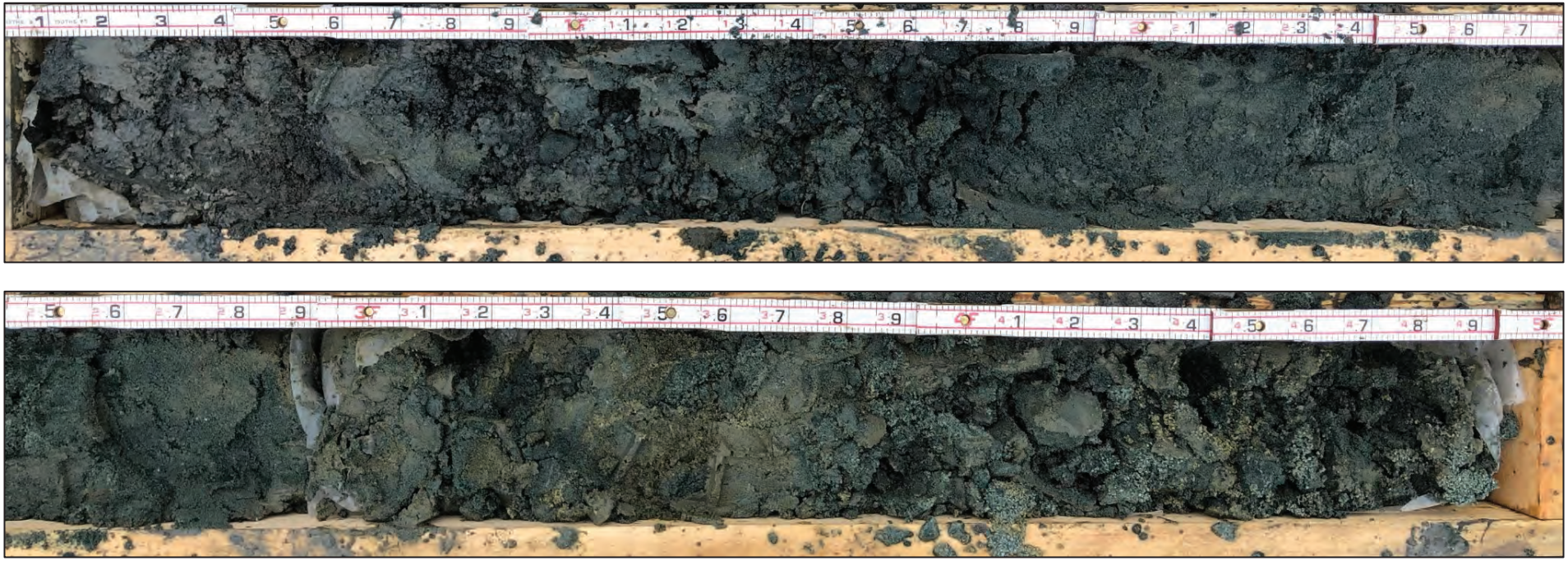

150 – 155 FEET

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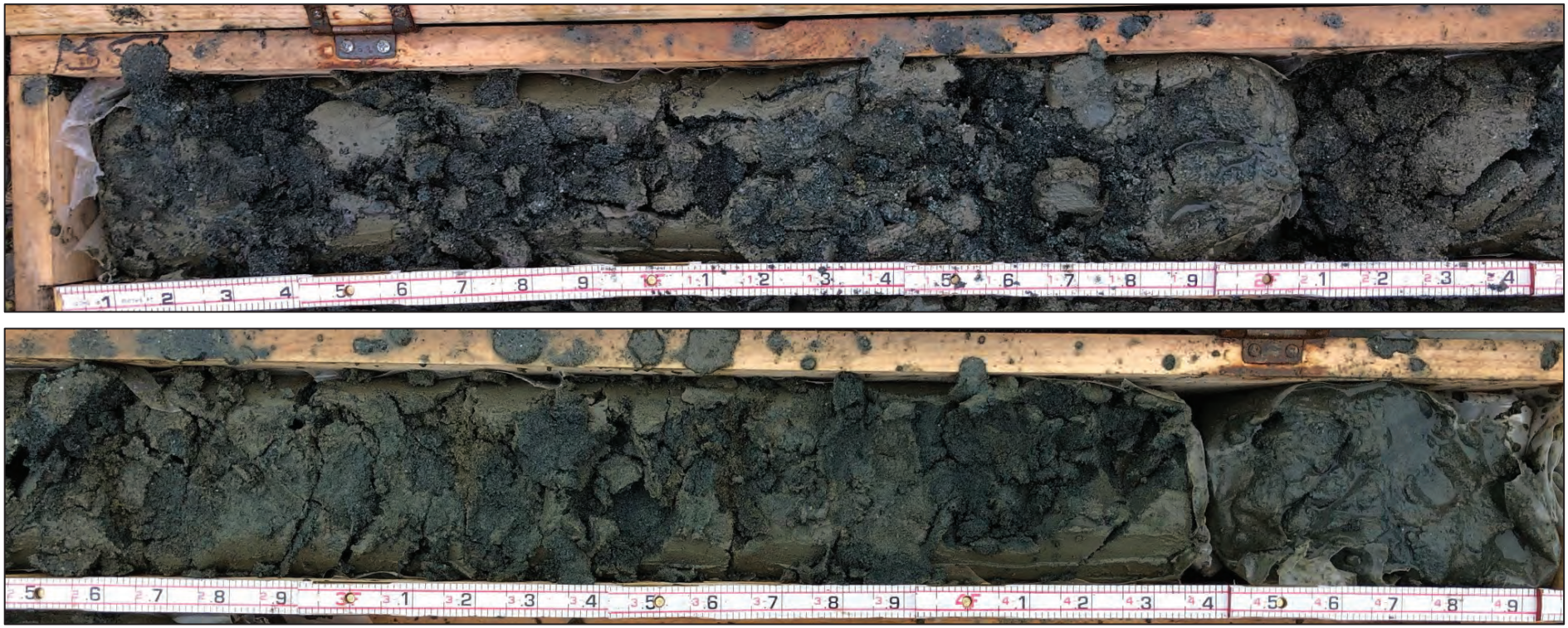

155 – 160 FEET

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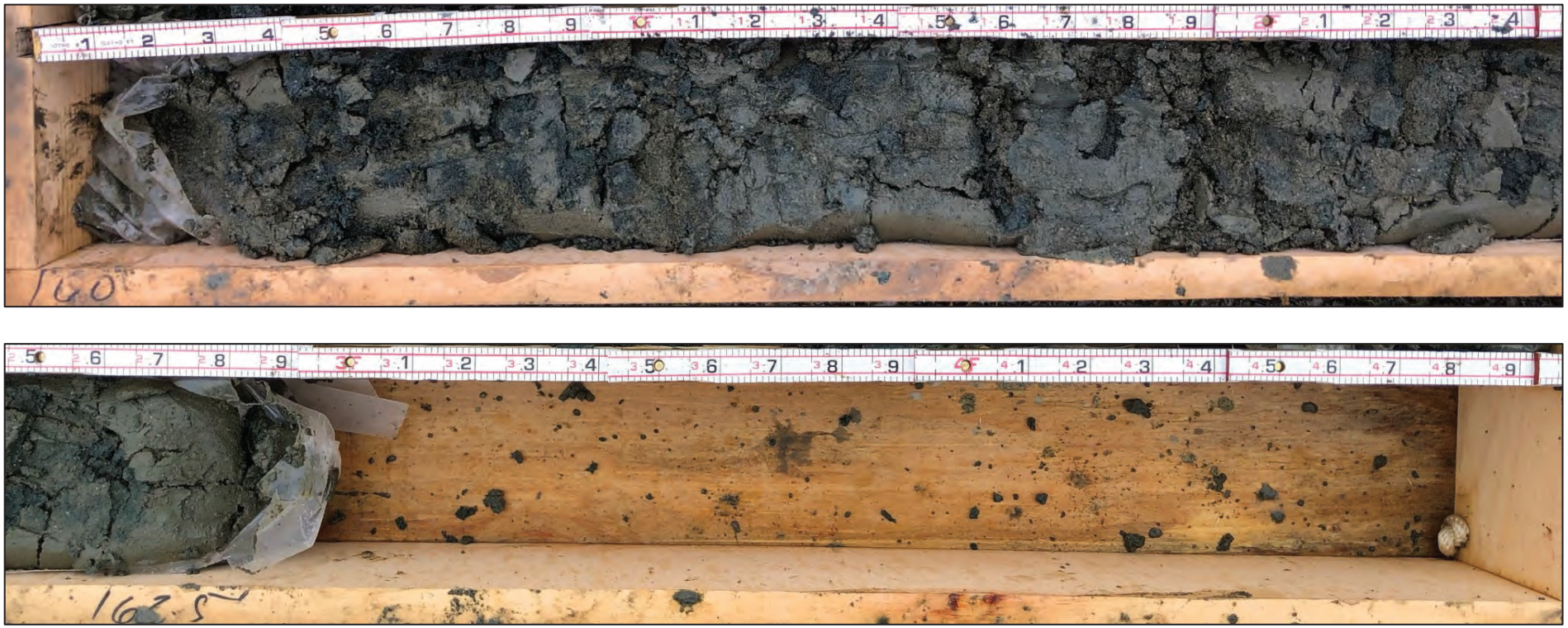

160 – 162.5 FEET

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162.5 – 167.5 FEET

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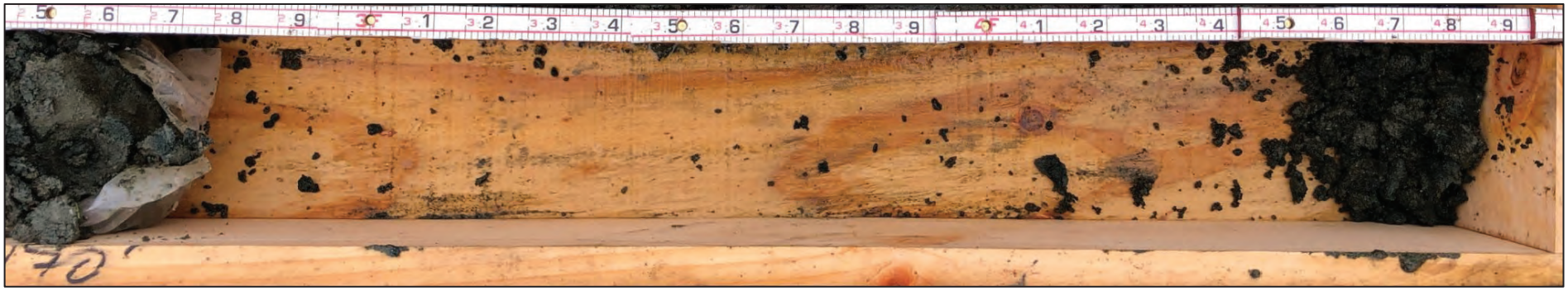

167.5 – 170 FEET

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-30**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,363**	Easting: **~ 349,114**		Start Card No. **N/A**
Equipment **GeoProbe 8150LS Tracked Sonic Rig**		Driller **Western States/Joe**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Kyle T. Romney**	Ground Elev. **~ -37 ft.**
Start Date **October 25, 2021**	End Date **October 27, 2021**	Total Depth **163.00 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core "GP" - GeoProbe®
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0	S1	100			S- 1 (0.00-23.00) S- 1a (0.00-1.00) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown; Low plasticity fines; Wet; Fine to coarse, subrounded gravel; Fine to coarse sand; (Gravel Alluvium)	**0.00 - 1.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Brown; Low plasticity fines; Wet; Fine to coarse, subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**		Borehole drilled from barge using sonic rotary drilling technique (6-inch hole); all depths are reported in feet below mudline; 6-inch ID steel casing installed to 55.6 feet below mudline	
	S1a								
	S1b				S- 1b (1.00-8.00) SAND with some silt and gravel; SP-SM; Brown; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to medium sand; (Sand Alluvium)	**1.00 - 20.50 SAND with some silt and gravel; SP-SM; Brown; Nonplastic to low plasticity fines; Wet; Fine to coarse, subrounded gravel; Fine to coarse sand; (Sand Alluvium)**			
5									
	S1c				S- 1c (8.00-19.50) SAND with some silt and gravel; SP-SM; Brown; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to medium sand; (Sand Alluvium)				
10									
15									
20	S1d				S- 1d (19.50-20.50) Silty SAND with some gravel; SM;				

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20					Brown; Nonplastic to low plasticity fines; Wet; Fine to coarse, subrounded gravel; Fine to coarse sand; (Sand Alluvium)				
	S1e				S- 1e (20.50-22.00) SILT; ML; Brown; Low plasticity; Wet; Micaceous; (Fine-grained Alluvium)	**20.50 - 22.00 SILT; ML; Brown; Low plasticity; Wet; Micaceous; (Fine-grained Alluvium)**			
	S1f				S- 1f (22.00-23.00) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Black; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)				
	S2	100			S- 2 (23.00-44.00)	**22.00 - 26.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Black; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
	S2a				S- 2a (23.00-26.00) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Black; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)				
25									
	S2b				S- 2b (26.00-44.00) Silty SAND to Silty SAND with trace gravel; SM; Black; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Trace to some organics from 40 to 42 feet; Gravelly interbed from 42.5 to 44 feet; (Sand Alluvium)	**26.00 - 44.00 Silty SAND to Silty SAND with trace gravel; SM; Black; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Trace to some organics from 40 to 42 feet; Gravelly interbed from 42.5 to 44 feet; (Sand Alluvium)**		S2b: 4% gravel, 73% sand, 23% fines.	
30									
35									
40									
	S3	60			S- 3 (44.00-65.00)	**44.00 - 49.00 SAND with some silt to SAND with some silt and trace gravel; SP-SM; Black; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)**		S3a: 3% gravel, 89% sand, 8% fines.	
45	S3a				S- 3a (44.00-49.00) SAND with some silt to SAND with some silt, with trace gravel; SP-SM; Black; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)				
	S3b				S- 3b (49.00-51.00) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Black; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel;	**49.00 - 51.00 Sandy silty GRAVEL,**			
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50					Fine to coarse sand; (Gravel Alluvium)	**with cobbles and possible boulders; GM; Black ; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
	S3c				S- 3c (51.00-65.00) Silty SAND with trace gravel; SM; Black; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)	**51.00 - 66.00 Silty SAND with trace gravel; SM; Dark gray; Nonplastic fines; Wet; Fine to coarse, subrounded gravel; Fine to medium sand; (Sand Alluvium)**			
55									
60									
65	S4	100			S- 4 (65.00-85.00)				
	S4a				S- 4a (65.00-66.00) Silty SAND with trace gravel; SM; Black; Nonplastic fines; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)				
	S4b				S- 4b (66.00-71.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray; Nonplastic fines; Moist; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Slight iron oxide staining; Micaceous; (Gravel Alluvium)	**66.00 - 71.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Dark gray; Moist to wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Slight iron oxide staining; Micaceous; (Gravel Alluvium)**			
70									
	S4c				S- 4c (71.00-72.00) CLAY; CH; Brown mottled; High plasticity; Moist; Slight iron oxide staining; Micaceous; (Upper Troutdale Formations)	**71.00 - 79.00 CLAY; CH; Brown to blue-gray mottled; High plasticity; Moist; Slight iron oxide staining; Micaceous; (Upper Troutdale Formation)**		Atterberg Limits S4d: LL=64, PL=31, PI=33.	
	S4d				S- 4d (72.00-79.00) CLAY; CH; Blue-gray; High plasticity; Moist; Micaceous; (Upper Troutdale Formations)				
75									
	S4e				S- 4e (79.00-85.00) SILT with trace sand; ML; Gray; Low plasticity; Moist to wet; Fine sand; Micaceous; Stratified with 2- to 6-inch interbeds of SILT with some sand to	**79.00 - 89.00 SILT with trace sand;**			
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80					Sandy SILT (ML); (Upper Troutdale Formations)	**ML; Gray; Low plasticity; Moist to wet; Fine sand; Micaceous; Stratified with 2- to 6-inch interbeds of SILT with some sand to Sandy SILT (ML); (Upper Troutdale Formation)**			
85	S5	100			S- 5 (85.00-98.00)				
	S5a				S- 5a (85.00-89.00) SILT with trace sand; ML; Gray; Low plasticity; Moist to wet; Fine sand; Micaceous; Stratified with 2- to 6-inch interbeds of SILT with some sand to Sandy SILT (ML); (Upper Troutdale Formations)			Atterberg Limits S5a: LL=40, PL=32, PI=8.	
	S5b				S- 5b (89.00-91.00) Silty CLAY with trace sand; CL; Yellow-brown; Medium plasticity; Moist; Fine sand; Micaceous; Moderate iron oxide staining; (Upper Troutdale Formations)	**89.00 - 91.00 Silty CLAY with trace sand; CL; Yellow-brown; Medium plasticity; Moist; Fine sand; Micaceous; Moderate iron oxide staining; (Upper Troutdale Formation)**			
90	S5c				S- 5c (91.00-98.00) Clayey GRAVEL with some sand, with cobbles; GC; Dark gray to yellow-brown; Medium plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas cemented to gravel clasts; Weak cementation; (Lower Troutdale Formation)	**91.00 - 98.00 Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Dark gray to yellow-brown; Medium plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micas adhered to gravel clasts; Weak cementation; (Lower Troutdale Formation)**		S5c: 58% gravel, 29% sand, 13% fines.	
95									
	S6	100			S- 6 (98.00-106.00) Sandy GRAVEL with some clay, with cobbles and possible boulders; GP-GC; Dark gray to yellow-brown; Medium plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas cemented to gravel clasts; Weak cementation; (Lower Troutdale Formation)	**98.00 - 111.00 Sandy GRAVEL with some clay, with cobbles and possible boulders; GP-GC; Dark gray to yellow-brown; Medium plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas adhered to gravel clasts; Weak cementation; (Lower Troutdale Formation)**			
100									
105	S7	100			S- 7 (106.00-120.00)				
	S7a				S- 7a (106.00-111.00) Sandy GRAVEL with some clay, with cobbles and possible boulders; GP-GC; Dark gray to yellow-brown; Medium plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas cemented to gravel clasts; Weak cementation; (Lower Troutdale Formation)			S7a: 52% gravel, 37% sand, 11% fines.	
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110									
	S7b				S- 7b (111.00-116.00) SAND with some silt and trace gravel; SP-SM; Brown; Nonplastic fines; Moist; Fine to coarse, subrounded gravel; Fine to medium sand; Micaceous; (Lower Troutdale Formation)	**111.00 - 116.00 SAND with some silt and trace gravel; SP-SM; Brown; Nonplastic fines; Moist; Fine to coarse, subrounded gravel; Fine to medium sand; Micaceous; (Lower Troutdale Formation)**			
115									
	S7c				S- 7c (116.00-120.00) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Gray to yellow-brown; Low to medium plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Quartzite clasts; (Lower Troutdale Formation)	**116.00 - 123.00 Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Gray to yellow-brown; Low to medium plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Quartzite clasts; (Lower Troutdale Formation)**			
120	S8	100			S- 8 (120.00-128.00)				
	S8a				S- 8a (120.00-123.00) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Gray to yellow-brown; Low to medium plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Quartzite clasts; (Lower Troutdale Formation)				
	S8b				S- 8b (123.00-127.00) Clayey SAND; SC; Light blue; Medium to high plasticity fines; Moist; Fine sand; Micaceous; (Sandy River Mudstone)	**123.00 - 133.00 Clayey SAND to Clayey SAND with trace gravel; SC; Light blue to gray; Medium to high plasticity fines; Moist; Fine to coarse, subrounded gravel; Fine to coarse sand; Micaceous; Stratified with 2- to 6-inch interbeds of Sandy Silty CLAY (CL); (Sandy River Mudstone)**			
125									
	S8c				S- 8c (127.00-128.00) Clayey SAND to Clayey SAND with trace gravel; SC; Gray; Medium plasticity fines; Moist; Fine to coarse, subrounded gravel; Fine to coarse sand; Stratified with 2- to 6-inch interbeds of Sandy silty CLAY (CL); (Sandy River Mudstone)			S8c: 1% gravel, 68% sand, 31% fines.	
	S9	100			S- 9 (128.00-146.00)				
	S9a				S- 9a (128.00-133.00) Clayey SAND to Clayey SAND with trace gravel; SC; Gray; Medium plasticity fines; Moist; Fine to coarse, subrounded gravel; Fine to coarse sand; Stratified with 2- to 6-inch interbeds of Sandy Silty CLAY (CL); (Sandy River Mudstone)				
130									
	S9b				S- 9b (133.00-139.00) CLAY with trace sand; CH; Blue; High plasticity; Moist; Slight iron oxide staining; (Sandy River Mudstone)	**133.00 - 139.00 CLAY with trace sand; CH; Blue; High plasticity; Moist; Slight iron oxide staining; (Sandy River Mudstone)**			
135									
	S9c				S- 9c (139.00-143.00) SILT with some sand; ML; Blue-gray; Low plasticity; Moist; Fine sand; (Sandy River Mudstone)	**139.00 - 143.00 SILT with some sand;**			
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140						**ML; Blue-gray; Low plasticity; Moist; Fine sand; (Sandy River Mudstone)**			
	S9d				S- 9d (143.00-146.00) Silty SAND to Silty SAND with trace gravel; SM; Gray; Low plasticity fines; Moist; Fine to coarse, subrounded gravel; Fine to coarse sand; Micaceous; (Sandy River Mudstone)	**143.00 - 163.00 Silty SAND; SM; Gray; Low plasticity fines; Moist; Trace amounts of fine to coarse, subrounded gravel; Fine to coarse sand; (Sandy River Mudstone)**			
145									
	S10	100			S- 10 (146.00-163.00) Silty SAND to Silty SAND with trace gravel; SM; Gray; Low plasticity fines; Moist; Fine to coarse, subrounded gravel; Fine to coarse sand; Micaceous; (Sandy River Mudstone)			S10: 1% gravel, 86% sand, 12% fines.	
150									
155									
160									
						163.00 End of hole			
165									
170									



0 – 4 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

SONIC CORE PHOTOS
BORING B-30

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4 – 8.5 FEET

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8.5 – 13.5 FEET

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13.5 – 17 FEET

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17 – 21 FEET

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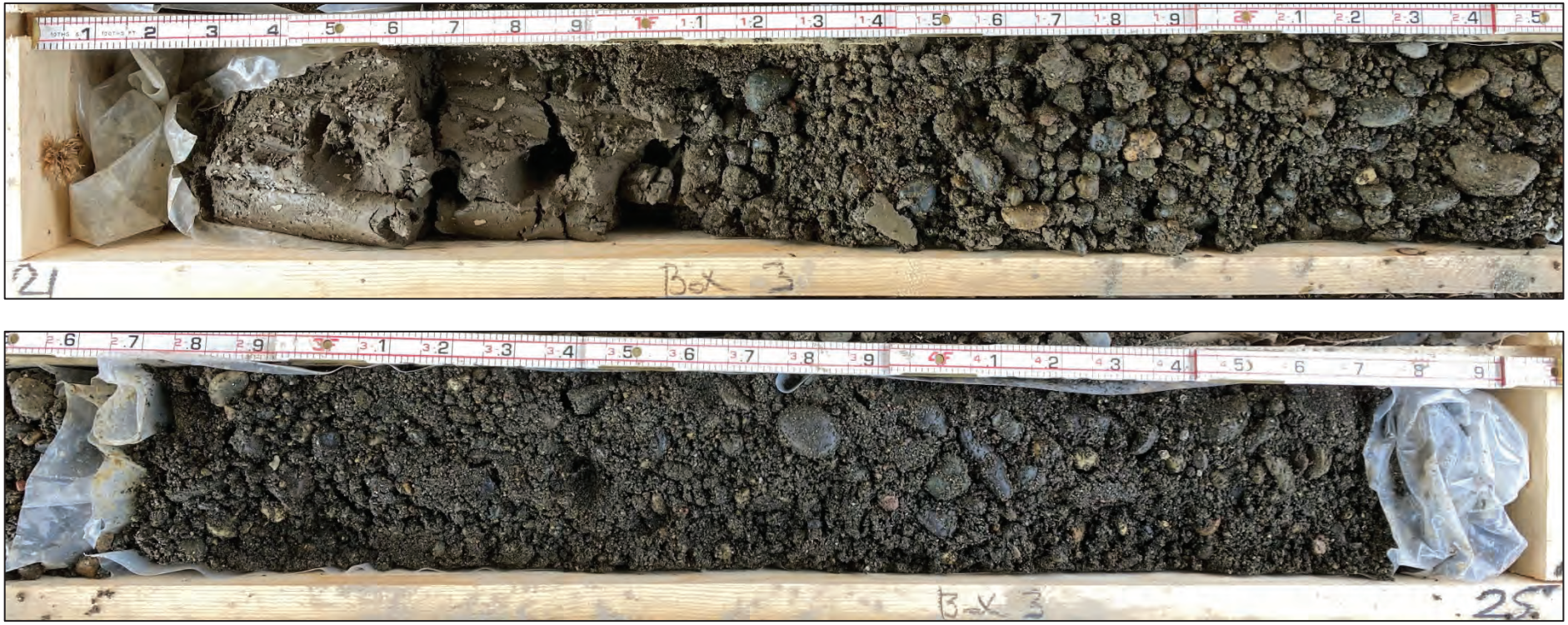

21 – 25 FEET

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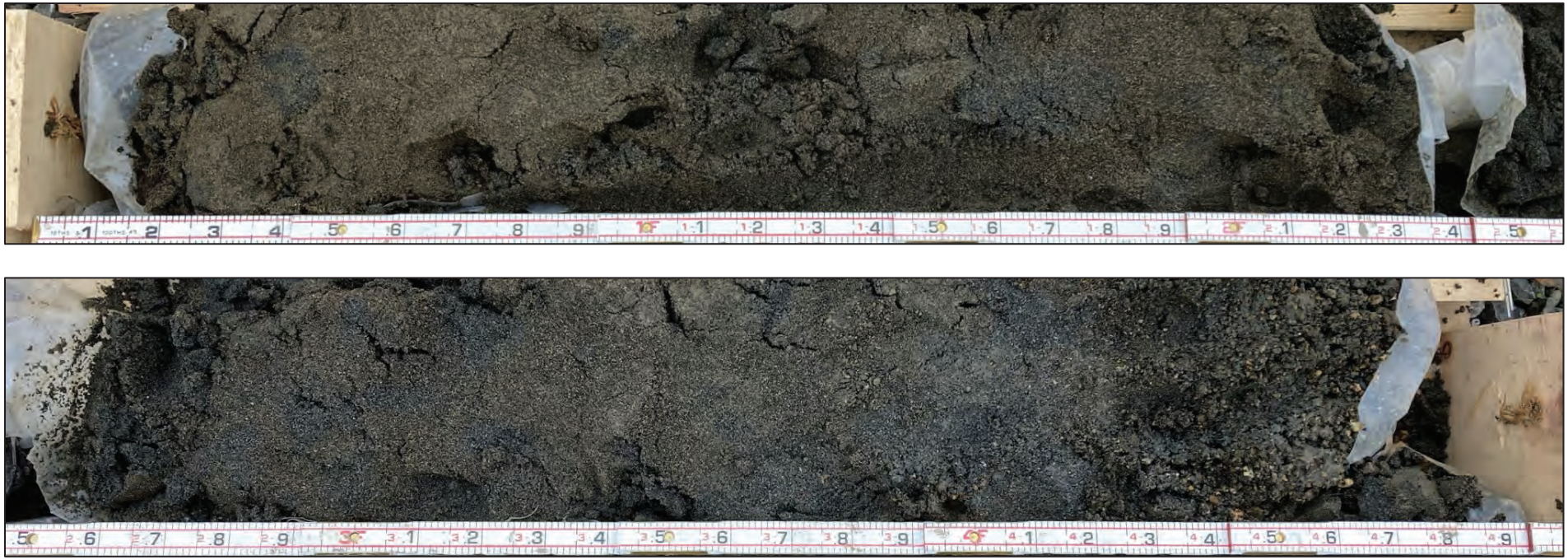

25 – 30 FEET

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30 – 35 FEET

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35 – 40 FEET

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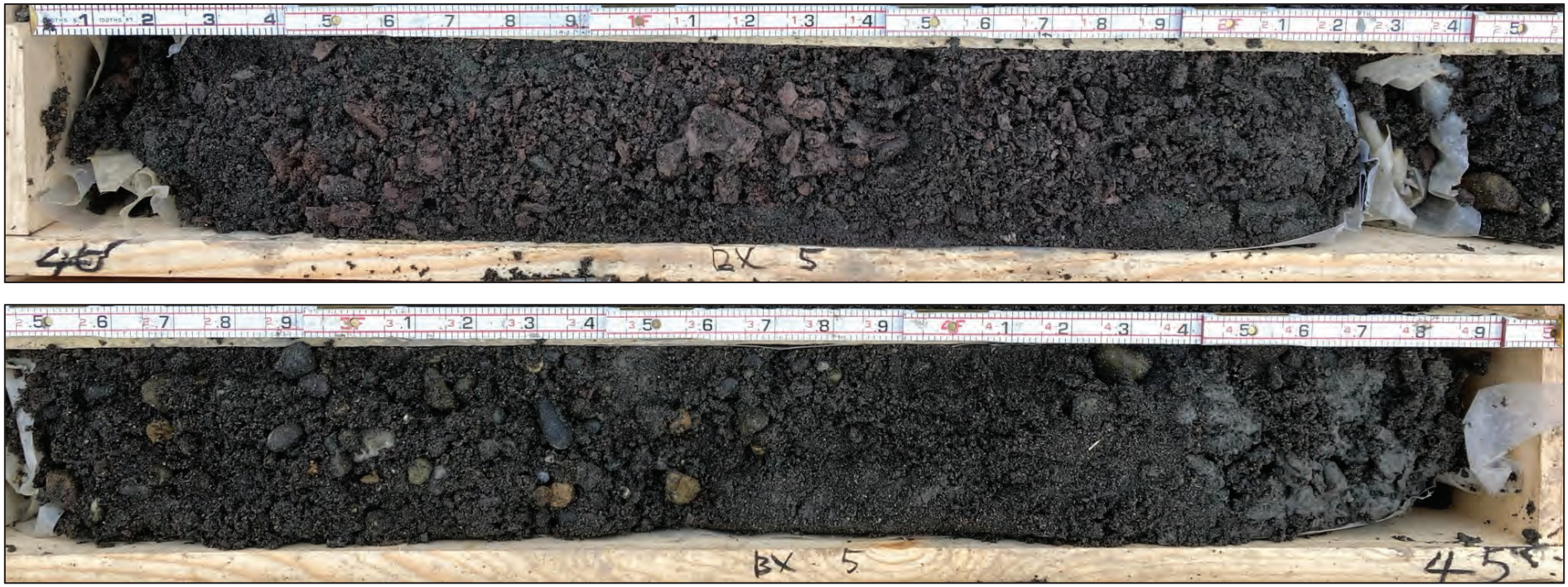

40 – 45 FEET

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45 – 50 FEET

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50 – 55 FEET

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55 – 67 FEET

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67 – 71 FEET

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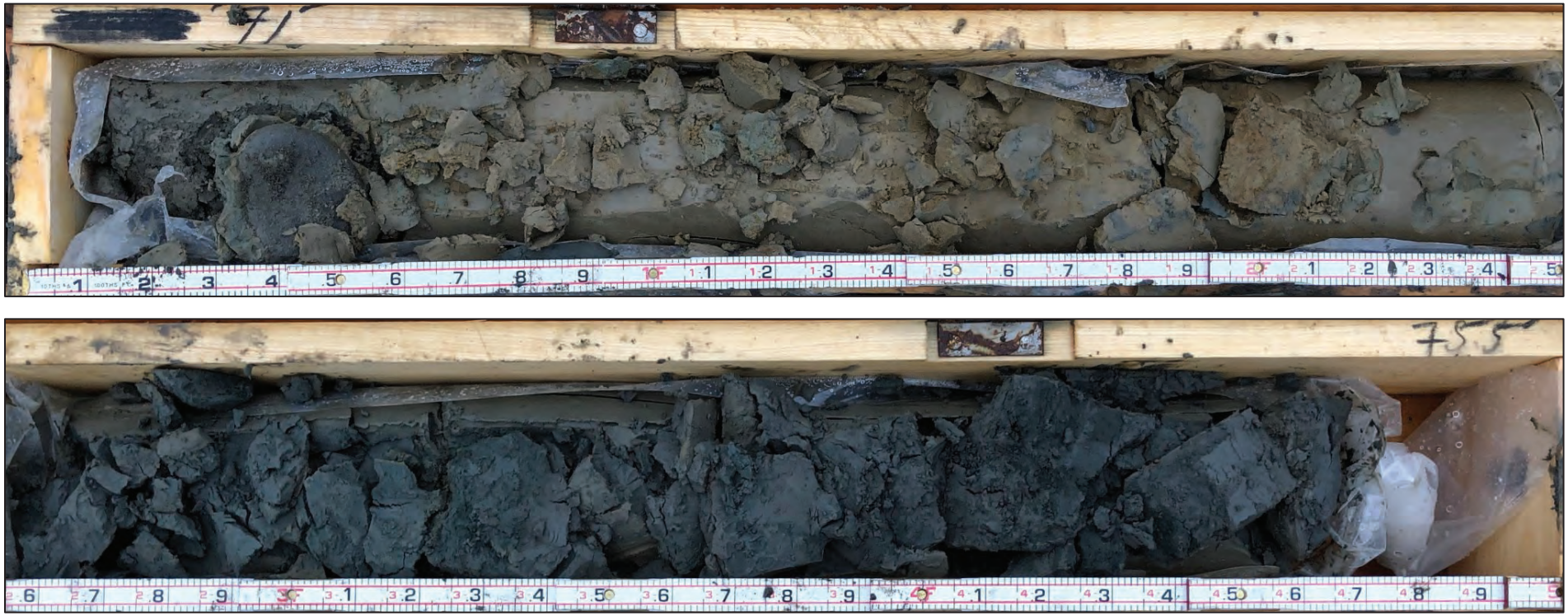

71 – 75.5 FEET

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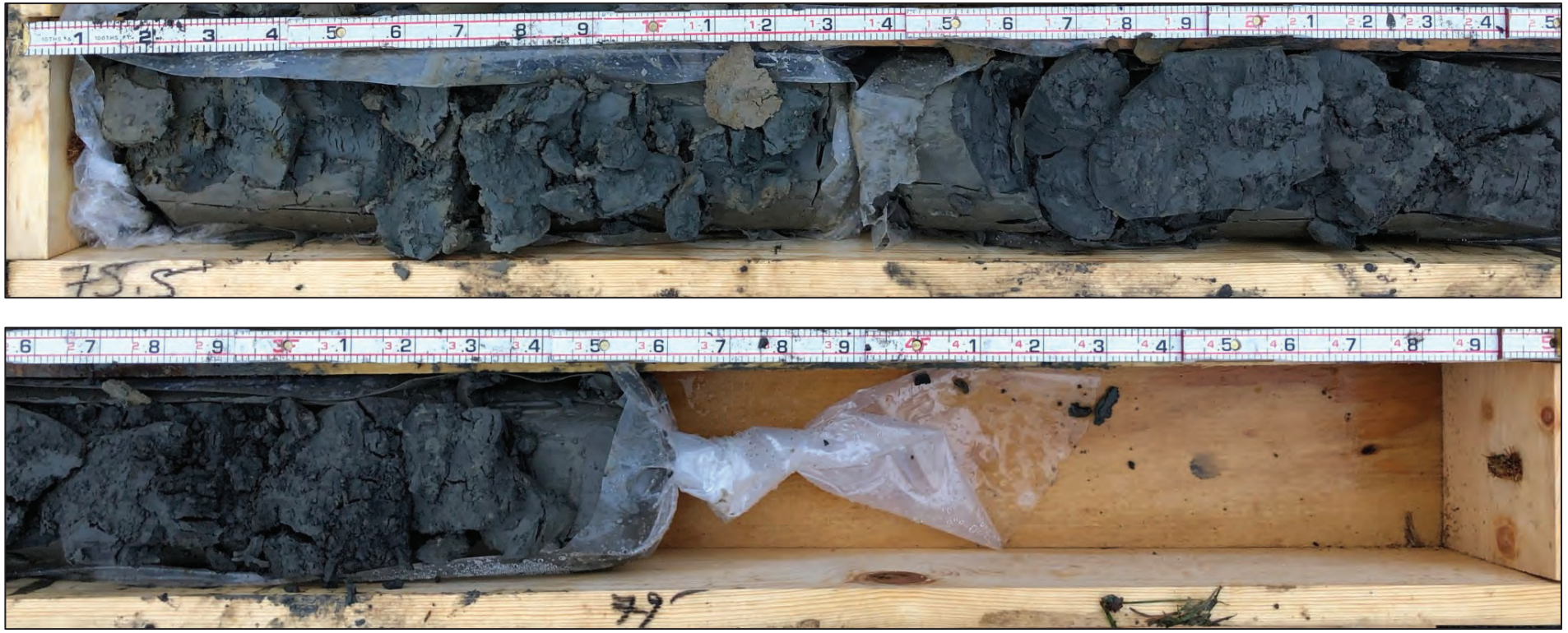

75.5 – 79 FEET

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79 – 83 FEET

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83 – 88 FEET

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88 – 93 FEET

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93 – 98 FEET

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98 – 102 FEET

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102 – 106 FEET

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106 – 111 FEET

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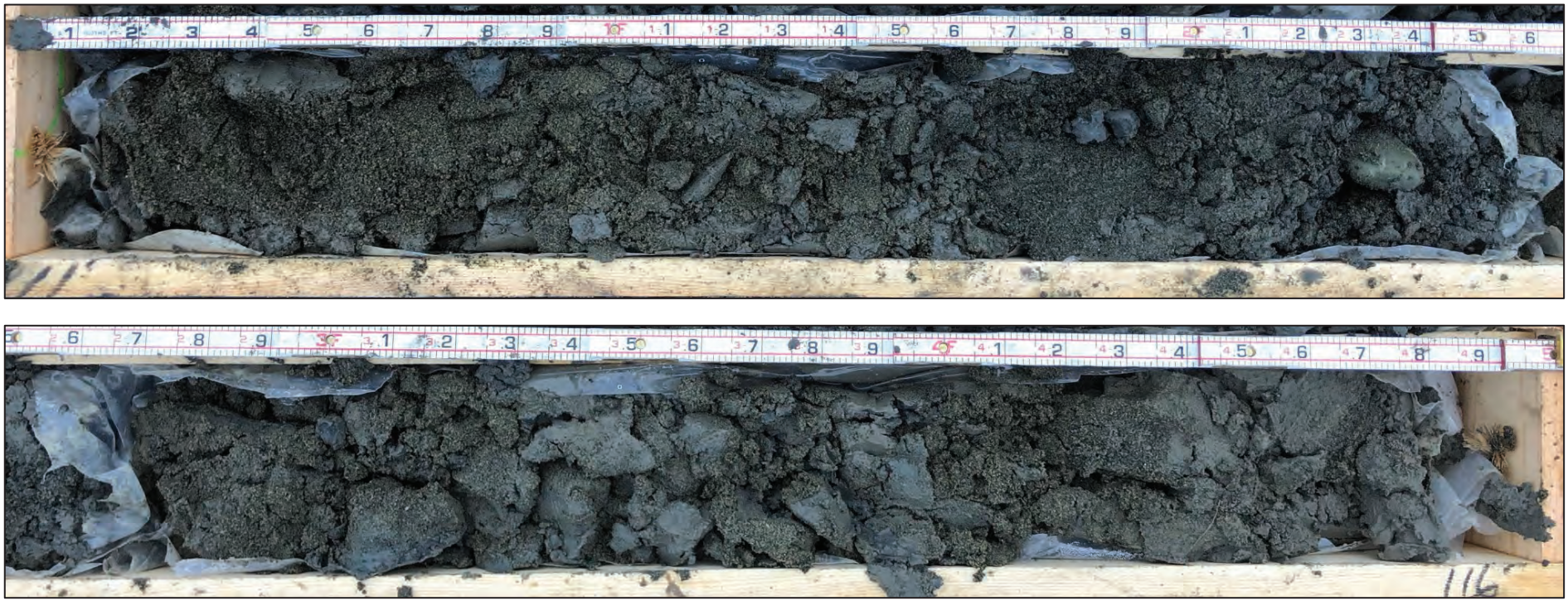

111 – 116 FEET

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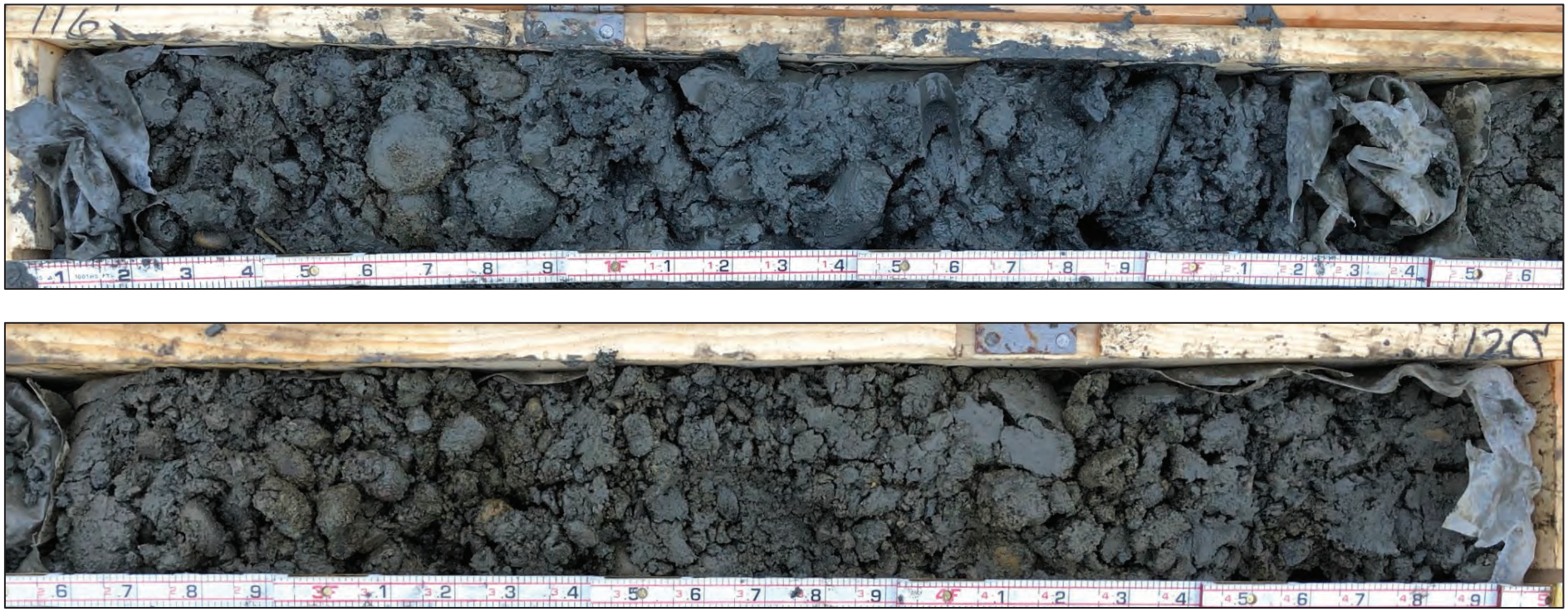

116 – 120 FEET

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120 – 123 FEET

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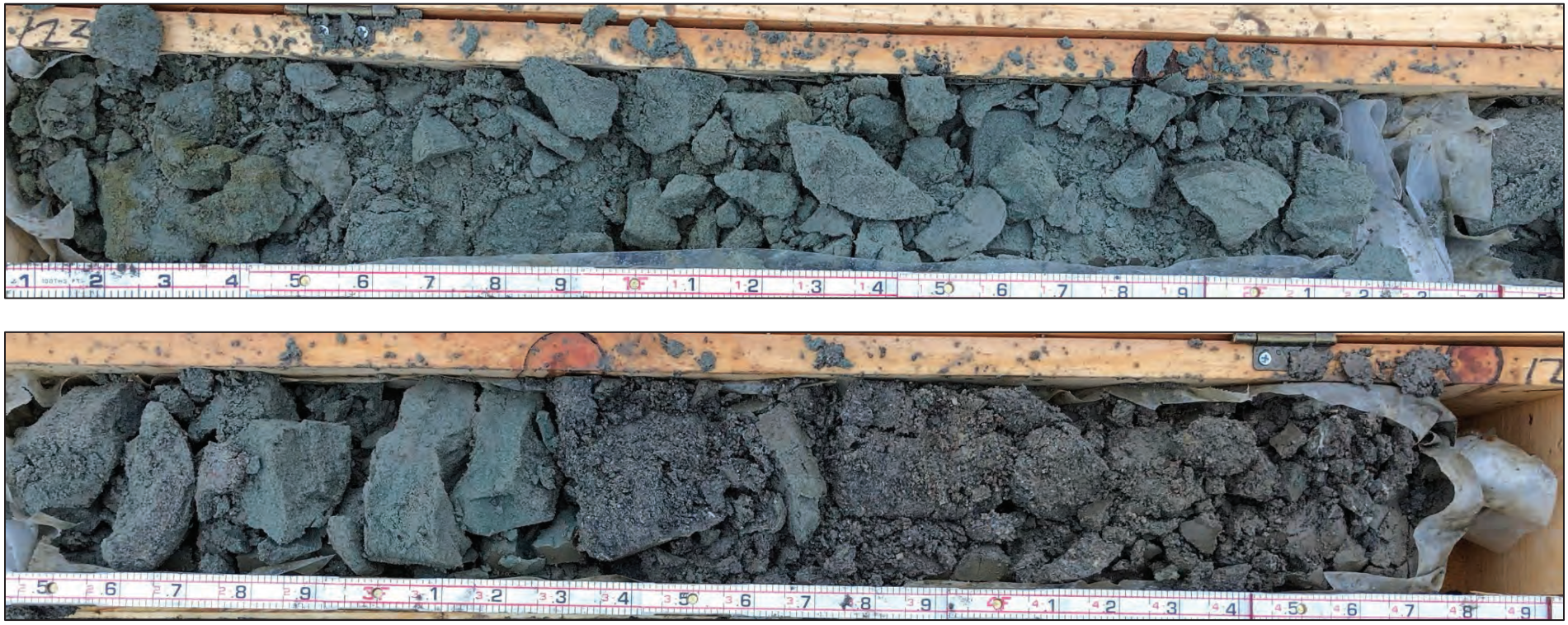

123 – 128 FEET

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128 – 133 FEET

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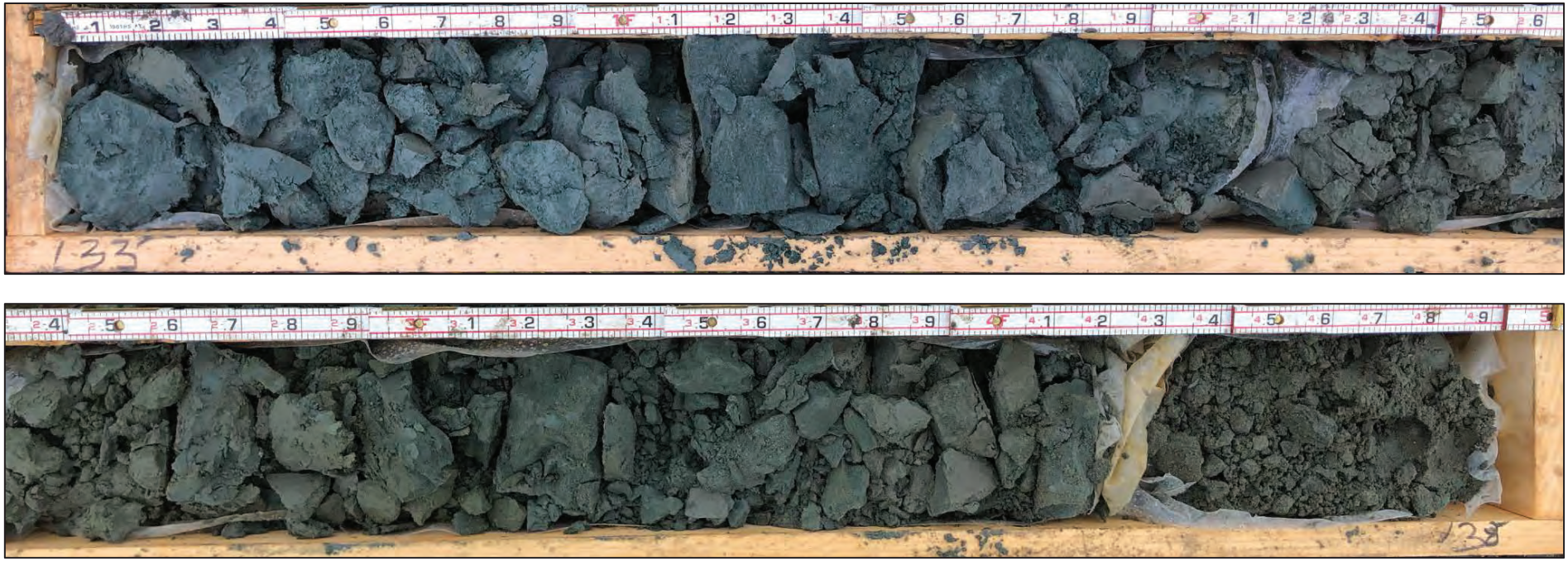

133 – 138 FEET

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138 – 143 FEET

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143 – 148 FEET

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148 – 153 FEET

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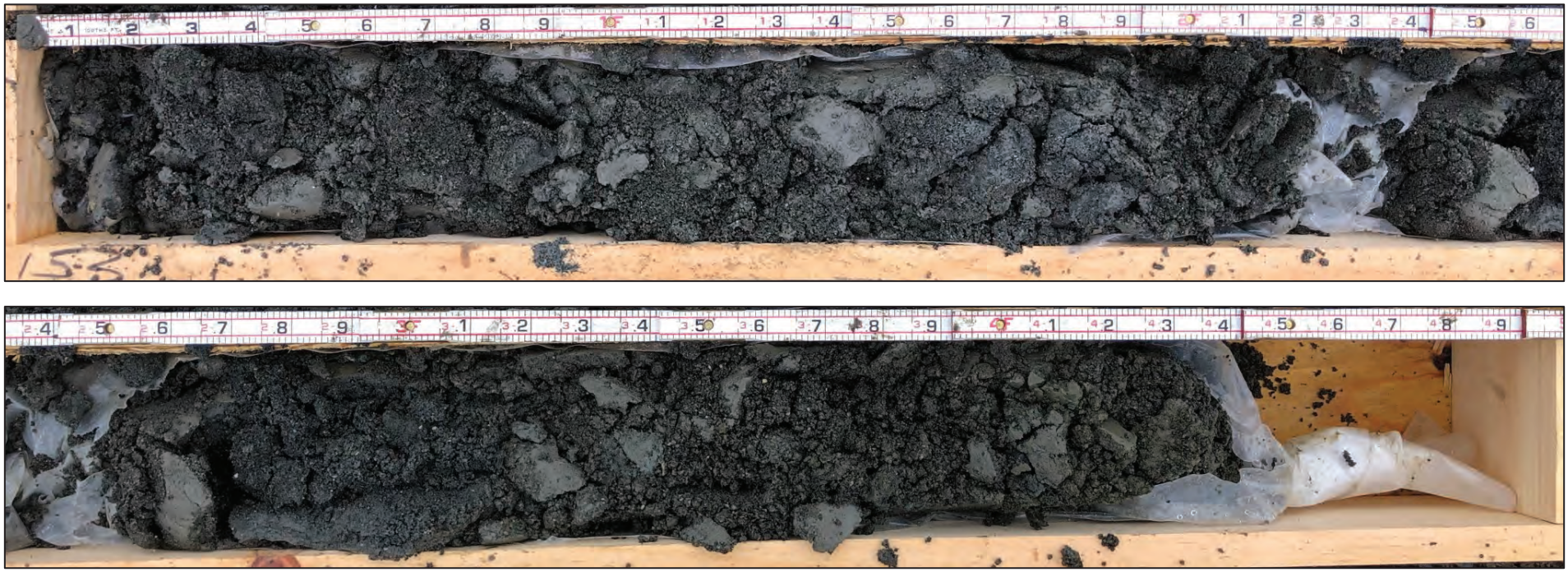

153 – 163 FEET

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-31**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,384**	Easting: **~ 349,429**		Start Card No. **N/A**
Equipment **GeoProbe 8150LS Tracked Sonic Rig**		Driller **Western States/Joe**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Kyle T. Romney**	Ground Elev. **~ -65 ft.**
Start Date **October 15, 2021**	End Date **October 19, 2021**	Total Depth **153.50 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil Driving Resistance / Rock Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0	S1	76			S- 1 (0.00-20.00) S- 1a (0.00-1.00) Sandy GRAVEL with trace silt; GP; Gray; Nonplastic fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; (Fill) S- 1b (1.00-20.00) Sandy GRAVEL with trace silt; GP; Gray; Nonplastic fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)	**0.00 - 1.00** **Sandy GRAVEL with trace silt; GP; Gray; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Fill)** **1.00 - 20.00** **Sandy GRAVEL with trace silt; GP; Gray; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)**		Borehole drilled from barge using sonic rotary drilling technique (6-inch hole); all depths are reported in feet below mudline; 6-inch ID steel casing installed to 79.5 feet below mudline S1b: 1% fines.	
	S1a								
	S1b								
5									
10									
15									
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	S2	100			S- 2 (20.00-30.70) SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)	**20.00 - 32.00 SAND with trace silt and gravel to Silty SAND; SP/SM; Gray; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)**			
25									
30									
	S3	10			S- 3 (30.70-50.30) Poor recovery S- 3a (30.70-32.00) Silty SAND; SM; Gray; Nonplastic fines; Wet; Fine to medium sand; (Sand Alluvium)			S3a: 22% fines.	
	S3a								
	S3b				S- 3b (32.00-50.30) SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)	**32.00 - 55.00 SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)**			
35									
40									
45									
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	S4 S4a	68			S- 4 (50.30-70.10) S- 4a (50.30-55.00) SAND with trace silt and gravel; SP; Gray; Nonplastic fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; (Sand Alluvium)				
55	S4b				S- 4b (55.00-63.50) GRAVEL with trace silt and sand, with cobbles and possible boulders; GP; Brown to gray; Low plasticity fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)	**55.00 - 63.50 GRAVEL with trace silt and sand, with cobbles and possible boulders; GP; Brown to gray; Low plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; (Gravel Alluvium)**		S4b: 87% gravel, 10% sand, 3% fines.	
60									
65	S4c				S- 4c (63.50-70.10) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Gray; Medium plasticity fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; Micas adhered to gravel and cobbles clasts; Zones of weak cementation; (Lower Troutdale Formation)	**63.50 - 101.80 Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Gray; Medium plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micas adhered to gravel and cobbles clasts; Zones of weak cementation; (Lower Troutdale Formation)**			
70	S5	100			S- 5 (70.10-83.00) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Gray; Medium plasticity fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; Micas adhered to gravel and cobbles clasts; Zones of weak cementation; (Lower Troutdale Formation)			S5: 40% gravel, 35% sand, 26% fines.	
75									
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80					SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.				
	S6	100			S- 6 (83.00-101.80) Sandy clayey GRAVEL, with cobbles and possible boulders; GC; Gray; Medium plasticity fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; Micas adhered to gravel and cobbles clasts; Zones of weak cementation; (Lower Troutdale Formation)				
85									
90									
95									
100									
	S7	100			S- 7 (101.80-112.80) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown and gray; Nonplastic to low plasticity fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; Micas adhered to gravel and cobbles clasts; Zones of weak cementation; (Lower Troutdale Formation)	**101.80 - 128.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown and gray; Nonplastic to low plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micas adhered to gravel and cobbles clasts; Zones of weak cementation; (Lower Troutdale Formation)**		S7: 63% gravel, 30% sand, 7% fines.	
105									
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110					SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.				
	S8	100			S- 8 (112.80-125.90) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown and gray; Nonplastic to low plasticity fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; Micas adhered to gravel and cobbles clasts; Zones of weak cementation; (Lower Troutdale Formation)				
115									
120									
125									
	S9	100			S- 9 (125.90-140.10)				
	S9a				S- 9a (125.90-128.00) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Yellow-brown and gray; Nonplastic to low plasticity fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; Micas adhered to gravel and cobbles clasts; Zones of weak cementation; (Lower Troutdale Formation)				
	S9b				S- 9b (128.00-133.00) GRAVEL with some clay and sand, with cobbles and possible boulders; GW-GC; Gray; Medium plasticity fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)	**128.00 - 133.00 GRAVEL with some clay and sand, with cobbles and possible boulders; GW-GC; Gray; Medium plasticity fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; (Lower Troutdale Formation)**		S9b: 65% gravel, 28% sand, 7% fines.	
130									
	S9c				S- 9c (133.00-135.00) SILT with some sand; ML; Brown; Low plasticity; Wet; Fine to medium sand; Micaceous; Weak cementation; (Sandy River Mudstone)	**133.00 - 135.00 SILT with some sand; ML; Brown; Low plasticity; Wet; Fine to medium sand; Micaceous; Weak cementation; (Sandy River Mudstone)**			
135	S9d				S- 9d (135.00-138.00) CLAY with trace sand; CH; Blue-gray; Medium to high plasticity; Moist; Fine to medium sand; Slight iron oxide staining; Micaceous; (Sandy River Mudstone)	**135.00 - 138.00 CLAY with trace sand; CH; Blue-gray; Medium to high plasticity; Moist; Fine to medium sand; Slight iron oxide staining; Micaceous;**			
	S9e				S- 9e (138.00-140.00) SAND with some silt and trace gravel; SP-SM; Gray; Nonplastic fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to medium sand; Micaceous; (Sandy River Mudstone)				
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	S10	100			S- 10 (140.10-153.50) S- 10a (140.10-148.00) SAND with some silt and trace gravel; SP-SM; Gray; Nonplastic fines; Wet; Fine to coarse subrounded to rounded gravel; Fine to medium sand; Micaceous; (Sandy River Mudstone)	**(Sandy River Mudstone)** **138.00 - 148.00 SAND with some silt and trace gravel; SP-SM; Gray; Nonplastic fines; Wet; Fine to coarse, subrounded to rounded gravel; Fine to medium sand; Micaceous; (Sandy River Mudstone)**			
	S10a								
145									
	S10b				S- 10b (148.00-153.50) Silty SAND; SM; Blue-green; Low plasticity fines; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)	**148.00 - 153.50 Silty SAND; SM; Blue-green; Low plasticity fines; Moist; Fine to medium sand; Micaceous; (Sandy River Mudstone)**			
150									
						153.50 End of hole			
155									
160									
165									
170									



0 – 4.5 FEET

Earthquake Ready Burnside Bridge
Portland, Oregon

SONIC CORE PHOTOS
BORING B-31

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4.5 – 8 FEET

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8 – 13 FEET

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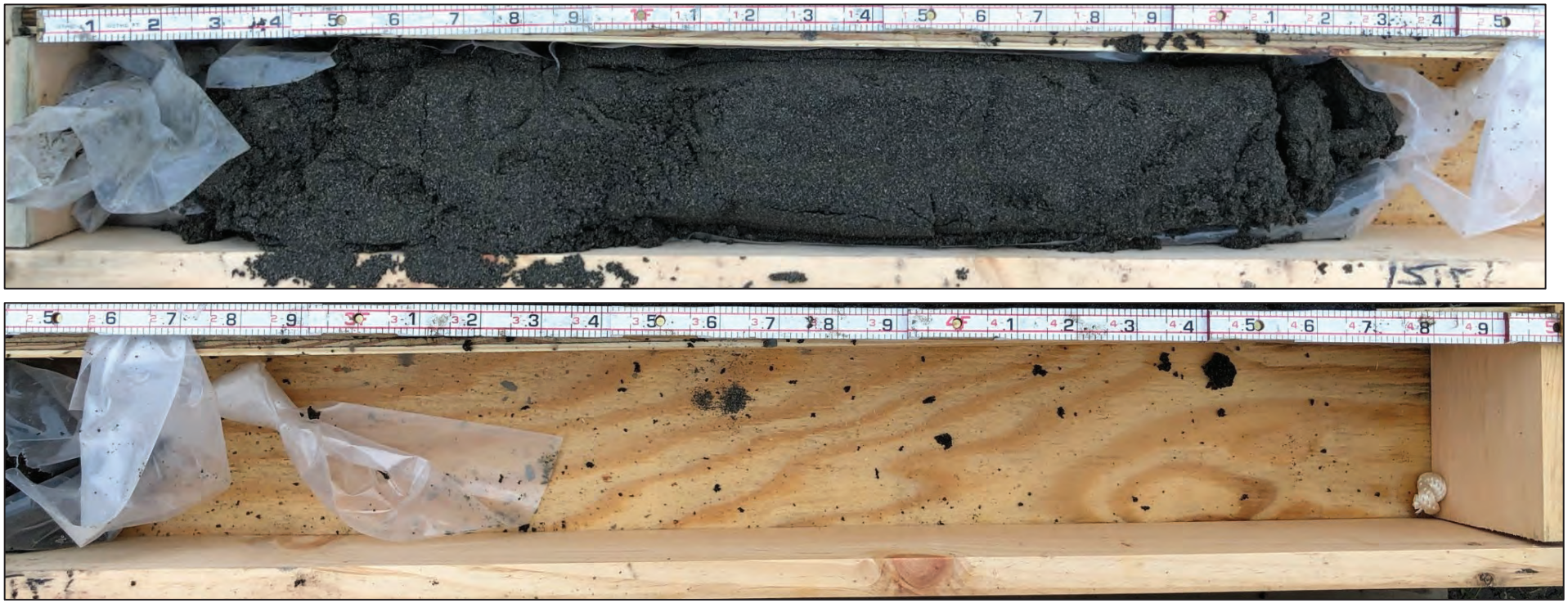

13 – 20 FEET

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20 – 25 FEET

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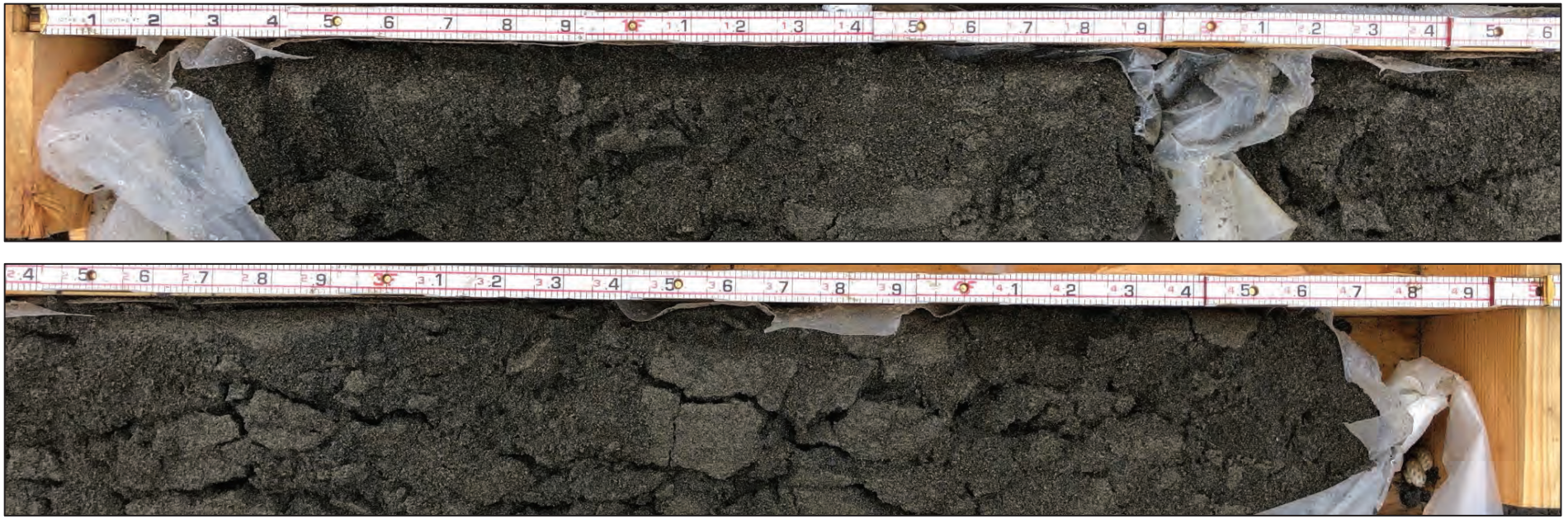

25 – 27.5 FEET

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27.5 – 30.7 FEET

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50 – 54.5 FEET

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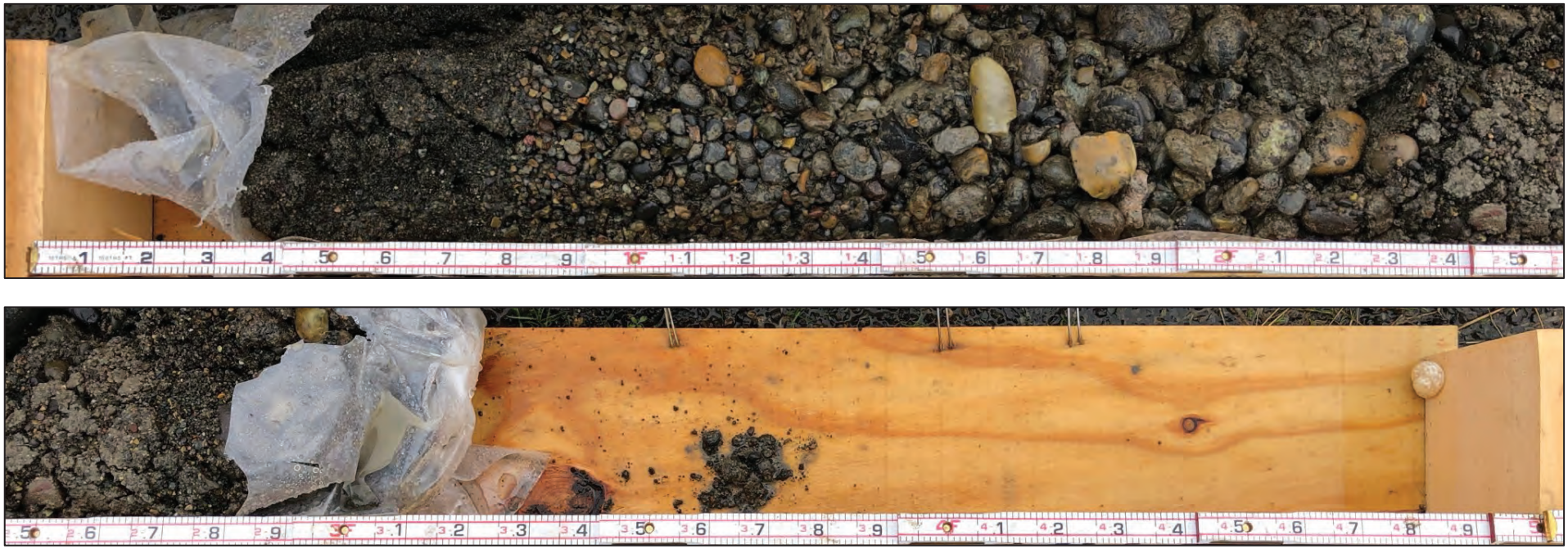

54.5 – 57.5 FEET

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57.5 – 62.5 FEET

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62.5 – 73.5 FEET

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73.5 – 77.5 FEET

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77.5 – 81 FEET

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81 – 85 FEET

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85 – 90 FEET

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90 – 94 FEET

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94 – 98 FEET

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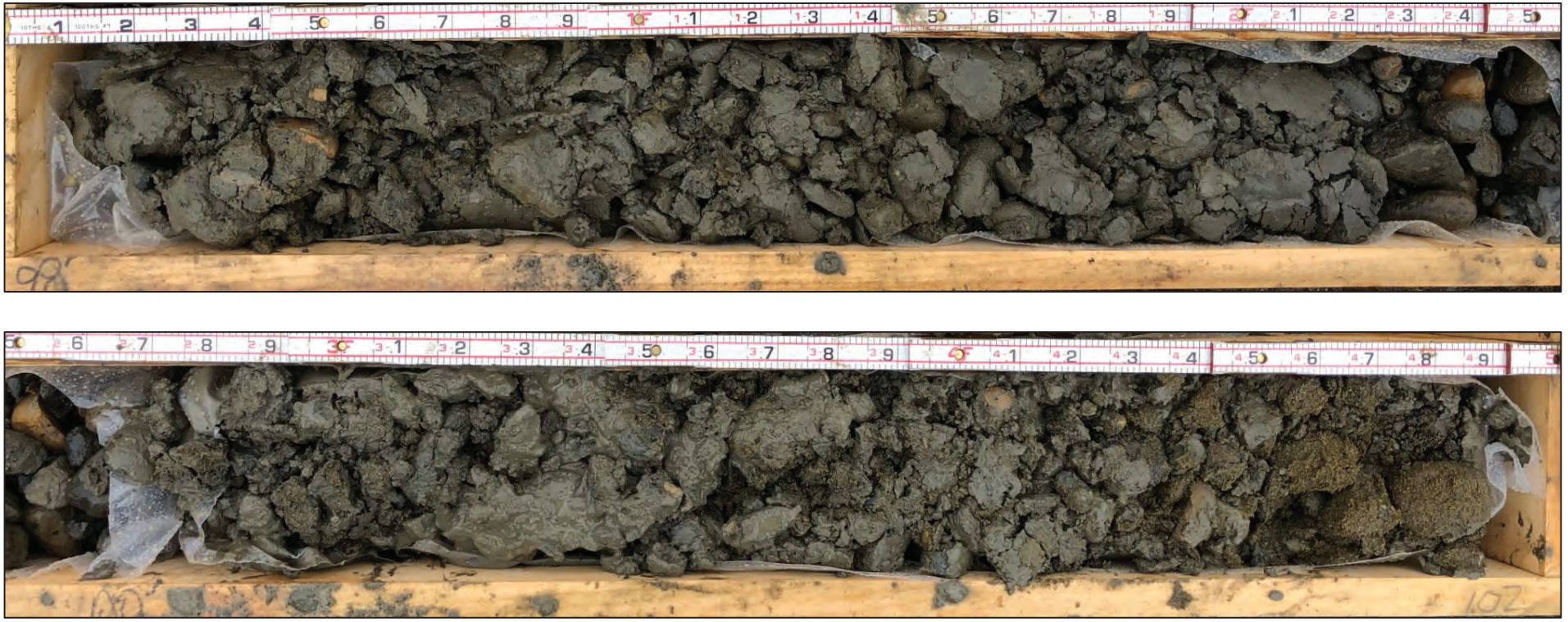

98 – 102 FEET

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102 – 106.5 FEET

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106.5 – 110 FEET

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110 – 115 FEET

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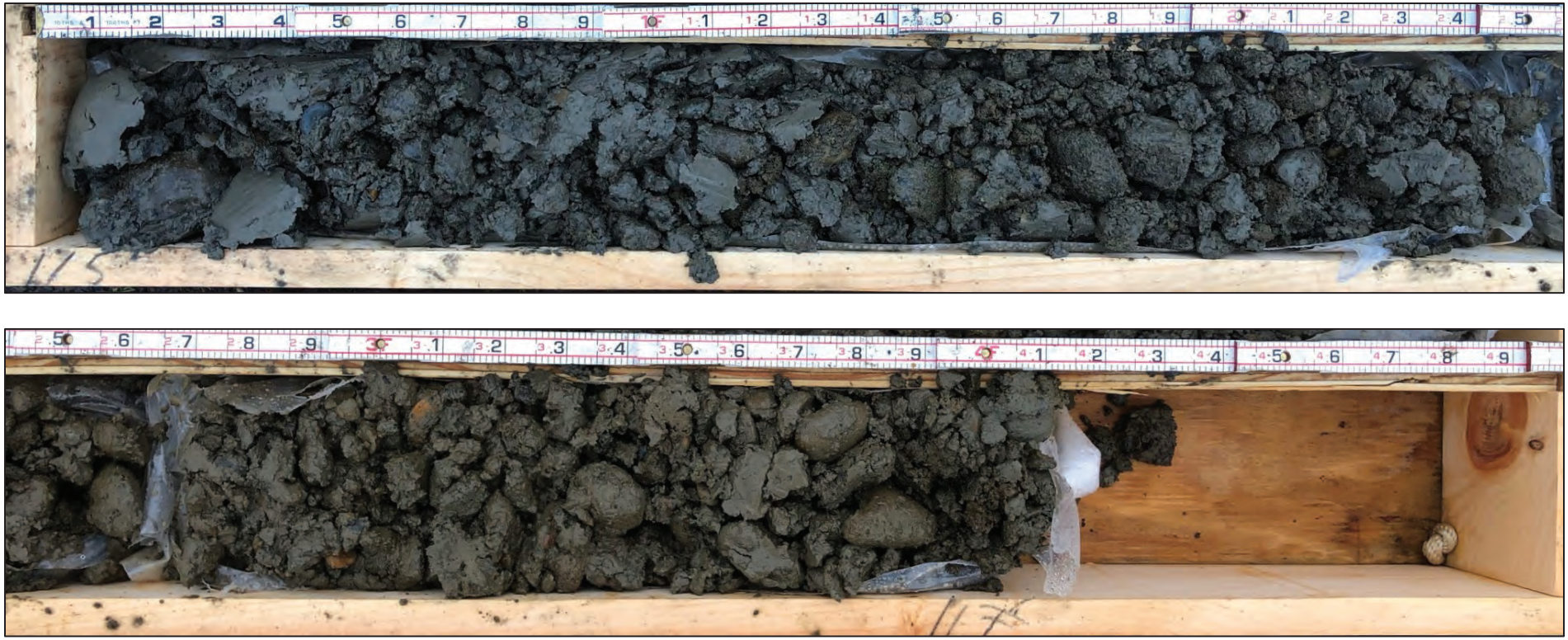

115 – 117 FEET

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117 – 122 FEET

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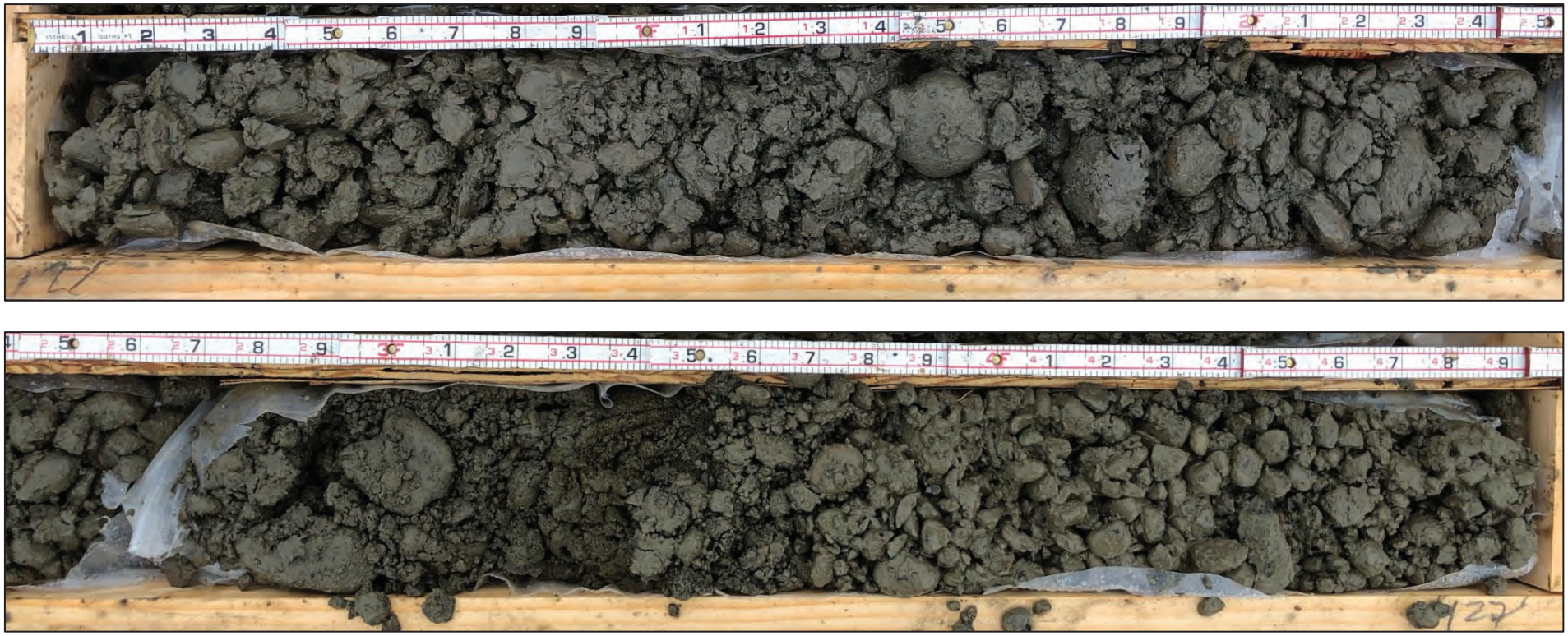

122 – 127 FEET

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127 – 132 FEET

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132 – 136 FEET

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136 – 141 FEET

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141 – 145.5 FEET

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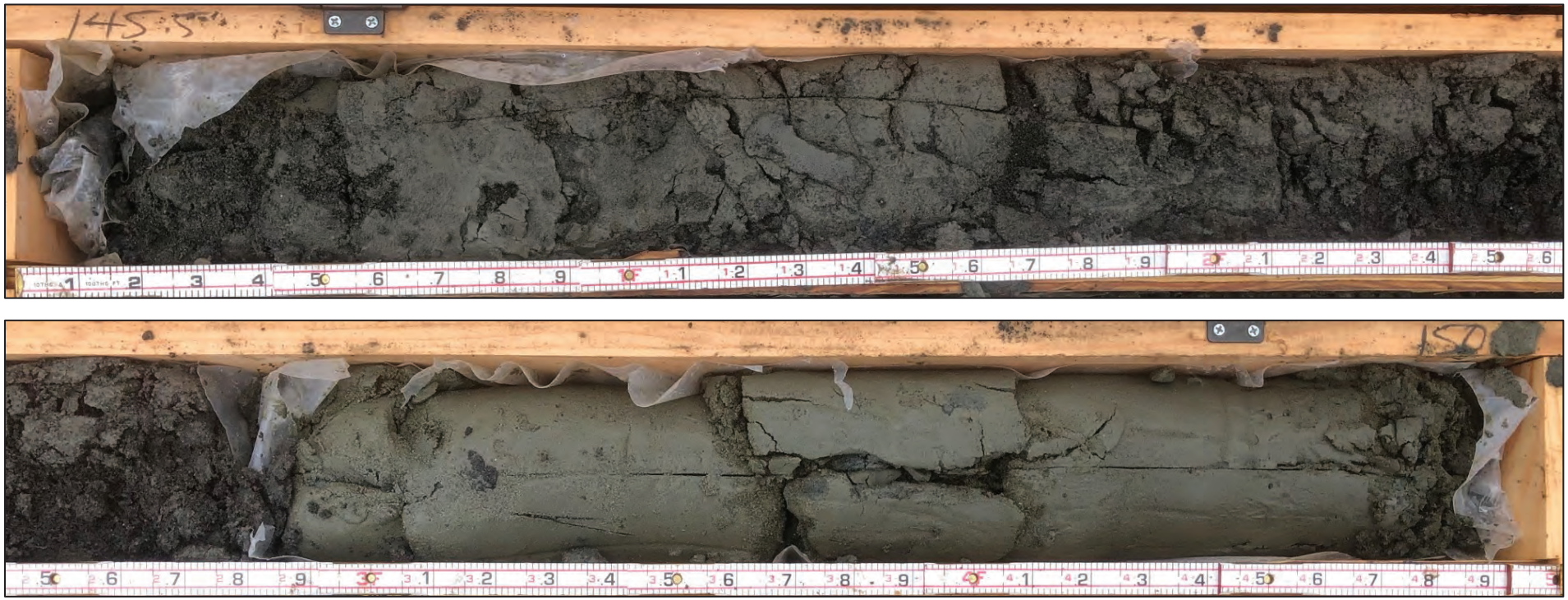

145.5 – 150.5 FEET

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150.5 – 153.5 FEET

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153.5 – 158 FEET

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DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-32**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,354**	Easting: **~ 350,124**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #5 (Hammer Efficiency = 80.8%)**		Driller **Western States/Adonis**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Alp Balcay**	Ground Elev. **~ 32 ft.**
Start Date **September 8, 2021**	End Date **September 13, 2021**	Total Depth **195.10 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0						**0.00 - 0.20 Asphalt Concrete; (Fill)**		Borehole vacuum excavated to 10 feet due to nearby utilities; 6-inch ID steel casing installed to 15 feet; OYO suspension logging performed from 16 to 182 feet.	
						0.20 - 1.00 Base Aggregate; (Fill)			
						1.00 - 3.00 Sandy GRAVEL with trace to some silt; GP/GP-GM; Moist; Based on observation of vacuum excavation; (Fill)			
5						**3.00 - 10.00 SILT with some sand and gravel; ML; Moist; Based on observation of vacuum excavation; (Fill)**			
10	N1	33	4-4-3		N- 1 (10.00-11.50) SAND with some silt and gravel; SP-SM; Brown; Nonplastic fines; Damp; Loose; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Trace organics; (Fill)	**10.00 - 12.00 SAND with some silt and gravel; SP-SM; Brown; Nonplastic fines; Damp; Loose; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Trace organics; (Fill)**		Borehole advanced using hollow-stem auger drilling technique (8-inch hole) from 10 feet to 15 feet.	
	N2	66	3-2-3	24	N- 2 (12.50-14.00) SAND with some silt with trace gravel; SP-SM; Brown; Nonplastic fines; Wet; Loose; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Trace organics; (Fill)			N2: 7% fines.	
15	N3	66	1-1-2	48	N- 3 (15.00-16.50) Organic CLAY with trace to some sand; OH; Gray; Medium plasticity; Wet; Soft; Fine sand; Micaceous; Some wood fragments and organics debris; (Fine-grained Alluvium)	**12.00 - 14.50 SAND with some silt with trace gravel; SP-SM; Brown; Nonplastic fines; Wet; Loose; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; Trace organics; (Fill)**		Switched to open-hole mud rotary technique (5-inch hole) at 15 feet due to groundwater encountered at approximately 15 feet. N3: 93% fines.	
						14.50 - 19.00 Organic CLAY with			
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N4	100	0-0-0	50	N- 4 (20.00-21.50) Organic CLAY with trace sand; OH; Brown mottled orange-brown; Low to medium plasticity; Wet; Very soft; Fine sand; Micaceous; Some fine organics and debris; (Fine-grained Alluvium)	**trace to some sand; OH; Gray; Medium plasticity; Moist; Very soft to soft; Fine sand; Micaceous; Some wood fragments and organic debris; (Fine-grained Alluvium)**		N4: 87% fines.	
								10/9/21 ▽	
								9/30/21 ▽	
25	N5	100	0-0-0	45	N- 5 (25.00-26.50) Organic CLAY; OH; Gray mottled orange-brown; Medium plasticity; Wet; Very soft; Micaceous; Some fine organics; (Fine-grained Alluvium)	**19.00 - 28.00 Organic CLAY to Organic CLAY with trace sand; OH; Brown and gray mottled orange-brown; Low to medium plasticity; Wet; Very soft; Fine sand; Micaceous; Some fine organics and organic debris; (Fine-grained Alluvium)**		Atterberg Limits N5: LL=52, PL=29, PI=23; 96% fines.	
30	N6	100	0-0-0	51	N- 6 (30.00-31.50) SILT to Silty CLAY; ML/CL; Gray; Low to medium plasticity; Wet; Very soft; Micaceous; Trace organics; (Fine-grained Alluvium)	**28.00 - 43.00 SILT to Silty CLAY with trace sand; ML/CL; Gray; Low to medium plasticity; Wet; Very soft; Fine sand; Micaceous; Trace organics; (Fine-grained Alluvium)**		N6: 99% fines.	
35	N7	100	0-0-0	43	N- 7 (35.00-36.50) SILT to Silty CLAY with trace sand; ML/CL; Gray; Medium plasticity; Wet; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)			Atterberg Limits N7: LL=49, PL=28, PI=21; 93% fines.	
40	N8	100	0-0-0	43	N- 8 (40.00-41.50) SILT to Silty CLAY; ML/CL; Gray; Low plasticity; Wet; Very soft; Micaceous; (Fine-grained Alluvium)			N8: 97% fines.	
45	N9	100	0-0-0	46	N- 9 (45.00-46.50) SILT with trace sand; ML; Gray; Low to medium plasticity; Wet; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)	**43.00 - 55.00 SILT with trace sand; ML; Gray; Low to medium plasticity; Moist to wet; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)**		N9: 94% fines.	
50									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
50	N10	100	0-1-1	41	N- 10 (50.00-51.50) SILT with trace sand; ML; Gray; Medium plasticity; Moist; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)			Atterberg Limits N10: LL=47, PL=28, PI=19; 88% fines.	
	U1	100			U- 1 (53.00-55.00) SILT with trace sand; ML; Gray; Low to medium plasticity; Moist; Fine sand; Micaceous; (Fine-grained Alluvium)				
55	N11	100	0-0-0	41	N- 11 (55.00-56.50) Sandy SILT; ML; Gray; Medium plasticity; Wet; Very soft; Fine sand; Micaceous; Trace organics; (Sand/Silt Alluvium)	**55.00 - 58.00 Sandy SILT; ML; Gray; Medium plasticity; Wet; Very soft; Fine sand; Micaceous; Trace organics; (Sand/Silt Alluvium)**		Atterberg Limits N11: LL=48, PL=29, PI=19; 65% fines. Geokon 4500S-350kPa vibrating wire piezometer (S/N=2136465) installed 55 feet below ground surface.	
60	N12	100	0-0-0	48	N- 12 (60.00-61.50) SILT with some sand; ML; Gray; Low plasticity; Wet; Very soft; Fine sand; Micaceous; Trace organics; (Fine-grained Alluvium)	**58.00 - 65.00 SILT with some sand; ML; Gray; Nonplastic to low plasticity; Wet; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)**		N12: 83% fines.	
	U2	100		37	U- 2 (63.00-65.00) SILT with some sand; ML; Gray; Nonplastic; Wet; Fine sand; Micaceous; (Fine-grained Alluvium)			Atterberg Limits U2: LL=NP, PL=NP, PI=NP.	
65	N13	100	0-1-3	48	N- 13 (65.00-66.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Loose; Fine sand; Micaceous; Trace organics; (Sand/Silt Alluvium)	**65.00 - 74.00 Sandy SILT to Sandy SILT with trace gravel; ML; Gray; Nonplastic; Wet; Loose; Fine, rounded gravel; Fine sand; Micaceous; Trace organics; Approx. 1/4-inch thick ash layer with fine rounded gravel in sample at 70 feet; (Sand/Silt Alluvium)**		Atterberg Limits N13: LL=NP, PL=NP, PI=NP; 54% fines.	
70	N14	100	2-4-3	44	N- 14 (70.00-71.50) Sandy SILT with trace gravel; ML; Gray; Nonplastic; Wet; Loose; Fine rounded gravel; Fine sand; Micaceous; Trace organics; Approx. 1/4-inch thick ash layer with fine rounded gravel in sample; (Sand/Silt Alluvium)			N14: 62% fines.	
75	N15	100	0-0-3	44	N- 15 (75.00-76.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Very loose; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**74.00 - 83.00 Silty SAND; SM; Gray; Nonplastic fines; Wet; Very loose; Fine to medium sand; Micaceous; Trace to few fine organics; Few interbeds of SILT with sand and Sandy SILT (ML); (Sand/Silt Alluvium)**		N15: 42% fines.	
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N16	100	0-2-3	45	N- 16 (80.00-81.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Very loose; Fine to medium sand; Micaceous; Few interbeds of Sandy SILT (ML); (Sand/Silt Alluvium)			N16: 50% fines.	
85	N17	100	1-0-1	46	N- 17 (85.00-86.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Very loose; Fine to medium sand; Micaceous; Trace to few fine organics; Few interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)	**83.00 - 103.00 Sandy SILT; ML; Gray; Nonplastic to low plasticity; Wet; Very loose/Soft to stiff; Fine sand; Micaceous; Trace to some interbeds of Silty SAND (SM); (Sand/Silt Alluvium)**		N17: 60% fines.	
90	N18	75	0-3-6	43	N- 18 (90.00-91.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Stiff; Fine sand; Micaceous; Trace interbeds of Silty SAND (SM); (Sand/Silt Alluvium)			N18: 60% fines.	
95	N19	100	2-3-1	43	N- 19 (95.00-96.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Soft to medium stiff; Fine sand; Micaceous; Trace to few interbeds of Silty SAND (SM); (Sand/Silt Alluvium)			N19: 60% fines.	
	U3	100			U- 3 (98.00-100.00) Sandy SILT; ML; Gray; Low plasticity; Wet; Fine sand; Micaceous; (Sand/Silt Alluvium)				
100	N20	100	0-0-4	42	N- 20 (100.00-101.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Soft to medium stiff; Fine to medium sand; Micaceous; Some interbeds of Silty SAND (SM); (Sand/Silt Alluvium)			N20: 52% fines.	
105	N21	66	4-8-11	38	N- 21 (105.00-106.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; Trace interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)	**103.00 - 113.00 Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; Trace interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)**		N21: 65% sand, 35% fines.	
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N22	66	6-7-11	39	N- 22 (110.00-111.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			N22: 27% fines.	
						113.00 - 133.00 Sandy SILT with possible cobbles; ML; Gray; Nonplastic to low plasticity; Wet; Medium dense/Stiff to hard; Fine sand; Micaceous; (Sand/Silt Alluvium)			
115	N23	66	0-7-7	43	N- 23 (115.00-116.50) Sandy SILT; ML; Gray; Nonplastic to low plasticity; Wet; Medium dense/Stiff; Fine sand; Micaceous; Few to some interbeds of Silty SAND (SM); (Sand/Silt Alluvium)			N23: 57% fines.	
120	N24a N24b	15	10-50/4"		N- 24a (120.00-120.40) Sandy SILT; ML; Gray; Low plasticity; Wet; Hard; Fine sand; Micaceous; Poor recovery; (Sand/Silt Alluvium) N- 24b (120.40-120.80) Recovered a fragment of a large gravel or cobble at 120.4 feet; Possible large gravel or cobble in Sand/Silt Alluvium; (Sand/Silt Alluvium)			Large gravel or cobble at 120.4 feet.	
125	N25	0	9-11-12		N- 25 (125.00-126.50) No Recovery; Possibly chased gravel or cobble down hole			Driller noted wood fragments in drilling mud after drilling from 120 to 125 feet.	
130	N26	100	5-9-14	35	N- 26 (130.00-131.50) Sandy SILT; ML; Gray and brown; Nonplastic; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			N26: 55% fines.	
						133.00 - 145.50 Silty SAND; SM; Gray and brown; Nonplastic fines; Wet; Medium dense to very dense; Fine to medium sand; Micaceous; Trace interbeds of Sandy SILT (ML); Numerous wood fragments and wood debris in sample at 145 feet; (Sand/Silt Alluvium)			
135	N27	100	10-10-13	32	N- 27 (135.00-136.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; Trace interbeds of Sandy SILT (ML); (Sand/Silt Alluvium)			N27: 33% fines.	
140									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	N28	66	7-13-12	32	N- 28 (140.00-141.50) Silty SAND; SM; Gray; Nonplastic to low plasticity fines; Moist; Medium dense; Fine to medium sand; Micaceous; Trace interbeds of Sandy SILT (ML); (Sand/Silt Alluvium)			N28: 28% fines.	
145	N29a	66	33-50/5"		N- 29a (145.00-145.50) Recovered numerous wood fragments with Silty SAND from 140 to 145.5 feet; SM; (Sand/Silt Alluvium)				
	N29b				N- 29b (145.50-146.00) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; Trace organics; (Gravel Alluvium)	**145.50 - 148.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; Trace organics; (Gravel Alluvium)**			
150	N30	66	7-15-12	36	N- 30 (150.00-151.50) Silty SAND; SM; Gray and brown; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)	**148.00 - 154.00 Silty SAND; SM; Gray and brown; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand Alluvium)**		N30: 36% fines.	
155	N31	50	26-39-50/5"	15	N- 31 (155.00-155.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)	**154.00 - 168.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**		N31: 13% fines.	
160	N32	10	50/1st 1"		N- 32 (160.00-160.10) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Poor recovery; (Gravel Alluvium)				
165									
170						**168.00 - 175.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM;**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
170	N33	10	50/1st 1"		N- 33 (170.00-170.10) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Poor recovery; (Gravel Alluvium)	**Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Gravel Alluvium)**			
175						**175.00 - 193.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray, brown, yellow-brown, and dark green-black; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Dark green-black staining of gravel clasts in sample at 180 feet; (Lower Troutdale Formation)**			
180	N34	10	50/1st 2"		N- 34 (180.00-180.20) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray, brown, yellow-brown, and dark green-black; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Dark green-black staining of gravel clasts; Poor recovery; (Lower Troutdale Formation)				
185									
190	N35	10	50/1st 1"		N- 35 (190.00-190.10) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Gray, brown, yellow-brown, and dark green-black; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Poor recovery; (Lower Troutdale Formation)				
						193.00 - 195.10 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, gray, and green-gray; Low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; (Lower Troutdale Formation)			
195	N36	10	50/1st 1"		N- 36 (195.00-195.10) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, brown, gray, and green-gray; Low plasticity fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Poor recovery; (Lower Troutdale Formation)				
200						**195.10**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
200						**End of hole**			
205									
210									
215									
220									
225									
230									

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

DRILL LOG

OREGON DEPARTMENT OF TRANSPORTATION

			Hole No. **B-33**
Project **Earthquake Ready Burnside Bridge**		Purpose **Burnside Bridge**	E.A. No. **N/A**
Highway **Burnside Street**		County **Multnomah**	Key No. **N/A**
Hole Location Northing: **~ 172,380**	Easting: **~ 349,993**		Start Card No. **N/A**
Equipment **CME-75 Truck Rig #5 (Hammer Efficiency = 80.8%)**		Driller **Western States/Adonis**	Bridge No. **00511**
Project Geologist **Cody K. Sorensen, CEG**		Recorder **Veronica C. Biesiada & Alp Balcay**	Ground Elev. **~ 34 ft.**
Start Date **September 1, 2021**	End Date **September 7, 2021**	Total Depth **195.10 ft**	Tube Height **N/A**

Test Type
"A" - Auger Core
"X" - Auger
"C" - Core, Barrel Type
"N" - Standard Penetration
"U" - Undisturbed Sample
"T" - Test Pit
"GP" - GeoProbe®

Rock Abbreviations

Discontinuity	Shape	Surface Roughness
J - Joint	Pl - Planar	P - Polished
F - Fault	C - Curved	Sl - Slickensided
B - Bedding	U - Undulating	Sm - Smooth
Fo - Foliation	St - Stepped	R - Rough
S - Shear	Ir - Irregular	VR - Very Rough

Typical Drilling Abbreviations

Drilling Methods	Drilling Remarks
WL - Wire Line	LW - Lost Water
HS - Hollow Stem Auger	WR - Water Return
DF - Drill Fluid	WC - Water Color
SA - Solid Auger	DP - Down Pressure
CA - Casing Advancer	DR - Drill Rate
HA - Hand Auger	DA - Drill Action

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
0					SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.	**0.00 - 0.20 Asphalt Concrete; (Fill)**		Borehole vacuum excavated to 6 feet due to nearby utilities.	
						0.20 - 1.20 Base Aggregate; (Fill)			
						1.20 - 4.00 Sandy GRAVEL with trace to some silt; GP/GP-GM; Gray-brown; Nonplastic fines; Moist; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Trace concrete fragments; Based on observation of vacuum excavation; (Fill)			
5								Borehole advanced using hollow-stem auger drilling technique (8-inch hole) from 6 feet to 30 feet.	
	N1	67	1-1-2		N- 1 (7.50-9.00) Gravelly silty SAND; SM; Brown; Low plasticity fines; Moist; Very loose; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Fill)				
						4.00 - 6.00 GRAVEL and cobbles; Based on observation of vacuum excavation; (Fill)			
10	N2	40	12-5-5		N- 2 (10.00-11.50) Gravelly silty SAND; SM; Gray-brown; Low plasticity fines; Moist; Loose to medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Fill)	**6.00 - 12.00 Gravelly silty SAND; SM; Brown and gray-brown; Low plasticity fines; Moist; Very loose to medium dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; (Fill)**		Hard drilling at 12 feet.	
	N3	53	3-2-1		N- 3 (12.50-14.00) Silty GRAVEL with some sand; GM; Brown; Nonplastic fines; Moist; Loose; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Trace asphalt fragments; Strong petroleum odor; (Fill)				
15	N4	80	3-2-3		N- 4 (15.00-16.50) Gravelly silty SAND; SM; Black; Nonplastic fines; Moist; Loose; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Trace wood debris; Oil saturated; Heavy contamination; (Fill)	**12.00 - 14.50 Silty GRAVEL with some sand; GM; Brown; Nonplastic fines; Moist; Loose; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Trace asphalt fragments; Strong petroleum odor; (Fill)**			
	N5	100	0-0-0		N- 5 (17.50-19.00) Organic CLAY with trace sand; OH; Gray; Medium plasticity; Moist; Very soft; Fine sand; Few fine organics; Strong petroleum odor; (Fine-grained Alluvium)				
20									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
20	N6	100	0-0-0		N- 6 (20.00-21.50) Organic CLAY with trace sand; OH; Gray; Medium plasticity; Moist to wet; Very soft; Fine sand; Few fine organics; Strong petroleum odor; (Fine-grained Alluvium)	**14.50 - 17.00 Gravelly silty SAND; SM; Black; Nonplastic fines; Moist; Loose; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Trace wood debris; Oil saturated; Heavy contamination; (Fill)**			
	N7	100	0-0-0	52	N- 7 (22.50-24.00) Silty CLAY with trace sand; CL; Brown mottled orange-brown; Medium plasticity; Moist; Very soft; Fine sand; Micaceous; Slight iron oxidation and staining; (Fine-grained Alluvium)			N7: 87% fines.	
25	N8	100	0-0-0	48	N- 8 (25.00-26.50) Silty CLAY with trace sand; CL; Brown mottled orange-brown; Medium plasticity; Moist; Very soft; Fine sand; Micaceous; Slight iron oxidation and staining; (Fine-grained Alluvium)	**17.00 - 22.00 Organic CLAY with trace sand; OH; Gray; Medium plasticity; Moist; Very soft; Fine sand; Few fine organics; Strong petroleum odor; (Fine-grained Alluvium)**		N8: 91% fines. Due to contamination encountered at 12.5 feet, 6-inch ID casing was pushed to 30 feet to seal off borehole from contamination. Drilled out 6-inch ID casing and switched to open-hole mud rotary technique (5-inch hole) below 30 feet.	
30	N9	100	0-0-0	45	N- 9 (30.00-31.50) SILT with some sand; ML; Brown and gray mottled; Low to medium plasticity; Moist; Very soft; Fine sand; Micaceous; Slight iron oxidation and staining; (Fine-grained Alluvium)	**22.00 - 28.00 Silty CLAY with trace sand; CL; Brown mottled orange-brown; Medium plasticity; Moist; Very soft; Fine sand; Micaceous; Slight iron oxide staining; (Fine-grained Alluvium)**		Atterberg Limits N9: LL=48, PL=33, PI=15; 84% fines.	
	U1	100		49	U- 1 (33.00-35.00) SILT with some sand; ML; Gray; Nonplastic; Moist; Fine sand; Micaceous; (Fine-grained Alluvium)			Atterberg Limits U1: LL=NP, PL=NP, PI=NP.	
35	N10	100	0-0-0	46	N- 10 (35.00-36.50) SILT with some sand; ML; Gray; Nonplastic; Wet; Very loose; Fine sand; Micaceous; (Sand/Silt Alluvium)	**28.00 - 35.00 SILT with some sand; ML; Brown and gray mottled to gray; Nonplastic to medium plasticity; Moist; Very soft; Fine sand; Micaceous; Slight iron oxide staining; (Fine-grained Alluvium)**		Atterberg Limits N10: LL=NP, PL=NP, PI=NP; 70% fines.	
40	N11	100	0-1-3	43	N- 11 (40.00-41.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Very loose to loose; Fine sand; Micaceous; (Sand/Silt Alluvium)	**35.00 - 43.00 Sandy SILT to SILT with some sand; ML; Gray; Nonplastic; Wet; Very loose to loose; Fine sand; Micaceous; (Sand/Silt Alluvium)**		N11: 58% fines.	
45	N12	100	0-0-0	47	N- 12 (45.00-46.50) SILT with some sand; ML; Gray; Low plasticity; Wet; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)	**43.00 - 50.00 SILT with some sand; ML; Gray; Low plasticity; Wet; Very soft; Fine sand; Micaceous; (Fine-grained Alluvium)**		Atterberg Limits N12: LL=43, PL=40, PI=3; 77% fines.	
	U2	100		44	U- 2 (48.00-50.00) SILT with some sand; ML; Gray; Low plasticity; Wet; Fine sand; Micaceous; (Fine-grained Alluvium)			Atterberg Limits U2: LL=36, PL=30, PI=6.	
50									

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50	N13	100	0-0-0	45	N- 13 (50.00-51.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Very soft; Fine sand; Micaceous; (Sand/Silt Alluvium)	**50.00 - 62.00 Sandy SILT to SILT with some sand; ML; Gray; Nonplastic to low plasticity; Wet; Soft/Very loose to loose; Fine sand; Micaceous; Few interbeds of SILT with some sand (ML) at 60 feet; (Sand/Silt Alluvium)**		Atterberg Limits N13: LL=39, PL=35, PI=4.	
55	N14	100	0-0-0	45	N- 14 (55.00-56.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Very loose; Fine sand; Micaceous; (Sand/Silt Alluvium)			N14: 63% fines.	
60	N15	100	0-0-5	46	N- 15 (60.00-61.50) SILT with some sand; ML; Gray; Nonplastic; Wet; Loose; Fine sand; Micaceous; (Sand/Silt Alluvium)			Atterberg Limits N15: LL=42, PL=40, PI=2; 71% fines.	
	U3	100		43	U- 3 (63.00-65.00) SILT with some sand; ML; Gray; Nonplastic; Wet; Fine sand; Micaceous; (Fine-grained Alluvium)	**62.00 - 65.00 SILT with some sand; ML; Gray; Nonplastic; Wet; Fine sand; Micaceous; (Fine-grained Alluvium)**		Atterberg Limits U3: LL=NP, PL=NP, PI=NP.	
65	N16	100	1-4-5	43	N- 16 (65.00-66.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Stiff; Fine sand; Micaceous; Few interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)	**65.00 - 68.00 Sandy SILT; ML; Gray; Low plasticity; Wet; Stiff; Fine sand; Micaceous; Few interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)**		Atterberg Limits N16: LL=36, PL=32, PI=4; 68% fines.	
70	N17	67	4-6-5	40	N- 17 (70.00-71.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; Trace organics; (Sand/Silt Alluvium)	**68.00 - 73.00 Silty SAND; SM; Gray; Nonplastic fines; Wet; Very loose to medium dense; Fine to medium sand; Micaceous; Trace organics; (Sand/Silt Alluvium)**		N17: 37% fines.	
75	N18	100	5-0-1	44	N- 18 (75.00-76.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Very loose; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**73.00 - 80.00 Sandy SILT; ML; Gray; Nonplastic; Wet; Very loose; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)**		N18: 61% fines.	
	U4	80			U- 4 (78.00-80.00) Sandy SILT; ML; Gray; Nonplastic; Wet; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)				
80									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
80	N19	100	1-2-6	40	N- 19 (80.00-81.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Medium stiff to stiff; Fine to medium sand; Micaceous; Few to some interbeds of Silty SAND (SM); (Sand/Silt Alluvium)	**80.00 - 83.00 Sandy SILT; ML; Gray; Low plasticity; Wet; Medium stiff to stiff; Fine to medium sand; Micaceous; Few to some interbeds of Silty SAND (SM); (Sand/Silt Alluvium)**		N19: 69% fines.	
85	N20	100	4-6-4	42	N- 20 (85.00-86.50) Silty SAND; SM; Gray; Low plasticity fines; Wet; Loose to medium dense; Fine sand; Micaceous; Some interbeds of SILT with some sand (ML); Trace organics; (Sand/Silt Alluvium)	**83.00 - 88.00 Silty SAND; SM; Gray; Low plasticity fines; Wet; Loose to medium dense; Fine sand; Micaceous; Some interbeds of SILT with some sand (ML); Trace organics; (Sand/Silt Alluvium)**		N20: 43% fines.	
90	N21	100	0-1-4	43	N- 21 (90.00-91.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Loose; Fine sand; Micaceous; Trace organics; (Sand/Silt Alluvium)	**88.00 - 93.00 Sandy SILT; ML; Gray; Nonplastic; Wet; Loose; Fine sand; Micaceous; Trace organics; (Sand/Silt Alluvium)**		N21: 65% fines.	
95	N22	100	1-0-3	42	N- 22 (95.00-96.50) SILT with some sand; ML; Gray; Low plasticity; Wet; Soft; Fine sand; Micaceous; Trace to few interbeds of Silty SAND (SM); Trace organics; (Fine-grained Alluvium)	**93.00 - 98.00 SILT with some sand; ML; Gray; Low plasticity; Wet; Soft to very stiff; Fine sand; Micaceous; Trace interbeds to Interbedded with Silty SAND (SM); (Fine-grained Alluvium)**		Atterberg Limits N22: LL=38, PL=33, PI=5; 75% fines.	
100	N23	80	0-6-11	44	N- 23 (100.00-101.50) Sandy SILT; ML; Gray; Low plasticity; Wet; Very stiff; Fine sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)	**98.00 - 103.00 Sandy SILT; ML; Gray; Low plasticity; Wet; Very stiff; Fine sand; Micaceous; Interbedded with Silty SAND (SM); (Sand/Silt Alluvium)**		N23: 57% fines.	
105	N24	87	4-8-7	39	N- 24 (105.00-106.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)	**103.00 - 113.00 Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)**		N24: 46% fines.	
110									

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
110	N25	87	7-11-11	39	N- 25 (110.00-111.50) Silty SAND; SM; Dark gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			N25: 25% fines.	
115	N26	100	3-10-4	41	N- 26 (115.00-116.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Medium dense; Fine to medium sand; Micaceous; Interbedded with Silty SAND (SM); Trace organics; (Sand/Silt Alluvium)	**113.00 - 123.00 Sandy SILT; ML; Gray; Nonplastic; Wet; Medium dense; Fine to medium sand; Micaceous; Interbedded with Silty SAND (SM); Trace organics; (Sand/Silt Alluvium)**		Atterberg Limits N26: LL=NP, PL=NP, PI=NP; 61% fines.	
120	N27	93	6-6-14	38	N- 27 (120.00-121.50) Sandy SILT; ML; Gray; Nonplastic; Wet; Medium dense; Fine to medium sand; Micaceous; Interbedded with Silty SAND (SM); Trace organics; (Sand/Silt Alluvium)			N27: 56% fines.	
125	N28	100	6-4-2	46	N- 28 (125.00-126.50) SILT with some sand; ML; Gray; Low plasticity; Wet; Medium stiff; Fine sand; Micaceous; Interbedded with Silty SAND (SM); Trace organics; (Fine-grained Alluvium)	**123.00 - 127.00 SILT with some sand; ML; Gray; Low plasticity; Wet; Medium stiff; Fine sand; Micaceous; Interbedded with Silty SAND (SM); Trace organics; (Fine-grained Alluvium)**		Atterberg Limits N28: LL=44, PL=38, PI=6; 80% fines.	
	U5	75		29	U- 5 (127.00-129.00) Silty SAND; SM; Gray; Nonplastic fines; Moist to wet; Fine to medium sand; (Sand/Silt Alluvium)	**127.00 - 138.00 Silty SAND; SM; Gray; Nonplastic fines; Moist to wet; Fine to medium sand; Micaceous; Trace interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)**		Dry Density U5: 95 pcf; 77% sand, 23% fines.	
130	N29	100	3-2-4	34	N- 29 (129.00-130.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Loose; Fine to medium sand; Micaceous; Trace interbeds of SILT with some sand (ML); (Sand/Silt Alluvium)			N29: 36% fines.	
135	N30	67	18-16-11	31	N- 30 (135.00-136.50) Silty SAND; SM; Gray; Nonplastic fines; Wet; Medium dense; Fine to medium sand; Micaceous; (Sand/Silt Alluvium)			N30: 13% fines.	
140						**138.00 - 143.00 Gravelly silty SAND; SM; Gray; Nonplastic fines; Wet; Dense; Fine to coarse sand;**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
140	N31	33	2-5-30	33	N- 31 (140.00-141.50) Gravelly silty SAND; SM; Gray; Nonplastic fines; Wet; Dense; Fine to coarse sand; Micaceous; Trace organics; (Sand Alluvium)	**Micaceous; Trace organics; (Sand Alluvium)**		N31: 22% fines.	
145	N32	50	36-31-27		N- 32 (145.00-146.50) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**143.00 - 153.00 Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**			
150	N33	56	35-50/5"		N- 33 (150.00-150.90) Silty GRAVEL with some sand, with cobbles and possible boulders; GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)				
155	N34	61	50/1st 4"		N- 34 (155.00-155.33) GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**153.00 - 160.00 GRAVEL with some silt and sand, with cobbles and possible boulders; GP-GM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**			
160						**160.00 - 167.00 SAND with some silt and gravel; SP-SM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)**		Softer drilling at 160 feet.	
165	N35	67	11-19-37	24	N- 35 (165.00-166.50) SAND with some silt and gravel; SP-SM; Gray and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to rounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)			N35: 10% fines.	
170						**167.00 - 174.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines;**			

Depth (ft)	Test Type, No.	Percent Recovery	Soil / Rock: Driving Resistance / Discontinuity Data Or RQD%	Percent Natural Moisture	Material Description (SOIL: Soil Name, USCS, Color, Plasticity, Moisture, Consistency/Relative Density, Texture, Cementation, Structure, Origin. ROCK: Rock Name, Color, Weathering, Hardness, Discontinuity Spacing, Joint Filling, Core Recovery, Formation Name.)	Unit Description	Graphic Log	Drilling Methods, Size and Remarks / Water Level/ Date	Backfill/ Instrumentation
170	N36	80	50/1st 6"		N- 36 (170.00-170.50) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**			
175	N37	67	20-18-23	13	N- 37 (175.00-176.50) SAND with some silt and gravel; SP-SM; Gray and brown; Nonplastic fines; Wet; Dense; Fine to coarse, subrounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)	**174.00 - 177.00 SAND with some silt and gravel; SP-SM; Gray and brown; Nonplastic fines; Wet; Dense; Fine to coarse, subrounded gravel; Fine to coarse sand; Micaceous; (Sand Alluvium)**		N37: 10% fines.	
180	N38	38	23-37-50/4"		N- 38 (180.00-181.33) Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)	**177.00 - 183.00 Sandy GRAVEL with some silt, with cobbles and possible boulders; GP-GM; Brown and gray; Nonplastic fines; Wet; Very dense; Fine to coarse, subangular to subrounded gravel; Fine to coarse sand; Micaceous; (Gravel Alluvium)**			
185	N39	100	50/1st 1"		N- 39 (185.00-185.10) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, red-brown, gray, and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Weak cementation; (Lower Troutdale Formation)	**183.00 - 195.10 Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, red-brown, gray, and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Weak cementation; (Lower Troutdale Formation)**			
190									
195	N40	100	50/1st 1"		N- 40 (195.00-195.10) Sandy silty GRAVEL, with cobbles and possible boulders; GM; Yellow-brown, red-brown, gray, and brown; Nonplastic fines; Wet; Very dense; Fine to coarse, subrounded to rounded gravel; Fine to coarse sand; Micaceous; Micas and sand adhered to gravel clasts; Weak cementation; (Lower Troutdale Formation)	**195.10 End of hole**			
200									

APPENDIX C: IN SITU TESTING

Appendix C

In Situ Testing

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C.2 OYO Suspension Logging....C-1
C.3 Pressuremeter Testing....C-1

Table

Table C1: Pressuremeter Testing Summary

Attachments

GEOVision report dated November 28, 2016: "Burnside Bridge Suspension PS Velocities; Boreholes B-1, B-2, and B-3"

In Situ Engineering report dated October 27, 2021: "Earthquake Ready Burnside Bridge – EQRB; Report of P and S Wave Velocity Logging; Boreholes"

In Situ Engineering report dated October 29, 2021: "Report of In Situ Pressuremeter Testing; Earthquake Ready Burnside Bridge – EQRB Project; Portland, OR"

APPENDIX C: IN SITU TESTING

C.1 GENERAL

The field exploration program performed in 2016 included geophysical measurements of compressional and shear wave velocities in all three borings. The 2021 field exploration program included geophysical measurements of compressional and shear wave velocities in 11 borings. Approximate locations of the tested boreholes are shown on the Site and Exploration Plan and Interpretive Subsurface Profile A-A', Figure 2-2. The measurements were taken at regular depth intervals and used to generate profiles of compressional and shear wave velocities, the latter of which were used in this study to model the seismic response of the site to earthquake loading.

The 2021 field exploration program also included in situ pressuremeter testing (PMT) in four over-water Borings: B-09, B-10, B-11, and B-27. PMTs were performed at selected depths in open-hole mud rotary borings to obtain in situ soil strength measurements for foundation design.

C.2 OYO SUSPENSION LOGGING

The measurements of compressional and shear wave velocities were made using OYO Suspension Logging techniques. The OYO Suspension Logging in Borings B-01 through B-03 was performed by GEOVision Geophysical Services of Corona, California, using an OYO Model 170 Suspension Logging Recorder and Suspension Logging Probe. The P-S Suspension Logging for the 2021 borings was performed by In Situ Engineering of Snohomish, Washington, using a Robertson Geo Micrologger-2 Recorder and PSLogger Probe. During suspension logging, measurements were taken at 1.6-foot depth intervals using a down-hole probe that contains a wave source and two geophones. Borehole information, including the approximate collar elevation and encountered geotechnical units, are shown on the drill logs in Appendix B. Descriptions of the P-S Suspension Logging procedures and logs of the recorded compressional wave and shear wave velocities are provided in reports prepared by GEOVision Geophysical Services and In Situ Engineering, which are attached to the end of this appendix.

C.3 PRESSUREMETER TESTING

PMT measurements were used to estimate shear modulus, limit pressure, shear or frictional strength, and lateral stress. The PMTs were performed by In Situ Engineering of Snohomish, Washington, using two pre-bored mono cell high pressure instruments. One of the 21 tests attempted did not produce useable data, apparently due to an oversized pocket

at the test depth of 133 feet in Boring B-10. Borehole information, including the approximate mudline elevation and encountered geotechnical units, are shown on the drill logs in Appendix B and summarized in Table C1. Descriptions of the pressuremeter testing procedures and resulting data are provided in a report prepared by In Situ Engineering, which is attached to the end of this appendix. Note that the actual test depths in Boring B-27 were 10 feet deeper than noted in the attached report due to a temporary miscount of drill rods during drilling.

Table C1 - Pressuremeter Testing Summary

Boring	Northing (ft)[1,3]	Easting (ft)[1,3]	Mudline Elevation (ft)[2]	Date Tested	Test Reference Depth (ft)[4,5]	Test Reference Elevation (ft)[2]	Test Interval Top Depth (ft)[4]	Test Interval Bottom Depth (ft)[4]	Geotechnical Unit
B-09	172357	348830	-25.3	8/18/2021	124.5	-149.8	122.5	124.0	Sandy River Mudstone
				8/18/2021	126.0	-151.3	124.0	125.5	Sandy River Mudstone
				8/18/2021	130.5	-155.8	128.5	130.0	Sandy River Mudstone
				8/18/2021	132.0	-157.3	130.0	131.5	Sandy River Mudstone
B-10	172524	349033	-53.9	7/29/2021	36.0	-89.9	34.0	35.5	Sand/Silt Alluvium
				7/29/2021	37.5	-91.4	35.5	37.0	Sand/Silt Alluvium
				7/30/2021	70.5	-124.4	68.5	70.0	Lower Troutdale Formation
				8/2/2021	131.5	-185.4	129.5	131.0	Sandy River Mudstone
				8/2/2021	133.0	-186.9	131.0	132.5	Sandy River Mudstone
				8/3/2021	138.0	-191.9	136.0	137.5	Sandy River Mudstone
				8/3/2021	139.5	-193.4	137.5	139.0	Sandy River Mudstone
B-11	172522	349346	-35.5	8/5/2021	37.5	-73.0	35.5	37.0	Sand Alluvium
				8/5/2021	39.0	-74.5	37.0	38.5	Sand Alluvium
				8/5/2021	44.5	-80.0	42.5	44.0	Sand Alluvium
				8/5/2021	46.0	-81.5	44.0	45.5	Sand Alluvium
				8/5/2021	71.5	-107.0	69.5	71.0	Gravel Alluvium
				8/5/2021	73.0	-108.5	71.0	72.5	Gravel Alluvium
				8/12/2021	112.5	-148.0	110.5	112.0	Lower Troutdale Formation
				8/12/2021	114.0	-149.5	112.0	113.5	Lower Troutdale Formation
B-27[5]	172371	349058	-32.3	8/10/2021	153.5	-185.8	151.5	153.0	Sandy River Mudstone
				8/10/2021	155.0	-187.3	153.0	154.5	Sandy River Mudstone

NOTES:
1 Oregon Coordinate Reference System (OCRS), Portland Zone, 2011
2 North American Vertical Datum of 1988 (NAVD88)
3 Locations not surveyed; locations based on GPS or field measurements relative to existing site features.
4 Reference depths are the bottom of the pressuremeter instrument. The test interval ranges from 6.5 to 24 inches above the reference depth. See attached PMT report for details.
5 Due to a temporary miscount of the drill rods during drilling, tested depths in B-27 were actually 10 feet deeper than noted in the attached PMT report.

GEOVision
geophysical services

BURNSIDE BRIDGE

SUSPENSION PS VELOCITIES

BOREHOLES B-1, B-2, AND B-3

PORTLAND, OREGON

November 28, 2016

Report 16361-01 rev 0

BURNSIDE BRIDGE

SUSPENSION PS VELOCITIES

BOREHOLES B-1, B-2, AND B-3

PORTLAND, OREGON

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APPENDICES

APPENDIX A **SUSPENSION VELOCITY MEASUREMENT QUALITY ASSURANCE SUSPENSION SOURCE TO RECEIVER ANALYSIS RESULTS**

APPENDIX B **GEOPHYSICAL LOGGING SYSTEMS - NIST TRACEABLE CALIBRATION RECORDS**

INTRODUCTION

GEO*Vision* acquired borehole geophysical data in three boreholes at the Burnside Bridge in Portland, Oregon. The work was performed for Shannon & Wilson, Inc. Fieldwork was performed by Jonathan Jordan and Glenn Goss. Analysis and report was completed by Emily Feldman, and reviewed by John Diehl, Professional Engineer.

SCOPE OF WORK

This report presents results of Suspension PS velocity data acquired in three boreholes between September 26th and October 23rd, 2016, as detailed in Table 1. The purpose of these measurements was to supplement stratigraphic information by acquiring shear wave and compressional wave velocities as a function of depth.

The OYO Suspension PS Logging System (Suspension System) was used to obtain in-situ horizontal shear (S_H) and compressional (P) wave velocity measurements in three uncased boreholes at 1.6 foot intervals. Measurements followed **GEO***Vision* Procedure for P-S Suspension Seismic Velocity Logging, revision 1.5. Acquired data were analyzed and a profile of velocity versus depth was produced for both S_H and P waves. Borehole B-2 was logged offshore from a barge, while boreholes B-1 and B-3 were logged on land.

A detailed reference for the suspension PS velocity measurement techniques used in this study is:

> Guidelines for Determining Design Basis Ground Motions, Report TR-102293, Electric Power Research Institute, Palo Alto, California, November 1993, Sections 7 and 8.

INSTRUMENTATION

Suspension Velocity Instrumentation

Suspension velocity measurements were performed using the suspension PS logging system, manufactured by OYO Corporation, and their subsidiary, Robertson Geologging. This system directly determines the average velocity of a 3.3-foot high segment of the soil column surrounding the borehole of interest by measuring the elapsed time between arrivals of a wave propagating upward through the soil column. The receivers that detect the wave, and the source that generates the wave, are moved as a unit in the borehole producing relatively constant amplitude signals at all depths.

The suspension system probe consists of a combined reversible polarity solenoid horizontal shear-wave source (S_H) and compressional-wave source (P), joined to two biaxial receivers by a flexible isolation cylinder, as shown in Figure 1. The separation of the two receivers is 3.3 feet, allowing average wave velocity in the region between the receivers to be determined by inversion of the wave travel time between the two receivers. The total length of the probe as used in these surveys is approximately 25 feet, with the center point of the receiver pair 12.5 feet above the bottom end of the probe.

The probe receives control signals from, and sends the digitized receiver signals to, instrumentation on the surface via an armored multi-conductor cable. The cable is wound onto the drum of a winch and is used to support the probe. Cable travel is measured to provide probe depth data using a sheave of known circumference fitted with a digital rotary encoder.

The entire probe is suspended in the borehole by the cable, therefore, source motion is not coupled directly to the borehole walls; rather, the source motion creates a horizontally propagating impulsive pressure wave in the fluid filling the borehole and surrounding the source. This pressure wave is converted to P and S_H-waves in the surrounding soil and rock as it passes through the casing and grout annulus and impinges upon the wall of the borehole. These waves propagate

through the soil and rock surrounding the borehole, in turn causing a pressure wave to be generated in the fluid surrounding the receivers as the soil waves pass their location. Separation of the P and S_H-waves at the receivers is performed using the following steps:

1. Orientation of the horizontal receivers is maintained parallel to the axis of the source, maximizing the amplitude of the recorded S_H -wave signals.
2. At each depth, S_H-wave signals are recorded with the source actuated in opposite directions, producing S_H-wave signals of opposite polarity, providing a characteristic S_H-wave signature distinct from the P-wave signal.
3. The 6.3 foot separation of source and receiver 1 permits the P-wave signal to pass and damp significantly before the slower S_H-wave signal arrives at the receiver. In faster soils or rock, the isolation cylinder is extended to allow greater separation of the P- and S_H-wave signals.
4. In saturated soils, the received P-wave signal is typically of much higher frequency than the received S_H-wave signal, permitting additional separation of the two signals by low pass filtering.
5. Direct arrival of the original pressure pulse in the fluid is not detected at the receivers because the wavelength of the pressure pulse in fluid is significantly greater than the dimension of the fluid annulus surrounding the probe (feet versus inches scale), preventing significant energy transmission through the fluid medium.

In operation, a distinct, repeatable pattern of impulses is generated at each depth as follows:

1. The source is fired in one direction producing dominantly horizontal shear with some vertical compression, and the signals from the horizontal receivers situated parallel to the axis of motion of the source are recorded.
2. The source is fired again in the opposite direction and the horizontal receiver signals are recorded.

3. The source is fired again and the vertical receiver signals are recorded. The repeated source pattern facilitates the picking of the P and S_H-wave arrivals; reversal of the source changes the polarity of the S_H-wave pattern but not the P-wave pattern.

The data from each receiver during each source activation is recorded as a different channel on the recording system. The Suspension PS system has six channels (two simultaneous recording channels), each with a 1024 sample record. The recorded data are displayed as six channels with a common time scale. Data are stored on disk for further processing.

Review of the displayed data on the recorder or computer screen allows the operator to set the gains, filters, delay time, pulse length (energy), and sample rate to optimize the quality of the data before recording. Verification of the calibration of the Suspension PS digital recorder is performed every twelve months using a NIST traceable frequency source and counter, as presented in Appendix B.

MEASUREMENT PROCEDURES

Suspension Velocity Measurement Procedures

Boreholes B-1, B-2, and B-3 were logged uncased and filled with fresh water mud. Measurements followed the **GEO***Vision* Procedure for P-S Suspension Seismic Velocity Logging, revision 1.5. Prior to the logging run, the probe was positioned with the top of the probe even with a stationary reference point such as top of casing stick up. The electronic depth counter was set to the distance between the mid-point of the receiver and the top of the probe, minus the height of the stationary reference point, if any. For borehole B-2, the probe was then lowered until the mid-point between receivers coincided with the mudline, recorded in the boring log, where the depth counter was reset to zero. Measurements were verified with a tape measure, and calculations recorded on a field log.

The probe was lowered to the bottom of the boreholes, stopping at 1.6 foot intervals to collect data, as summarized in Table 2. At each measurement depth the measurement sequence of two opposite horizontal records and one vertical record was performed. Gains were adjusted as required. The data from each depth were viewed on the computer display, checked, and saved to disk before moving to the next depth.

Upon completion of the measurements, the probe was returned to the surface and the zero depth indication at the depth reference point was verified prior to removal from the borehole.

DATA ANALYSIS

Suspension Velocity Analysis

Using the proprietary OYO program PSLOG.EXE version 1.0, the recorded digital waveforms were analyzed to locate the most prominent first minima, first maxima, or first break on the vertical axis records, indicating the arrival of P-wave energy. The difference in travel time between receiver 1 and receiver 2 (R1-R2) arrivals was used to calculate the P-wave velocity for that 1.0 meter segment of the soil column. When observable, P-wave arrivals on the horizontal axis records were used to verify the velocities determined from the vertical axis data. The time picks were then transferred into a Microsoft Excel® template to complete the velocity calculations based on the arrival time picks made in PSLOG. The Microsoft Excel® analysis files accompany this report.

The P-wave velocity over the 6.3-foot interval from source to receiver 1 (S-R1) was also picked using PSLOG, and calculated and plotted in Microsoft Excel®, for quality assurance of the velocity derived from the travel time between receivers. In this analysis, the depth values as recorded were increased by 4.8 feet to correspond to the mid-point of the 6.33-foot S-R1 interval. Travel times were obtained by picking the first break of the P-wave signal at receiver 1 and subtracting the calculated and experimentally verified delay, in milliseconds, from source trigger pulse (beginning of record) to source impact. This delay corresponds to the duration of acceleration of the solenoid before impact.

As with the P-wave records, the recorded digital waveforms were analyzed to locate clear S_H-wave pulses, as indicated by the presence of opposite polarity pulses on each pair of horizontal records. Ideally, the S_H-wave signals from the 'normal' and 'reverse' source pulses are very nearly inverted images of each other. Digital Fast Fourier Transform – Inverse Fast Fourier Transform (FFT – IFFT) lowpass filtering was used to remove the higher frequency P-wave signal from the S_H-wave signal. Different filter cutoffs were used to separate P- and S_H-waves at different depths, ranging from 600 Hz in the slowest zones to 4000 Hz in the regions of highest velocity. At each depth, the filter frequency was selected to be at least twice the fundamental frequency of the S_H-wave signal being filtered.

Generally, the first maxima were picked for the 'normal' signals and the first minima for the 'reverse' signals, although other points on the waveform were used if the first pulse was distorted. The absolute arrival time of the 'normal' and 'reverse' signals may vary by +/- 0.2 milliseconds, due to differences in the actuation time of the solenoid source caused by constant mechanical bias in the source or by borehole inclination. This variation does not affect the R1-R2 velocity determinations, as the differential time is measured between arrivals of waves created by the same source actuation. The final velocity value is the average of the values obtained from the 'normal' and 'reverse' source actuations.

As with the P-wave data, S_H-wave velocity calculated from the travel time over the 6.33-foot interval from source to receiver 1 was calculated and plotted for verification of the velocity derived from the travel time between receivers. In this analysis, the depth values were increased by 4.8 feet to correspond to the mid-point of the 6.33-foot S-R1 interval. Travel times were obtained by picking the first break of the S_H-wave signal at the near receiver and subtracting the calculated and experimentally verified delay, in milliseconds, from the beginning of the record at the source trigger pulse to source impact.

Poisson's Ratio, **ν**, was calculated in the Microsoft Excel® template using the following formula:

$$\nu = \frac{\left(\frac{v_s}{v_p}\right)^2 - 0.5}{\left(\frac{v_s}{v_p}\right)^2 - 1.0}$$

Data and analyses were reviewed by a **GEO***Vision* Professional Geophysicist or Engineer as a component of the in-house data validation program.

Figure 2 shows an example of R1 - R2 measurements on a sample filtered suspension record. In Figure 2, the time difference over the 3.3 foot interval of 1.88 milliseconds for the horizontal signals is equivalent to an S_H-wave velocity of 1745 feet/second. Whenever possible, time differences were determined from several phase points on the S_H-waveform records to verify the data obtained from the first arrival of the S_H-wave pulse. Figure 3 displays the same record before filtering of the S_H-waveform record with a 1400 Hz FFT - IFFT digital lowpass filter, illustrating the presence of higher frequency P-wave energy at the beginning of the record, and distortion of the lower frequency S_H-wave by residual P-wave signal.

RESULTS

Suspension Velocity Results

Suspension R1-R2 P- and S_H-wave velocities for boreholes B-1, B-2, and B-3 are plotted in Figures 4, 5, and 6, respectively. Suspension velocity data are also presented in Tables 3, 4, and 5, respectively. The Microsoft Excel® analysis files accompany this report.

P- and S_H-wave velocity data from R1-R2 analysis and quality assurance analysis of S-R1 data are plotted together in Figures A-1 through A-3 in Appendix A to aid in visual comparison. It should be noted that R1-R2 data are an average velocity over a 3.3-foot segment of the soil column; S-R1 data are an average over 6.3 feet, creating a significant smoothing relative to the R1-R2 plots. The S-R1 velocity data are also presented in Tables A-1 through A-3 and included in the Microsoft Excel® analysis files, which also includes Poisson's Ratio calculations, tabulated data and plots.

SUMMARY

Discussion of Suspension Velocity Results

Suspension PS velocity data are ideally collected in uncased fluid filled boreholes drilled with rotary wash methods, as was the borehole for this project. Overall, Suspension PS velocity data quality is judged on 5 criteria, as summarized below.

	Criteria	B-1	B-2	B-3
1	Consistent data between receiver to receiver (R1 – R2) and source to receiver (S – R1) data.	Yes.	Yes.	Yes.
2	Consistency between data from adjacent depth intervals.	Yes	Yes	Yes
3	Consistent relationship between P-wave and S_H - wave (excluding transition to saturated soils)	Yes Saturation occurs at about 40ft BGS	Yes All data is in saturated material (logged from a barge)	Yes Saturation occurs at about 25ft BGS
4	Clarity of P-wave and S_H- wave onset, as well as damping of later oscillations.	Overall, good data. Some sequences were difficult to interpret due to multiple arrivals in gravels or weathered rock	Excellent data set	Good data. Some sequences were difficult to interpret due to multiple arrivals in gravels or weathered rock
5	Consistency of profile between adjacent borings, if available.	Although the overall profiles are different, there are sequences that look very similar. The velocities in the soils are very similar, and the peak velocities in the rock are comparable.		

Quality Assurance

These borehole geophysical measurements were performed using industry-standard or better methods for measurements and analyses. All work was performed under **GEO***Vision* quality assurance procedures, which include:

- Use of NIST-traceable calibrations, where applicable, for field and laboratory instrumentation
- Use of standard field data logs
- Use of independent verification of velocity data by comparison of receiver-to-receiver and source-to-receiver velocities
- Independent review of calculations and results by a registered professional engineer, geologist, or geophysicist.

Suspension Velocity Data Reliability

P- and S_H-wave velocity measurement using the Suspension Method gives average velocities over a 3.3-foot interval of depth. This high resolution results in the scatter of values shown in the graphs. Individual measurements are very reliable with estimated precision of +/- 5%. Depth indications are very reliable with estimated precision of +/- 0.2 feet. Standardized field procedures and quality assurance checks contribute to the reliability of these data.

CERTIFICATION

All geophysical data, analysis, interpretations, conclusions, and recommendations in this document have been prepared under the supervision of and reviewed by a **GEO***Vision* California Professional Geophysicist.

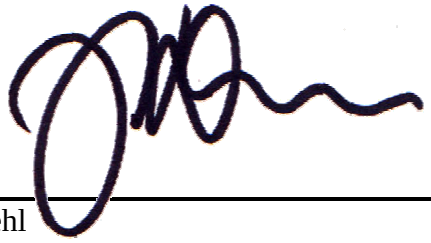
Prepared by



11/28/2016

Emily Feldman — Date
Senior Staff Geophysicist
GEO*Vision* Geophysical Services

Reviewed and approved by





11/28/2016

John G. Diehl — Date
California Professional Engineer 30362
GEO*Vision* Geophysical Services

* This geophysical investigation was conducted under the supervision of a California Professional Geophysicist using industry standard methods and equipment. A high degree of professionalism was maintained during all aspects of the project from the field investigation and data acquisition, through data processing, interpretation and reporting. All original field data files, field notes and observations, and other pertinent information are maintained in the project files and are available for the client to review for a period of at least one year.

  A professional geophysicist's certification of interpreted geophysical conditions comprises a declaration of his/her professional judgment. It does not constitute a warranty or guarantee, expressed or implied, nor does it relieve any other party of its responsibility to abide by contract documents, applicable codes, standards, regulations or ordinances.

Table 1. Borehole locations and logging dates

BOREHOLE DESIGNATION	DATES LOGGED	COORDINATES (1)		ELEVATION (1) (FEET)
		LATITUDE	LONGITUDE	
B-1	10/7/2016	684330.7	7646088.4	34.0
B-2	10/25/2016	684113.6	7646474.6	-37.7
B-3	9/23/2016	684157.8	7647283.1	32.0

(1) Survey locations State Plane North, Intl. Feet and NAVD88

Table 2. Logging dates and depth ranges

BOREHOLE NUMBER	TOOL AND RUN NUMBER	SURFACE CASING DEPTH (FEET)	DEPTH RANGE (FEET FROM SURFACE OR MUDLINE)	OPEN HOLE (FEET)	SAMPLE INTERVAL (FEET)	DATE LOGGED
B-1	SUSPENSION DOWN 01	N/A	1.64- 206.69	220	1.6	10/7/2016
B-2	SUSPENSION DOWN 01	41	41.01 – 134.51	148	1.6	10/25/2016
B-3	SUSPENSION DOWN 01	N/A	6.56 – 216.54	230	1.6	9/23/2016

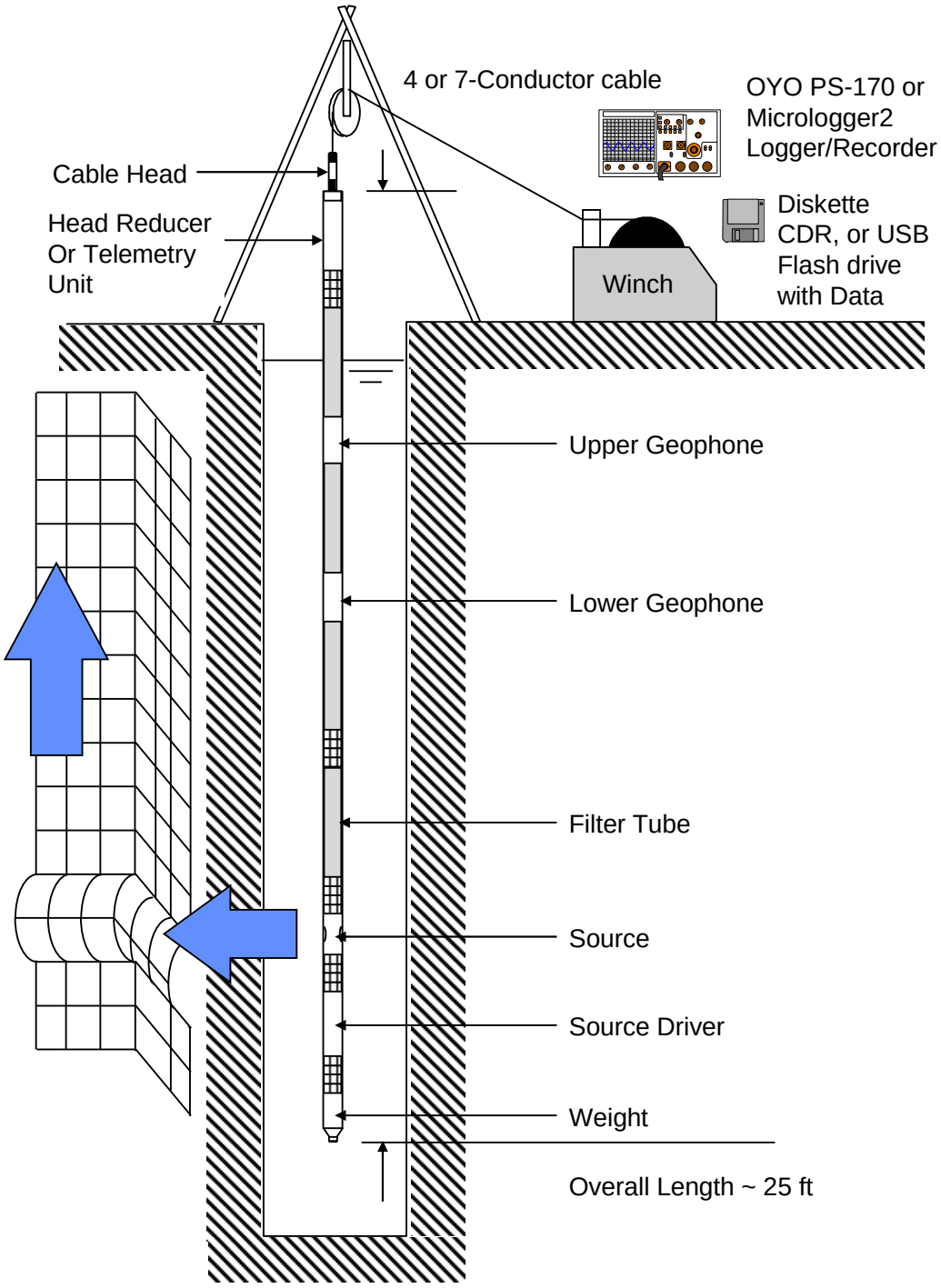


Figure 1: Concept illustration of P-S logging system

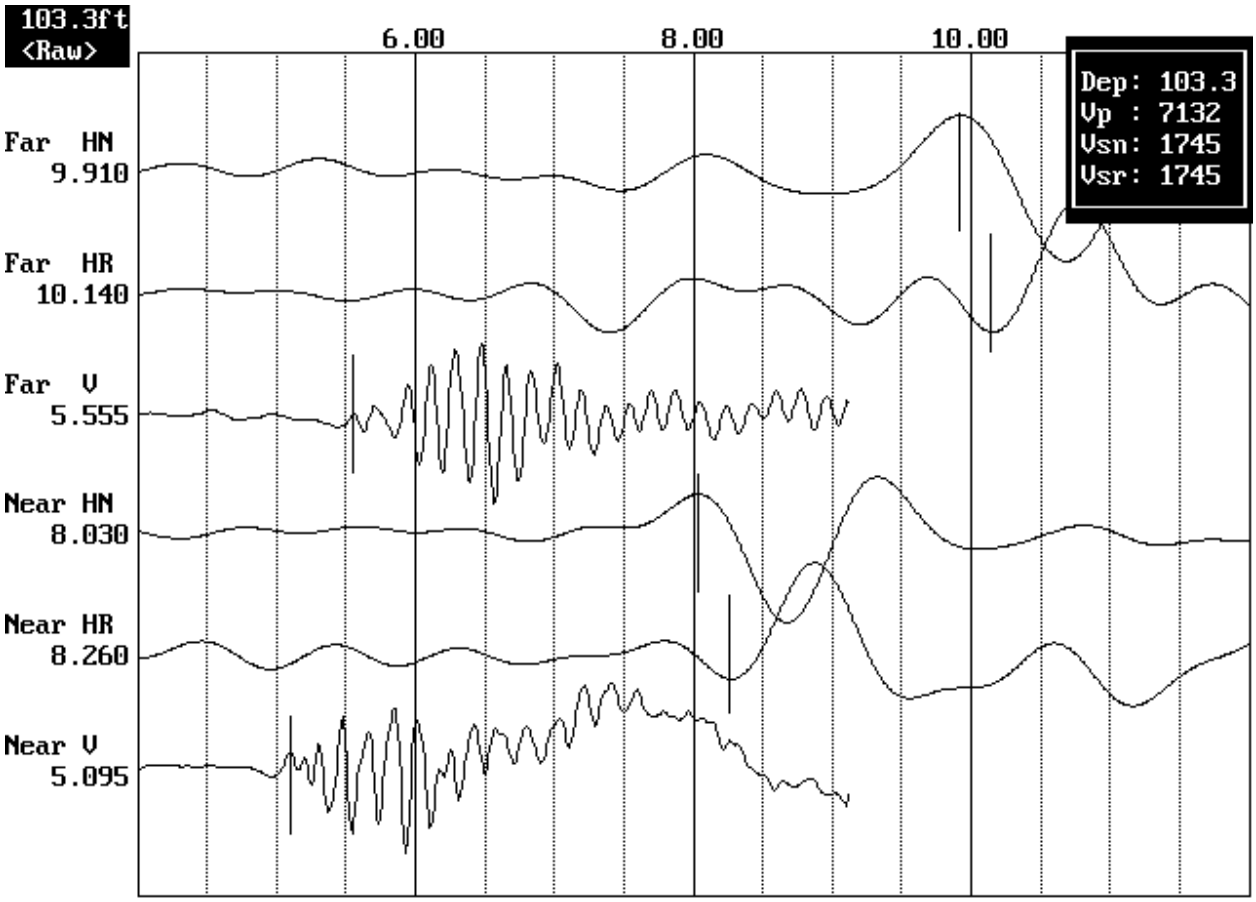


Figure 2: Example of filtered (1400 Hz lowpass) suspension record

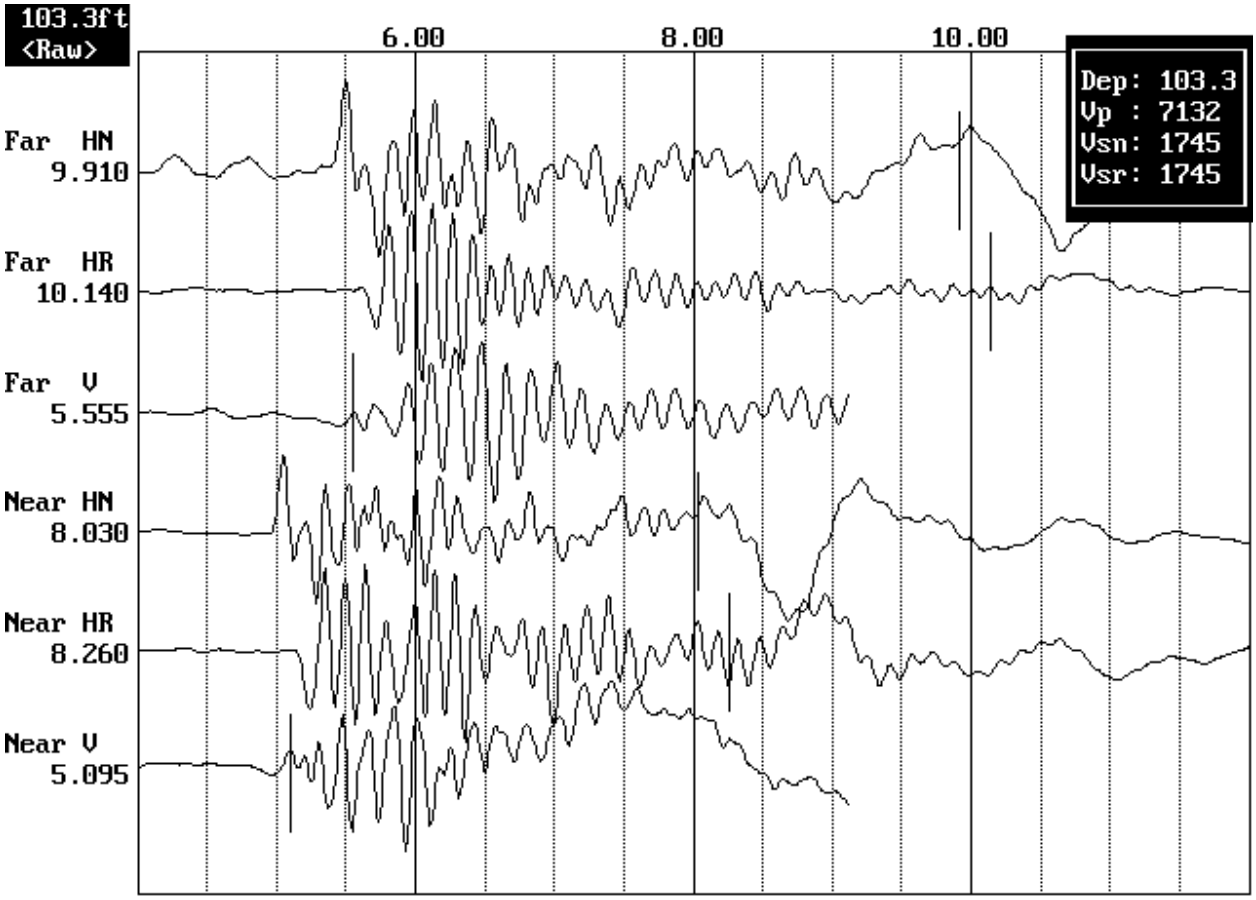


Figure 3. Example of unfiltered suspension record

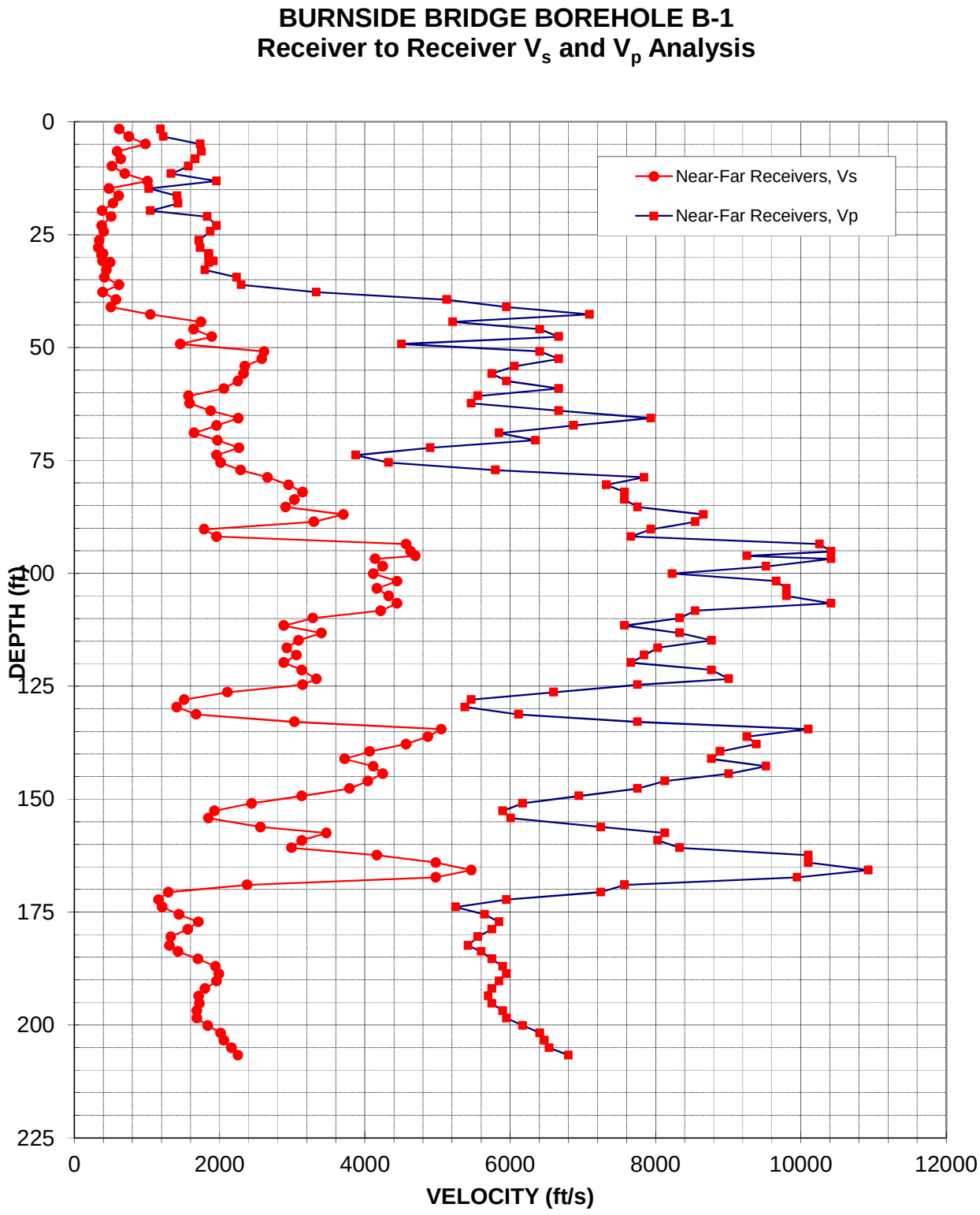


Figure 4: Borehole B-1, Suspension R1-R2 P- and S_H-wave velocities

Table 3. Borehole B-1, Suspension R1-R2 depths and P- and S_H-wave velocities

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole B-1

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
1.6	620	1190	0.31	0.5	190	360	0.31
3.3	750	1230	0.20	1.0	230	370	0.20
4.9	980	1740	0.27	1.5	300	530	0.27
6.6	590	1750	0.44	2.0	180	530	0.44
8.2	640	1670	0.41	2.5	200	510	0.41
9.8	520	1570	0.44	3.0	160	480	0.44
11.5	700	1330	0.31	3.5	210	410	0.31
13.1	1010	1960	0.32	4.0	310	600	0.32
14.8	480	1030	0.36	4.5	150	310	0.36
16.4	610	1420	0.39	5.0	190	430	0.39
18.0	540	1430	0.42	5.5	160	440	0.42
19.7	380	1050	0.42	6.0	120	320	0.42
21.0	510	1830	0.46	6.4	160	560	0.46
23.0	380	1960	0.48	7.0	120	600	0.48
24.3	410	1870	0.48	7.4	120	570	0.48
26.3	340	1720	0.48	8.0	110	520	0.48
27.9	330	1740	0.48	8.5	100	530	0.48
29.2	400	1850	0.48	8.9	120	560	0.48
29.5	380	1850	0.48	9.0	110	560	0.48
30.8	390	1920	0.48	9.4	120	580	0.48
31.2	500	1850	0.46	9.5	150	560	0.46
32.8	440	1800	0.47	10.0	140	550	0.47
34.5	420	2240	0.48	10.5	130	680	0.48
36.1	620	2300	0.46	11.0	190	700	0.46
37.7	390	3330	0.49	11.5	120	1020	0.49
39.4	580	5130	0.49	12.0	180	1560	0.49
41.0	510	5950	0.50	12.5	150	1810	0.50
42.7	1050	7090	0.49	13.0	320	2160	0.49
44.3	1750	5210	0.44	13.5	530	1590	0.44
45.9	1650	6410	0.46	14.0	500	1950	0.46
47.6	1890	6670	0.46	14.5	580	2030	0.46
49.2	1460	4500	0.44	15.0	450	1370	0.44
50.9	2610	6410	0.40	15.5	800	1950	0.40
52.5	2580	6670	0.41	16.0	790	2030	0.41
54.1	2350	6060	0.41	16.5	720	1850	0.41
55.8	2330	5750	0.40	17.0	710	1750	0.40
57.4	2250	5950	0.42	17.5	690	1810	0.42
59.1	2060	6670	0.45	18.0	630	2030	0.45

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole B-1

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
60.7	1570	5560	0.46	18.5	480	1690	0.46
62.3	1590	5460	0.45	19.0	480	1670	0.45
64.0	1880	6670	0.46	19.5	570	2030	0.46
65.6	2260	7940	0.46	20.0	690	2420	0.46
67.3	1960	6870	0.46	20.5	600	2090	0.46
68.9	1650	5850	0.46	21.0	500	1780	0.46
70.5	1970	6350	0.45	21.5	600	1940	0.45
72.2	2270	4900	0.36	22.0	690	1490	0.36
73.8	1960	3880	0.33	22.5	600	1180	0.33
75.5	2010	4330	0.36	23.0	610	1320	0.36
77.1	2290	5800	0.41	23.5	700	1770	0.41
78.7	2660	7840	0.43	24.0	810	2390	0.43
80.4	2950	7330	0.40	24.5	900	2230	0.40
82.0	3140	7580	0.40	25.0	960	2310	0.40
83.7	3030	7580	0.40	25.5	920	2310	0.40
85.3	2910	7750	0.42	26.0	890	2360	0.42
86.9	3700	8660	0.39	26.5	1130	2640	0.39
88.6	3300	8550	0.41	27.0	1010	2610	0.41
90.2	1790	7940	0.47	27.5	540	2420	0.47
91.9	1960	7660	0.46	28.0	600	2340	0.46
93.5	4570	10260	0.38	28.5	1390	3130	0.38
95.1	4630	10420	0.38	29.0	1410	3180	0.38
96.1	4690	9260	0.33	29.3	1430	2820	0.33
96.8	4140	10420	0.41	29.5	1260	3180	0.41
98.4	4250	9520	0.38	30.0	1290	2900	0.38
100.1	4120	8230	0.33	30.5	1250	2510	0.33
101.7	4440	9660	0.37	31.0	1350	2940	0.37
103.4	4170	9800	0.39	31.5	1270	2990	0.39
105.0	4330	9800	0.38	32.0	1320	2990	0.38
106.6	4440	10420	0.39	32.5	1350	3180	0.39
108.3	4220	8550	0.34	33.0	1290	2610	0.34
109.9	3280	8330	0.41	33.5	1000	2540	0.41
111.6	2890	7580	0.42	34.0	880	2310	0.42
113.2	3400	8330	0.40	34.5	1040	2540	0.40
114.8	3090	8770	0.43	35.0	940	2670	0.43
116.5	2920	8030	0.42	35.5	890	2450	0.42
118.1	3060	7840	0.41	36.0	930	2390	0.41
119.8	2890	7660	0.42	36.5	880	2340	0.42
121.4	3130	8770	0.43	37.0	950	2670	0.43
123.4	3330	9010	0.42	37.6	1020	2750	0.42

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole B-1

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
124.7	3140	7750	0.40	38.0	960	2360	0.40
126.3	2110	6600	0.44	38.5	640	2010	0.44
128.0	1520	5460	0.46	39.0	460	1670	0.46
129.6	1410	5380	0.46	39.5	430	1640	0.46
131.2	1680	6120	0.46	40.0	510	1860	0.46
132.9	3030	7750	0.41	40.5	920	2360	0.41
134.5	5050	10100	0.33	41.0	1540	3080	0.33
136.2	4870	9260	0.31	41.5	1480	2820	0.31
137.8	4570	9390	0.35	42.0	1390	2860	0.35
139.4	4070	8890	0.37	42.5	1240	2710	0.37
141.1	3720	8770	0.39	43.0	1140	2670	0.39
142.7	4120	9520	0.39	43.5	1250	2900	0.39
144.4	4250	9010	0.36	44.0	1290	2750	0.36
146.0	4040	8130	0.34	44.5	1230	2480	0.34
147.6	3790	7750	0.34	45.0	1150	2360	0.34
149.3	3130	6940	0.37	45.5	950	2120	0.37
150.9	2440	6170	0.41	46.0	740	1880	0.41
152.6	1930	5900	0.44	46.5	590	1800	0.44
154.2	1850	6010	0.45	47.0	560	1830	0.45
156.2	2560	7250	0.43	47.6	780	2210	0.43
157.5	3470	8130	0.39	48.0	1060	2480	0.39
159.1	3130	8030	0.41	48.5	950	2450	0.41
160.8	2990	8330	0.43	49.0	910	2540	0.43
162.4	4170	10100	0.40	49.5	1270	3080	0.40
164.0	4980	10100	0.34	50.0	1520	3080	0.34
165.7	5460	10930	0.33	50.5	1670	3330	0.33
167.3	4980	9950	0.33	51.0	1520	3030	0.33
169.0	2380	7580	0.45	51.5	730	2310	0.45
170.6	1290	7250	0.48	52.0	390	2210	0.48
172.2	1160	5950	0.48	52.5	350	1810	0.48
173.9	1210	5250	0.47	53.0	370	1600	0.47
175.5	1440	5650	0.47	53.5	440	1720	0.47
177.2	1710	5850	0.45	54.0	520	1780	0.45
178.8	1560	5750	0.46	54.5	480	1750	0.46
180.5	1330	5560	0.47	55.0	410	1690	0.47
182.4	1310	5420	0.47	55.6	400	1650	0.47
183.7	1430	5600	0.47	56.0	440	1710	0.47
185.4	1710	5750	0.45	56.5	520	1750	0.45
187.0	1940	5900	0.44	57.0	590	1800	0.44
188.7	1990	5950	0.44	57.5	610	1810	0.44

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole B-1

American Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
190.3	1960	5850	0.44
191.9	1800	5750	0.45
193.6	1710	5700	0.45
195.2	1720	5750	0.45
196.9	1690	5900	0.46
198.5	1690	5950	0.46
200.1	1840	6170	0.45
201.8	2010	6410	0.45
203.4	2060	6470	0.44
205.1	2160	6540	0.44
206.7	2250	6800	0.44

Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
58.0	600	1780	0.44
58.5	550	1750	0.45
59.0	520	1740	0.45
59.5	530	1750	0.45
60.0	510	1800	0.46
60.5	510	1810	0.46
61.0	560	1880	0.45
61.5	610	1950	0.45
62.0	630	1970	0.44
62.5	660	1990	0.44
63.0	690	2070	0.44

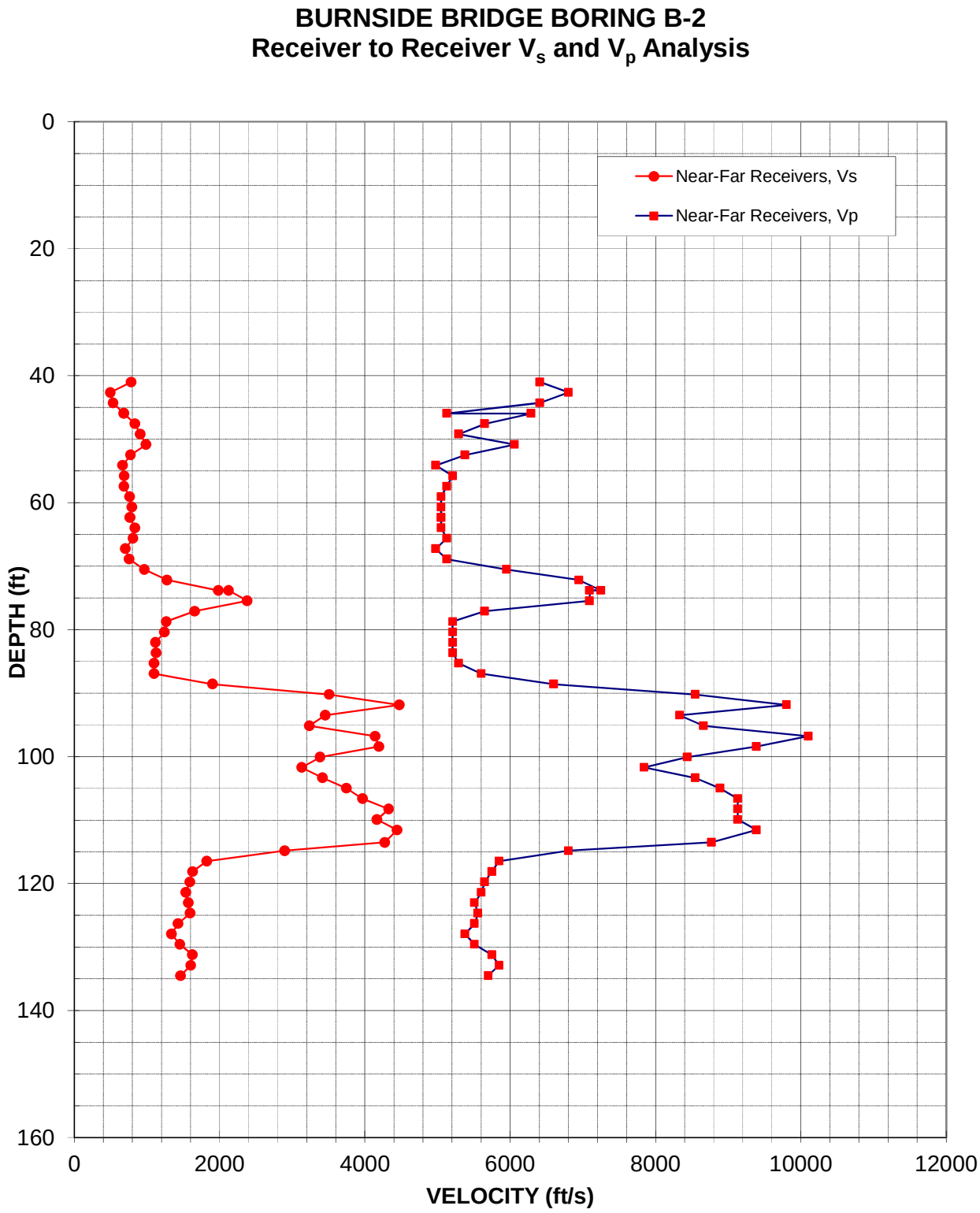


Figure 5: Borehole B-2, Suspension R1-R2 P- and S_H-wave velocities

Table 4. Borehole B-2, Suspension R1-R2 depths and P- and S_H-wave velocities

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole B-2

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
41.0	780	6410	0.49	12.5	240	1950	0.49
42.7	500	6800	0.50	13.0	150	2070	0.50
44.3	540	6410	0.50	13.5	160	1950	0.50
45.9	680	5130	0.49	14.0	210	1560	0.49
45.9	680	6290	0.49	14.0	210	1920	0.49
47.6	840	5650	0.49	14.5	250	1720	0.49
49.2	910	5290	0.48	15.0	280	1610	0.48
50.9	990	6060	0.49	15.5	300	1850	0.49
52.5	780	5380	0.49	16.0	240	1640	0.49
54.1	670	4980	0.49	16.5	200	1520	0.49
55.8	690	5210	0.49	17.0	210	1590	0.49
57.4	680	5130	0.49	17.5	210	1560	0.49
59.1	760	5050	0.49	18.0	230	1540	0.49
60.7	790	5050	0.49	18.5	240	1540	0.49
62.3	770	5050	0.49	19.0	230	1540	0.49
62.3	770	5050	0.49	19.0	230	1540	0.49
64.0	830	5050	0.49	19.5	250	1540	0.49
65.6	810	5130	0.49	20.0	250	1560	0.49
67.3	700	4980	0.49	20.5	210	1520	0.49
68.9	760	5130	0.49	21.0	230	1560	0.49
70.5	970	5950	0.49	21.5	290	1810	0.49
72.2	1280	6940	0.48	22.0	390	2120	0.48
73.8	1980	7250	0.46	22.5	600	2210	0.46
73.8	2120	7090	0.45	22.5	650	2160	0.45
75.5	2380	7090	0.44	23.0	730	2160	0.44
77.1	1660	5650	0.45	23.5	510	1720	0.45
78.7	1270	5210	0.47	24.0	390	1590	0.47
80.4	1240	5210	0.47	24.5	380	1590	0.47
82.0	1120	5210	0.48	25.0	340	1590	0.48
83.7	1130	5210	0.48	25.5	340	1590	0.48
85.3	1100	5290	0.48	26.0	340	1610	0.48
86.9	1100	5600	0.48	26.5	330	1710	0.48
88.6	1900	6600	0.45	27.0	580	2010	0.45
90.2	3510	8550	0.40	27.5	1070	2610	0.40
91.9	4470	9800	0.37	28.0	1360	2990	0.37
93.5	3450	8330	0.40	28.5	1050	2540	0.40
95.1	3240	8660	0.42	29.0	990	2640	0.42
96.8	4140	10100	0.40	29.5	1260	3080	0.40

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole B-2

American Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
98.4	4190	9390	0.38
100.1	3380	8440	0.40
101.7	3130	7840	0.41
103.4	3420	8550	0.40
105.0	3750	8890	0.39
106.6	3970	9130	0.38
108.3	4330	9130	0.36
109.9	4170	9130	0.37
111.6	4440	9390	0.36
113.5	4270	8770	0.34
114.8	2900	6800	0.39
116.5	1830	5850	0.45
118.1	1630	5750	0.46
119.8	1590	5650	0.46
121.4	1540	5600	0.46
123.0	1570	5510	0.46
124.7	1590	5560	0.46
126.3	1430	5510	0.46
128.0	1340	5380	0.47
129.6	1460	5510	0.46
131.2	1630	5750	0.46
132.9	1600	5850	0.46
134.5	1470	5700	0.46

Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
30.0	1280	2860	0.38
30.5	1030	2570	0.40
31.0	950	2390	0.41
31.5	1040	2610	0.40
32.0	1140	2710	0.39
32.5	1210	2780	0.38
33.0	1320	2780	0.36
33.5	1270	2780	0.37
34.0	1350	2860	0.36
34.6	1300	2670	0.34
35.0	880	2070	0.39
35.5	560	1780	0.45
36.0	500	1750	0.46
36.5	480	1720	0.46
37.0	470	1710	0.46
37.5	480	1680	0.46
38.0	490	1690	0.46
38.5	440	1680	0.46
39.0	410	1640	0.47
39.5	440	1680	0.46
40.0	500	1750	0.46
40.5	490	1780	0.46
41.0	450	1740	0.46

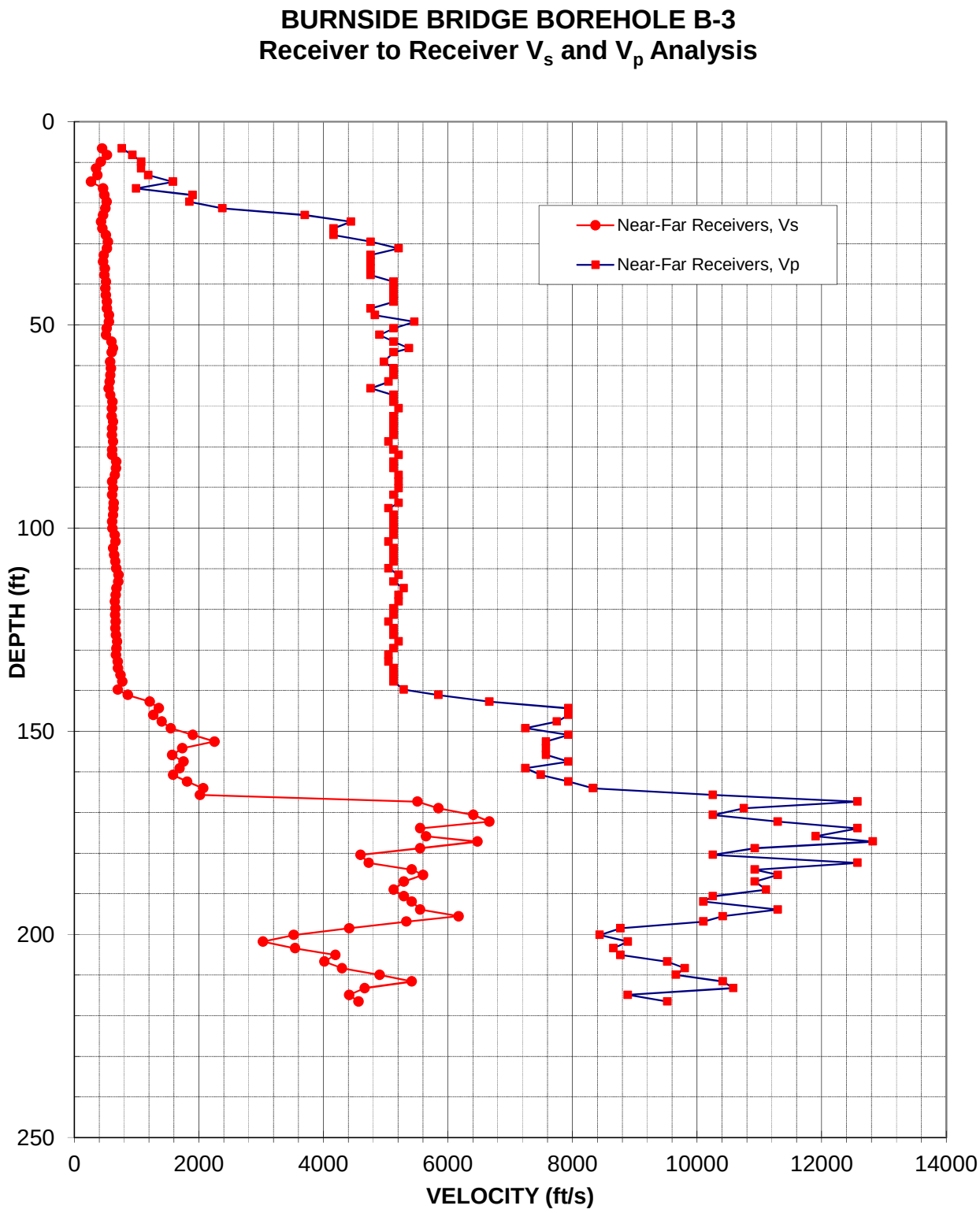


Figure 6: Borehole B-3, Suspension R1-R2 P- and S_H-wave velocities

Table 5. Borehole B-3, Suspension R1-R2 depths and P- and S_H-wave velocities

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Receiver-to-Receiver Travel Time Data - Borehole B-3

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
6.6	450	760	0.23	2.0	140	230	0.23
8.2	520	940	0.27	2.5	160	290	0.27
9.8	430	1080	0.41	3.0	130	330	0.41
11.5	350	1080	0.44	3.5	110	330	0.44
13.1	370	1190	0.45	4.0	110	360	0.45
14.8	270	1590	0.49	4.5	80	480	0.49
16.4	460	1000	0.36	5.0	140	300	0.36
18.0	480	1900	0.47	5.5	150	580	0.47
19.7	520	1850	0.46	6.0	160	560	0.46
21.3	500	2380	0.48	6.5	150	730	0.48
23.0	460	3700	0.49	7.0	140	1130	0.49
24.6	430	4440	0.50	7.5	130	1350	0.50
26.3	450	4170	0.49	8.0	140	1270	0.49
27.9	510	4170	0.49	8.5	150	1270	0.49
29.5	540	4760	0.49	9.0	160	1450	0.49
31.2	530	5210	0.49	9.5	160	1590	0.49
32.8	470	4760	0.49	10.0	140	1450	0.49
34.5	460	4760	0.50	10.5	140	1450	0.50
36.1	490	4760	0.49	11.0	150	1450	0.49
37.7	490	4760	0.49	11.5	150	1450	0.49
39.4	510	5130	0.49	12.0	160	1560	0.49
41.0	500	5130	0.50	12.5	150	1560	0.50
42.7	510	5130	0.50	13.0	160	1560	0.50
44.3	530	5130	0.49	13.5	160	1560	0.49
45.9	520	4760	0.49	14.0	160	1450	0.49
47.6	560	4830	0.49	14.5	170	1470	0.49
49.2	560	5460	0.49	15.0	170	1670	0.49
50.9	520	5130	0.49	15.5	160	1560	0.49
52.5	510	4900	0.49	16.0	160	1490	0.49
54.1	600	5130	0.49	16.5	180	1560	0.49
55.8	630	5380	0.49	17.0	190	1640	0.49
56.8	600	5130	0.49	17.3	180	1560	0.49
59.1	580	4980	0.49	18.0	180	1520	0.49
60.7	590	5130	0.49	18.5	180	1560	0.49
62.3	580	5130	0.49	19.0	180	1560	0.49
64.0	570	5050	0.49	19.5	170	1540	0.49

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole B-3

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
65.6	560	4760	0.49	20.0	170	1450	0.49
67.3	580	5130	0.49	20.5	180	1560	0.49
68.9	610	5130	0.49	21.0	190	1560	0.49
70.5	610	5210	0.49	21.5	180	1590	0.49
72.5	600	5130	0.49	22.1	180	1560	0.49
73.8	620	5130	0.49	22.5	190	1560	0.49
75.5	610	5130	0.49	23.0	190	1560	0.49
77.1	610	5130	0.49	23.5	180	1560	0.49
78.7	620	5050	0.49	24.0	190	1540	0.49
80.7	610	5130	0.49	24.6	190	1560	0.49
82.0	610	5210	0.49	25.0	190	1590	0.49
83.7	680	5130	0.49	25.5	210	1560	0.49
85.3	670	5130	0.49	26.0	210	1560	0.49
86.9	650	5210	0.49	26.5	200	1590	0.49
88.6	610	5210	0.49	27.0	190	1590	0.49
90.2	630	5210	0.49	27.5	190	1590	0.49
91.9	610	5130	0.49	28.0	190	1560	0.49
93.8	630	5210	0.49	28.6	190	1590	0.49
95.1	630	5050	0.49	29.0	190	1540	0.49
96.8	620	5130	0.49	29.5	190	1560	0.49
98.4	610	5130	0.49	30.0	190	1560	0.49
100.1	610	5130	0.49	30.5	190	1560	0.49
101.7	650	5130	0.49	31.0	200	1560	0.49
103.4	660	5050	0.49	31.5	200	1540	0.49
105.0	630	5130	0.49	32.0	190	1560	0.49
106.6	640	5130	0.49	32.5	200	1560	0.49
108.3	660	5130	0.49	33.0	200	1560	0.49
109.9	680	5050	0.49	33.5	210	1540	0.49
111.6	710	5210	0.49	34.0	220	1590	0.49
113.2	710	5130	0.49	34.5	220	1560	0.49
114.8	680	5290	0.49	35.0	210	1610	0.49
116.5	670	5210	0.49	35.5	200	1590	0.49
118.1	650	5210	0.49	36.0	200	1590	0.49
119.8	660	5130	0.49	36.5	200	1560	0.49
121.4	660	5130	0.49	37.0	200	1560	0.49
123.0	670	5050	0.49	37.5	200	1540	0.49
124.7	660	5130	0.49	38.0	200	1560	0.49
126.3	670	5130	0.49	38.5	210	1560	0.49
128.0	690	5210	0.49	39.0	210	1590	0.49
129.6	680	5130	0.49	39.5	210	1560	0.49

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole B-3

American Units				Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio	Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
131.2	670	5050	0.49	40.0	210	1540	0.49
132.9	700	5050	0.49	40.5	210	1540	0.49
134.5	710	5130	0.49	41.0	220	1560	0.49
136.2	740	5130	0.49	41.5	230	1560	0.49
137.8	780	5130	0.49	42.0	240	1560	0.49
139.8	700	5290	0.49	42.6	210	1610	0.49
141.1	860	5850	0.49	43.0	260	1780	0.49
142.7	1210	6670	0.48	43.5	370	2030	0.48
144.4	1360	7940	0.48	44.0	410	2420	0.48
146.0	1270	7940	0.49	44.5	390	2420	0.49
147.6	1410	7750	0.48	45.0	430	2360	0.48
149.3	1550	7250	0.48	45.5	470	2210	0.48
150.9	1900	7940	0.47	46.0	580	2420	0.47
152.6	2250	7580	0.45	46.5	690	2310	0.45
154.2	1740	7580	0.47	47.0	530	2310	0.47
155.8	1570	7580	0.48	47.5	480	2310	0.48
157.5	1750	7940	0.47	48.0	530	2420	0.47
159.1	1690	7250	0.47	48.5	520	2210	0.47
160.8	1590	7490	0.48	49.0	480	2280	0.48
162.4	1810	7940	0.47	49.5	550	2420	0.47
164.0	2070	8330	0.47	50.0	630	2540	0.47
165.7	2020	10260	0.48	50.5	620	3130	0.48
167.3	5510	12580	0.38	51.0	1680	3830	0.38
169.0	5850	10750	0.29	51.5	1780	3280	0.29
170.6	6410	10260	0.18	52.0	1950	3130	0.18
172.2	6670	11300	0.23	52.5	2030	3440	0.23
173.9	5560	12580	0.38	53.0	1690	3830	0.38
175.9	5650	11900	0.35	53.6	1720	3630	0.35
177.2	6470	12820	0.33	54.0	1970	3910	0.33
178.8	5560	10930	0.33	54.5	1690	3330	0.33
180.5	4600	10260	0.37	55.0	1400	3130	0.37
182.4	4730	12580	0.42	55.6	1440	3830	0.42
184.1	5420	10930	0.34	56.1	1650	3330	0.34
185.4	5600	11300	0.34	56.5	1710	3440	0.34
187.0	5290	10930	0.35	57.0	1610	3330	0.35
189.0	5130	11110	0.36	57.6	1560	3390	0.36
190.6	5290	10260	0.32	58.1	1610	3130	0.32
191.9	5420	10100	0.30	58.5	1650	3080	0.30
193.9	5560	11300	0.34	59.1	1690	3440	0.34
195.5	6170	10420	0.23	59.6	1880	3180	0.23

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Receiver-to-Receiver Travel Time Data - Borehole B-3

American Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
196.9	5330	10100	0.31
198.5	4420	8770	0.33
200.1	3530	8440	0.39
201.8	3030	8890	0.43
203.4	3550	8660	0.40
205.1	4190	8770	0.35
206.7	4020	9520	0.39
208.3	4300	9800	0.38
210.0	4900	9660	0.33
211.6	5420	10420	0.31
213.3	4660	10580	0.38
214.9	4420	8890	0.34
216.5	4570	9520	0.35

Metric Units			
Depth at Midpoint Between Receivers	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
60.0	1630	3080	0.31
60.5	1350	2670	0.33
61.0	1080	2570	0.39
61.5	920	2710	0.43
62.0	1080	2640	0.40
62.5	1280	2670	0.35
63.0	1220	2900	0.39
63.5	1310	2990	0.38
64.0	1490	2940	0.33
64.5	1650	3180	0.31
65.0	1420	3230	0.38
65.5	1350	2710	0.34
66.0	1390	2900	0.35

APPENDIX A

SUSPENSION VELOCITY MEASUREMENT QUALITY ASSURANCE SUSPENSION SOURCE TO RECEIVER ANALYSIS RESULTS

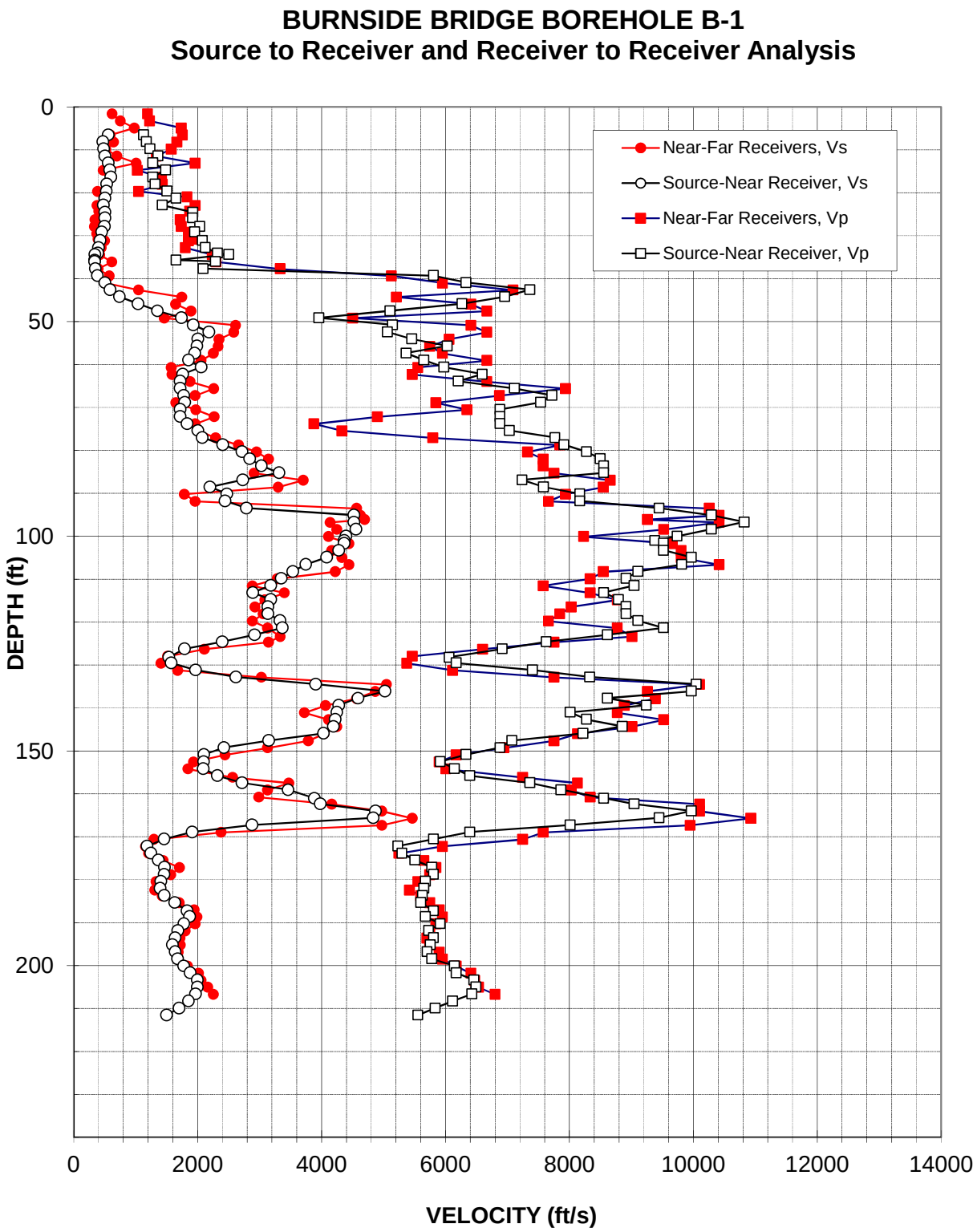


Figure A-1: Borehole B-1, Suspension S-R1 P- and S_H-wave velocities

Table A-1. Borehole B-1, S - R1 quality assurance analysis P- and S_H-wave data

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole B-1

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
6.5	560	1130	0.34	2.0	170	340	0.34
8.1	470	1170	0.40	2.5	140	360	0.40
9.8	480	1230	0.41	3.0	150	380	0.41
11.4	500	1360	0.42	3.5	150	410	0.42
13.0	560	1280	0.38	4.0	170	390	0.38
14.7	580	1490	0.41	4.5	180	450	0.41
16.3	600	1280	0.36	5.0	180	390	0.36
18.0	540	1320	0.40	5.5	160	400	0.40
19.6	530	1500	0.43	6.0	160	460	0.43
21.2	500	1650	0.45	6.5	150	500	0.45
22.9	480	1430	0.44	7.0	150	440	0.44
24.5	500	1920	0.46	7.5	150	590	0.46
25.8	510	1920	0.46	7.9	150	580	0.46
27.8	500	2040	0.47	8.5	150	620	0.47
29.1	450	1950	0.47	8.9	140	600	0.47
31.1	430	2080	0.48	9.5	130	630	0.48
32.7	400	2120	0.48	10.0	120	650	0.48
34.0	390	2320	0.49	10.4	120	710	0.49
34.4	340	2500	0.49	10.5	100	760	0.49
35.7	340	1650	0.48	10.9	100	500	0.48
36.0	340	2290	0.49	11.0	100	700	0.49
37.6	350	2090	0.49	11.5	110	640	0.49
39.3	380	5810	0.50	12.0	120	1770	0.50
40.9	500	6330	0.50	12.5	150	1930	0.50
42.6	590	7360	0.50	13.0	180	2240	0.50
44.2	740	6960	0.49	13.5	230	2120	0.49
45.8	1040	6270	0.49	14.0	320	1910	0.49
47.5	1350	5100	0.46	14.5	410	1560	0.46
49.1	1740	3960	0.38	15.0	530	1210	0.38
50.8	1930	5150	0.42	15.5	590	1570	0.42
52.4	2180	5060	0.39	16.0	670	1540	0.39
54.0	2000	5460	0.42	16.5	610	1660	0.42
55.7	1990	6030	0.44	17.0	610	1840	0.44
57.3	1950	5360	0.42	17.5	600	1640	0.42
59.0	1850	5650	0.44	18.0	560	1720	0.44
60.6	2060	5970	0.43	18.5	630	1820	0.43
62.2	1760	6590	0.46	19.0	540	2010	0.46

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole B-1

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
63.9	1720	6210	0.46	19.5	520	1890	0.46
65.5	1720	7110	0.47	20.0	520	2170	0.47
67.2	1770	7720	0.47	20.5	540	2350	0.47
68.8	1790	7540	0.47	21.0	550	2300	0.47
70.5	1720	6880	0.47	21.5	520	2100	0.47
72.1	1720	6880	0.47	22.0	520	2100	0.47
73.7	1830	6880	0.46	22.5	560	2100	0.46
75.4	2000	7030	0.46	23.0	610	2140	0.46
77.0	2080	7770	0.46	23.5	630	2370	0.46
78.7	2410	7910	0.45	24.0	730	2410	0.45
80.3	2720	8270	0.44	24.5	830	2520	0.44
81.9	2840	8500	0.44	25.0	870	2590	0.44
83.6	3030	8550	0.43	25.5	920	2610	0.43
85.2	3310	8550	0.41	26.0	1010	2610	0.41
86.9	2730	7230	0.42	26.5	830	2210	0.42
88.5	2200	7580	0.45	27.0	670	2310	0.45
90.1	2470	8170	0.45	27.5	750	2490	0.45
91.8	2440	8170	0.45	28.0	740	2490	0.45
93.4	2790	9450	0.45	28.5	850	2880	0.45
95.1	4520	10290	0.38	29.0	1380	3140	0.38
96.7	4520	10820	0.39	29.5	1380	3300	0.39
98.3	4550	10290	0.38	30.0	1390	3140	0.38
100.0	4400	9740	0.37	30.5	1340	2970	0.37
101.0	4370	9380	0.36	30.8	1330	2860	0.36
101.6	4370	9520	0.37	31.0	1330	2900	0.37
103.3	4280	9520	0.37	31.5	1300	2900	0.37
104.9	4080	9970	0.40	32.0	1240	3040	0.40
106.5	3750	9810	0.41	32.5	1140	2990	0.41
108.2	3540	9110	0.41	33.0	1080	2780	0.41
109.8	3350	8920	0.42	33.5	1020	2720	0.42
111.5	3180	9040	0.43	34.0	970	2760	0.43
113.1	2890	8550	0.44	34.5	880	2610	0.44
114.7	3180	8790	0.42	35.0	970	2680	0.42
116.4	3130	8920	0.43	35.5	960	2720	0.43
118.0	3130	8920	0.43	36.0	960	2720	0.43
119.7	3330	9110	0.42	36.5	1020	2780	0.42
121.3	3370	9520	0.43	37.0	1030	2900	0.43
122.9	2920	8610	0.44	37.5	890	2630	0.44
124.6	2400	7630	0.45	38.0	730	2320	0.45
126.2	1790	6920	0.46	38.5	550	2110	0.46

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole B-1

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p			V_s	V_p	
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
128.2	1540	6060	0.47	39.1	470	1850	0.47
129.5	1570	6180	0.47	39.5	480	1880	0.47
131.1	1970	7400	0.46	40.0	600	2260	0.46
132.8	2620	8330	0.45	40.5	800	2540	0.45
134.4	3910	10050	0.41	41.0	1190	3060	0.41
136.1	5020	9970	0.33	41.5	1530	3040	0.33
137.7	4590	8610	0.30	42.0	1400	2630	0.30
139.3	4280	9240	0.36	42.5	1300	2820	0.36
141.0	4250	8010	0.30	43.0	1290	2440	0.30
142.6	4220	8270	0.32	43.5	1290	2520	0.32
144.3	4190	8850	0.36	44.0	1280	2700	0.36
145.9	4030	8220	0.34	44.5	1230	2510	0.34
147.6	3150	7070	0.38	45.0	960	2160	0.38
149.2	2430	6880	0.43	45.5	740	2100	0.43
150.8	2100	6330	0.44	46.0	640	1930	0.44
152.5	2100	5920	0.43	46.5	640	1800	0.43
154.1	2090	6150	0.43	47.0	640	1870	0.43
155.8	2320	6390	0.42	47.5	710	1950	0.42
157.4	2720	7360	0.42	48.0	830	2240	0.42
159.0	3460	7860	0.38	48.5	1050	2400	0.38
161.0	3880	8550	0.37	49.1	1180	2610	0.37
162.3	3980	9040	0.38	49.5	1210	2760	0.38
164.0	4870	9970	0.34	50.0	1480	3040	0.34
165.6	4830	9450	0.32	50.5	1470	2880	0.32
167.2	2880	8010	0.43	51.0	880	2440	0.43
168.9	1910	6390	0.45	51.5	580	1950	0.45
170.5	1460	5810	0.47	52.0	440	1770	0.47
172.2	1190	5230	0.47	52.5	360	1590	0.47
173.8	1250	5300	0.47	53.0	380	1610	0.47
175.4	1370	5500	0.47	53.5	420	1680	0.47
177.1	1470	5780	0.47	54.0	450	1760	0.47
178.7	1460	5810	0.47	54.5	440	1770	0.47
180.4	1410	5680	0.47	55.0	430	1730	0.47
182.0	1390	5650	0.47	55.5	420	1720	0.47
183.6	1460	5630	0.46	56.0	450	1720	0.46
185.3	1630	5600	0.45	56.5	500	1710	0.45
187.2	1830	5810	0.44	57.1	560	1770	0.44
188.6	1870	5680	0.44	57.5	570	1730	0.44
190.2	1780	5920	0.45	58.0	540	1800	0.45
191.8	1680	5730	0.45	58.5	510	1750	0.45

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole B-1

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
193.5	1640	5810	0.46
195.1	1590	5750	0.46
196.8	1640	5700	0.46
198.4	1680	5780	0.45
200.0	1770	6150	0.45
201.7	1880	6180	0.45
203.3	2000	6460	0.45
205.0	2000	6490	0.45
206.6	1970	6430	0.45
208.2	1850	6120	0.45
209.9	1700	5830	0.45
211.5	1500	5550	0.46

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
59.0	500	1770	0.46
59.5	490	1750	0.46
60.0	500	1740	0.46
60.5	510	1760	0.45
61.0	540	1870	0.45
61.5	570	1880	0.45
62.0	610	1970	0.45
62.5	610	1980	0.45
63.0	600	1960	0.45
63.5	560	1860	0.45
64.0	520	1780	0.45
64.5	460	1690	0.46

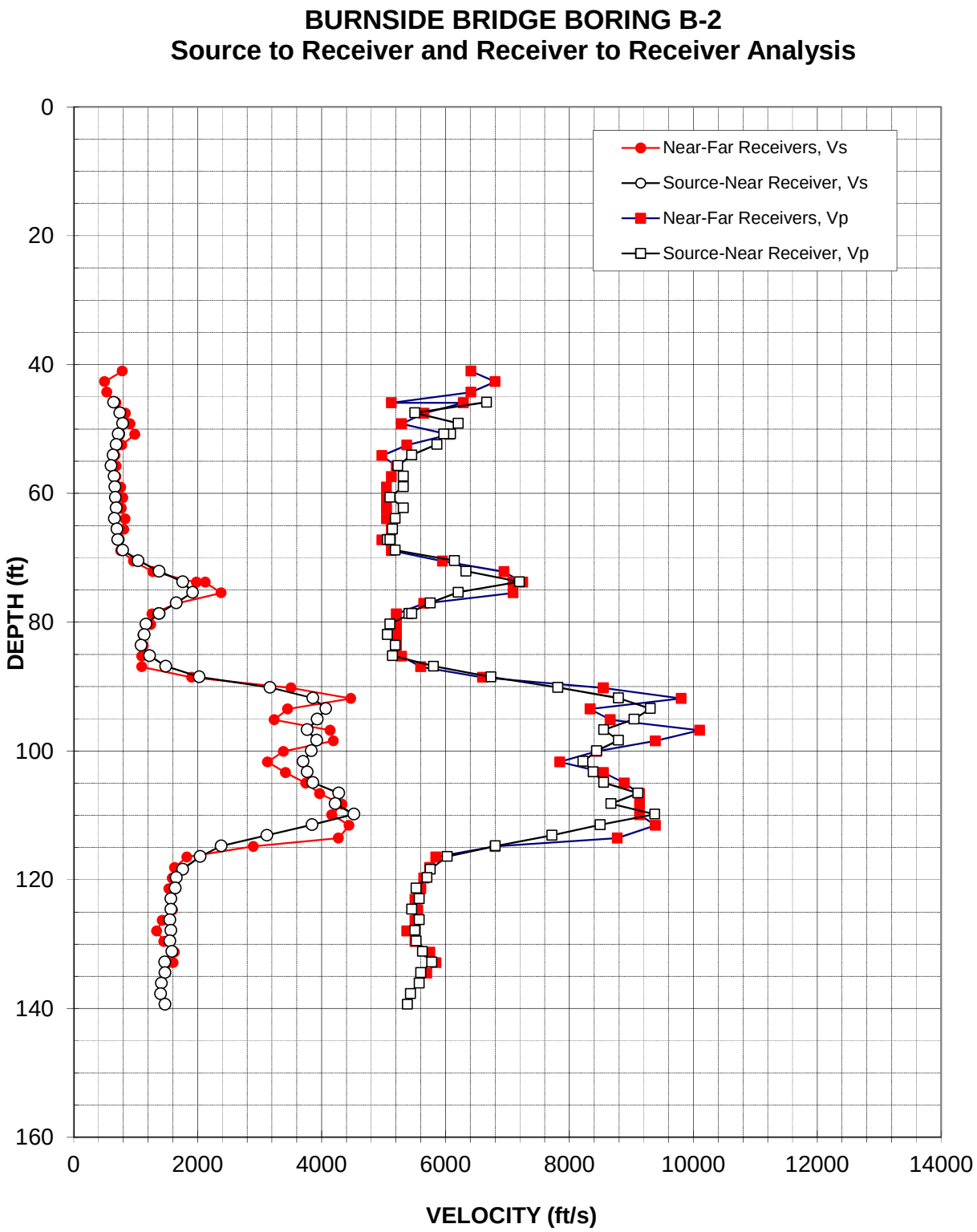


Figure A-2: Borehole B-2, Suspension S-R1 P- and S_H-wave velocities

Table A-2. Borehole B-2, S - R1 quality assurance analysis P- and S_H-wave data

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole B-2

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
45.8	650	6660	0.50	14.0	200	2030	0.50
47.5	740	5500	0.49	14.5	230	1680	0.49
49.1	790	6210	0.49	15.0	240	1890	0.49
50.8	730	6090	0.49	15.5	220	1860	0.49
50.8	720	5970	0.49	15.5	220	1820	0.49
52.4	690	5860	0.49	16.0	210	1790	0.49
54.0	630	5460	0.49	16.5	190	1660	0.49
55.7	610	5230	0.49	17.0	180	1590	0.49
57.3	650	5320	0.49	17.5	200	1620	0.49
59.0	660	5320	0.49	18.0	200	1620	0.49
60.6	670	5100	0.49	18.5	210	1560	0.49
62.2	690	5320	0.49	19.0	210	1620	0.49
63.9	660	5190	0.49	19.5	200	1580	0.49
65.5	700	5150	0.49	20.0	210	1570	0.49
67.2	720	5060	0.49	20.5	220	1540	0.49
67.2	710	5100	0.49	20.5	220	1560	0.49
68.8	790	5190	0.49	21.0	240	1580	0.49
70.5	1040	6150	0.49	21.5	320	1870	0.49
72.1	1380	6330	0.48	22.0	420	1930	0.48
73.7	1760	7190	0.47	22.5	540	2190	0.47
75.4	1920	6210	0.45	23.0	580	1890	0.45
77.0	1660	5750	0.45	23.5	510	1750	0.45
78.7	1380	5410	0.47	24.0	420	1650	0.47
78.7	1380	5460	0.47	24.0	420	1660	0.47
80.3	1170	5100	0.47	24.5	360	1560	0.47
81.9	1140	5060	0.47	25.0	350	1540	0.47
83.6	1090	5190	0.48	25.5	330	1580	0.48
85.2	1220	5150	0.47	26.0	370	1570	0.47
86.9	1490	5810	0.46	26.5	450	1770	0.46
88.5	2030	6730	0.45	27.0	620	2050	0.45
90.1	3170	7810	0.40	27.5	960	2380	0.40
91.8	3860	8790	0.38	28.0	1180	2680	0.38
93.4	4070	9310	0.38	28.5	1240	2840	0.38
95.1	3930	9040	0.38	29.0	1200	2760	0.38
96.7	3770	8550	0.38	29.5	1150	2610	0.38
98.3	3920	8790	0.38	30.0	1190	2680	0.38
100.0	3840	8440	0.37	30.5	1170	2570	0.37
101.6	3700	8220	0.37	31.0	1130	2510	0.37
103.3	3770	8380	0.37	31.5	1150	2560	0.37

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole B-2

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
104.9	3860	8550	0.37
106.5	4280	9110	0.36
108.2	4220	8670	0.34
109.8	4520	9380	0.35
111.5	3850	8500	0.37
113.1	3120	7720	0.40
114.7	2380	6810	0.43
116.4	2040	6030	0.44
118.4	1760	5750	0.45
119.7	1660	5700	0.45
121.3	1640	5530	0.45
122.9	1570	5580	0.46
124.6	1570	5460	0.45
126.2	1550	5580	0.46
127.9	1570	5500	0.46
129.5	1550	5530	0.46
131.1	1590	5630	0.46
132.8	1470	5780	0.47
134.4	1470	5600	0.46
136.1	1410	5580	0.47
137.7	1400	5430	0.46
139.3	1480	5390	0.46

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
32.0	1180	2610	0.37
32.5	1300	2780	0.36
33.0	1290	2640	0.34
33.5	1380	2860	0.35
34.0	1170	2590	0.37
34.5	950	2350	0.40
35.0	730	2070	0.43
35.5	620	1840	0.44
36.1	540	1750	0.45
36.5	510	1740	0.45
37.0	500	1690	0.45
37.5	480	1700	0.46
38.0	480	1660	0.45
38.5	470	1700	0.46
39.0	480	1680	0.46
39.5	470	1690	0.46
40.0	480	1720	0.46
40.5	450	1760	0.47
41.0	450	1710	0.46
41.5	430	1700	0.47
42.0	430	1660	0.46
42.5	450	1640	0.46

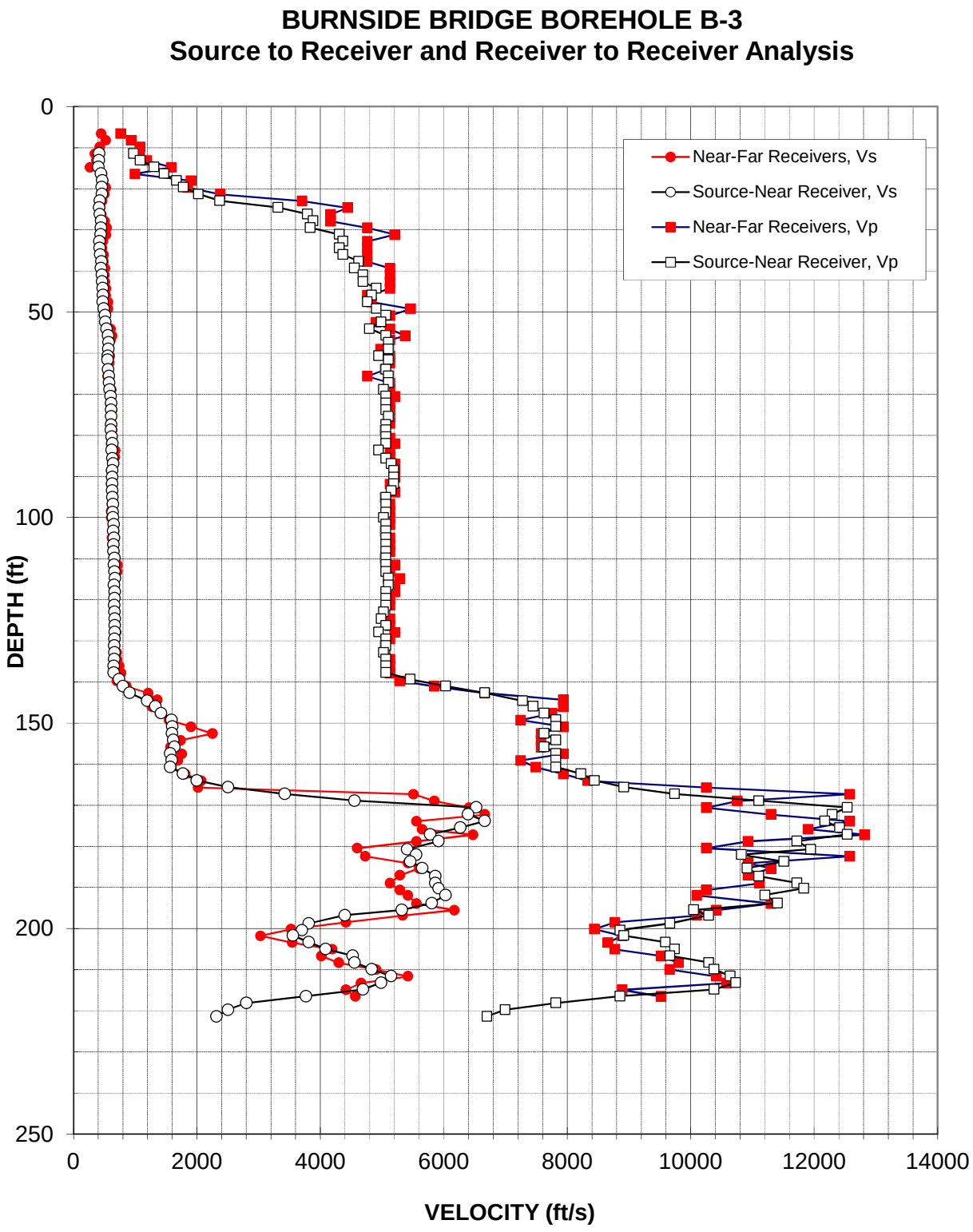


Figure A-3: Borehole B-3, Suspension S-R1 P- and S_H-wave velocities

Table A-3. Borehole B-3, S - R1 quality assurance analysis P- and S_H-wave data

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio Based on Source-to-Receiver Travel Time Data - Borehole B-3

American Units				Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio	Depth at Midpoint Between Source and Near Receiver	Velocity V_s	Velocity V_p	Poisson's Ratio
(ft)	(ft/s)	(ft/s)		(m)	(m/s)	(m/s)	
11.4	420	980	0.39	3.5	130	300	0.39
13.0	410	1080	0.42	4.0	130	330	0.42
14.7	410	1310	0.45	4.5	120	400	0.45
16.3	440	1470	0.45	5.0	140	450	0.45
18.0	470	1670	0.46	5.5	140	510	0.46
19.6	460	1780	0.46	6.0	140	540	0.46
21.2	460	2020	0.47	6.5	140	620	0.47
22.9	430	2370	0.48	7.0	130	720	0.48
24.5	420	3310	0.49	7.5	130	1010	0.49
26.2	430	3790	0.49	8.0	130	1160	0.49
27.8	450	3880	0.49	8.5	140	1180	0.49
29.4	450	3840	0.49	9.0	140	1170	0.49
31.1	440	4310	0.49	9.5	130	1310	0.49
32.7	420	4370	0.50	10.0	130	1330	0.50
34.4	420	4310	0.50	10.5	130	1310	0.50
36.0	440	4370	0.49	11.0	130	1330	0.49
37.6	450	4620	0.50	11.5	140	1410	0.50
39.3	440	4550	0.50	12.0	140	1390	0.50
40.9	460	4690	0.50	12.5	140	1430	0.50
42.6	460	4690	0.50	13.0	140	1430	0.50
44.2	470	4910	0.50	13.5	140	1500	0.50
45.8	480	4830	0.50	14.0	150	1470	0.50
47.5	470	4760	0.49	14.5	140	1450	0.49
49.1	490	4910	0.49	15.0	150	1500	0.49
50.8	510	5060	0.49	15.5	160	1540	0.49
52.4	520	4980	0.49	16.0	160	1520	0.49
54.0	530	4800	0.49	16.5	160	1460	0.49
55.7	560	5060	0.49	17.0	170	1540	0.49
57.3	570	5100	0.49	17.5	170	1560	0.49
59.0	570	5100	0.49	18.0	170	1560	0.49
60.6	560	4950	0.49	18.5	170	1510	0.49
61.6	550	5100	0.49	18.8	170	1560	0.49
63.9	560	5060	0.49	19.5	170	1540	0.49
65.5	580	5100	0.49	20.0	180	1560	0.49
67.2	580	5100	0.49	20.5	180	1560	0.49
68.8	590	5020	0.49	21.0	180	1530	0.49
70.5	600	5060	0.49	21.5	180	1540	0.49

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole B-3

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
72.1	610	5060	0.49
73.7	610	5060	0.49
75.4	610	5100	0.49
77.3	610	5060	0.49
78.7	610	5060	0.49
80.3	620	5060	0.49
81.9	630	5060	0.49
83.6	620	4950	0.49
85.5	630	5060	0.49
86.9	640	5150	0.49
88.5	630	5190	0.49
90.1	630	5190	0.49
91.8	630	5190	0.49
93.4	630	5150	0.49
95.1	630	5060	0.49
96.7	640	5060	0.49
98.7	640	5060	0.49
100.0	640	5020	0.49
101.6	650	5060	0.49
103.3	640	5060	0.49
104.9	660	5060	0.49
106.5	650	5060	0.49
108.2	650	5060	0.49
109.8	670	5060	0.49
111.5	660	5060	0.49
113.1	670	5060	0.49
114.7	670	5100	0.49
116.4	660	5100	0.49
118.0	670	5060	0.49
119.7	670	5060	0.49
121.3	660	5060	0.49
122.9	670	5020	0.49
124.6	670	4980	0.49
126.2	670	5060	0.49
127.9	670	4950	0.49
129.5	670	5060	0.49
131.1	660	5060	0.49
132.8	670	5020	0.49
134.4	660	5060	0.49
136.1	650	5060	0.49

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
22.0	190	1540	0.49
22.5	190	1540	0.49
23.0	190	1560	0.49
23.6	190	1540	0.49
24.0	180	1540	0.49
24.5	190	1540	0.49
25.0	190	1540	0.49
25.5	190	1510	0.49
26.1	190	1540	0.49
26.5	200	1570	0.49
27.0	190	1580	0.49
27.5	190	1580	0.49
28.0	190	1580	0.49
28.5	190	1570	0.49
29.0	190	1540	0.49
29.5	190	1540	0.49
30.1	190	1540	0.49
30.5	190	1530	0.49
31.0	200	1540	0.49
31.5	200	1540	0.49
32.0	200	1540	0.49
32.5	200	1540	0.49
33.0	200	1540	0.49
33.5	200	1540	0.49
34.0	200	1540	0.49
34.5	200	1540	0.49
35.0	210	1560	0.49
35.5	200	1560	0.49
36.0	200	1540	0.49
36.5	200	1540	0.49
37.0	200	1540	0.49
37.5	200	1530	0.49
38.0	200	1520	0.49
38.5	200	1540	0.49
39.0	200	1510	0.49
39.5	200	1540	0.49
40.0	200	1540	0.49
40.5	200	1530	0.49
41.0	200	1540	0.49
41.5	200	1540	0.49

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole B-3

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
137.7	660	5060	0.49
139.3	740	5460	0.49
141.0	800	6030	0.49
142.6	910	6660	0.49
144.6	1190	7280	0.49
145.9	1330	7450	0.48
147.6	1420	7630	0.48
149.2	1590	7810	0.48
150.8	1600	7810	0.48
152.5	1590	7630	0.48
154.1	1620	7810	0.48
155.8	1640	7630	0.48
157.4	1570	7810	0.48
159.0	1590	7810	0.48
160.7	1570	7810	0.48
162.3	1770	8220	0.48
164.0	2000	8440	0.47
165.6	2500	8920	0.46
167.2	3420	9740	0.43
168.9	4550	11110	0.40
170.5	6530	12530	0.31
172.2	6390	12290	0.31
173.8	6660	12170	0.29
175.4	6270	12410	0.33
177.1	5780	12530	0.36
178.7	5920	11720	0.33
180.7	5410	11940	0.37
182.0	5550	10820	0.32
183.6	5460	11510	0.35
185.3	5650	10910	0.32
187.2	5860	11110	0.31
188.9	5860	11720	0.33
190.2	5920	11830	0.33
191.8	6030	11200	0.30
193.8	5810	11410	0.33
195.5	5320	10050	0.31
196.8	4400	10290	0.39
198.7	3810	9660	0.41
200.4	3700	8850	0.39
201.7	3560	8920	0.41

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
42.0	200	1540	0.49
42.5	230	1660	0.49
43.0	250	1840	0.49
43.5	280	2030	0.49
44.1	360	2220	0.49
44.5	400	2270	0.48
45.0	430	2320	0.48
45.5	480	2380	0.48
46.0	490	2380	0.48
46.5	490	2320	0.48
47.0	490	2380	0.48
47.5	500	2320	0.48
48.0	480	2380	0.48
48.5	480	2380	0.48
49.0	480	2380	0.48
49.5	540	2510	0.48
50.0	610	2570	0.47
50.5	760	2720	0.46
51.0	1040	2970	0.43
51.5	1390	3380	0.40
52.0	1990	3820	0.31
52.5	1950	3750	0.31
53.0	2030	3710	0.29
53.5	1910	3780	0.33
54.0	1760	3820	0.36
54.5	1800	3570	0.33
55.1	1650	3640	0.37
55.5	1690	3300	0.32
56.0	1660	3510	0.35
56.5	1720	3330	0.32
57.1	1790	3380	0.31
57.6	1790	3570	0.33
58.0	1800	3610	0.33
58.5	1840	3410	0.30
59.1	1770	3480	0.33
59.6	1620	3060	0.31
60.0	1340	3140	0.39
60.6	1160	2950	0.41
61.1	1130	2700	0.39
61.5	1080	2720	0.41

Summary of Compressional Wave Velocity, Shear Wave Velocity, and Poisson's Ratio
Based on Source-to-Receiver Travel Time Data - Borehole B-3

American Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(ft)	(ft/s)	(ft/s)	
203.3	3810	9590	0.41
205.0	4080	9740	0.39
206.6	4520	9660	0.36
208.2	4550	10290	0.38
209.9	4830	10380	0.36
211.5	5150	10640	0.35
213.2	4980	10730	0.36
214.8	4690	10380	0.37
216.4	3770	8850	0.39
218.1	2800	7810	0.43
219.7	2500	6990	0.43
221.4	2320	6700	0.43

Metric Units			
Depth at Midpoint Between Source and Near Receiver	Velocity		Poisson's Ratio
	V_s	V_p	
(m)	(m/s)	(m/s)	
62.0	1160	2920	0.41
62.5	1240	2970	0.39
63.0	1380	2950	0.36
63.5	1390	3140	0.38
64.0	1470	3160	0.36
64.5	1570	3240	0.35
65.0	1520	3270	0.36
65.5	1430	3160	0.37
66.0	1150	2700	0.39
66.5	850	2380	0.43
67.0	760	2130	0.43
67.5	710	2040	0.43

APPENDIX B

BOREHOLE GEOPHYSICAL LOGGING SYSTEMS - NIST TRACEABLE CALIBRATION RECORDS

MICRO PRECISION CALIBRATION INC.

MICRO PRECISION CALIBRATION, INC
2165 N. Glassell St.,
Orange, CA 92865
714-901-5659

Certificate of Calibration

Calibration CERT # AC-1969

Date: Jul 14, 2016

Cert No. 222200812421146

Customer:

GEOVISION

1124 OLYMPIC DRIVE
CORONA CA 92881

Work Order #: N/A

MPC Control #:	AM6767	Serial Number:	160023
Asset ID:	160023	Department:	N/A
Gage Type:	LOGGER	Performed By:	TYLER MCKEEN
Manufacturer:	OYO	Received Condition:	IN TOLERANCE
Model Number:	3403	Returned Condition:	IN TOLERANCE
Size:	N/A	Cal. Date:	July 14, 2016
Temp/RH:	72.0°F / 54.0%	Cal. Interval:	12 MONTHS
		Cal. Due Date:	July 14, 2017

Calibration Notes:

See attached data sheet for calculations. (1 Page)

Calibrated IAW customer supplied data form Rev 2.1
Frequency measurement uncertainty = 0.0005 Hz
Unit calibrated with Laptop Panasonic Model CF-29,s/n: 4FKSA41798
Calibrated To 4:1 Accuracy Ratio

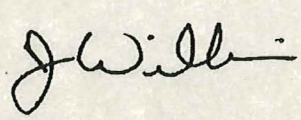
This Calibration has been performed in conformance with, and complies to all requirements as set forth in S&ME purchase order SCP-0022, Dated July 13, 2016

Standards Used to Calibrate Equipment

I.D.	Description.	Model	Serial	Manufacturer	Cal. Due Date	Traceability #
T1100	UNIVERSAL COUNTER	53131A	3546A09912	HEWLETT PACKARD	Feb 2, 2017	222008122827657
DB8748	GPS TIME AND FREQUENCY RECEIVER	58503A	3625A01225	HEWLETT PACKARD	Jun 17, 2017	222008122553843
AM4000	WAVEFORM GENERATOR	33250A	MY40000703	AGILENT	Jul 8, 2017	222200812420653

Calibrating Technician: 

TYLER MCKEEN

QC Approval: 

Jim Williams

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA's Publication and NIST Technical Note 1297, 1994 Edition. Services rendered comply with ISO 17025:2005, ANSI/NCSL Z540-1, MPC Quality Manual, MPC CSD and with customer purchase order instructions.

Calibration cycles and resulting due dates were submitted/approved by the customer. Any number of factors may cause an instrument to drift out of tolerance before the next scheduled calibration. Recalibration cycles should be based on frequency of use, environmental conditions and customer's established systematic accuracy. The information on this report, pertains only to the instrument identified.

All standards are traceable to SI through the National Institute of Standards and Technology (NIST) and/or recognized national or international standards laboratories. Services rendered include proper manufacturer's service instruction and are warranted for no less than thirty (30) days. This report may not be reproduced in part or in a whole without the prior written approval of the issuing MPC lab.

MICRO PRECISION CALIBRATION, INC
2165 N. Glassell St.,
Orange, CA 92865
714-901-5659

Calibration CERT # AC-1969

Certificate of Calibration

Date: Jul 14, 2016

Cert No. 222200812421146

Procedures Used in this Event

Procedure Name	Description
GEOVISION SEISMIC	Suspension PS Seismic Logger/Recorder Calibration Procedure

Calibrating Technician: TYLER MCKEEN

QC Approval: Jim Williams

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for normal distribution corresponds to a coverage probability of approximately 95%. The standard uncertainty of measurement has been determined in accordance with EA's Publication and NIST Technical Note 1297, 1994 Edition. Services rendered comply with ISO 17025:2005, ANSI/NCSL Z540-1, MPC Quality Manual, MPC CSD and with customer purchase order instructions.

Calibration cycles and resulting due dates were submitted/approved by the customer. Any number of factors may cause an instrument to drift out of tolerance before the next scheduled calibration. Recalibration cycles should be based on frequency of use, environmental conditions and customer's established systematic accuracy. The information on this report, pertains only to the instrument identified.

All standards are traceable to SI through the National Institute of Standards and Technology (NIST) and/or recognized national or international standards laboratories. Services rendered include proper manufacturer's service instruction and are warranted for no less than thirty (30) days. This report may not be reproduced in part or in a whole without the prior written approval of the issuing MPC lab.

GEOVision geophysical services

SUSPENSION PS SEISMIC LOGGER/RECORDER CALIBRATION DATA FORM

INSTRUMENT DATA

System mfg.:	OYO / Robertson Geologging	Model no.:	3403
Serial no.:	160023	Calibration date:	7/14/16
By:	Emily Feldman	Due date:	7/14/17
Counter mfg.:	Hewlett Packard	Model no.:	5313 1A
Serial no.:	3546A09912	Calibration date:	2/02/16
By:	Micro Precision	Due date:	2/02/17
Signal generator mfg.:	Agilent	Model no.:	33250A
Serial no.:	MY40000703	Calibration date:	7/08/16
By:	Micro Precision	Due date:	7/08/17
Laptop controller mfg.:	Panasonic	Model no.:	CF-29 Tough book
Serial no.:	4FKSA41798	Calibration date:	N/A

SYSTEM SETTINGS:

Gain:	~~x10~~ EFF 7/14/16 2
Filter	Open (Low pass 10k)
Range:	200 to 50 µs
Delay:	0.3 msec
Stack (1 std)	1
System date = correct date and time	7/14/16, 1300 hrs

PROCEDURE:

Set sine wave frequency to target frequency with amplitude of approximately 0.25 volt peak
Note actual frequency on data form.
Set sample period and record data file to disk. Note file name on data form.
Pick duration of 9 cycles using PSLOG.EXE program, note duration on data form, and save as .sps file. Calculate average frequency for each channel pair and note on data form.

Average frequency must be within +/- 1% of actual frequency at all data points.

Maximum error ((AVG-ACT)/ACT*100)% As found 0.22% As left 0.22%

Target Frequency (Hz)	Actual Frequency (Hz)	Sample Period (microS)	File Name COO1	Time for 9 cycles Hn (msec)	Average Frequency Hn (Hz)	Time for 9 cycles Hr (msec)	Average Frequency Hr (Hz)	Time for 9 cycles V (msec)	Average Frequency V (Hz)
50.00	50.00	200	001	180.2	50.06	179.8	50.06	180.4	49.89
100.0	100.0	100	002	90.0	100.0	90.0	100.0	89.9	100.1
200.0	200.0	50	003	45.0	200.0	45.05	199.8	44.95	200.2
500.0	500.0	20	004	18.02	499.5	18.00	500.0	18.00	~~200.~~ EFF 7/14/16
1000	1000	10	005	9.01	998.9	9.01	998.9	9.00	1000
2000	2000	5	006	4.50	2000	4.495	~~2002.2~~ 2000 EFF 7/14/16 2002	4.5	2000

500.0 EFF 7/14/16

Calibrated by: _____ 7/14/16 Tyler McKeen
Name Date Signature

Witnessed by: Emily Feldman 7/14/16 _____
Name Date Signature

Suspension PS Seismic Recorder/Logger Calibration Data Form Rev 2.1 February 7, 2012

Earthquake Ready Burnside Bridge – EQRB
Report of P and S Wave Velocity Logging
Boreholes

Submitted to:

Shannon & Wilson
Lake Oswego, OR 97035



Shannon & Wilson Project number: 102636
In Situ Engineering Project Number: 1974
October 27, 2021

Testing conducted, and report prepared by:

In Situ Engineering

6232 195th Avenue SE

Snohomish, WA 98290 360-568-2807

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1.0 INTRODUCTION

In-situ borehole compression (P) and shear (S)wave velocity measurements were conducted in eleven (11) uncased boreholes drilled by Western States Drilling. All boreholes were prepared by Shannon & Wilson (S&W) as part of the Earthquake Ready Burnside Bridge Project (EQRB), in Portland OR. The geophysical data acquisition was performed on several mobilizations from the 1st week of August to the 4th week of September. The tests were performed by In Situ Engineering using a method known as OYO P-S Suspension Logging. Data analysis, review and report preparation was also performed by In Situ Engineering. This report describes the field measurements, data analysis, and results of the work.

2.0 PURPOSE

The purpose of these studies was to acquire shear-wave and compressional-wave velocities as a function of depth, and to determine a Seismic Property of the target formations which would assist in the design of Earthquake Ready Burnside Bridge replacement. This report presents the results of in-situ geophysical OYO P-S Suspension Logging seismic measurements collected on 11 open boreholes drilled by mud rotary method.

The acquired data was analyzed, and a profile of the following properties versus depth are produced:

Velocity for both P and horizontally polarized S waves.

Arrival Time

Poison's and V_p/V_s ratios

3.0 FACTORS AFFECTING THE P-S LOG QUALITY

In general P waves are less susceptible to borehole factors than S waves, and as the P waves are the first arrivals they can usually be readily identified. The S waves tend to arrive in conjunction with earlier wave arrivals of the P waves and therefore, as earlier signals overlap the S waves, it can be masked or distorted.

In most cases, the following factors cannot be controlled, but a good understanding will help the P-S instrument operator interpret what is happening to the data.

DIAMETER: Smaller diameter boreholes will produce better data, all else being equal. A step increase in borehole diameter, as is often found at the top of a borehole, will inevitably degrade data quality, again, all else being equal.

RUGOSITY: is defined as a measure of small-scale variations or amplitude in the height of a surface. The re-transmission of waves back into the borehole fluid from the wall is affected by the roughness or rugosity of the surface. A smooth borehole wall will re-transmit a smooth coherent waveform. As the irregularity increases the re-transmitted waves become more and more distorted.

CAVITATION: Cavities and dropouts (washout) in the borehole wall will degrade the signal quality. Sharp edges within the cavity can cause diffraction waves where the edge acts another point source. In extreme cases the S waves can become unrecognizable. The effect is most evident when either the source or a receiver is at exactly the same depth as the cavity and is characterized by a jagged appearance in the S waveforms.

COMPACTION: Competent rocks and fine-grained compacted formations produce the best data. Thus, data quality often improves with depth. Layers of gravel or pebbles or layers with loose mixed material can severely degrade data quality.

FRACTURES: Closed fractures should not markedly affect data quality. Open fractures can give rise to multiples, which occur when a seismic wave reverberates within a layer. The higher velocity contrast from open factures amplifies this effect. Multiples can give a jagged appearance to the S waves caused by the superposition of different ray paths.

CASING: Where plastic casing has been installed it must be cement grouted so that no voids exist between the casing and the formation. The presence of voids will interrupt the transmission of waves to the formation.

BACKGROUND NOISE: The instrument measures all the ground/fluid accelerations within the short period of each test measurement. Of interest is the accelerations caused by the internal hammer of the instrument as we know the distance and timing of the source. Other sources of measurable ground accelerations could be waves slapping at bulkheads, the shoreline or barges; traffic from roadways or railroads; construction activity as well as any other impact producing activity.

4.0 INSTRUMENTATION

The Digital OYO P-S Suspension Logger Probe and Micrologger-2 Recorder, manufactured by Robertson Geo in the United Kingdom were used to acquire in-situ horizontal shear and compressional wave velocity measurements. The P-S Suspension instrument and Micrologger were powered separately by a 12 volt battery to reduce any current interference from an alternating current power. A winch with depth counter pully was used to lower the probe downhole. Both the winch and pully were strapped down and/or secured to permanent structures to minimize any movement during acquisition.

5.0 MEASUREMENT PROCEDURES

The 20ft (6.03m) long PS logger (with 3.28ft (1.0m) filter) is inserted in the borehole, and its probe top is zeroed to the ground surface. This positioning will place the receiver point (which is midpoint between the geophones) to be at 8.04ft (2.45m) below surface, see Figure 1. This depth is the "*shallowest reading"* of the probe. The probe was then lowered to the bottom of the drilled boreholes. Logging then starts from bottom of the boring, minus 11.75ft (3.58m) of rathole for the driver & filter section of the instrument. The probe was then incrementally raised by the winch to the surface, stopping for testing at 0.5m intervals, which are called "***The Stations***".

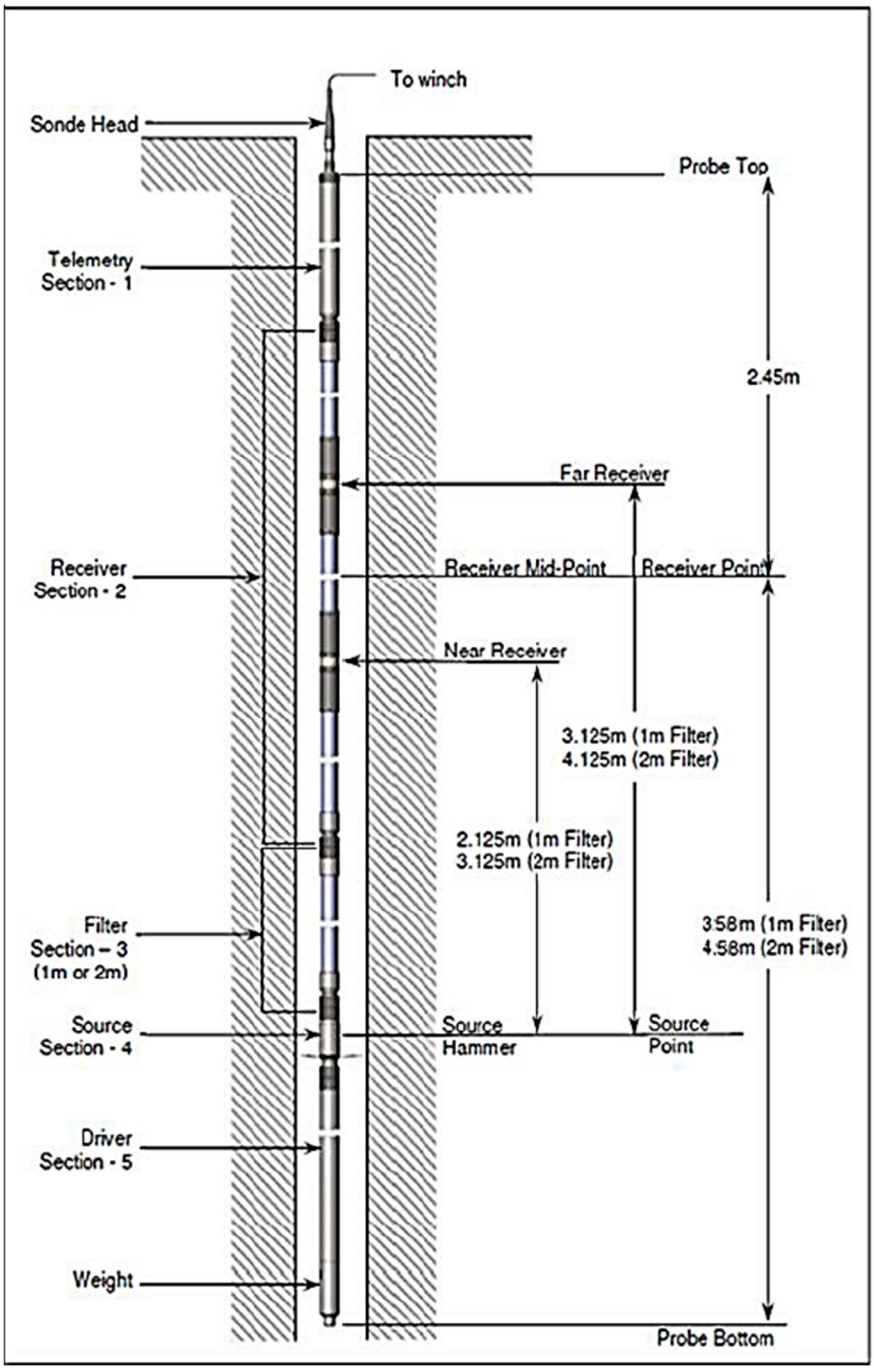

Figure 1: PS Logger Configuration, (source PS Logger Manual, Robertson Geo)

In addition to some of the issues discussed in Section 3.0, testing overwater presents unique challenges that can affect test results.

- Movement of the barge or work platform due to wake from water traffic or waves from current and tidal influences
- Downhole noise from the movement of water along the casing between the top deck and the mudline

- Saturation of the upper elevation materials can result in a varied waveform that may not represent the materiel present

Weather and time of year were also key factors. Warm, sunny summer weather led to active sharing of the waterway on which testing was occurring. Despite posted "No Wake" signs, frequent boat traffic adjacent to the barges produced almost constant wake.

For this project we were to utilize two barges locally provided by Marks Marine Services, identified as the Mark 12 and the Patterson.

Mark 12:

- 110' Length
- 35' Width
- 11' Height
- 2' of Draft
- Moon Hole located in the center, 55' in from the front and back and 17.5' in from the sides

Patterson:

- 75' Length
- 24' Width
- 4' Height
- 2.5' Draft
- Moon Hole located in the center, 37.5' in from the front and back and 12' in from the sides

Both barges were held in place for each test location via the use of two spuds, located diagonally on opposite sides. Spuds were very effective in preventing horizontal movement during the work. However, spuds are not able to prevent vertical motion caused by wake and waves. This led directly to stabilizing the tool while the logger was deployed downhole. If the barge platform oscillated due to water wave actions, the probe also moved, often while acquiring seismic readings for a station. This often produced a distorted and useless signal. Because of this, the field technician had to repeat multiple readings.

In some sections of the boreholes, the logger noticed distorted signals upon acquisition and stacked multiple shots to ascertain a better wave form. Some sections of few boreholes were re-logged with different acquisition parameters to ascertain a good data quality (Table 1).

6.0 DATA ANALYSIS

Data was analyzed using PS Logger Application V 1.6. The first step in the process was to filter out and clean the raw waveforms, Figure 2. Most of the stations had similar background noises and the waves were filtered around 160-240Hz and 1-3kHz respectively for Shear & Compressional waves. Figure 3 shows a filtered PS waveform with the arrival time picked for each of the near and far receivers.

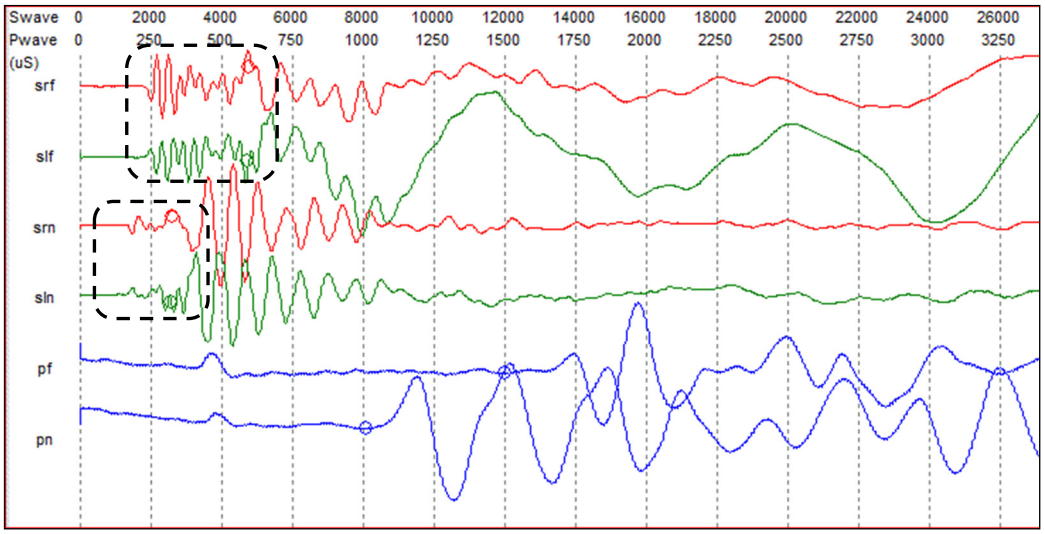

Figure 2: Station 23m - raw PS waveforms. Noises in the first thousand of µs.

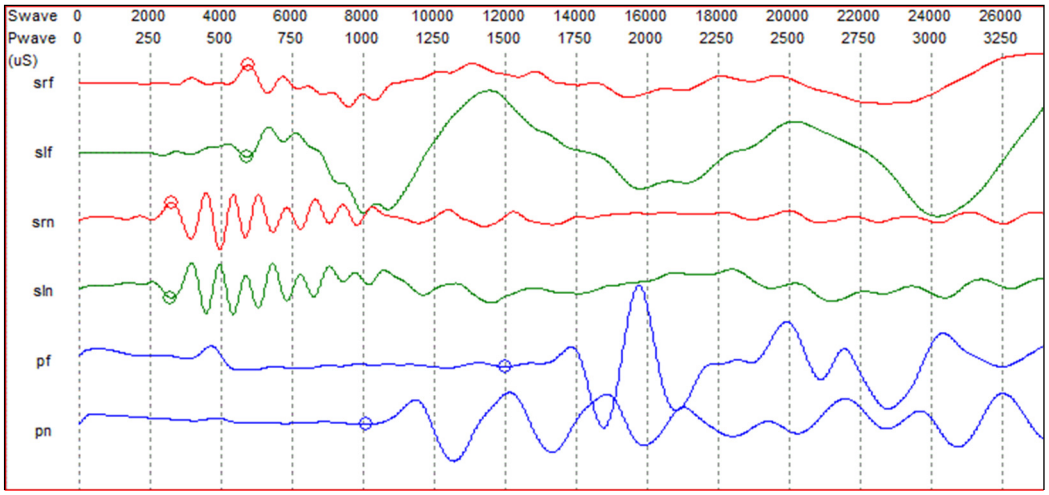

Figure 3: Station 23m - filtered PS waveforms. Noises removed, and 1st arrival time picked.

Overall, most stations for the 11 boreholes have easily recognizable seismic waveforms and were not hard to interpret. As seen in Figure 4 below for example, the S-waves have very strong responses for both the near and far receivers (which are 1m apart) coming up to station 49.5m. At 49m the upper receiver was in a different borehole environment (see section 3) and the signal response quality diminished. At 48m both receivers are out of the good or competent zone and the interpretation was solely on the *1st relatively* crossing-sinusoidal waves.

Unfortunately, there were a few gravely layers or washed-out areas that were very difficult to interpret, especially with the shear waves. In-Situ Engineering decided it's not valid to interpret and report distorted or unrecognizable waveforms. Hence, they are not included in the report. For example, see borehole B-10 and B-17 reports.

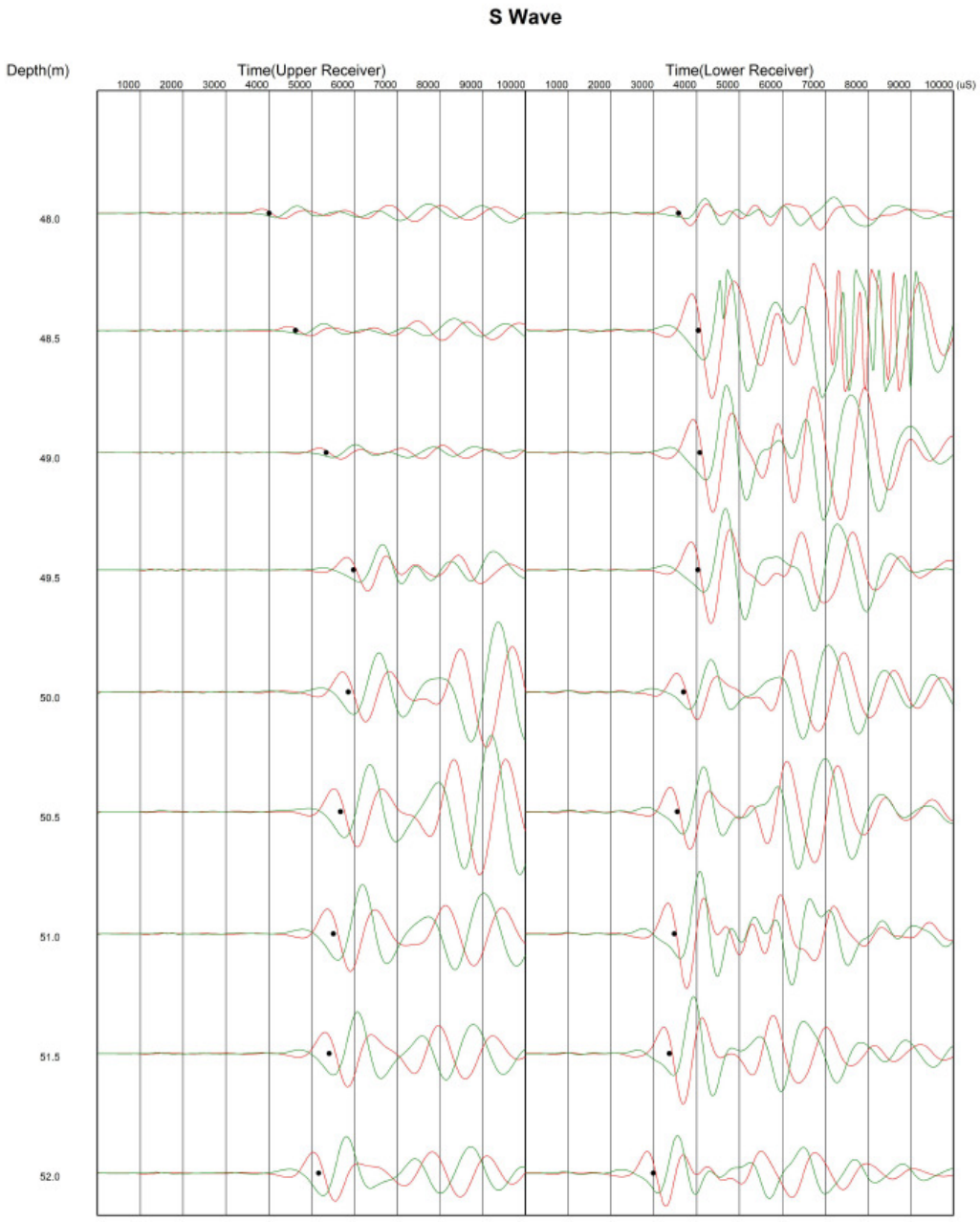

Figure 4: Dots marking 1st arrival time picks for filtered S waves.

7.0 RESULTS

Reported below are the results of the PS logging for all eleven boreholes. In general, the waveforms in all boreholes were of good to fair quality, with few stations difficult to interpret. A reasonable explanation of the cause is detailed on Section 3 above. Our bestr engineering judgment was applied in picking a reasonable high strength amplitude of a first arrival time. Once analyses were

complete, the PS-logs are compared to, and are in agreement with (less than +/- 5ft) the drilling logs provided by Shannon & Wilson.

All seismic properties of the boreholes were determined from the interpreted logs, except for a density parameter. Density needed to set accordingly to the stratigraphy profile, which is vital for the moduli analysis. The table below summarizes depth of boreholes, logged interval, number of logging runs and completion date of all OYO logged boreholes for the EQRB project.

Table 1 Summary list of all Boreholes with OYO logged total section.

Borehole name	Total depth drilled (ft)	Casing set depth (ft)	Number of log runs	OYO logged section (ft)	Interpreted total section [1], (ft)	OYO Completed date
B – 06	150	25	Run 2 Run 1	25 –46.4 46.2 – 128.4	103.5	9/24/2021
B – 08	210	35	Run 2 Run 1	32-82.8/140.2-258.3 59.8 – 158.5	126.3	9/23/2021
B – 09[2]	151	46	Run 1	6.9 – 138.1	88.6	8/19/2021
B – 10[2]	184	56	Run 1	42.7 – 172.2	91.4	8/4/2021
B – 12[2]	129	85	Run 1	83.3 – 116.1	32.8	8/25/2021
B – 13[2]	160	35	Run 1	26.9 – 138.1	101.5	8/3/2021
B – 15	210	25	Run 2 Run 1	19.7 – 57.4 57.4 – 203.3	177.5	9/16/2021
B – 16	210	20	Run 1	19.3 – 198	175.5	9/2/2021
B – 17	195	25	Run 1	20.4 – 182.7	42.6	8/26/2021
B – 27[2]	180	65	Run 1	12.2 – 165	100.1	8/11/2021
B - 32	195	15	Run 2 Run 1	11.5 – 49.2 26.2 – 181.8	165.4	9/13/2021

[1] This “interpreted total section” is part of the borehole below the casing excluding uninterpreted sections due to bad seismic signals.
[2] Indicates testing was performed overwater.

The Velocities and Poisson’s ratio of all the boreholes with their respected plots are provided below in Appendix I.

Appendix I: Spreadsheet and Velocity Profile of All Data

Table 2 B - 06: Summary of Velocities and Poison's Ratio

B-06 Run1 (46.42 – 128.41ft)			
Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
46.4	1674.6	7629.8	0.48
48.1	1745.2	8270.9	0.48
49.7	1414.3	6075.6	0.47
51.3	1157.3	5755.8	0.48
53.0	1937.6	5929.2	0.44
54.6	2539.1	5858.6	0.38
56.3	2366.8	6931.3	0.43
57.9	2389.2	6931.3	0.43
59.5	2675.8	7873.9	0.44
61.2	2197.7	6605.6	0.44
62.8	1851.0	6075.6	0.45
64.5	2051.1	6349.9	0.44
66.1	1493.2	7317.8	0.48
67.7	4296.9	9696.9	0.38
69.4	2933.0	7811.4	0.42
71.0	1955.4	6209.7	0.45
72.7	1894.5	5938.1	0.44
74.3	2360.4	6661.5	0.43
76.0	3286.1	9113.3	0.43
77.6	3694.9	9113.3	0.40
79.2	3686.8	8927.3	0.40
80.9	3864.6	8690.9	0.38
82.5	4003.4	8412.3	0.35
84.2	4001.0	9113.3	0.38
85.8	3914.6	9050.5	0.39
87.4	4025.4	8867.0	0.37
89.1	4556.7	9842.4	0.36
90.7	4921.2	10146.8	0.35
92.4	4826.6	9555.7	0.33
94.0	5146.4	11444.7	0.37
95.6	4841.5	11444.7	0.39
97.3	5530.1	11313.1	0.34
98.9	4917.3	10252.5	0.35
100.6	4684.3	9029.7	0.32
102.2	4119.3	9029.7	0.37
103.8	3848.4	9113.3	0.39
105.5	4101.0	9285.3	0.38
107.1	4952.9	10360.4	0.35
108.8	4921.2	9555.7	0.32
110.4	5237.7	9842.4	0.30
112.0	5663.3	9941.8	0.26
113.7	3816.9	9113.3	0.39
115.3	3647.1	8867.0	0.40
117.0	3731.6	7937.4	0.36
118.6	4034.9	7873.9	0.32
120.2	3327.6	6475.3	0.32
121.9	2511.9	6835.0	0.42
123.5	2299.8	5893.7	0.41
125.2	2257.6	6475.3	0.43
126.8	2158.4	6695.5	0.44
128.4	2285.4	6764.5	0.44
B-06 Run2 (25.1 – 46.4ft)			
25.1	32.5	3771.0	0.50
26.7	1731.5	6249.1	0.46
28.4	1708.7	4075.5	0.39
30.0	433.7	5378.4	0.50
31.7	377.3	6627.9	0.50
33.3	357.3	5207.6	0.50
34.9	375.5	4970.9	0.50
36.6	366.7	4860.4	0.50
38.2	98.5	6132.3	0.50
39.9	65.6	5911.4	0.50
41.5	691.7	5608.2	0.49
43.1	1384.1	6627.9	0.48
44.8	1193.4	6627.9	0.48
46.4	1683.6	7456.4	0.47

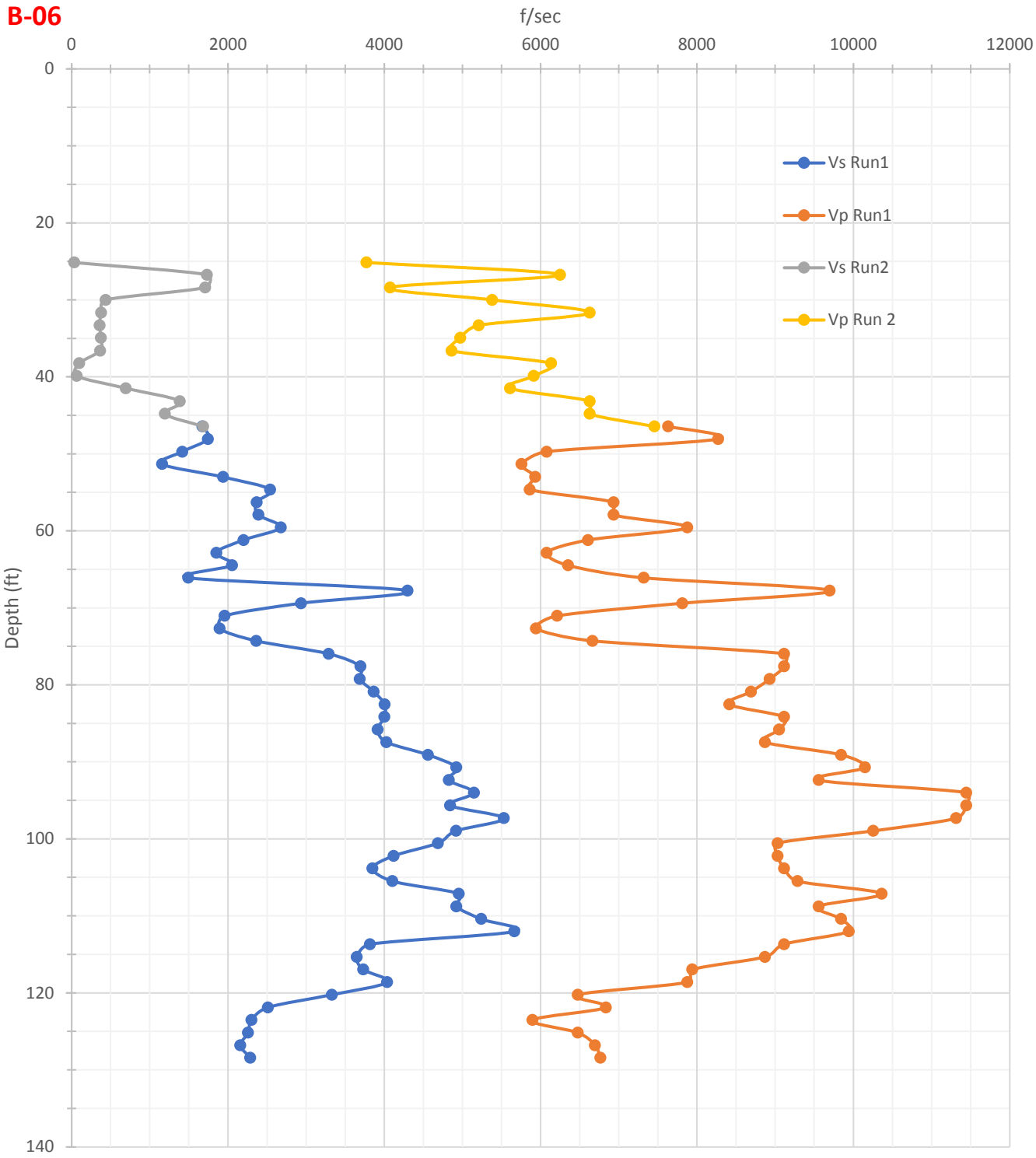

Figure 5: Borehole_B - 06. Two run Vp and Vs Profile.

Table 3 B - 08: Summary of Velocities and Poison's Ratio

B-08 Run1 (59.8 – 158.5ft)			
Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
59.9	3075.8	5755.8	0.30
61.5	2174.8	6075.6	0.43
63.2	1721.2	5498.5	0.45
64.8	1295.1	5560.7	0.47
66.4	1159.0	5789.6	0.48
68.1	1801.2	6561.6	0.46
69.7	3154.6	8002.0	0.41
71.4	3647.1	8341.0	0.38
73.0	3116.7	7030.3	0.38
74.6	3674.4	8202.0	0.37
76.3	3325.1	9113.3	0.42
77.9	3498.8	8633.7	0.40
79.6	4242.4	9842.4	0.39
81.2	5180.8	10252.5	0.33
82.8	5468.0	10698.3	0.32
84.5	5307.0	10698.3	0.34
86.1	5349.1	10815.8	0.34
87.8	5292.2	11184.5	0.36
89.4	5292.2	11313.1	0.36
91.0	5592.3	10936.0	0.32
92.7	5413.8	10698.3	0.33
94.3	4213.8	9555.7	0.38
96.0	3789.1	8947.6	0.39
97.6	3906.7	9113.3	0.39
99.2	4988.9	10583.2	0.36
100.9	6230.4	11444.7	0.29
102.5	6346.8	11058.9	0.25
104.2	6155.3	10786.2	0.26
105.8	5858.6	9720.9	0.22
107.4	3702.0	10068.9	0.42
109.1	4659.5	10094.8	0.37
110.7	4025.7	8748.8	0.37
112.4	4740.4	9720.9	0.34
114.0	3750.6	9649.4	0.41
115.6	3596.9	9649.4	0.42
117.3	3844.7	9649.4	0.41
118.9	3877.1	9198.5	0.39
120.6	3756.9	8867.0	0.39
122.2	4318.2	9373.7	0.37
123.9	4873.0	10146.8	0.35
125.5	4824.7	10146.8	0.35
127.1	4101.0	9555.7	0.39
128.8	4138.1	10936.0	0.42
130.4	5228.7	9842.4	0.30
132.1	6119.2	11058.9	0.28
133.7	7030.3	10252.5	0.06
135.3	6479.8	11858.3	0.29
137.0	6590.9	12002.9	0.28
138.6	6309.2	11184.5	0.27
140.1	5657.3	9941.8	0.26
142.1	5408.6	10583.2	0.32
143.7	5468.0	10583.2	0.32
145.3	5530.1	10470.6	0.31
147.0	6155.3	11058.9	0.28
148.6	4873.0	8633.7	0.27
150.3	2498.7	6882.8	0.42
151.9	2103.1	6695.5	0.45
153.5	3441.6	7873.9	0.38
155.2	5468.0	9842.4	0.28
156.8	4473.8	9050.5	0.34
158.5	4876.8	9418.6	0.32
B-08 Run2 (32.0 – 82.8ft and 140.2 – 158.3ft)			
32.0	2597.3	6787.9	0.41
33.6	2628.4	7689.4	0.43
35.3	2052.8	4686.9	0.38
36.9	1401.0	6001.5	0.47
38.5	888.3	5153.1	0.49
40.2	1485.7	5099.7	0.45
41.8	953.8	5378.4	0.48
43.4	1171.7	5893.7	0.48
45.1	1557.3	6882.8	0.47
46.8	1547.6	6787.9	0.47
48.4	1373.1	6787.9	0.48
50.0	1258.7	6787.9	0.48
51.7	831.3	7513.3	0.49
53.3	2003.8	8134.2	0.47
55.0	2930.9	8202.0	0.43
56.6	3083.5	9198.5	0.44

58.2	3002.5	7629.8	0.41
59.8	1827.6	6475.3	0.46
61.5	1177.0	4921.2	0.47
63.2	1326.7	5153.1	0.47
66.4	1149.9	5656.6	0.48
68.1	2177.7	6931.3	0.45
69.7	2935.9	7937.4	0.42
71.4	2944.3	7400.3	0.41
73.0	3295.4	8134.2	0.40
74.6	3002.5	7749.9	0.41
76.3	3518.0	8947.6	0.41
77.9	4475.3	9842.4	0.37
79.5	5126.3	9745.0	0.31
81.2	4562.9	11184.5	0.40
82.8	5023.7	9285.3	0.29

140.2	5663.3	9198.5	0.20
141.9	5408.6	9285.3	0.24
143.5	5468.0	9745.0	0.27
145.2	5734.7	9744.9	0.24
146.8	6238.4	10252.5	0.21
148.5	4690.7	8710.1	0.30
150.1	2551.6	6787.9	0.42
151.7	2034.1	6229.4	0.44
153.4	3376.4	7873.9	0.39
155.0	5321.8	9745.0	0.29
156.7	4395.3	8270.9	0.30
158.3	4923.2	9649.4	0.32

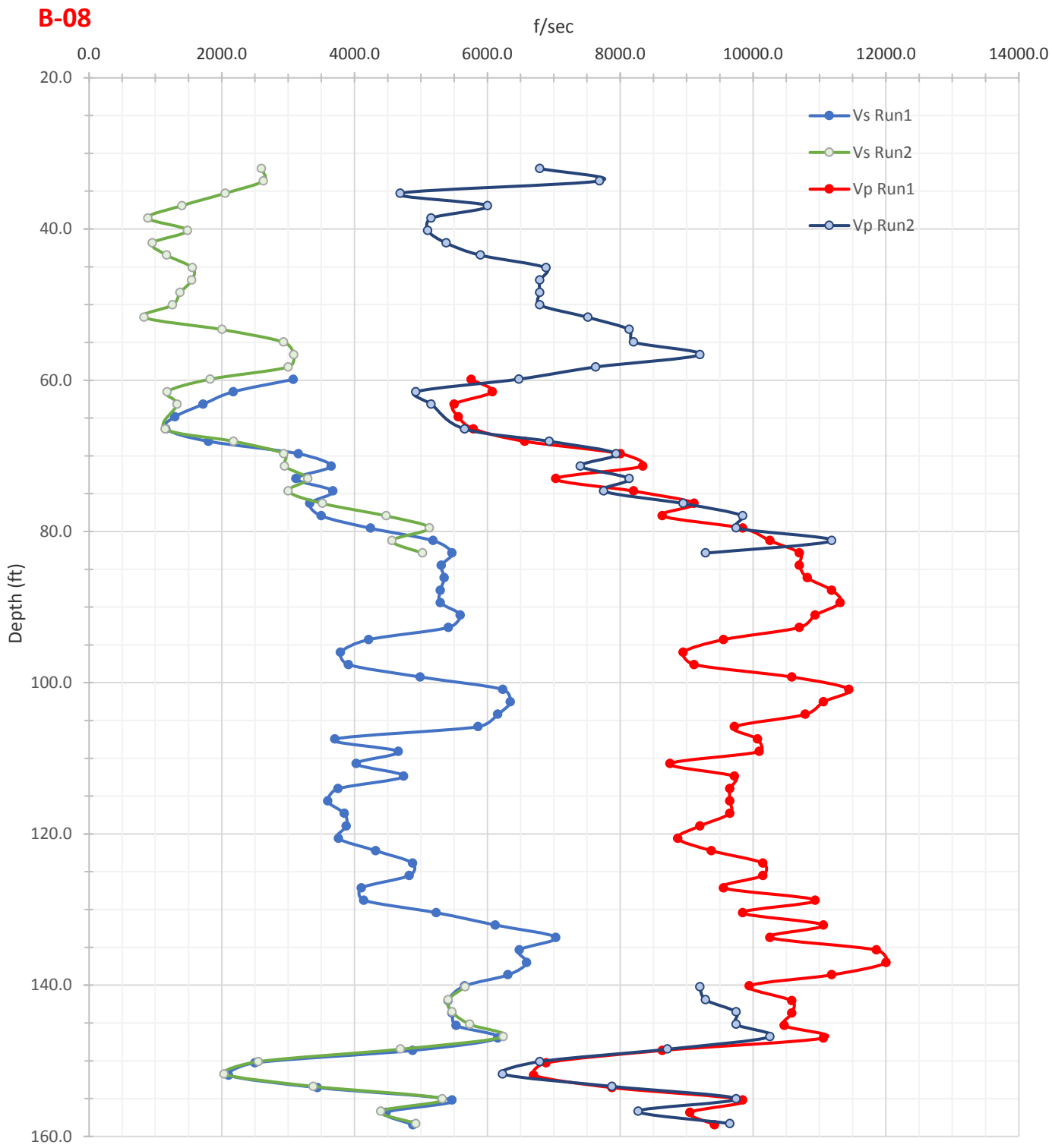

Figure 6: Borehole_ B - 08. Two run Vp and Vs Profile.

Table 4 B – 09: Summary of Velocities and Poison's Ratio

B-09 Run1 (8.5 – 138.1ft)			
Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
8.5		CASED TO 46 ft	1.032
10.2			1.071
11.8			1.297
13.5			1.150
15.1			1.138
16.7			1.245
18.4			1.438
20.0			1.879
21.7			1.446
23.3			27.009
24.9			1.894
26.6			-0.743
38.1			2.190
39.7			-1.267
41.3			0.326
43.0			-0.392
44.6			-0.066
46.3	5092.9	8633.7	0.233
47.9	5827.7	7456.4	-0.285
49.5	6098.8	7456.4	-0.511
51.2	5244.4	7456.4	0.011
52.8	4979.0	7873.9	0.167
54.5	4353.8	7030.3	0.189
56.1	4599.7	7811.4	0.235
57.4	5656.2	8484.8	0.100
59.4	4054.8	8633.7	0.359
61.0	5313.6	9113.3	0.242
62.7	5154.0	9649.4	0.300
64.3	3890.8	8633.7	0.373
65.9	3834.4	8633.7	0.377
67.6	3716.7	8787.9	0.391
69.2	3984.8	8484.8	0.359
70.9	3658.2	8341.0	0.381
72.5	4149.8	9463.8	0.381
74.1	4516.4	10043.3	0.373
75.8	5047.5	11444.7	0.379
77.4	5354.8	10936.0	0.342
79.1	5725.4	10470.6	0.287
80.7	5378.5	10698.3	0.331
82.3	6231.8	11444.6	0.289
84.0	4669.8	9649.4	0.347
85.6	4336.6	10252.5	0.391
87.3	5126.8	10698.3	0.351
88.9	5633.2	12002.9	0.359
90.6	3325.1	11444.6	0.454
92.2	6040.3	11444.7	0.307
93.8	3842.8	8202.0	0.359
95.5	2719.2	7132.2	0.415
97.1	4393.9	9463.8	0.363
98.8	3561.1	9285.3	0.414
100.4	5407.9	10936.0	0.338
102.0	5756.0	10252.5	0.270
103.7	6083.9	11184.5	0.290
105.3	6076.9	10583.2	0.254
107.0	5337.8	10470.6	0.324
108.6	6274.5	11511.6	0.289
110.2	6634.0	10583.2	0.176
111.9	6038.5	12458.7	0.346
113.5	4188.6	11717.1	0.427
115.2	2833.7	7400.3	0.414
116.8	1808.7	6075.6	0.451
118.4	1994.4	6561.6	0.449
120.1	2009.5	6391.2	0.445
121.7	1679.7	6229.4	0.461
123.4	1445.7	6001.5	0.469
125.0	1339.2	5789.6	0.472
126.6	1404.2	5929.2	0.470
128.3	1714.9	6229.4	0.459
129.9	1878.8	6229.4	0.450
131.6	1833.3	6151.5	0.451
133.2	1665.8	5755.8	0.454
134.8	1882.1	6001.5	0.445
136.5	2154.2	6309.2	0.434
138.1	2030.1	6309.2	0.442

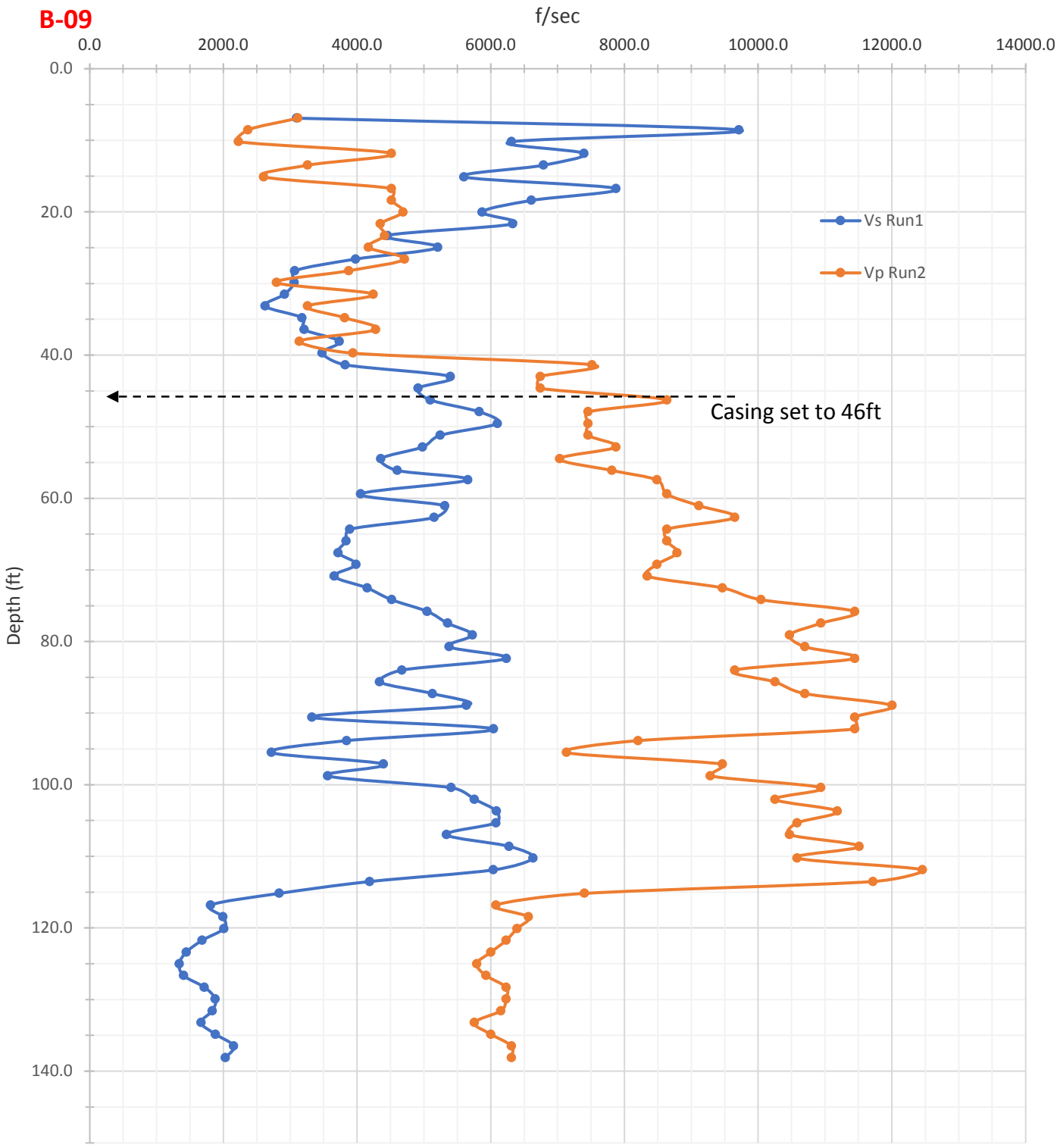

Figure 6: Borehole_ B - 09. One run Vp and Vs Profile.

Table 5 B – 10: Summary of Velocities and Poison's Ratio

B-10 Run1 (42.7 – 172.2ft)			
Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
42.7	CASED TO 56 ft		
45.9			
49.2			
52.5			
55.8	3330.8	3905.7	-0.83
57.4	2152.5	4970.9	0.39
59.1	2231.9	625.7	1.04
60.7	2118.1	5180.2	0.40
62.3	2515.8	4896.7	0.32
64.0	4653.9	5047.4	-2.34
65.6	3178.8	4777.9	0.10
67.3	2508.1	2718.9	-2.35
68.9	2734.2	5126.3	0.30
70.5	2335.4	4896.7	0.35
72.2	3419.0	5235.3	0.13
73.8	2086.6	4970.9	0.39
75.5	938.7	5643.6	0.49
77.1	825.5	5126.3	0.49
78.7	810.8	5404.9	0.49
80.3	948.4	5900.7	0.49
82.1	1253.9	7055.5	0.48
83.7	1734.4	7811.4	0.47
85.3	2216.8	7571.1	0.45
86.9	2372.0	6349.9	0.42
88.6	2780.4	6475.3	0.39
90.2	2832.4	6561.6	0.39
91.8	2638.7	5592.3	0.36
93.5	2638.7	5929.2	0.38
95.1	2631.7	5858.6	0.37
96.8	3367.1	6309.2	0.30
98.4	98 ft to 123 ft, bad P & S wave signals. Unable to use data for valid interpretation.		
100.0			
101.7			
105.0			
123.0			
124.7	1822.7	3453.5	0.31
126.3	1573.8	3124.6	0.33
128.0	1848.4	2852.9	0.14
129.6	1455.9	7345.1	0.48
131.2	1508.4	6309.2	0.47
132.9	1731.6	7811.4	0.47
134.5	1432.7	7689.4	0.48
136.2	1787.3	9649.4	0.48
137.8	1816.1	9113.3	0.48
139.4	1735.9	8202.0	0.48
141.1	1764.1	3490.2	0.33
142.7	1988.4	3728.2	0.30
144.4	1952.9	3645.3	0.30
146.0	2009.8	4686.9	0.39
147.6	2239.5	3605.3	0.19
149.3	1901.9	3347.8	0.26
150.9	1750.1	2852.9	0.20
152.5	1958.7	2412.4	-0.47
154.2	1754.5	2645.8	0.11
155.8	1653.8	2734.0	0.21
157.5	1695.8	2852.9	0.23
159.1	5469.5	7811.4	0.02
160.8	2583.7	5656.6	0.37
162.4	1678.2	6151.5	0.46
164.0	1511.1	5789.6	0.46
165.7	1540.8	5789.6	0.46
167.4	1614.5	5929.2	0.46
169.0	1600.6	6001.5	0.46
170.6	1502.3	5789.6	0.46
172.2	1686.9	6190.2	0.46

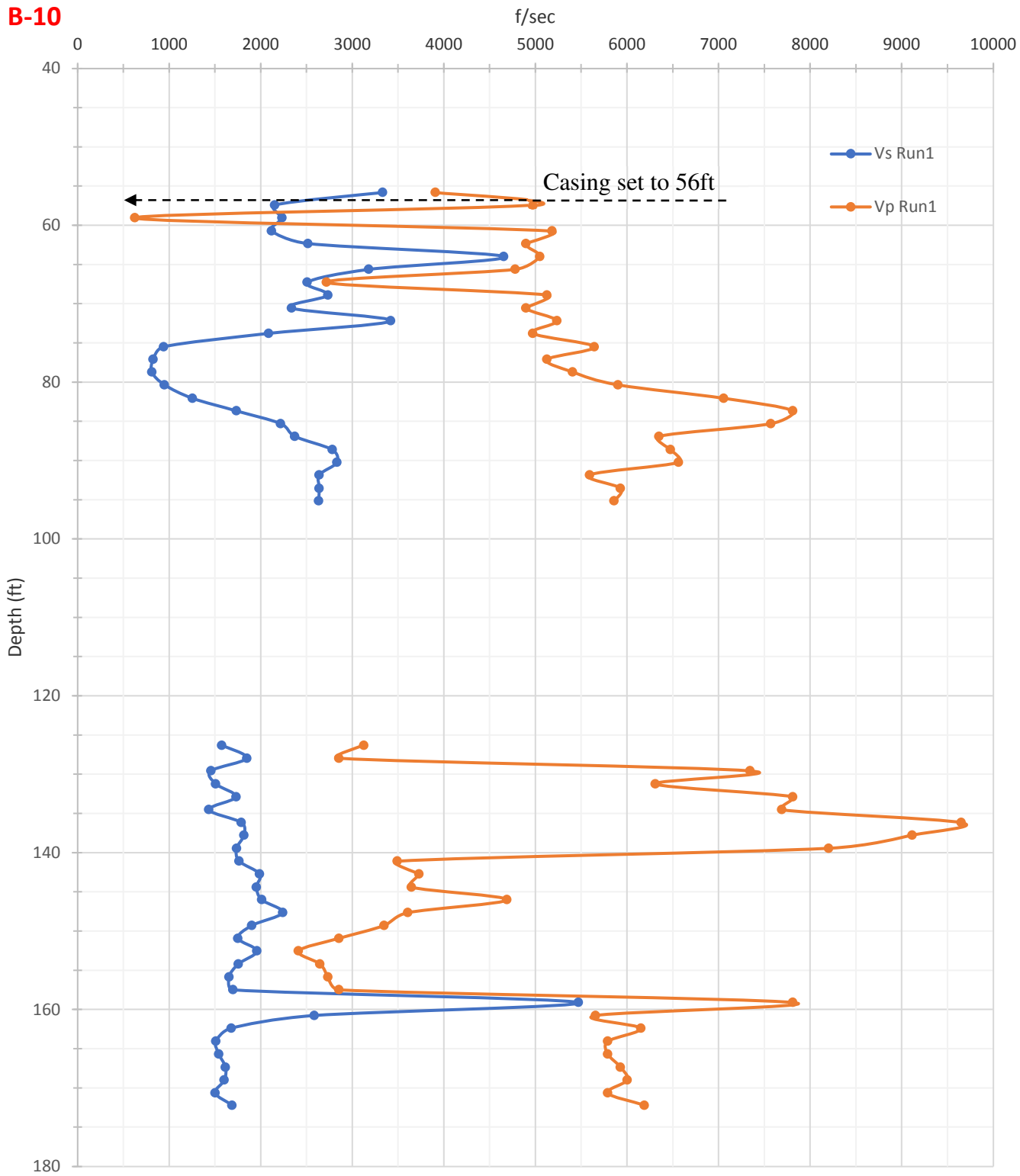

Figure 8: Borehole_ B - 10. One run Vp and Vs Profile. (98' – 123' bad signal).

Table 6 B – 12: Summary of Velocities and Poison's Ratio

B-12 Run1 (81.6 – 116.1 ft)			
Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
81.6	2646.1	7237.1	0.42
83.3	2844.7	6835.0	0.40
84.9	3236.2	8633.7	0.42
86.6	3325.1	9463.8	0.43
88.2	4279.6	9113.3	0.36
89.9	5235.3	9842.4	0.30
91.5	5022.2	10043.3	0.33
93.1	5022.2	9285.3	0.29
94.8	4971.4	9842.4	0.33
96.4	5292.2	9463.8	0.27
98.1	5859.4	10043.3	0.24
99.7	6329.6	9649.4	0.12
101.3	6741.4	10210.0	0.11
103.0	5560.9	9842.4	0.27
104.6	5235.9	10043.3	0.31
106.3	5929.2	10252.5	0.25
107.9	5965.3	10470.6	0.26
109.5	5689.4	9649.4	0.23
111.2	5438.0	9555.7	0.26
112.8	5498.7	9842.4	0.27
114.5	5723.1	10470.6	0.29
116.1	5535.7	9463.8	0.24

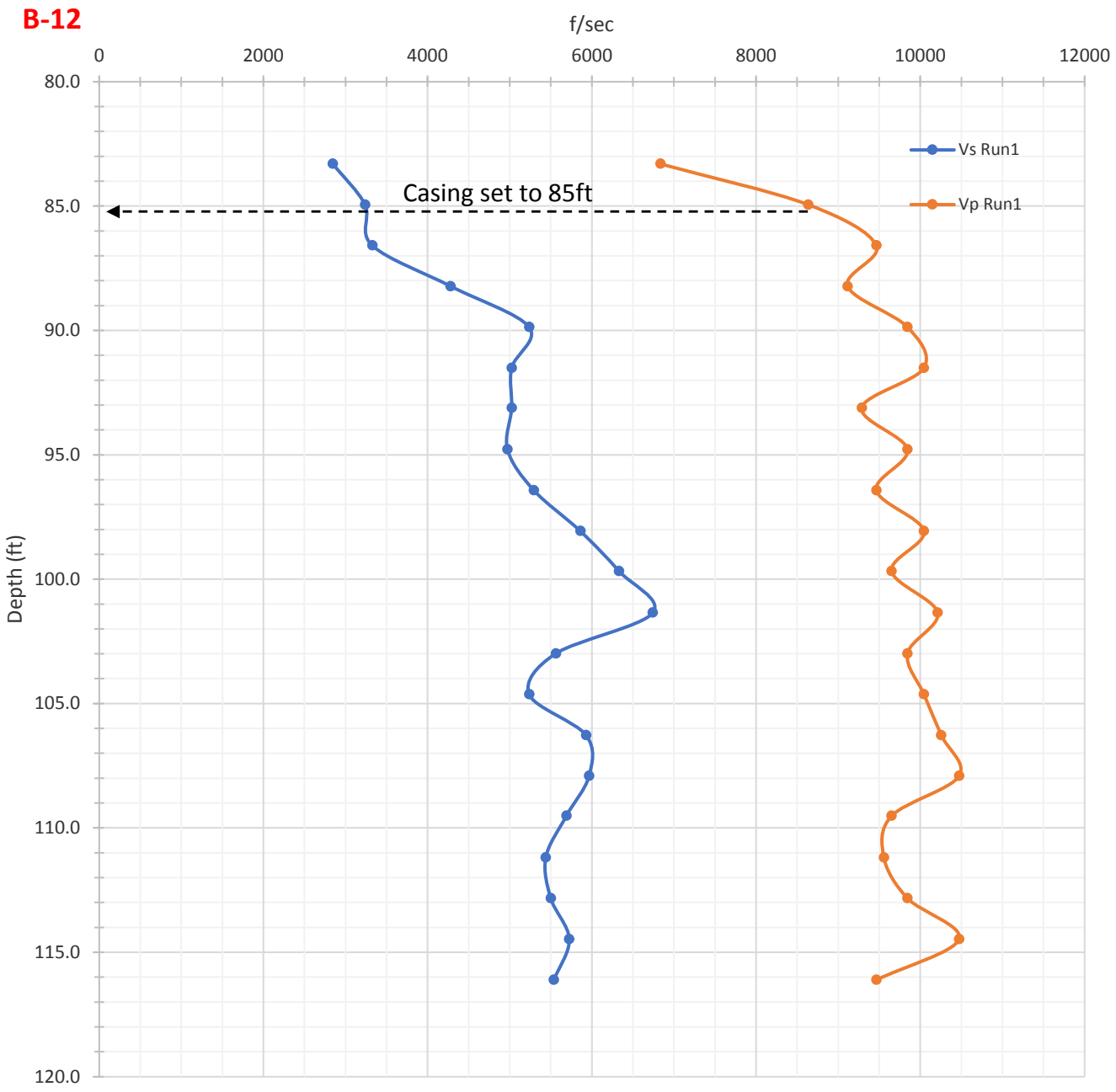

Figure 9: Borehole_ B - 12. One run Vp and Vs Profile.

Table 7 B – 13: Summary of Velocities and Poison's Ratio

B-13 Run1 (26.9 – 138.1 ft)			
Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
26.9		CASED TO 35 ft	0.49
28.4			0.49
29.8			0.49
31.7			0.48
33.3			0.48
35.0			0.48
36.6	811.1	6561.6	0.49
38.2	1095.7	6931.3	0.49
39.9	849.9	6650.3	0.49
41.5	849.0	7356.1	0.49
43.2	864.5	9649.4	0.50
44.8	796.3	10043.3	0.50
46.5	802.7	9113.3	0.50
48.2	859.2	7184.2	0.49
49.8	777.5	6980.4	0.49
51.3	917.7	6835.0	0.49
53.1	819.2	6695.5	0.49
54.7	1432.8	7132.2	0.48
56.3	1448.8	6695.5	0.48
57.9	1758.5	6882.8	0.47
59.5	1264.8	6475.3	0.48
61.2	1283.5	6518.1	0.48
62.9	2869.0	7811.4	0.42
64.4	2661.5	6835.0	0.41
66.1	2421.3	6741.4	0.43
67.7	1322.9	7345.1	0.48
69.5	1350.3	7456.4	0.48
71.0	1475.3	7811.4	0.48
72.7	1313.9	7080.9	0.48
74.4	1345.7	8067.5	0.49
76.0	1981.4	7030.3	0.46
77.6	1948.5	7132.2	0.46
79.2	2085.0	7629.8	0.46
81.0	2303.0	6561.6	0.43
82.3	3796.0	9113.3	0.40
84.2	3625.3	9113.3	0.41
85.7	2701.4	8412.3	0.44
87.4	2668.9	6190.2	0.39
89.2	3048.6	5560.7	0.29
90.6	3668.6	6980.4	0.31
92.3	4006.3	7456.4	0.30
94.0	2895.1	6075.6	0.35
95.6	2782.1	6309.2	0.38
97.2	3628.0	7629.8	0.35
98.8	5517.5	7811.4	0.00
100.5	4323.6	6980.4	0.19
102.3	5560.7	7132.2	-0.28
103.9	5469.5	8867.0	0.19
105.5	4687.8	7290.7	0.15
107.2	4686.9	8001.9	0.24
108.7	4897.8	7030.3	0.03
110.4	4375.2	7030.3	0.18
112.0	4307.6	7345.1	0.24
113.7	3528.9	6980.4	0.33
115.3	2479.2	7132.2	0.43
116.8	2772.6	6561.6	0.39
118.6	1784.0	6561.6	0.46
120.3	2792.6	6561.6	0.39
121.8	3042.0	6475.3	0.36
123.6	2627.8	6561.6	0.40
125.1	3326.5	6269.0	0.30
126.7	2358.1	7237.1	0.44
128.4	4209.9	7571.1	0.28
130.1	4564.6	7571.1	0.21
131.7	5021.6	8787.9	0.26
133.4	5721.6	9649.4	0.23
135.1	7243.3	10043.3	-0.04
136.6	4773.6	8067.5	0.23
138.1	4211.1	7237.1	0.24

B-13

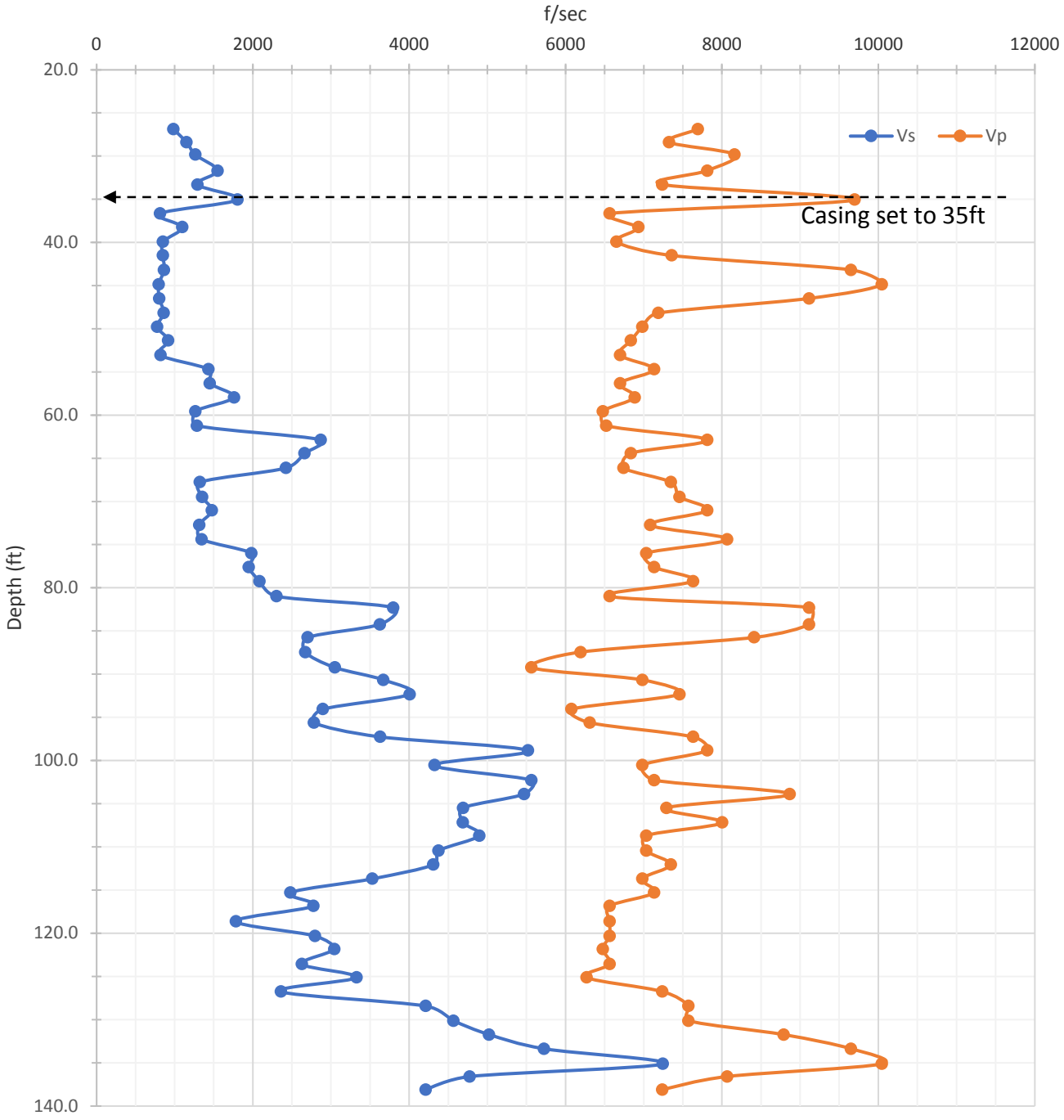

Figure 10: Borehole_ B - 13. One run Vp and Vs Profile.

Table 8 B – 15: Summary of Velocities and Poison's Ratio

B-15 Run1 (57.4 – 203.3 ft)			
Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
57.4	508.9	3216.5	0.49
59.1	517.0	3216.5	0.49
60.7	514.2	3264.5	0.49
62.3	528.0	3453.5	0.49
64.0	563.1	3382.3	0.49
65.6	568.9	3399.8	0.49
67.3	574.9	3508.9	0.49
68.9	585.2	3585.6	0.49
70.5	576.6	3566.1	0.49
72.2	561.1	3417.5	0.49
73.8	606.8	3605.3	0.49
75.5	611.3	3566.1	0.49
77.1	600.9	3605.3	0.49
78.7	616.7	3605.3	0.49
80.3	622.2	3585.6	0.48
82.0	644.6	3546.8	0.48
83.7	625.3	3566.1	0.48
85.3	593.7	3686.3	0.49
86.9	632.6	3605.3	0.48
88.5	672.3	3686.3	0.48
90.3	665.9	3792.8	0.48
91.9	648.8	3665.7	0.48
93.5	657.9	3749.5	0.48
95.1	670.5	3749.5	0.48
96.8	697.1	3645.3	0.48
98.4	697.1	3837.2	0.48
100.1	711.3	3792.8	0.48
101.7	673.2	3749.5	0.48
103.3	636.7	3749.5	0.49
105.0	676.0	3605.3	0.48
106.6	689.3	3814.9	0.48
108.3	661.5	3665.7	0.48
109.9	667.7	3749.5	0.48
111.5	643.3	3625.2	0.48
113.2	629.3	3605.3	0.48
114.8	662.3	3546.8	0.48
116.5	661.5	3585.6	0.48
118.1	695.1	3453.5	0.48
119.7	647.5	3645.3	0.48
121.4	646.7	3645.3	0.48
123.0	697.1	3625.2	0.48
124.7	654.4	3625.2	0.48
126.3	606.1	3771.0	0.49
128.0	646.7	3707.1	0.48
129.6	671.0	3716.9	0.48
131.2	743.4	3763.8	0.48
132.9	738.9	3527.7	0.48
134.5	783.0	3779.7	0.48
136.2	698.1	3707.1	0.48
137.8	687.8	3665.7	0.48
139.4	756.0	3758.1	0.48
141.1	737.3	3726.1	0.48
142.7	705.6	4166.1	0.49
144.4	837.0	4233.3	0.48
146.0	875.2	4463.7	0.48
147.6	1097.9	4607.9	0.47
149.3	911.4	4653.6	0.48
150.9	1464.6	5374.0	0.46
152.6	916.5	5755.8	0.49
154.2	1041.5	6155.3	0.49
155.8	2023.4	6069.9	0.44
157.5	2473.6	7124.4	0.43
159.1	1918.7	7943.8	0.47
160.8	2351.1	6973.0	0.44
162.4	929.6	6899.7	0.49
164.0	1270.8	6899.7	0.48
165.7	1710.4	6943.5	0.47
167.3	1555.2	6695.5	0.47
169.0	1887.8	6249.1	0.45
170.6	2025.5	6906.9	0.45
172.2	841.4	7202.6	0.49
173.8	2903.6	6561.6	0.38
175.5	2039.7	7282.6	0.46
177.2	1537.9	7710.5	0.48
178.8	5023.7	7456.4	0.08
181.2	3965.3	7911.9	0.33
182.1	4102.1	7771.3	0.31
181.2	5492.4	9241.7	0.23
182.1	3890.6	7992.2	0.35

183.7	3157.9	7947.0	0.41
185.4	3939.2	8581.0	0.37
187.0	4929.1	9369.2	0.31
188.6	4983.6	9720.9	0.32
190.3	5282.0	9400.6	0.27
191.9	5739.1	10079.3	0.26
193.5	4687.8	9454.8	0.34
195.2	4814.3	9104.9	0.31
196.8	5750.0	10415.2	0.28
198.5	6137.2	10537.9	0.24
200.1	6190.2	10125.9	0.20
201.8	508.9	3216.5	0.49
203.3	517.0	3216.5	0.49

B-15 Run2 (19.7 – 57.4 ft)			
Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
19.7			0.41
21.3			0.45
23.0	CASED TO 25 ft		0.46
24.6	933.1	5965.1	0.49
26.2	689.3	4860.4	0.49

27.9	1347.9	4824.7	0.46
29.5	882.9	4860.4	0.48
31.2	629.6	4684.6	0.49
32.8	533.0	2667.3	0.48
34.4	482.5	2231.8	0.48
36.1	460.8	2889.7	0.49
37.7	556.1	2890.6	0.48
39.4	538.0	3037.8	0.48
41.0	532.6	3124.6	0.49
42.7	536.1	3051.9	0.48
44.3	519.1	3080.6	0.49
45.9	500.3	3154.6	0.49
47.6	517.6	3051.9	0.49
49.2	517.5	3313.9	0.49
50.9	512.6	3264.5	0.49
52.5	539.8	3169.9	0.49
54.1	473.2	3216.5	0.49
55.7	519.1	3200.8	0.49
57.4	506.3	3139.5	0.49

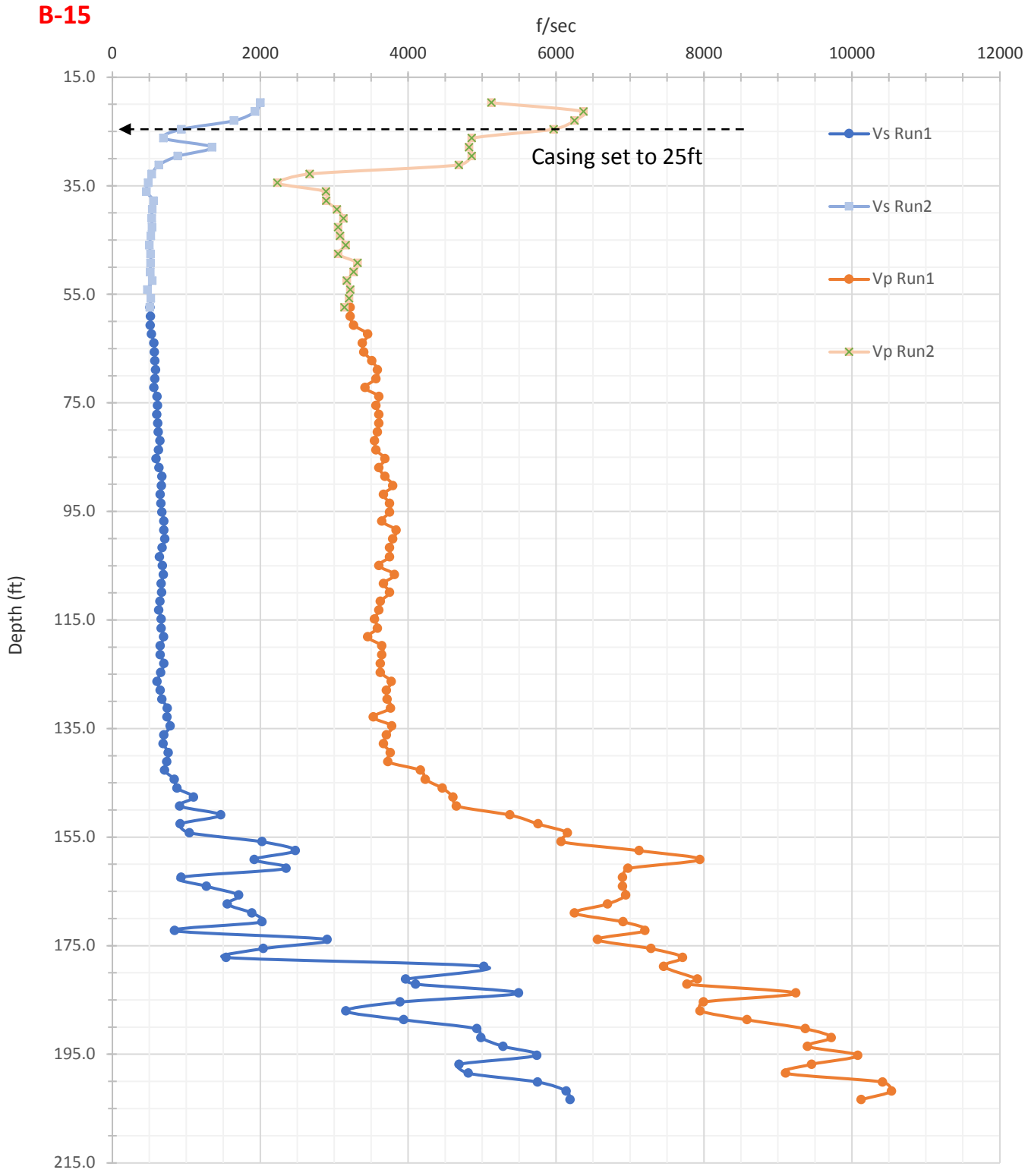

Figure 11: Borehole_ B - 15. Two run Vp and Vs Profile.

Table 9 B – 16: Summary of Velocities and Poison's Ratio

B-16 Run1 (19.3 – 198.0 ft)			
Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
19.3	2073.2	3700.2	0.27
20.9	1796.3	3700.2	0.35
22.5	1309.2	3700.2	0.43
24.1	1484.8	3700.2	0.40
25.8	1836.4	3700.2	0.34
27.5	2087.7	3490.2	0.22
29.1	2107.6	3618.5	0.24
30.8	2371.7	3540.4	0.09
32.4	2238.6	3728.2	0.22
34.0	1881.9	3756.6	0.33
35.7	2094.7	3645.3	0.25
37.3	2125.8	3618.5	0.24
38.9	2042.3	3756.6	0.29
40.6	2371.7	3937.0	0.22
42.2	2371.7	3937.0	0.22
43.8	1926.2	3728.2	0.32
45.4	2153.8	4033.8	0.30
47.1	2879.5	3905.7	-0.10
48.7	2749.4	4135.5	0.10
50.4	2278.4	3875.0	0.24
52.0	2689.5	3905.7	0.05
53.6	2491.8	4067.1	0.20
55.3	2247.1	3672.5	0.20
56.9	3010.2	4355.0	0.04
58.6	2544.6	5529.4	0.37
60.2	2443.0	3937.0	0.19
61.8	2611.6	4170.5	0.18
63.5	2734.8	4355.0	0.17
65.1	2611.6	4170.5	0.18
66.8	2949.5	4556.7	0.14
68.4	2531.5	4355.0	0.25
70.0	2705.3	4242.4	0.16
71.7	1842.5	4642.6	0.41
73.3	2190.7	4473.8	0.34
75.0	2422.9	4599.3	0.31
76.6	2294.0	4556.7	0.33
78.2	2544.3	4514.9	0.27
79.9	2776.5	5021.6	0.28
81.5	2588.5	5126.3	0.33
83.2	3162.0	4642.6	0.07
84.8	2315.8	4599.3	0.33
86.4	2448.3	4556.7	0.30
88.1	2485.5	5291.6	0.36
89.7	2209.9	4642.6	0.35
91.4	2642.5	5180.2	0.32
93.0	3015.4	4686.9	0.15
94.7	2479.2	4642.6	0.30
96.3	2946.9	5073.4	0.25
97.9	3280.9	5021.6	0.13
99.6	2391.4	5073.4	0.36
101.2	2146.3	5180.2	0.40
102.9	2031.8	5407.9	0.42
104.5	1648.6	5291.6	0.45
106.1	1677.8	5180.2	0.44
107.8	2166.2	5407.9	0.40
109.4	2494.9	5263.3	0.36
111.1	3259.6	5656.6	0.25
112.7	2454.6	5722.3	0.39
114.3	2299.7	5592.3	0.40
116.0	2804.1	6229.4	0.37
117.6	2664.3	5656.6	0.36
119.3	2396.7	5349.1	0.37
120.9	2525.7	5656.6	0.38
122.5	2816.3	5592.3	0.33
124.2	2750.3	6001.5	0.37
125.8	3334.9	5656.6	0.23
127.5	3206.0	5789.6	0.28
129.1	3382.3	6001.5	0.27
130.7	3359.5	5592.3	0.22
132.4	3395.4	5858.6	0.25
134.0	3302.8	6001.5	0.28
135.7	3453.5	5592.3	0.19
137.3	3009.9	5407.9	0.28
138.9	3077.7	6229.4	0.34
140.6	3407.7	5529.4	0.19
142.2	2653.1	6151.5	0.39
143.9	2766.9	6391.2	0.39

145.5	4475.3	7237.1	0.19
147.1	4546.2	6931.3	0.12
148.8	4538.1	7456.4	0.21
150.4	4825.2	7937.4	0.21
152.1	3771.5	8484.8	0.38
153.7	3466.3	8947.6	0.41
155.3	3314.3	10936.0	0.45
157.0	3454.5	7937.4	0.38
158.6	3268.4	7811.4	0.39
160.3	3441.6	7811.4	0.38
161.9	4194.4	7237.1	0.25
163.5	4487.2	7689.4	0.24
165.2	3527.8	7937.4	0.38
166.8	4570.8	11313.1	0.40
168.5	5895.6	12303.0	0.35
170.1	7291.1	14060.6	0.32
171.7	6310.3	10698.3	0.23
173.4	5321.6	8484.8	0.18
175.0	3845.6	10043.3	0.41
176.7	3701.0	8484.8	0.38
178.3	3939.2	8202.0	0.35

180.0	4623.4	9842.4	0.36
181.6	3984.8	9842.4	0.40
183.2	4020.6	8787.9	0.37
184.9	2982.7	10252.5	0.45
186.5	3314.9	9463.8	0.43
188.2	3815.1	8947.6	0.39
189.8	3844.9	12002.9	0.44
191.4	4067.4	12303.0	0.44
193.1	6605.9	12950.5	0.32
194.7	3907.9	10936.0	0.43
196.4	3771.5	8633.7	0.38
198.0	3707.2	9373.7	0.41

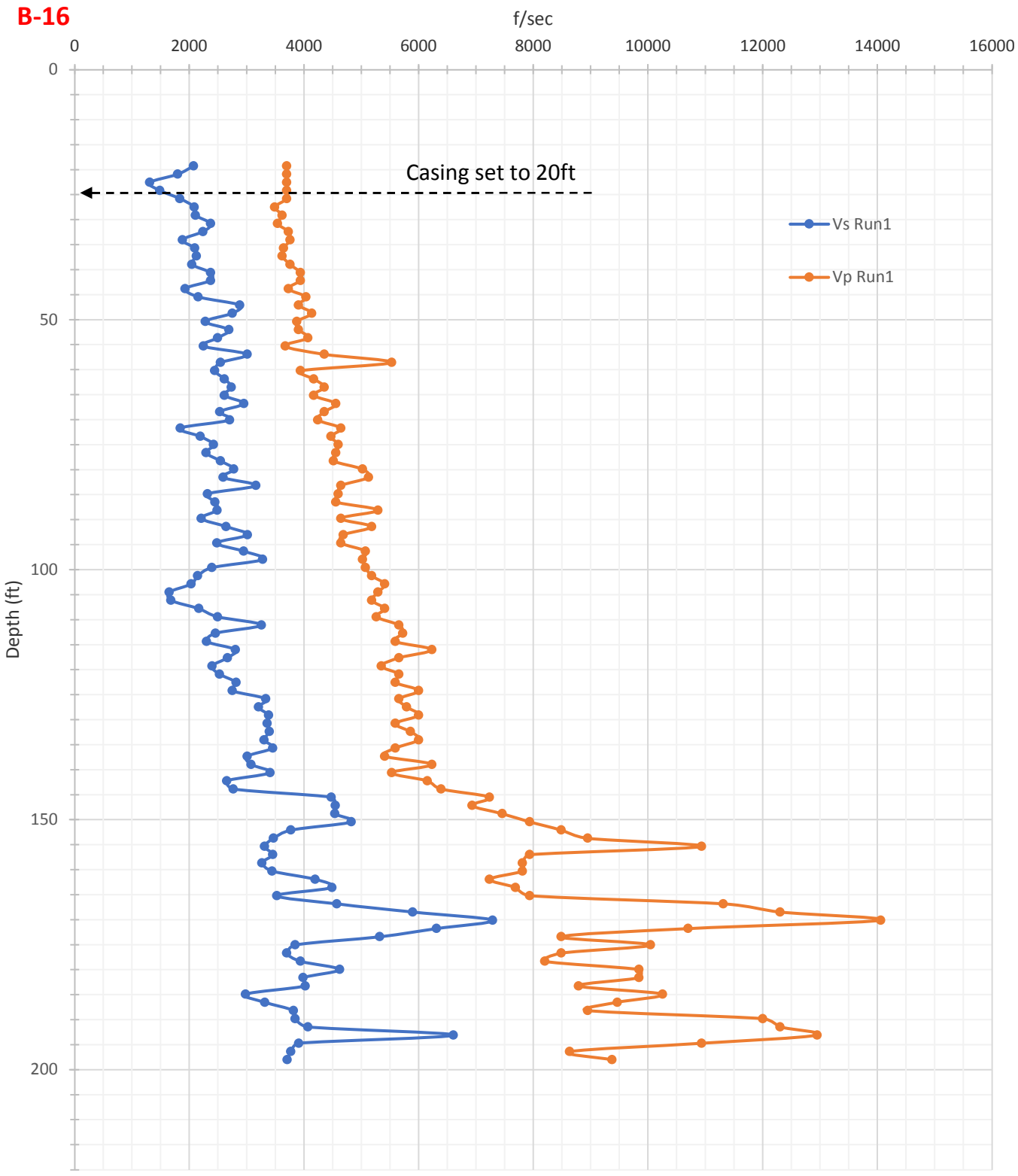

Figure 12: Borehole_ B - 16. One run Vp and Vs Profile.

Table 10 B – 17: Summary of Velocities and Poison's Ratio

B-17 Run1 (20.4 – 182.7 ft)			
Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
20.4			
22.0	20 ft to 140 ft, bad P & S wave signals. Unable to use data for valid interpretation.		
23.7			
25.2			
27.0			
28.6			
30.2			
138.4			
140.1	1491.3	5560.7	0.46
141.7	1056.6	5529.4	0.48
143.4	792.6	5929.2	0.49
145.0	744.0	5789.6	0.49
146.7	1049.3	6650.3	0.49
148.3	1973.1	8067.5	0.47
149.9	1891.3	8412.3	0.47
151.6	1982.5	8341.0	0.47
153.2	2130.5	7937.4	0.46
154.9	1965.7	8202.0	0.47
156.5	2166.7	8484.8	0.47
158.1	1989.0	8067.5	0.47
159.8	1941.4	7937.4	0.47
161.4	2518.5	8412.3	0.45
163.1	2394.7	6741.4	0.43
164.7	1182.5	6229.4	0.48
166.3	1040.1	6432.9	0.49
168.0	1612.2	7629.8	0.48
169.6	2286.5	8202.0	0.46
171.3	2262.6	7629.8	0.45
172.9	1901.9	7629.8	0.47
174.5	2144.7	7811.4	0.46
176.2	1880.3	7132.2	0.46
177.8	1817.7	7290.7	0.47
179.5	2467.3	8001.9	0.45
181.1	1746.3	7811.4	0.47
182.7	1745.1	6835.0	0.47

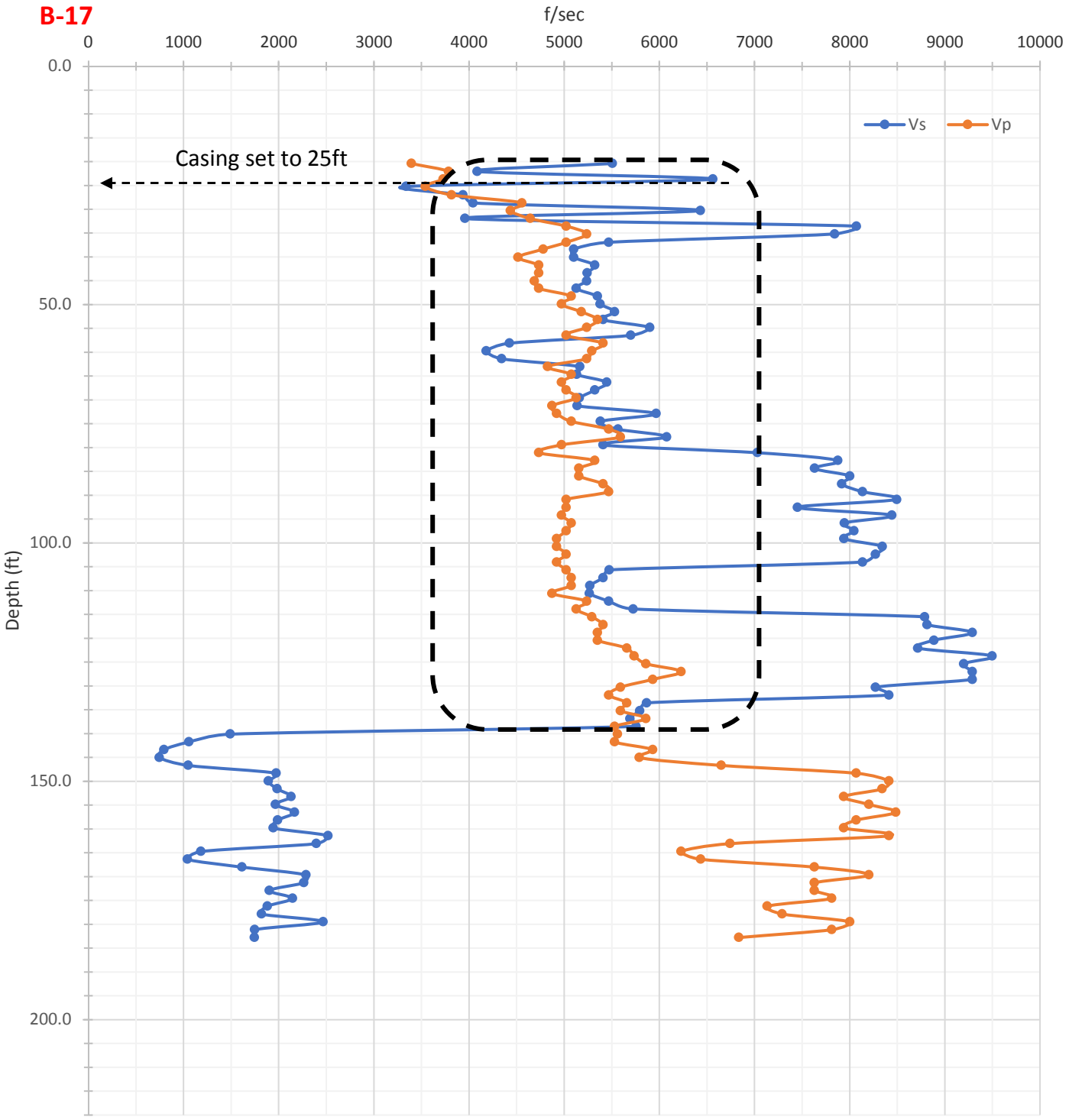

Figure 13: Borehole_ B - 17. One run Vp and Vs Profile.

Table 11 B – 27: Summary of Velocities and Poison's Ratio

B-27 Run1 (12.2 – 165.0 ft)			
Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
12.2		CASED TO 65 FT	
14.0			
15.7			
17.3			
19.0			
20.5			
51.8			
53.3			
55.1			
56.6			
58.3			
59.9			
61.6			
63.3			
64.9			
66.5			
68.2			
69.8	2903.6	4970.9	0.24
71.4	4323.6	6370.5	0.07
73.1	3010.2	7323.2	0.40
74.7	6290.7	7132.2	-1.25
76.4	4876.8	6931.3	0.01
78.0	2771.7	6892.4	0.40
79.7	1892.2	6370.5	0.45
81.3	1997.7	5929.2	0.44
82.9	1771.2	5560.7	0.44
84.6	1707.3	5858.6	0.45
86.2	1550.0	5468.0	0.46
87.9	1427.7	5560.7	0.47
89.5	1936.9	5965.1	0.44
91.1	5161.1	6432.9	-0.40
92.8	5022.8	9285.3	0.29
94.4	5648.1	10583.2	0.30
96.1	5440.4	10863.6	0.33
97.7	4393.9	10252.5	0.39
99.3	5532.7	12002.9	0.37
101.0	5174.6	9113.3	0.26
102.6	5441.8	10161.8	0.30
104.3	5313.4	8867.0	0.22
105.9	6708.2	9696.9	0.04
107.5	4556.7	12333.8	0.42
109.2	3943.2	9329.3	0.39
110.8	2911.8	8284.8	0.43
112.4	4804.7	9118.2	0.31
114.1	5168.2	8725.5	0.23
115.7	3988.6	7905.5	0.33
117.4	2575.5	6561.6	0.41
119.0	2562.5	6475.3	0.41
120.7	1995.0	6496.6	0.45
122.3	1859.5	6166.9	0.45
123.9	1913.8	5900.7	0.44
125.6	1773.5	5911.4	0.45
127.2	1547.7	5695.8	0.46
128.9	1364.2	5650.1	0.47
130.5	1400.6	5688.3	0.47
132.2	1588.7	5949.6	0.46
133.8	1771.7	6339.7	0.46
135.4	1732.3	6337.9	0.46
137.1	1580.2	6370.5	0.47
138.7	1791.5	6407.8	0.46
140.4	1955.2	6012.6	0.44
142.0	1692.9	5689.2	0.45
143.6	1596.6	5782.8	0.46
145.3	1438.9	5585.9	0.46
146.9	1385.8	5702.4	0.47
148.5	1563.8	6038.3	0.46
150.2	1708.7	6083.6	0.46
151.9	1783.1	5858.6	0.45
153.5	1829.5	6014.3	0.45
155.1	1934.3	6229.4	0.45
156.8	1917.7	6113.3	0.45
158.4	1777.8	5789.6	0.45
160.0	1652.9	5858.6	0.46
161.6	1655.6	6155.3	0.46
163.3	1670.0	6349.9	0.46
165.0	1793.3	6407.8	0.46

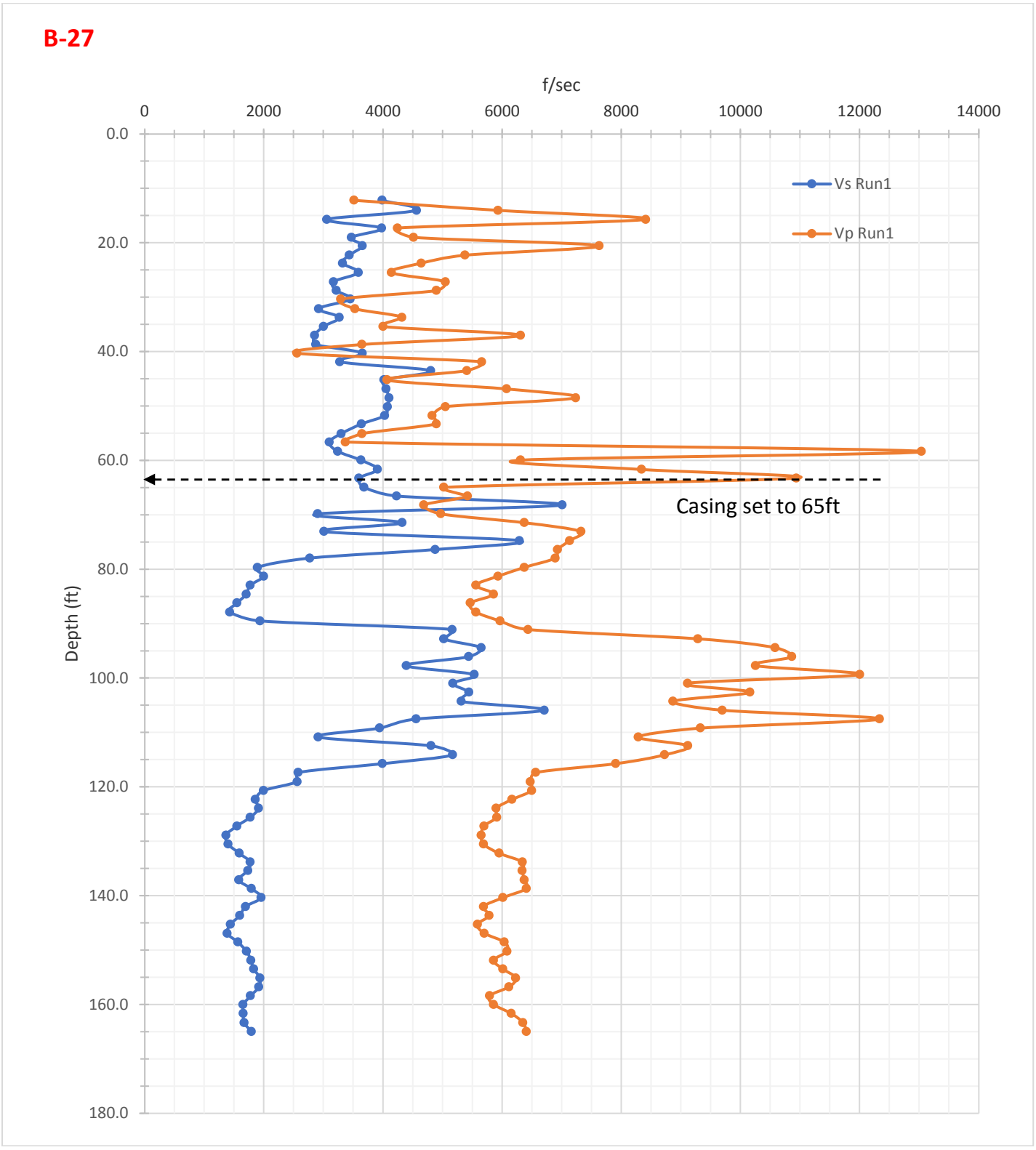

Figure 14: Borehole_ B - 27. One run Vp and Vs Profile.

Table 12 B – 32: Summary of Velocities and Poison's Ratio

B-32 Run1 (26.2 – 181.8 ft)			
Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
26.2	493.5	3453.5	0.49
27.9	516.1	3527.7	0.49
29.5	479.6	3611.9	0.49
31.2	539.7	3749.5	0.49
32.8	586.0	3605.3	0.49
34.4	583.8	3837.2	0.49
36.1	561.1	3848.4	0.49
37.7	622.6	3771.0	0.49
39.4	612.5	3717.6	0.49
41.0	634.6	3665.7	0.49
42.7	662.8	3635.2	0.48
44.3	612.1	3696.7	0.49
45.9	554.2	3707.1	0.49
47.6	559.9	3707.1	0.49
49.2	564.7	3686.3	0.49
50.9	623.7	3703.6	0.49
52.5	642.5	3760.2	0.49
54.1	597.2	3800.2	0.49
55.8	584.8	3707.1	0.49
57.4	629.1	3771.0	0.49
59.1	599.8	3771.0	0.49
60.7	626.1	3781.9	0.49
62.3	651.0	3760.2	0.49
64.0	590.1	3803.8	0.49
65.6	580.8	3837.2	0.49
67.3	655.3	3886.4	0.49
68.9	646.7	3905.7	0.49
70.5	674.1	3829.7	0.48
72.2	686.4	3859.8	0.48
73.8	630.9	3814.9	0.49
75.5	619.0	3792.8	0.49
77.1	643.3	3826.0	0.49
78.7	627.7	3738.8	0.49
80.4	620.6	3803.8	0.49
82.0	651.0	3728.2	0.48
83.7	635.0	3771.0	0.49
85.3	636.6	3707.1	0.49
86.9	698.0	3738.8	0.48
88.6	699.0	3652.1	0.48
90.2	658.1	3778.3	0.48
91.9	674.1	3803.8	0.48
93.5	665.0	3676.0	0.48
95.1	675.1	3781.9	0.48
96.8	671.4	3803.8	0.48
98.4	635.8	3760.2	0.49
100.1	645.8	3792.8	0.49
101.7	682.8	3792.8	0.48
103.3	691.4	3700.2	0.48
105.0	685.4	3749.5	0.48
106.6	666.8	3803.8	0.48
108.3	684.5	3803.8	0.48
109.9	703.1	3763.8	0.48
111.5	746.8	4088.2	0.48
113.2	741.2	4316.8	0.49
114.8	688.3	4556.7	0.49
116.5	653.5	4525.2	0.49
118.1	763.0	4772.1	0.49
119.7	957.5	4824.7	0.48
121.4	1174.5	4374.4	0.46
123.0	1115.9	4374.4	0.47
124.7	798.9	3894.1	0.48
126.3	709.1	3917.4	0.48
128.0	752.5	3917.4	0.48
129.6	764.2	4001.0	0.48
131.2	787.4	4013.2	0.48
132.9	858.9	3988.8	0.48
134.5	788.7	3968.7	0.48
136.2	800.2	3929.1	0.48
137.8	786.8	4789.5	0.49
139.4	835.5	4593.9	0.48
141.1	813.4	4588.5	0.48
142.7	724.8	4692.4	0.49
144.4	1002.3	5445.3	0.48
146.0	1284.9	5513.9	0.47
147.6	957.5	5146.4	0.48
149.3	1057.2	4670.2	0.47
150.9	2590.1	6329.5	0.40
152.6	2866.1	6496.6	0.38
154.2	2737.9	5490.9	0.34
155.8	2319.3	5965.1	0.41
157.5	2869.7	7937.4	0.43

159.1	2530.2	10415.2	0.47
160.8	7346.7	11027.9	0.10
162.4	8202.0	10936.0	-0.14
164.0	7133.7	10498.6	0.07
165.7	5180.8	8633.7	0.22
167.3	4644.3	9941.8	0.36
169.0	5861.9	10756.7	0.29
170.6	6650.3	9941.8	0.10
172.2	4720.6	8988.5	0.31
173.9	5530.1	9307.2	0.23
175.5	7084.2	10669.3	0.11
177.2	6932.6	10756.7	0.15
178.8	5423.2	10756.7	0.33
180.4	4102.1	8521.6	0.35
181.8	4233.5	8305.8	0.33
B-32 Run2 (11.5 – 49.2 ft)			
Depth (ft)	Vs Avg (f/sec)	Vp (ft/sec)	Poisson Ratio
11.5			0.47
13.1			0.48
14.8	CASED TO 15ft		0.47

16.4	820.2	4494.2	0.48
18.0	380.9	2861.2	0.49
19.7	414.9	3037.8	0.49
21.3	444.2	3269.9	0.49
23.0	445.8	3465.6	0.49
24.6	440.2	3679.4	0.49
26.2	456.5	3540.4	0.49
27.9	486.3	3658.9	0.49
29.5	502.2	3735.3	0.49
32.8	526.9	3844.7	0.49
36.1	572.2	3859.8	0.49
39.3	580.3	3829.7	0.49
42.7	624.2	3721.1	0.49
46.0	601.0	3579.1	0.49
49.2	552.4	3658.9	0.49

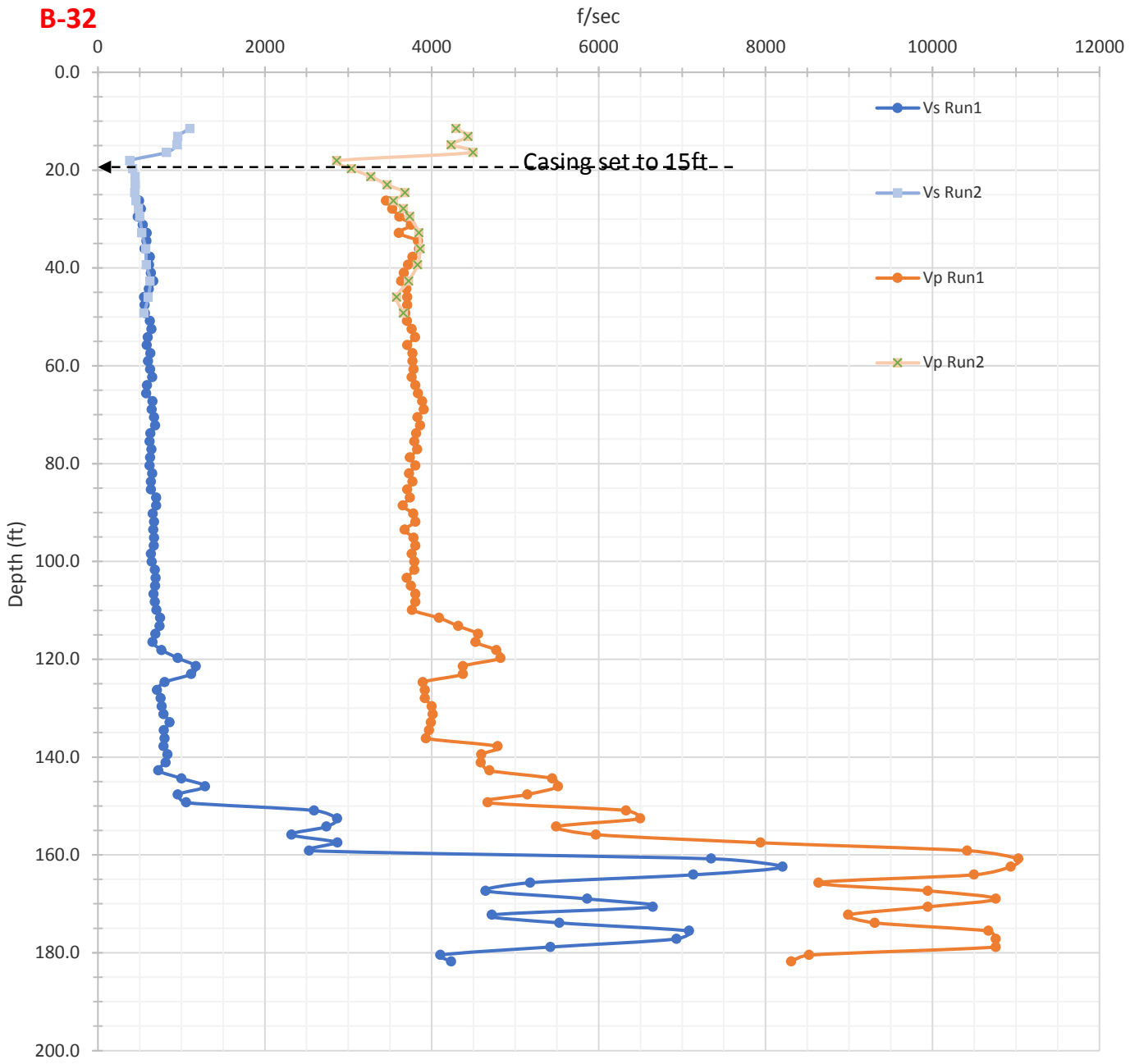

Figure 15: Borehole_ B - 32. Two Run Vp and Vs Profile.

Report of In Situ Pressuremeter Testing
Earthquake Ready Burnside Bridge – EQRB Project
Portland, OR

Submitted to:
Shannon and Wilson, Inc
3990 SW Collins Way, Suite 203
Lake Oswego, Oregon 97035



Shannon & Wilson Project Number: 102636
In Situ Engineering Project Number: 1974
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1.0 INTRODUCTION

This report contains the test results and analysis for electronic pressuremeter testing (PMT) performed under contract to Shannon & Wilson, Inc., Lake Oswego, OR. Drilling on the project was performed by Western States Drilling using two CME-75 truck mounted drilling rigs, each positioned on a separate barge. Testing was performed in four boreholes at depths between 36.0 and 145.0 feet below mudline. A total of 21 PMT tests were performed in the four borings using a high pressure, pre-bored pressuremeter instrument (PBPM) manufactured and calibrated by In Situ Engineering.Test depths are recorded using the bottom of the pressuremeter as a reference.

2.0 PURPOSE

The purpose of this project was to better characterize the subsurface adjacent to and beneath the Burnside Bridge, Portland, Oregon, to assess and mitigate future seismic hazards.

The in-situ material properties derived from testing are as follows:

Shear Modulus
Limit Pressure
Shear or Frictional Strength
Lateral Stress Estimation

3.0 PRESSUREMETER TESTING

A total of 21 pressuremeter tests were attempted in four boreholes, 20 of which produced useable data. Two Western States drillers and drill rigs were used to advance the PMT test for a specific interval of formations. Each driller and associated drill rig are listed in Table 2 in the appendix. All tests were performed using the pre-bored pressuremeter instrument (PBPM) in sands/silts, gravels, Sandy River Mudstone and the Troutdale Formation. One test EQRB-B10_133 was attempted in an oversized pocket, and thus produced no useable data. Pressuremeter testing was conducted over one mobilization, spanning from July 29, 2021-August 18, 2021. The details of the pressuremeter testing and interpretations of these tests are included in the following sections of this report.

3.1 Instrumentation

Both instruments used for this study were pre-bored (PBPM) mono cell high pressure instrument. All pressuremeters are equipped with a pressure sensor and three electronic displacement sensors spaced 120 degrees apart and located at the center of the instrument. A flexible membrane is placed over the sensors and clamped at each end. The membrane is covered by a protective sheet of stainless-steel strips referred to as a shield. The unit is pressurized using compressed air, which expands the membrane to deform the adjacent material. The electronic signals from the displacement sensors and pressure sensor are transmitted via cable to the surface. During the test, the average expansion versus pressure is displayed on a computer screen. The membrane is expanded and drained by regulating the flow of compressed air to the instrument with a control panel operated by the field engineer. A schematic of the instruments is shown below in Figure 1.

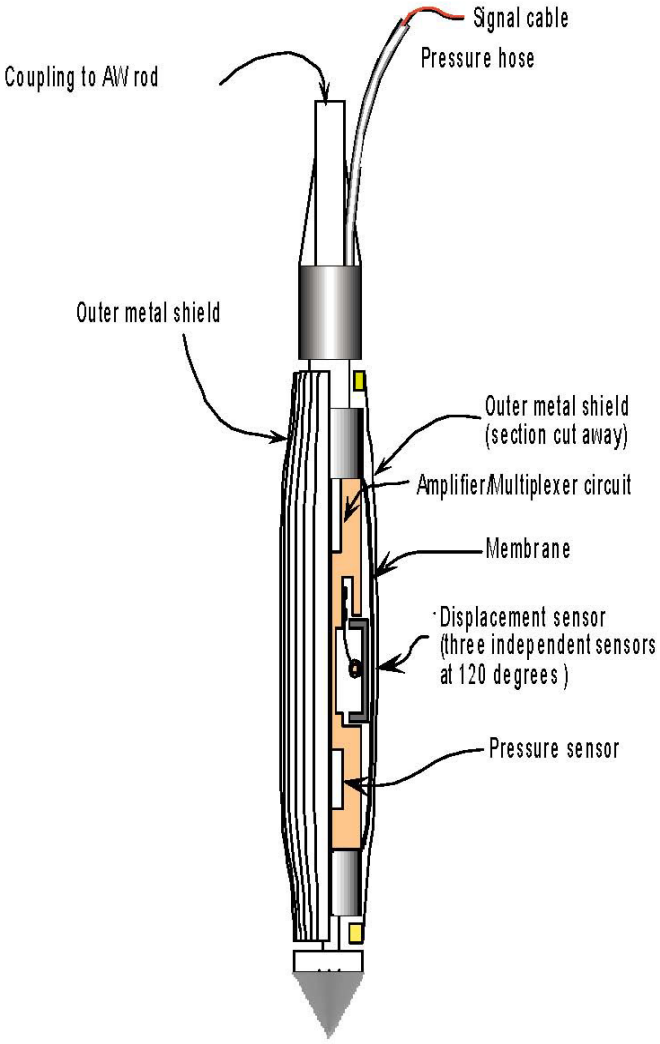


Figure 1 Schematic Details of the Pre-Bored Pressuremeter Instrument

The data recorded at the time of testing are uncorrected data. The flexible membrane has a given strength and stiffness. To correct for these effects, membrane correction tests are performed (air and tube tests) each time a membrane is replaced on the instrument.

To correct for the strength of the membrane, an air correction is applied to the raw data. The instrument is inflated, at the surface, several times (normally 0% to 14% strain). A stress-strain response is a recorded which quantifies the amount of resistance to expansion caused by the membrane, or membrane strength. This response is approximately linear within the range of membrane expansion for the test. As a procedure, a membrane air test is performed prior to beginning of field work.

To correct for membrane compressibility and the effect of pressure on the electronics on the PBPM, a tube test is performed. The instrument is placed vertically inside a thick-walled steel tube and inflated to high pressures up to 2000 psi. The resulting stress strain curve is a record of the membrane's stiffness and pressure effects on the electronics. All data presented in this report are corrected for membrane effects.

Test depths are recorded using the bottom of the pressuremeter as a reference. The expansion of the pressuremeter occurs approximately between 6.5 inches and 24 inches above the reference depth. For example, if the reported test depth is 6.0 feet, the actual test zones would be between 4.5 and 5.45 feet.

3.2 Pre- Bored Hole Formation

The borehole and test pockets were formed using mud rotary techniques. With mud rotary, the test pockets were drilled with a 2-$^{15}/_{16}$" diameter tri-cone bit. Once the test interval was opened, the instrument was then lowered down to the bottom of the pocket with AWJ rod above the instrument and a test was performed. The instrument was then raised 18 inches and a second test was performed. After testing each pocket, the instrument was removed, and the pocket was over-drilled with a larger diameter tri-cone bit such as 4.5 inch.

3.3 Test Procedure

After advancing the instrument to the bottom of a newly created test pocket, the membrane is inflated by controlling the flow of compressed air into the pressuremeter, increasing the pressure until the membrane starts to expand against the borehole wall. After the instrument has begun to deform the material, the first of a series of unload-reload cycles (loop) is performed. The point of initiation of the unload-reload loop is a judgment call of the field engineer, but usually there is a series of loops which are spaced as evenly as possible through the pressure-expansion curve. The loops are formed by reducing the applied pressure by no more than 40% of the initiation point of the loop, then increasing again.

The resulting unload-reload loop can be used to evaluate the elastic behavior of the material. In materials which behave in a plastic manner, the loops will exhibit a hysteretic behavior. That is, the unloading path will follow the "mirror" image of the reloading path. Materials such as sand the loops will be very tight, exhibiting little hysteretic behavior. In materials such as clay, the loops will exhibit large hysteretic behavior. Occasionally, an unload/reload loop will exhibit unusual characteristics, such as an open "V" shape. In these circumstances, a three-minute creep hold is sometimes performed to recompress an overly relaxed formation which was disturbed by the drilling process.

The pressure is then advanced until a sufficient increase in stress or strain has occurred before completing a second unload-reload loop. This process is then repeated a third or fourth time as the test is conducted. If the disturbance from drilling is small and the material behavior is consistent with increased strain, the slope of the loops will tend to be parallel.

After the strain reaches the maximum range (16% to 18%) or the stress reaches the maximum range (~2000 psi), the pressure is reduced to zero. The exact maximum stress or strain at which the pressure is reduced to zero is a decision made by the operator based on the behavior of the three arms, instrument response and other limiting conditions. Tests may be terminated before the failure of the material if one of the following occurs: the limit of any one strain arm is reached, the maximum pressure of the pressure bottle is reached, electronic failure occurs, the membrane ruptures, or the instrument response is such that membrane rupture may be imminent.

An example of the PMT curve is shown below in Figure 2. Examining the figure, we see four unload-reload loops were performed. The unload-reload loops were initiated at approximately 2.5%, 5.5%, 9% and 11.5% strain.

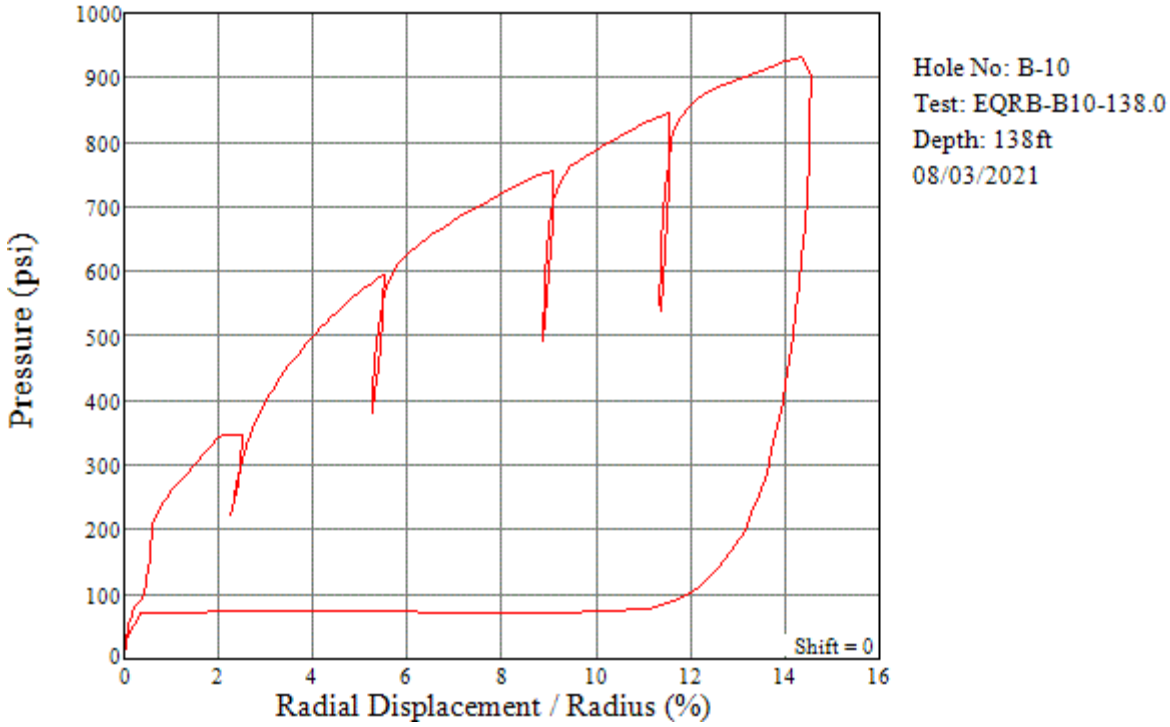


Figure 2 Example PMT Curve

3.4 Site Specific Test Procedure and Conditions

Pressuremeter testing was performed on the Willamette River in Portland Oregon. Testing sub surface material in a body of water generally involves two scenarios, either a primarily stationary depth range such as a river or a lake, or a tidally influenced body such as a sound or open ocean where the depth of the water will change throughout the testing. As this location was a river, we saw very little depth changes in relation to the testing at the time.

For this project we were to utilize two working platforms (Barges) provided by Marks Marine Services, identified as the Mark 12 and the Patterson.

Mark 12:

- 110' Length
- 35' Width
- 11' Height
- 2' of Draft
- Moon Hole located in the center, 55' in from the front and back and 17.5' in from the sides

Patterson:

- 75' Length
- 24' Width
- 4' Height
- 2.5' Draft
- Moon Hole located in the center, 37.5' in from the front and back and 12' in from the sides

Both barges were held in place for each test location via the use of two spuds, located diagonally on opposite sides.

4.0 Analysis of the Shear Modulus

If the material surrounding the pressuremeter is assumed to extend to infinity, and assumed to behave as an idealized linear elastic, homogeneous material, which does not fail under shear or tension, then the displacement on the boundary of the pressuremeter, u_a, for a given pressure, P, is given by:

$$\mu_a = P(a)\ (1 + \upsilon) / E \qquad 1)$$

where:

"E" is Young's Modulus
"a" is radius of the pressuremeter cavity
"υ" is Poisson's ratio.

As the shear modulus, "G", and the Young's modulus, "E", are related by the following relationship:

$$E = 2\ (G)\ (1 + \upsilon) \qquad 2)$$

Equation 1 reduces to:

$$\mu_a = 0.5\ P(a) / G \qquad 3)$$

Hence, the shear modulus G is given by:

$$G = 0.5\ (\Delta \text{ Pressure} / \Delta \text{ (radial displacement / radius)}) \qquad 4)$$

The American Society for Testing and Materials (ASTM) D4719, Section 9.5 defines a pressuremeter modulus (E_p). This is derived from using the shear modulus for the average slope of the initial loading curve of the pressuremeter curve. This "initial shear modulus" is converted to a Young's modulus or E_p (Poisson's ratio of 0.33 is used if no other information known) using equation 2 above. However, in most tests a straight section in this part of the curve is not sufficiently well defined to enable the modulus to be determined and the initial curve is often prone to drilling disturbance resulting in lower modulus values or if the instrument pushed (shoved in) resulting very high modulus values. In the example of Figure 3, we can see that the slope of the tangent line and hence the value the initial shear modulus is highly dependent and very subjective of which portion of the curve is applied. We do not recommend the use of this initial shear modulus for the soils on this project.

The modulus determined from an unload-reload loop is more accurately defined and is more representative of the modulus for the *in-situ* material. Figure 3, shown below, is an example of the shear moduli determined from unload-reload loops.

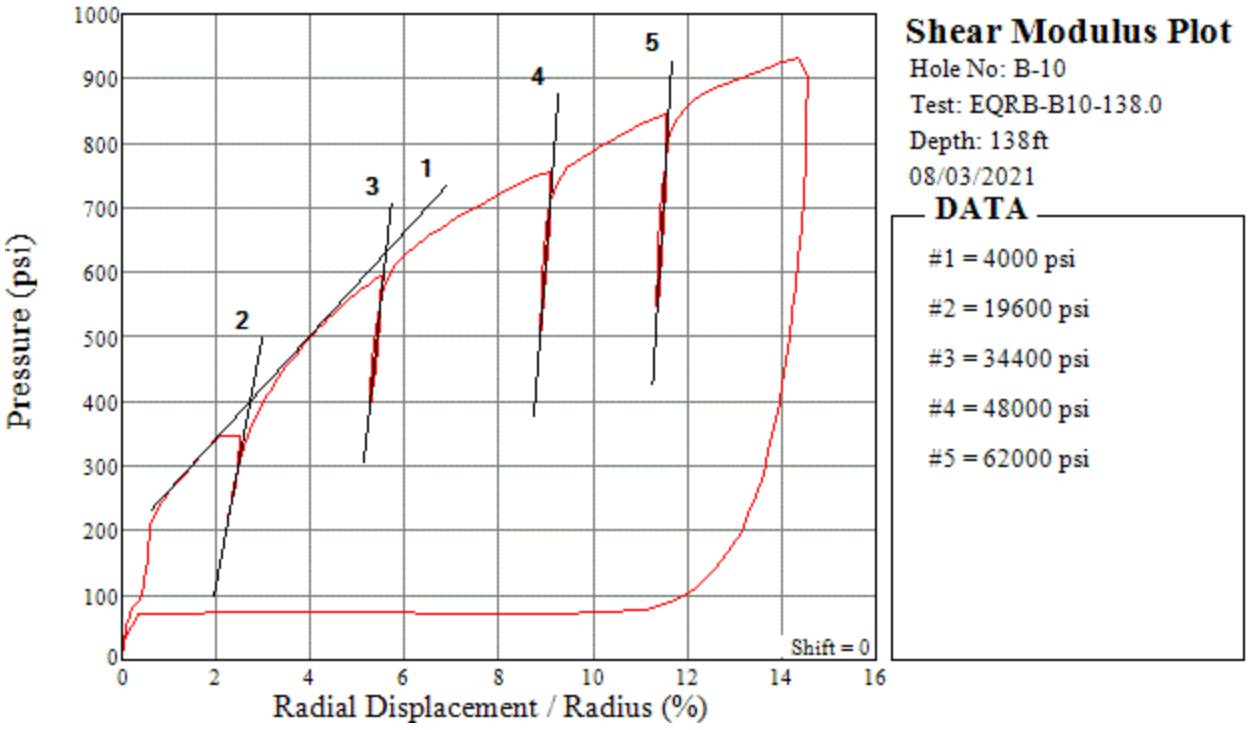


Figure 3 Modulus Analysis of Borehole B-10 at 138ft

Typically, by performing multiple unload-reload loops during a test, two or more of the loops tend to be parallel, confirming a particular shear modulus value and indicating that the material is not disturbed. However, if the test pocket is highly disturbed, then parallel loops can be difficult to obtain. Also, these unload-reload loops may exhibit anti-parallel behavior (decreasing or increasing shear modulus) due to the nature of the material. In other words, the material behavior may change with strain. In general, *frictional material will exhibit strain hardening and cohesive materials strain softening*. In the example shown above, it appears that the moduli, defined by the loops, are increasing, representing more frictional behavior and that a strain hardening phenomena is occurring.

The initial shear modulus, #1 in the example above, can be converted to the pressuremeter modulus or E_p using equation 2.

The shear modulus values are summarized in Appendix I, Table 3.

5.0 Determination of the Limit Pressure and Shear Strength by Log Method

From a visual inspection of a typical PMT curve, Figure 4 shown below, it is observable that the rate of strain increase is continual (6% - 10%) but increase in pressure is decreased. And pressure will eventually reach a maximum no matter how large the strain. A visual observation of the test would indicate that the maximum or limiting pressure reached would be above 1500-1600 psi.

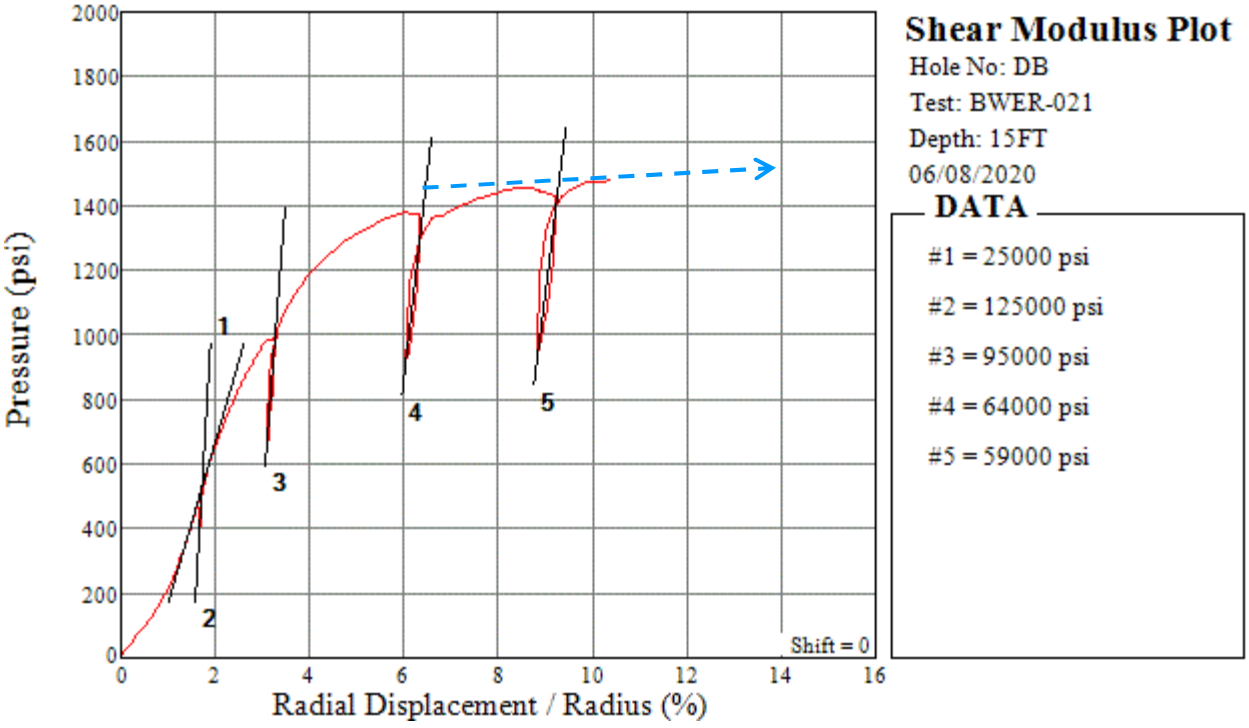


Figure 4 Limit Pressure by Visual Inspection

Different materials reach their limit pressure at different strains. For consistency, the limit pressure has been defined by ASTM D-47619 as that pressure which occurs when the volume of the pressuremeter has doubled. This arbitrary limit pressure was initially defined because virtually all-natural materials have totally failed when they have strained that far. Few pressuremeters can expand this far before reaching the limit of the strain sensing system. It is actually preferable that they do not expand this much, at this large expansion the deformation does not resemble a right circular cylinder, but more closely resembles a football. The mathematical equations are not relevant at high strains, and the membrane is over deformed. The pressuremeters used in this investigation will only expand to about 18% before the displacement limit is reached. Therefore, the double volume must be mathematically extrapolated. This is performed by plotting the data on a semi-log scale and extrapolating to 41% strain, which is mathematically equivalent to doubling the cavity volume. Figure 5 below shows how the limit pressure is obtained using the log method.

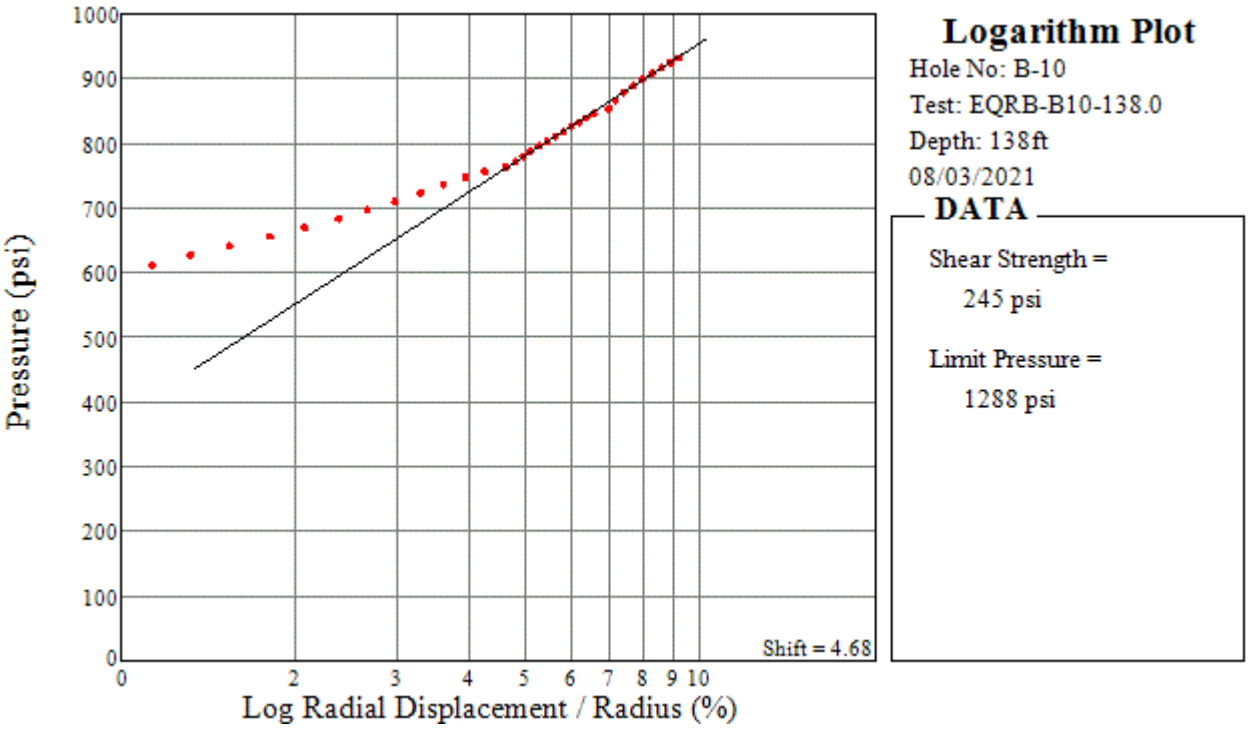


Figure 5 Limit Pressure by Log Method

If the material being tested is assumed to behave as an elastic cohesive material, then the equation governing the pressure-displacement curve is given by:

$$P = P_L + (c)\log_e (u_a/_a) \qquad 5)$$

$$P_L = P_o + c + (c)\log_e [G/c] \qquad 6)$$

Where:

P_L" is the theoretical limit pressure at infinite expansion

"c" is the undrained cohesive strength,

"P_O" is the total *in-situ* lateral stress, and "G" is the shear modulus.

From Equation 5, a plot of pressure P against the log of u_a/a will be a straight line, provided the shear strength remains constant with strain. The slope of this line will provide a measure of the undrained shear strength, c. If any disturbance is present, the above method of determining the cohesive strength usually provides an overly optimistic value. The above method applies only to cohesive materials with no frictional component. The limit pressure and shear strength results are tabulated in Appendix I, Table 4. The computer program plots both limit pressure and shear strength tests (shown in Appendix II) even though the shear strength is not technically valid for frictional or decomposed rocks which are not purely cohesive. The engineer should be cautioned of the limited applicability of cohesive shear strength determined by log method in predominantly frictional materials which are denoted with Ø or Ø-C on the tables in Appendix I.

6.0 Material Properties by Model Analyses

The strength of a material being tested can be determined if a failure mechanism or model is assumed. The modeling approach incorporates assumptions about the material properties and mechanism of failure. Each type of model has input variables. The simpler the model, the fewer the number of variables, whereas more complex models have more variables. In most modeling, the variables are input, and the resultant curve examined against the field curve. The variables are then adjusted until a best fit curve is obtained.

The analysis of the data is performed in the office and utilizes a proprietary computer program developed by the In-Situ Engineering. This computer program analyzes shear strength, shear modulus, limit pressure, lateral earth pressure and frictional strength using various methods and models. These methods and models are described in more detail in the References cited in Section 8.0.

In Situ Engineering uses three primary models in analysis. These are the *Gibson and Anderson cohesive model*, the *Hughes friction model* and the *Arnold cohesive model*. According to B.G. Clarke in *Pressuremeters in Geotechnical Design*: "There are two approaches to the theoretical interpretation of a pressuremeter test. The first is to assume a constitutive model for the ground and derive an equation that will give an approximate fit to the test curve. The second is to fit a mathematical function to that curve and then derive parameters from that function using a constitutive model". The Hughes and Gibson methods are the former and the Arnold is the later. In that sense, the better the field curve fits to either the Hughes or Gibson model, then the more closely the material is to the ideal of the model. In the Palmer/Anderson model, the points on the field curve are chosen by the engineer and the model is almost always a near perfect fit. Judgement must be utilized in the application of any of the results, particularly where the field material does not fit the model assumptions. In general, we like to analyze the material in as many ways as possible as this gives us insight into the material behavior and helps us to either reinforce or eliminate solutions.

Modeling analysis involves fitting a theoretical curve to the field curve data. For instance, if the field material is a sand, then a theoretical friction model curve can be overlain, and the input parameters adjusted until the theoretical curve fits the field curve. The input parameters are a solution set. As can be imagined, there are multiple solutions sets because the input parameters are all variables unless they can be determined as constants. For example, the friction model developed by Hughes has input parameters that are water pressure, critical friction angle, effective lateral stress, friction angle and shear modulus. Water pressure is usually a known value from piezometers; the shear modulus is known from performing an unload-reload loop during the test; and the critical friction angle is normally about 32 degrees for dilatant granular materials; thus 3 of the 5 input parameters are essentially constants. In this example, the friction angle and the effective lateral stress become variables. If one of these can be constrained or determined by some other method, then the last remaining input parameter can be determined. If frictional data is available from other sources, such as laboratory shear testing, then that variable could be constrained and thus provide the lateral stress.

One of the limitations we have in modeling analysis is that the model has certain assumptions. Following are lists of assumptions and boundary conditions of each model:

Cohesive Model by Gibson.

Variables:
1. Shear strength
2. Total lateral stress
3. Shear modulus

Assumptions:
1. Material deforms as a right circular cylinder
2. Material behaves as a purely cohesive material with no friction
3. Shear strength remains constant during failure
4. No volume change

Cohesive Model by Palmer with Arnold's Analysis

Variables:
1. Model the curve with three points

Assumptions:
1. Material deforms as a right circular cylinder
2. Material behaves as a purely cohesive material with no friction
3. Shear strength remains constant during failure
4. No volume change

Friction Model by Hughes Sand Model

Variables:

1. Friction angle
2. Lateral effective stress
3. Critical friction angle is constant
4. Water pressure
5. Shear modulus

Assumptions:
1. Material deforms as a right circular cylinder
2. Material behaves as a purely frictional material with no cohesion
3. Frictional strength remains constant

Experience has taught us how to observe the curve form and quickly determine if the material is behaving predominately as either a frictional or a cohesive material. Most of the materials tested on this project conform to the idealized behavior of either cohesive or frictional material. This is denoted on all data Tables as either Ø for frictional materials, C for cohesive materials or Ø-C for materials which are exhibiting hybrid properties. Shown below are a frictional model (on the left) and a cohesive model (on the right) applied to a test. Both tests have had their origin shifted to fit more accurately to the true origin of undisturbed material. The amount of the shift (%) is shown in the lower right-hand corner of the plots. Compare this with Figure 2, which shows the entire field curve.

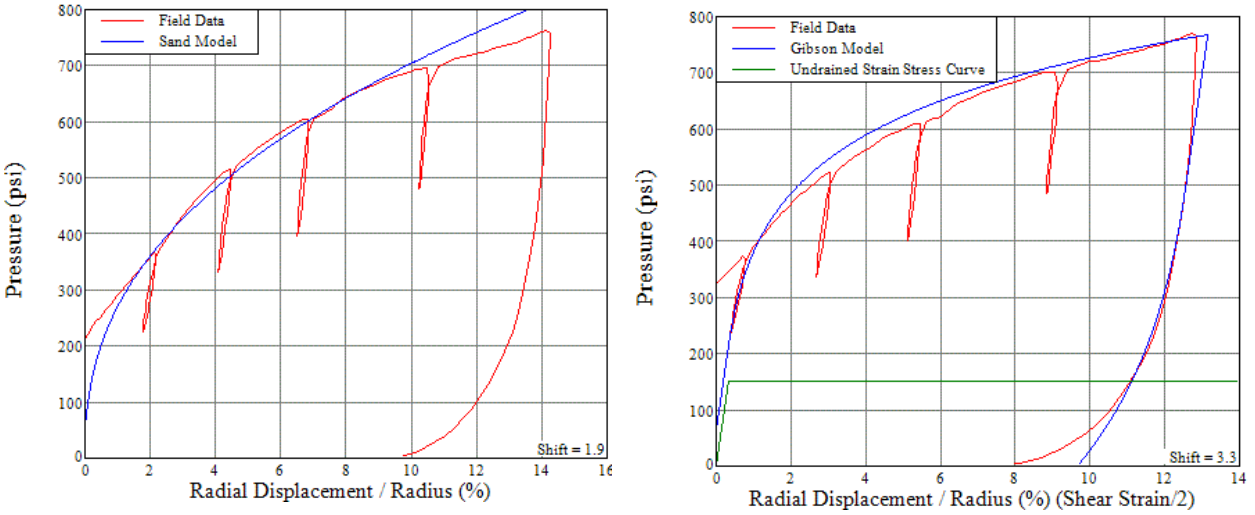


Figure 6 Comparison of Frictional and Cohesive Models

Notice how the frictional model curve on the left fits most of the portion of the curve nicely and deviate away from the field data above 700psi, whereas the cohesive model curve on the right fits throughout after the field-curve shifted 3.3%. This kind of model fitting indicates that the materials been tested are not quite totally frictional nor are they totally cohesive.

It may be possible to develop a cohesive-frictional model to properly fit these curves, but it would have so many variables that it would be impossible to define a definite solution, in other words you would probably have an almost infinite number of solutions. We usually use either a totally

frictional model or a totally cohesive model which usually comes down to only two major variables – lateral stress and strength.

Another indication of soil behavior is the unload-reload curves tend to be tighter on frictional material and more open on cohesive material.

The sections following describe each of the models and analyses in more detail.

6.1 Cohesive Strength Properties Derived from Gibson Model Analysis

As mentioned previously, the PMT curve can be used directly to determine the *in-situ* material strength properties such as the cohesive strength through modeling analysis. To accomplish this, a material model and failure mechanism must be assumed. During a pressuremeter test, a simple assumption is the material surrounding the instrument deforms as a right cylinder. Initially, the material is assumed to behave as an elastic material. As the pressure builds inside the instrument, the material on the cavity boundary will start to fail under shear. As the pressure continues to build, the zone of failed material expands while the cavity radius increases. The stress path of an element along the boundary will follow the form shown in Figure 6.

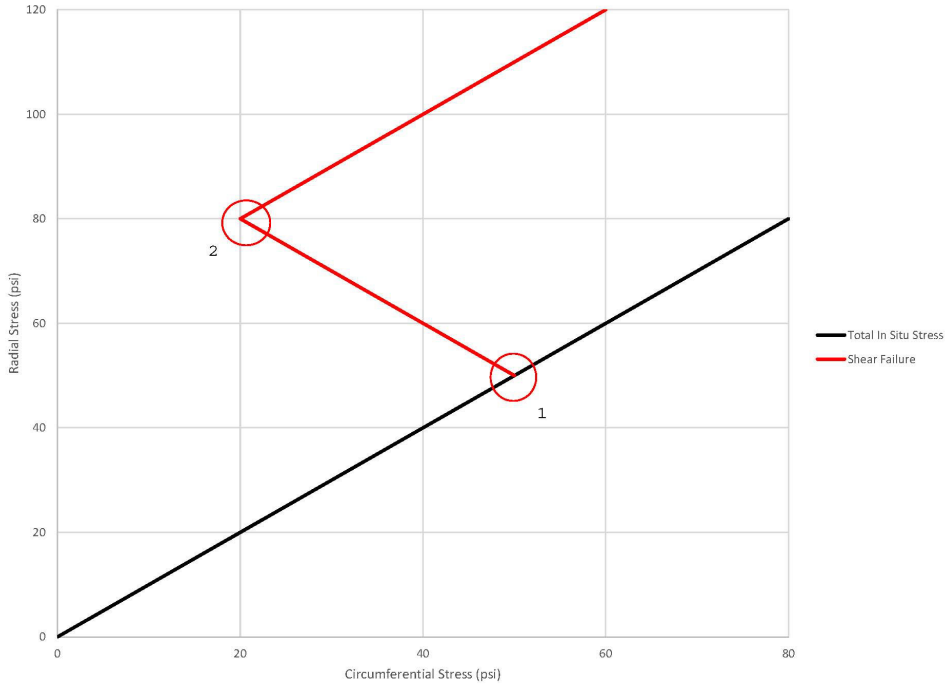


Figure 7 Cohesive Stress Path

The *in situ* stress state is set at 50psi, point 1. The shear strength is 30psi, point 2. As the pressure is increased from the *in situ* stress state, the stress path will move from point 1 to point 2. After the initiation of failure, point 2, the plastic zone forms and increases in size as the pressuremeter is expanded. The shear stress and volume strain will remain constant while in this

plastic zone. Figure 8, shown below, is the same example but using Mohr's circle for the illustration.

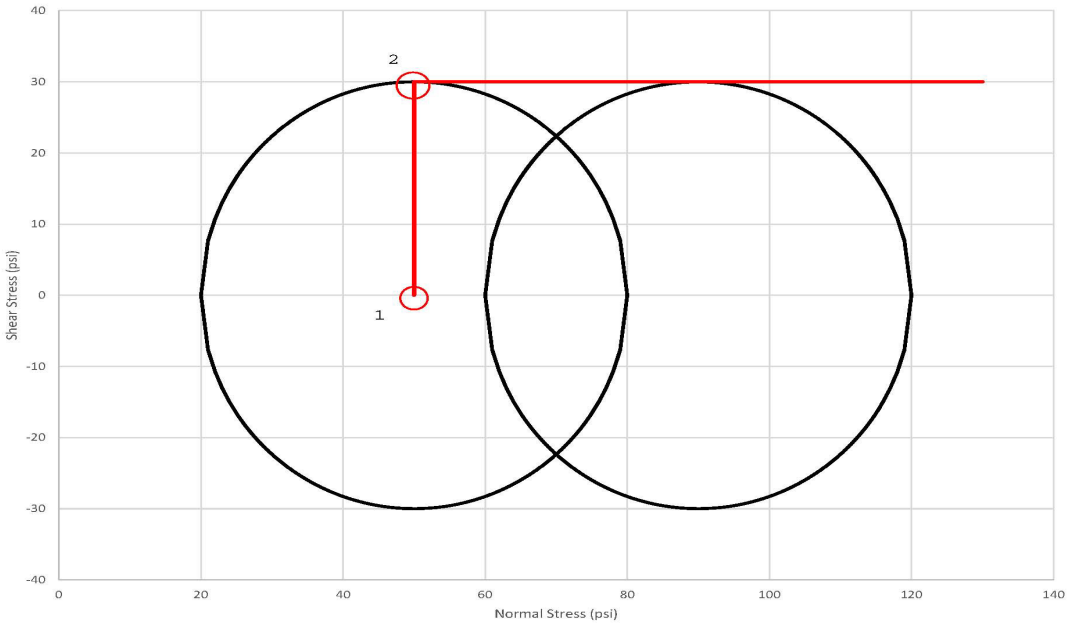


Figure 8 Cohesive Mohr's Circle

There are two phases of the PMT curve. The first is the elastic phase and the following is the equation governing the displacement:

$$U = R * (P - P_o) / 0.5G \qquad 7)$$

Where:

"G" is Shear Modulus
"P" is Pressure
"P_o" is *in situ* lateral stress
"R" is radius of the hole

Once the pressure has been increased so that shear failure has accord, point 2 in Figure 8, the basic equation that describes this behavior developed by Gibson is:

$$P - P_o = c_u * (1 + \log_e (G / c_u)) + c_u * (\log_e (2 * U/R)) \qquad 8)$$

Figure 9, shown below, is an example of the above method. The example shown is a good example of a material that is quite a good cohesive fit as the model curve can be manipulated to fit the field curve well on both the loading/unloading portion of the curve.

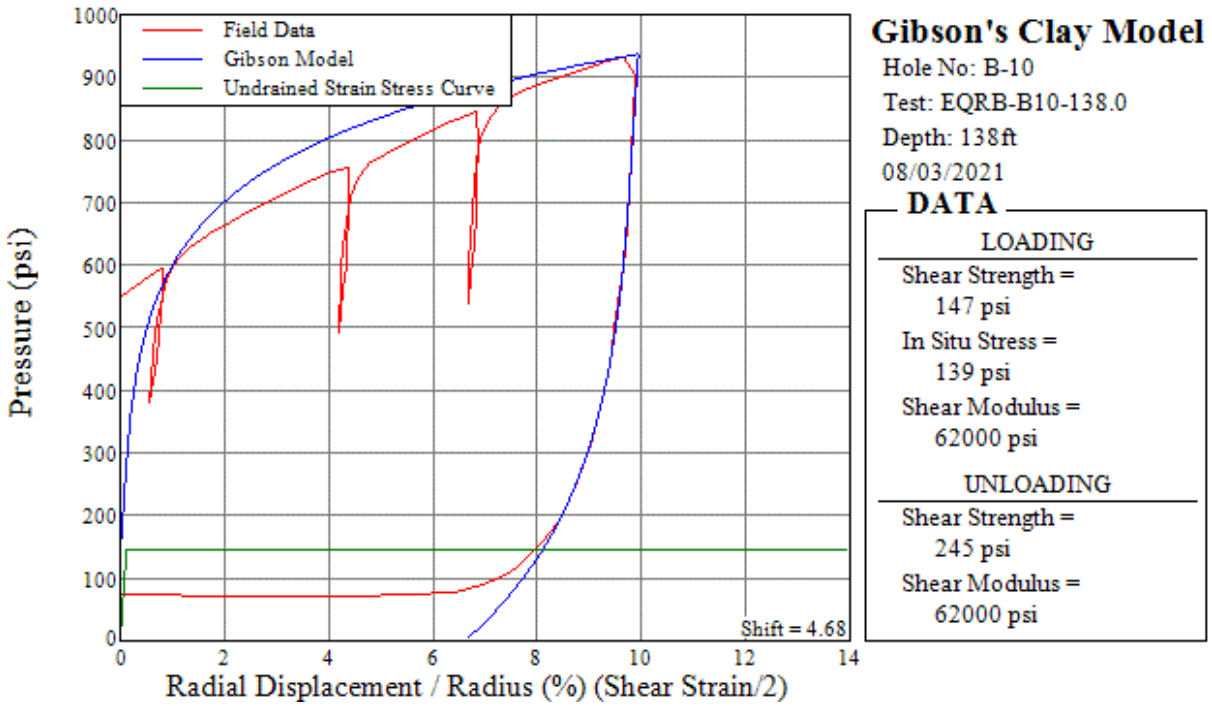


Figure 9 Shear Strength Analysis by Gibson Model

The strength for a cohesive material can also be determined from the unloading section of the pressuremeter curve. The shear strength determined from the unloading section will be approximately twice the loading shear strength. The reason for this is on unloading the shear stress path has to completely reverse. This is illustrated in Figure 10, shown below. The left-hand sketch is the ideal stress path followed during the test. The principal stresses are the radial stress (the pressure on the boundary) and the circumferential stress. The ideal pressuremeter curve is shown to the right. The test starts at the *in-situ* stress, point A then moves elastically to point B. At point B the shear strength becomes constant and shear failure occurs at constant shear strength. With further loading the radial peak stress is reached at point C. On unloading the stress path follows from C to D, elastically, then at D the soil shears at a constant value. Determining the shear strength using this method will often produce conservative values since the soil has been disturbed by the movement of the pressuremeter prior to unloading. Use of the unloading curve strengths is also appropriate for open face applications such as a cut bank or tunnel.

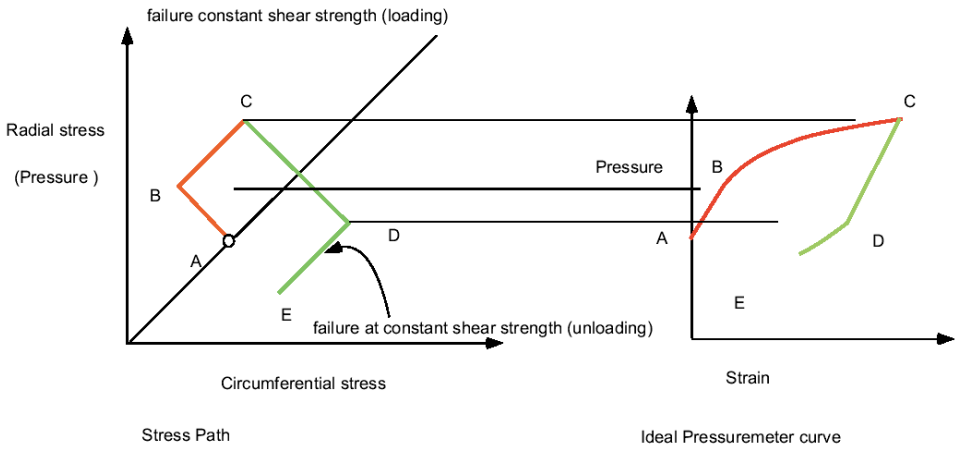


Figure 10 Stress Diagram for Pressure Curve

Where appropriate, cohesive shear strength values determined by Gibson modeling are recorded in Appendix I, Table 4.

6.2 Arnold's Method of Shear Strength Analysis

An alternative method put forward by Arnold can be used to determine whether the strength reduces with strain. Arnold proposed that the pressure displacement curve can be approximated by a hyperbolic function,

$$P(a) = (u_a/a) / (a+b(u_a/a)) + c \qquad 9)$$

where a, b, and c are constants. The constants are selected by visually estimating the pressure at three points on the pressuremeter curve. Our software has predetermined three strain points of 1%, 2.5%, and 7.5%. The computer then calculates the three constants and draws the ideal curve. If the ideal curve does not fit the pressures at the selected strain points, then the pressures are adjusted until the ideal curve best fits the field curve.

The method of Palmer (1972) is used to determine the ideal undrained stress-strain curve. This method requires the differentiation of the ideal pressuremeter curve to give the shear stress versus shear strain. The shear strain is equal to twice the radial strain (u_a/a).

$$T = a*(u_a/a) / (a+b(u_a/a))^2 \qquad 8)$$

Figure 11, shown below, is an example of the Arnold's method. The material's strength varies with strain as shown by the green line. The peak shear strength is close to 236 psi at 13.9% shear strain while decreasing to 229 psi at 10% shear strain. Values derived from Arnold's method are shown in Table 4.

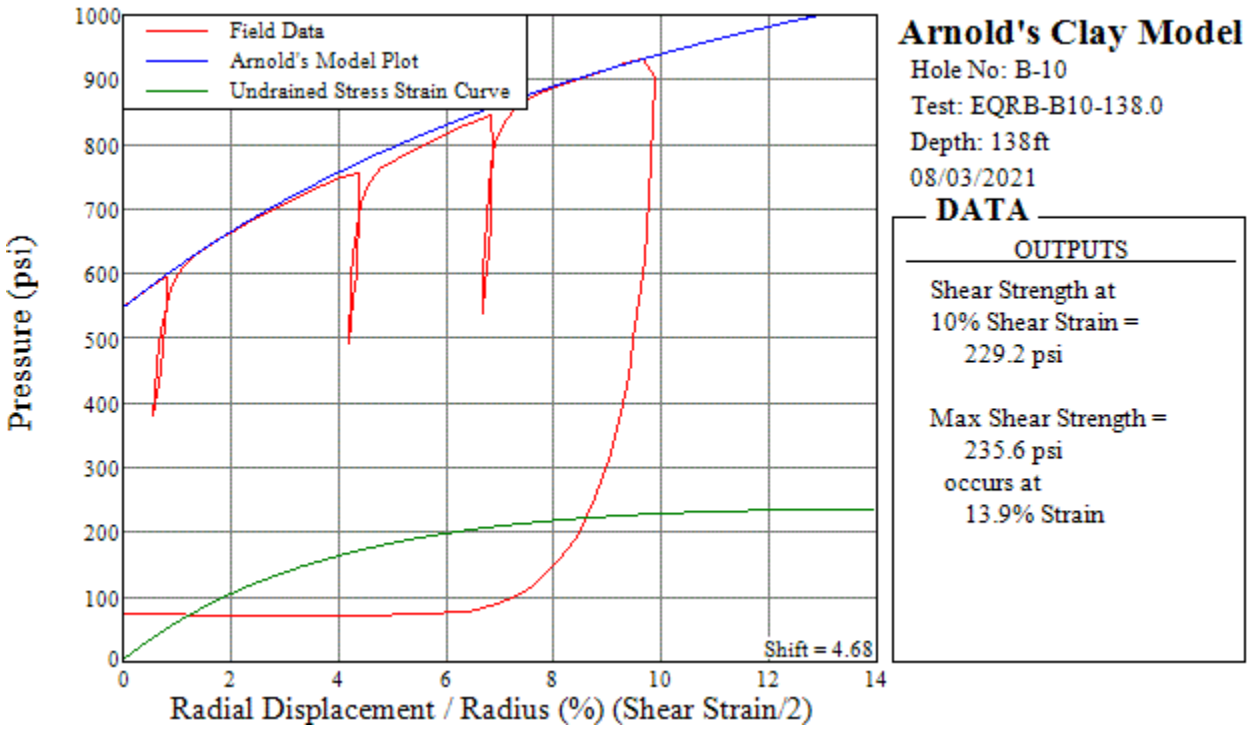


Figure 11 Arnold's Method

6.3 Frictional Strength Model Analysis

The PMT data can be used directly to determine the *in-situ* material properties such as friction angle on cohesionless material. For frictional materials it is assumed that the material surrounding the pressuremeter deforms as a uniform right cylinder; that is, it deforms in plane strain. Another assumption is that the material has a constant friction angle and little to no cohesion. The method used for interpretation is based on analysis presented by Hughes *et* al (1977), this can also be found in Mair and Wood, *Pressuremeter Testing*.

The friction angle and lateral stress are adjusted, using engineering judgment, until a best fit is obtained. Figure 12, shown below, is an example of the model analysis.

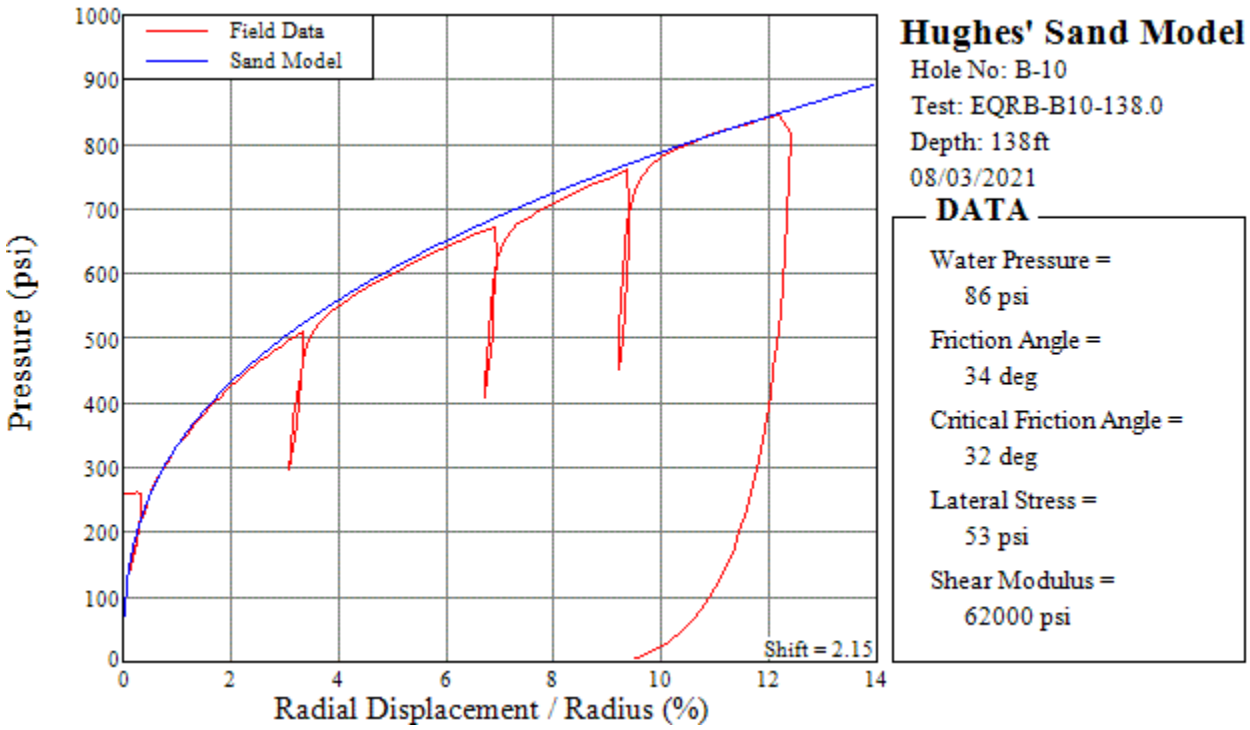


Figure 12 Example Frictional Model

In examining the results of the friction model on this test, the model curve fits the field curve well through the loading portion of the curve. We have shifted the curve 2.15% to put the new origin where we estimate the beginning of the stress-strain should be on a tighter hole.

The results of this model analysis have been presented in Appendix I, Table 5.

7.0 Pile Displacement Curves (P-Y)

The design of laterally loaded piles can be considered in two ways. Firstly, the ground can be considered as a continuum with some ideal material properties. That is each element in the surrounding soil is influenced by neighboring elements in three dimensions. A simple model would include a stiffness strength and lateral stress. Finite element or FLAC models are useful for that approach. Alternatively, the soil can be divided up into discrete horizontal layers with each layer acting as a spring against the pile. An example of this is shown in Figure 13. However, in this case the layers do not interact with each other. This is a much simpler approach from an analytical point of view. The pile is considered as a continuous elastic member with known properties and the lateral resistance of the soil is considered as a series of independent springs.

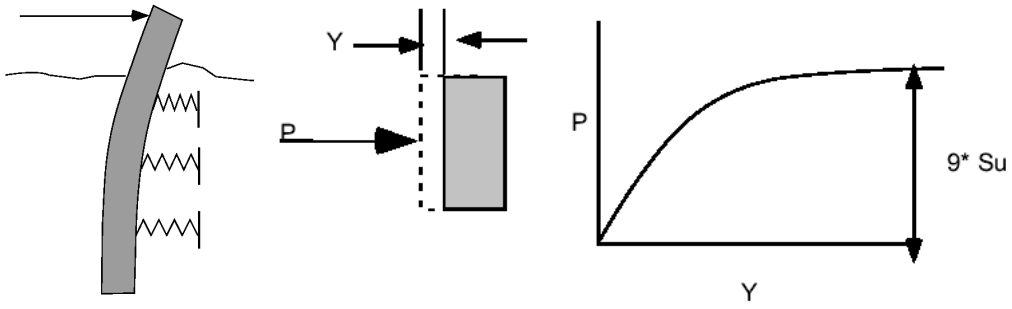


Figure 13 Spring action acting on a length of pile.

From back calculation of lateral loading tests (Briaud 1986) it has been found that in medium clays, the spring stiffness of the soil is geometrically similar to the loading stage of a pressuremeter tests. However, some adjustment to the pressuremeter curve is necessary. If a section of pile, some distance below the ground surface (at least 4x diameters) is pushed laterally, the ultimate resistance will be approximately 9 * the cohesive strength (Figure 11 – right side). In contrast the Limit Pressure from the pressuremeter test is approximately 5 * the cohesive strength + the static lateral pressure, shown below in Figure 14.

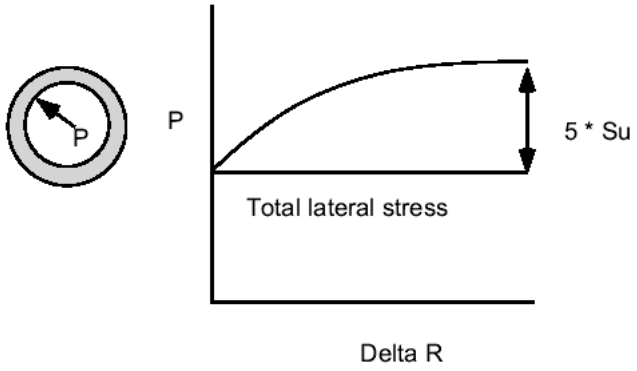


Figure 14 Ideal pressuremeter test

Hence the P/Y curve can be developed from the ideal pressuremeter curve by increasing the pressure (less the lateral pressure) by a factor. For clays this factor is 2 and for sands it is 1.5. An example representative P/Y curve is shown in Figure 15.

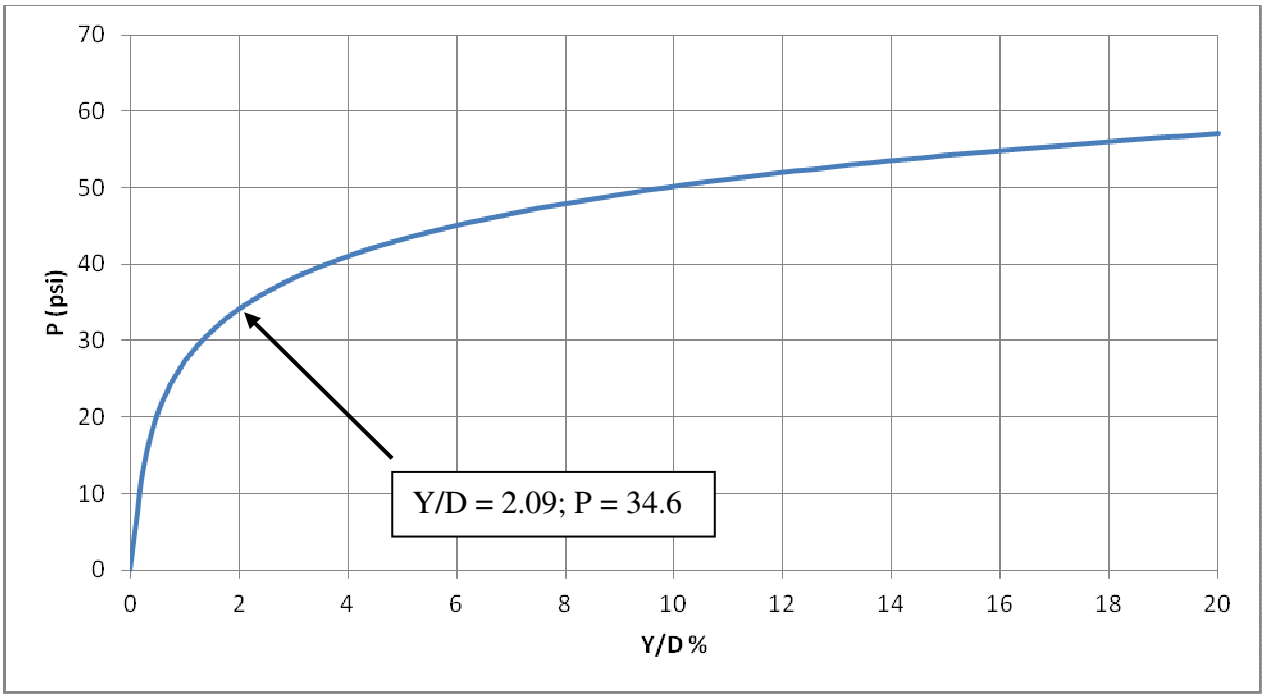


Figure 15 P-Y data developed from a pressuremeter test

The chart shown above displays the P-Y data as a pressure on the vertical axis and displacement divided by pile diameter on the horizontal axis.

For example, using a drilled shaft foundation 36 inches in diameter with the springs at 72-inch center then the load displacement curve is shown in Figure 16.

An example calculation using the point shown in Figure 15:
The projected area of a 36-inch diameter shaft for a 72-inch increment with the applied 34.6 psi load is: 36*72 *34.6= 89,683 lbs.
The corresponding displacement is Y/D = 2.09%;
therefore Y = (36*2.09)/100 = 0.752 inches

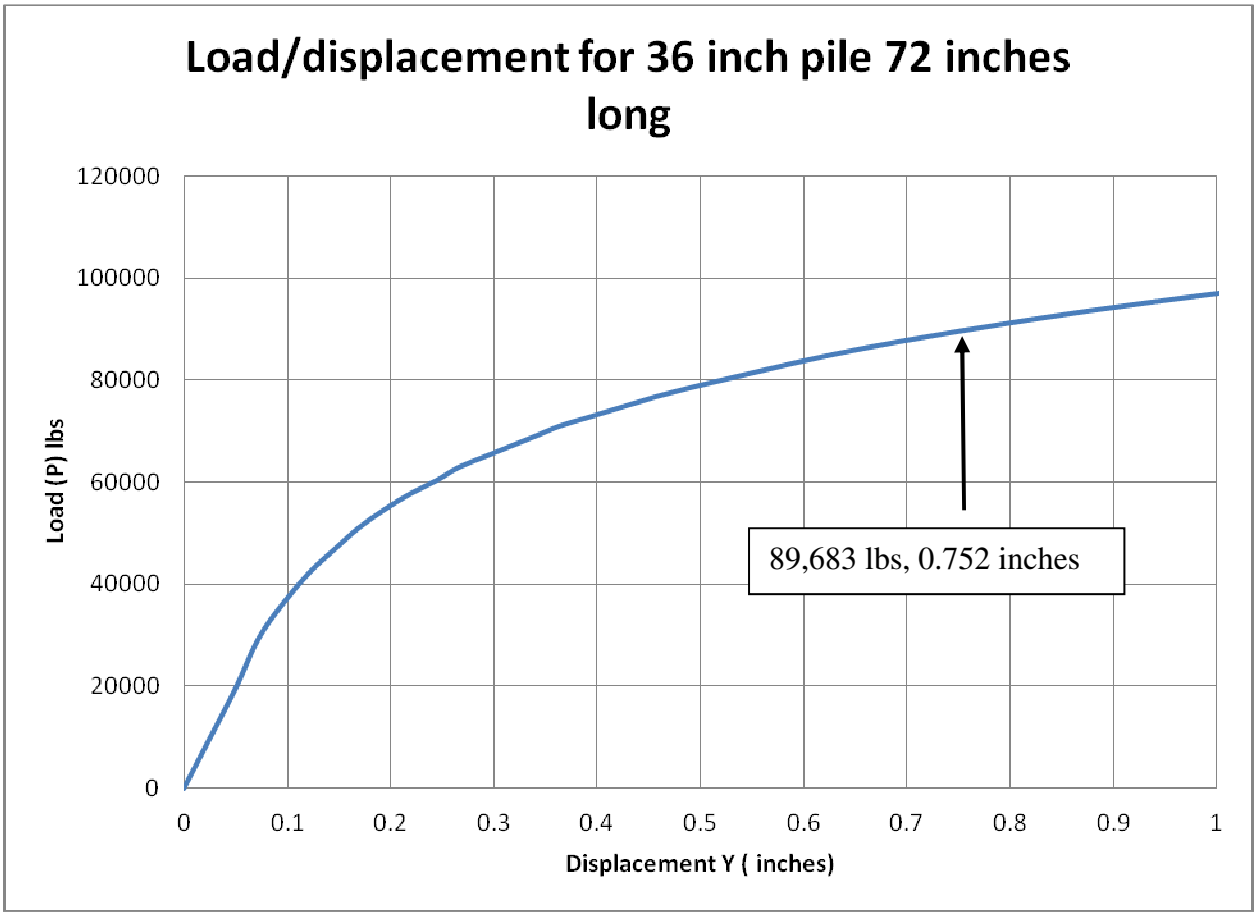


Figure 16 Example Load Displacement Data

P-Y curves for field curve responses are provided in the Appendices.

8.0 REFERENCES

Mair, R.J. and Wood, D.M. 1987. Pressuremeter testing: methods and interpretation. CIRIA Ground Engineering Report. Butterworths, London.

ASTM D-4719. 2007. Standard tests method for pressuremeter testing in soils.

Clarke, B.G.,1995, Pressuremeters in Geotechnical Design, Blackie Academia and Professional, Glasgow

Appendix I – Data Tables

Table 1 – Numeric test qualification and data analysis explanation notes:

C	Cohesive material behavior
ϕ	Frictional material behavior
C - ϕ	Test material behaved both as frictional and cohesive
	Blank values indicate that no data could be derived from the test OR no analysis performed
0	Poor test, oversized hole, no usable data
1	Fair hole with some degree of oversize, insufficient data to determine strength of material
2	Good hole size, but instrument failed /membrane rupture during test. Partial data may be used but insufficient to determine strength of material
3	Good hole with some percentage of oversizing but good usable data quality
4	Very good tight hole, excellent usable data quality
5	The shear strength by log method shown may not be strictly applicable for materials with frictional component as the theory is based upon purely cohesive, non-dilative material. However, it can be used in the onsite materials to give an indication of the strength and limit pressure that can be applied to the ground.
6	Primarily frictional material but consists cohesive properties.
7	Primarily cohesive material but consists frictional properties.

Table 2 – Pressuremeter Test Depths and Material Descriptions

Test	Borehole ID	Test Date	Test Depth (ft)	Lithology	Mudline Depth (ft)	Material Property	Test Pocket Quality
EQRB-B10 36	B10	7/29/2021	36.0	Sand/Silt	62.0	C [7]	3
EQRB-B10 37.5	B10	7/29/2021	37.5	Sand/Silt	62.0	Ø	3
EQRB-B10 70.5	B10	7/30/2021	70.5	Troutdale Formation	62.0	C - Ø	4
EQRB-B10 131.5	B10	8/2/2021	131.5	Sandy River Mudstone	62.0	C - Ø	2
EQRB-B10 133	B10	8/2/2021	133.0	Sandy River Mudstone	62.0		0
EQRB-B10 138	B10	8/3/1931	138.0	Sandy River Mudstone	62.0	Ø - C	4
EQRB-B10 139.5	B10	8/3/2021	139.5	Sandy River Mudstone	62.0	Ø - C [6]	4
EQRB-B11 - 37.5	B11	8/5/2021	37.5	Sand/Silt	42.0	Ø - C [7]	1
EQRB-B11 - 39	B11	8/5/21	39.0	Sand/Silt	42.0	Ø - C	1
EQRB-B11 - 44.5	B11	8/5/2021	44.5	Sand/Silt	42.0	C - Ø	1
EQRB-B11 - 46	B11	8/5/2021	46.0	Sand/Silt	42.0	C - Ø	1
EQRB-B11 - 71.5	B11	8/5/2021	71.5	Gravel	42.0	Ø	3
EQRB-B11 -73	B11	8/5/2021	73.0	Gravel	42.0	Ø - C	1
EQRB-B11 112.5	B11	8/12/2021	112.5	Troutdale Formation	42.0	Ø	3
EQRB-B11 114	B11	8/12/2021	114.0	Troutdale Formation	42.0	Ø	3
EQRB-B27 143.5	B27	8/10/2021	143.5	Sandy River Mudstone	41.0	C [7]	4
EQRB-B27 145	B27	8/10/2021	145.0	Sandy River Mudstone	41.0	C [7]	4
EQRB-B09 124.5	B09	8/18/2021	124.5	Sandy River Mudstone	45.0	C - Ø	3
EQRB-B09 126	B09	8/18/2021	126	Sandy River Mudstone	45.0	C - Ø	3
EQRB-B09 130.5	B09	8/18/2021	130.50	Sandy River Mudstone	45.0	C - Ø	3
EQRB-B09 132	B09	8/18/2021	132.00	Sandy River Mudstone	45.0	C - Ø	3

Table 3 – Shear Modulus and Test Pocket Quantitative Values

Test	Borehole ID	Test Depth (ft)	Initial Shear Modulus (psi)	Unload-Reload Shear Modulus (psi)					Material Property	Test Pocket Quality
EQRB-B10 36	B10	36.0	1160	3100	4170	5700			C [7]	3
EQRB-B10 37.5	B10	37.5	1000	2900	4300				Ø	3
EQRB-B10 70.5	B10	70.5	40800	168200	274000	415400	535500	626200	C - Ø	4
EQRB-B10 131.5	B10	131.5	9500	37100	33300				C - Ø	2
EQRB-B10 133	B10	133.0								0
EQRB-B10 138	B10	138.0	4000	19600	34400	48000	62000		Ø - C	4
EQRB-B10 139.5	B10	139.5	3000	14600	22700	47900	69100		Ø - C [6]	4
EQRB-B11 - 37.5	B11	37.5	130	180	460	1010			Ø - C [7]	1
EQRB-B11 - 39	B11	39.0	270	380	1090	1100			Ø - C	1
EQRB-B11 - 44.5	B11	44.5	300	440	1270	2320	2690		C - Ø	1
EQRB-B11 - 46	B11	46.0	300	900	1700	1600			C - Ø	1
EQRB-B11 - 71.5	B11	71.5	6400	11700	49300	109200	159700		Ø	3
EQRB-B11 -73	B11	73.0	1440	5800	13500	34700	137500		Ø - C	1
EQRB-B11 112.5	B11	112.5	133000	592000	8394700				Ø	3
EQRB-B11 114	B11	114.0	80000	87000	274000	742000	1432000		Ø	3
EQRB-B27 143.5	B27	143.5	8500	38100	41100	42700	53500	54100	C [7]	4
EQRB-B27 145	B27	145.0	5800	26900	38800	48400	64900	64500	C [7]	4
EQRB-B09 124.5	B09	124.5	5800	21000	24200	28600	29200		C - Ø	3
EQRB-B09 126	B09	126	8400	19200	19800	19000	18500		C - Ø	3
EQRB-B09 130.5	B09	130.50	11900	35900	64900	49400	55900		C - Ø	3
EQRB-B09 132	B09	132.00	12700	36700	75300	69900	73700		C - Ø	3

Table 4 – Shear Strength and Limit Pressure Values

Test	Test Depth (ft)	Log [5] (psi)	Gibson Load (psi)	Gibson Unload (psi)	Arnold Max (psi)	Arnold 10% Strain (psi)	Limit [5] Pressure (psi)	Material Behavior	Test Pocket Quality
EQRB-B10 36	36.0	27	27	46/2= 23	30	24	218	C [7]	3
EQRB-B10 37.5	37.5	27	26	44/2= 22	29	25	207	Ø	3
EQRB-B10 70.5	70.5	1329 [5]					5966 [5]	C - Ø	4
EQRB-B10 131.5	131.5	233	138				1353	C - Ø	2
EQRB-B10 133	133.0								0
EQRB-B10 138	138.0	245	147	245/2= 123	236	229	1288	Ø - C	4
EQRB-B10 139.5	139.5	217 [6]	124	206/2= 103	305	261	1163	Ø - C [6]	4
EQRB-B11 - 37.5	37.5	11	8		10	10	96	Ø - C [7]	1
EQRB-B11 - 39	39.0	15	14		17	17	120	Ø - C	1
EQRB-B11 - 44.5	44.5	15	13		19	19	128	C - Ø	1
EQRB-B11 - 46	46.0	15	13		16	14	126	C - Ø	1
EQRB-B11 - 71.5	71.5							Ø	3
EQRB-B11 -73	73.0		53 [1]					Ø - C	1
EQRB-B11 112.5	112.5							Ø	3
EQRB-B11 114	114.0							Ø	3
EQRB-B27 143.5	143.5	197	165	260/2= 130	187	169	1270	C [7]	4
EQRB-B27 145	145.0	133	133	216/2= 108	142	101	1068	C [7]	4
EQRB-B09 124.5	124.5	155	118	150/2= 75	201	194	959	C - Ø	3
EQRB-B09 126	126	142	135	180/2= 90	148	114	916	C - Ø	3
EQRB-B09 130.5	130.50	152	143	200/2= 100	161	102	1131	C - Ø	3
EQRB-B09 132	132.00	212	208	260/2= 130	224	137	1530	C - Ø	3

Table 5 – Friction Angle and Lateral Stresses Values

Test	Test Depth (ft)	K_0	Pore Pressure	Shear Modulus	Effective Lateral σ'_h	Friction Angle	Material Behavior	Test Pocket Quality
		Sand Model	(psi)	(psi)	(psi)	(degrees)		
EQRB-B10 36	36.0	0.80	42	5700	11	37 [7]	C [7]	3
EQRB-B10 37.5	37.5	0.80	43	4300	11	36 [7]	Ø	3
EQRB-B10 70.5	70.5	0.90	57	626200	28	46	C - Ø	4
EQRB-B10 131.5	131.5	1.10	83	37100	61	41	C - Ø	2
EQRB-B10 133	133.0		84		0			0
EQRB-B10 138	138.0	0.92	86	62000	53	34	Ø - C	4
EQRB-B10 139.5	139.5	0.82	87	69100	48	33	Ø - C [6]	4
EQRB-B11 - 37.5	37.5	0.75	34	1010	10	32 [7]	Ø - C [7]	1
EQRB-B11 - 39	39.0	0.80	35	1100	12	33	Ø - C	1
EQRB-B11 - 44.5	44.5	0.60	37	2690	10	31	C - Ø	1
EQRB-B11 - 46	46.0	0.65	38	1700	11	32	C - Ø	1
EQRB-B11 - 71.5	71.5	0.85	49	159700	24	40	Ø	3
EQRB-B11 - 73	73.0	0.85	49	137500	24	32 [1]	Ø - C	1
EQRB-B11 112.5	112.5	0.95	66	8394700	46	39	Ø	3
EQRB-B11 114	114.0	0.95	67	1432000	47	41	Ø	3
EQRB-B27 143.5	143.5	0.95	79	54100	60	37 [7]	C [7]	4
EQRB-B27 145	145.0	0.95	80	64900	60	35 [7]	C [7]	4
EQRB-B09 124.5	124.5	0.93	73	29200	51	37	C - Ø	3
EQRB-B09 126	126	0.90	74	19800	49	40	C - Ø	3
EQRB-B09 130.5	130.50	0.90	75	64900	51	38	C - Ø	3
EQRB-B09 132	132.00	0.90	76	75300	52	40	C - Ø	3

Appendix II – Pressuremeter Data

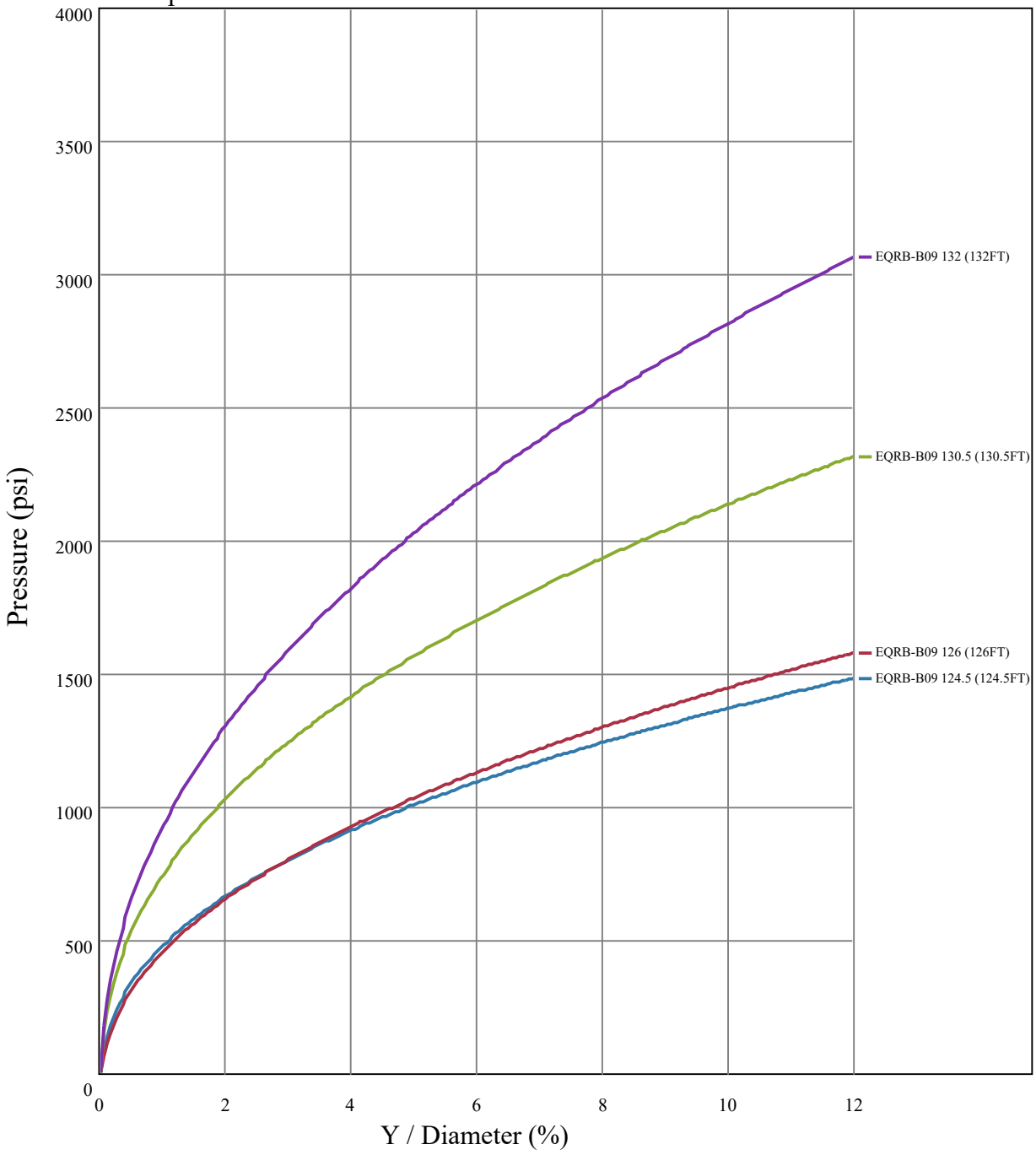
In Situ Engineering - PY Data - Frictional

Shannon and Wilson

EQRB

Boring: B09

Oper: Job # Time of Test: Inst:



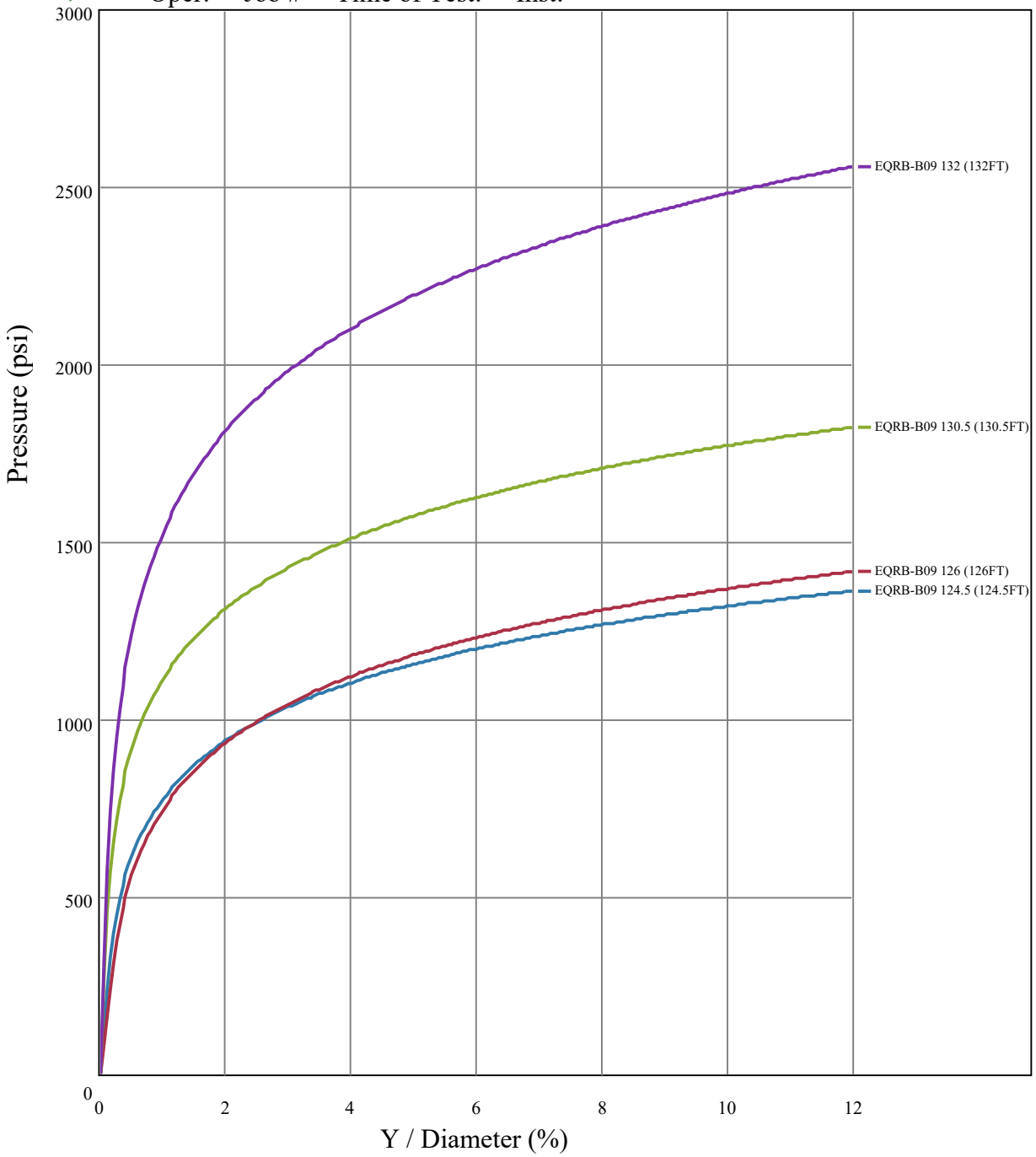
In Situ Engineering - PY Data - Cohesive

Shannon and Wilson

EQRB

Boring: B09

Oper: Job # Time of Test: Inst:



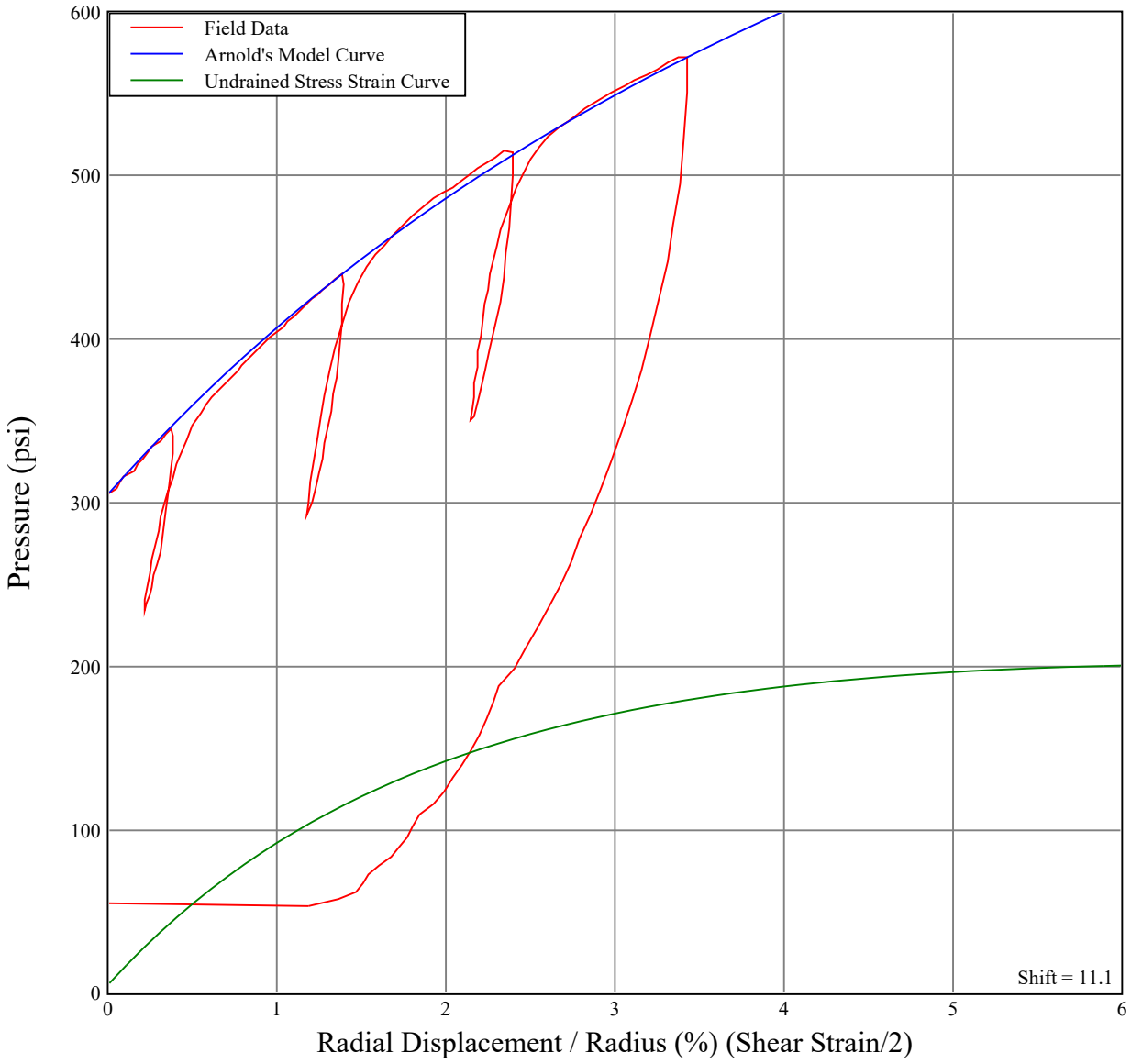
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 124.5 Depth: 124.5FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 12:59 PM Inst: 04



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 408 psi	Shear Strength at 10% Strain = 194.3 psi
Pressure at 2.5% Strain = 520 psi	Max Shear Strength = 201.2 psi
Pressure at 7.5% Strain = 725 psi	occurs at 6.9% Strain

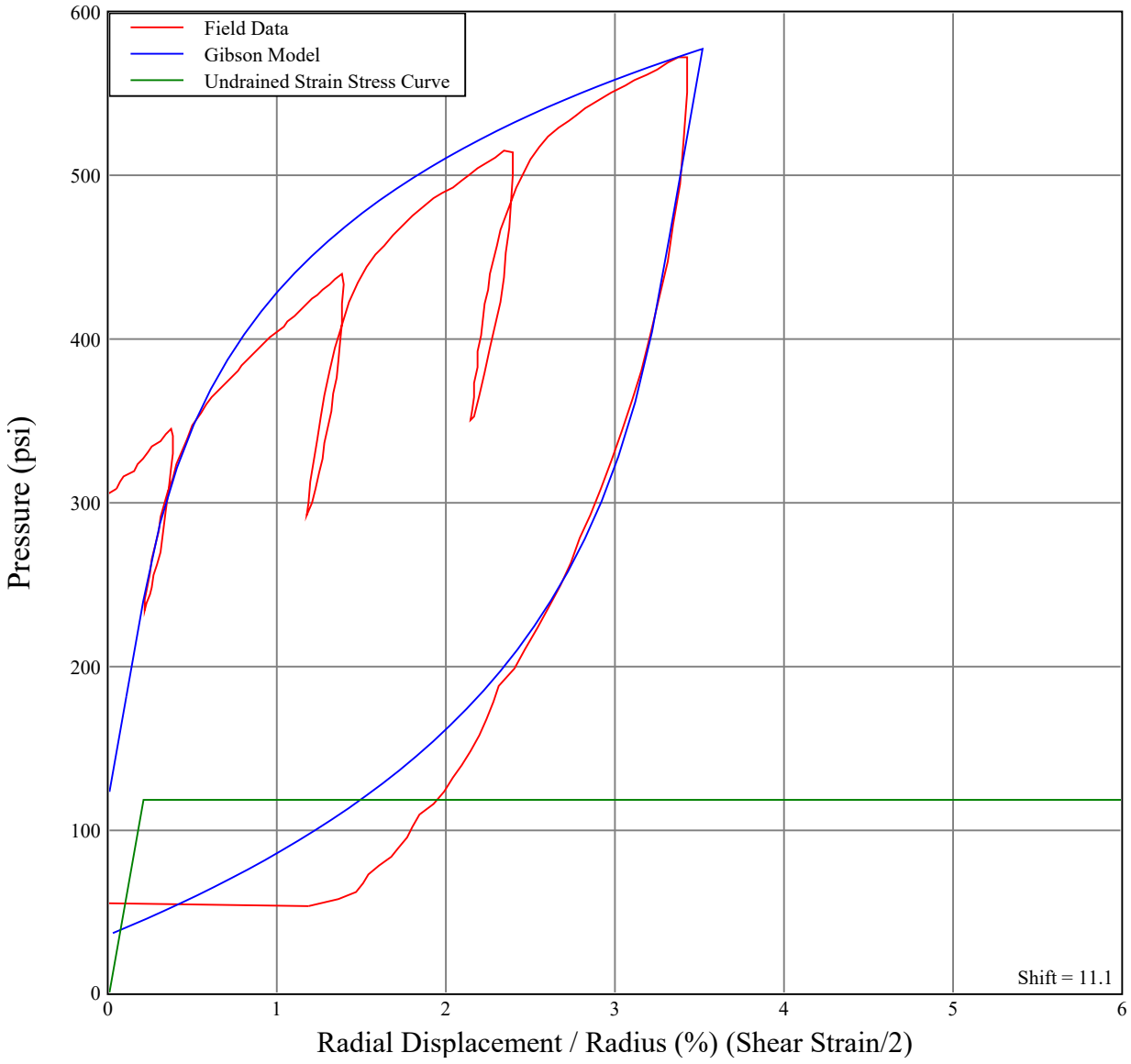
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 124.5 Depth: 124.5FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 12:59 PM Inst: 04



DATA

LOADING	UNLOADING
Shear Strength = 118 psi	Shear Strength = 150 psi
In Situ Stress = 123 psi	Shear Modulus = 29200 psi
Shear Modulus = 29200 psi	

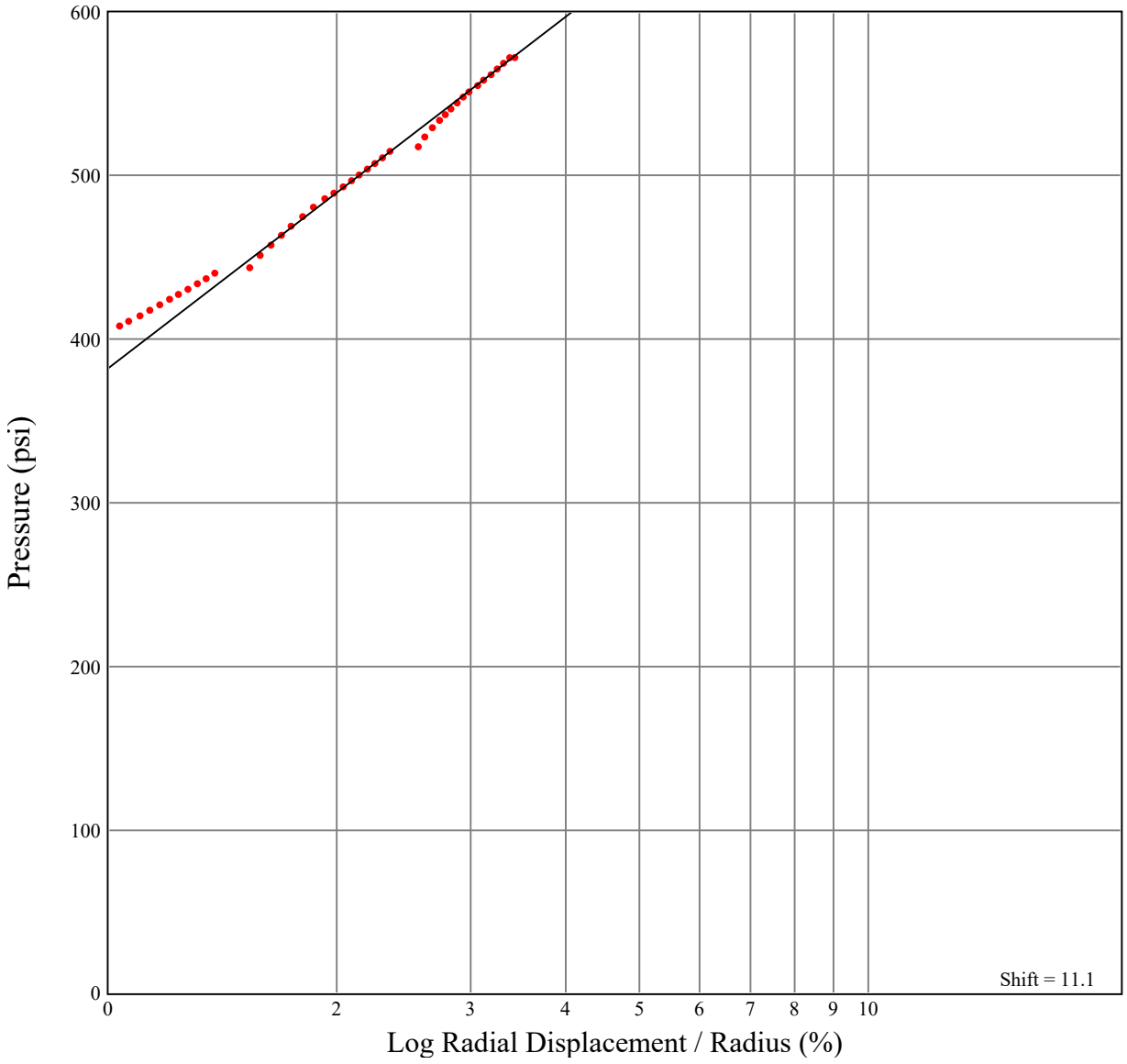
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 124.5 Depth: 124.5FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 12:59 PM Inst: 04



DATA

Shear Strength = 155 psi

Limit Pressure = 959 psi

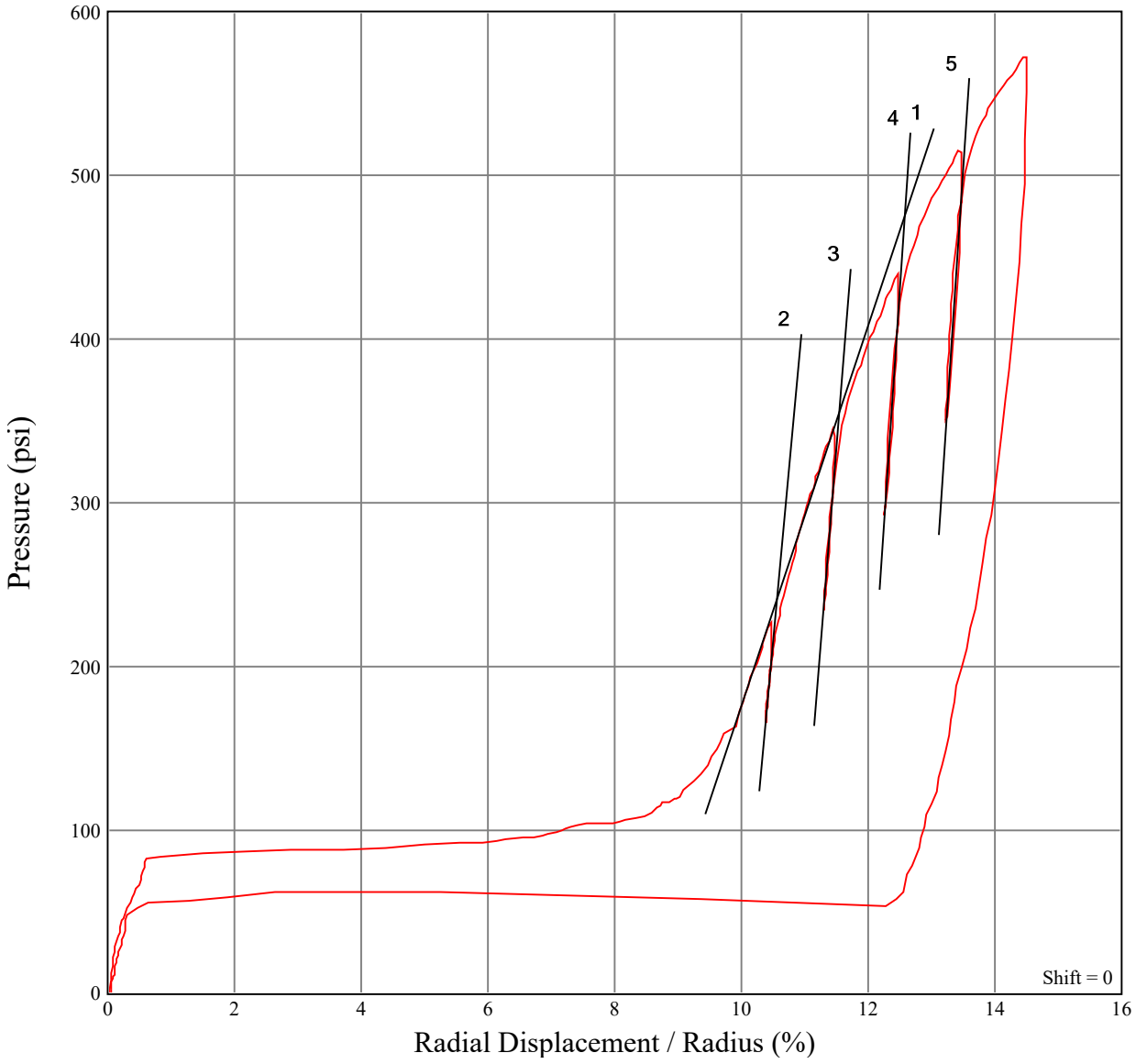
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 124.5 Depth: 124.5FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 12:59 PM Inst: 04



DATA

#1 Shear Modulus = 5800 psi

#2 Shear Modulus = 21000 psi

#3 Shear Modulus = 24200 psi

#4 Shear Modulus = 28600 psi

#5 Shear Modulus = 29200 psi

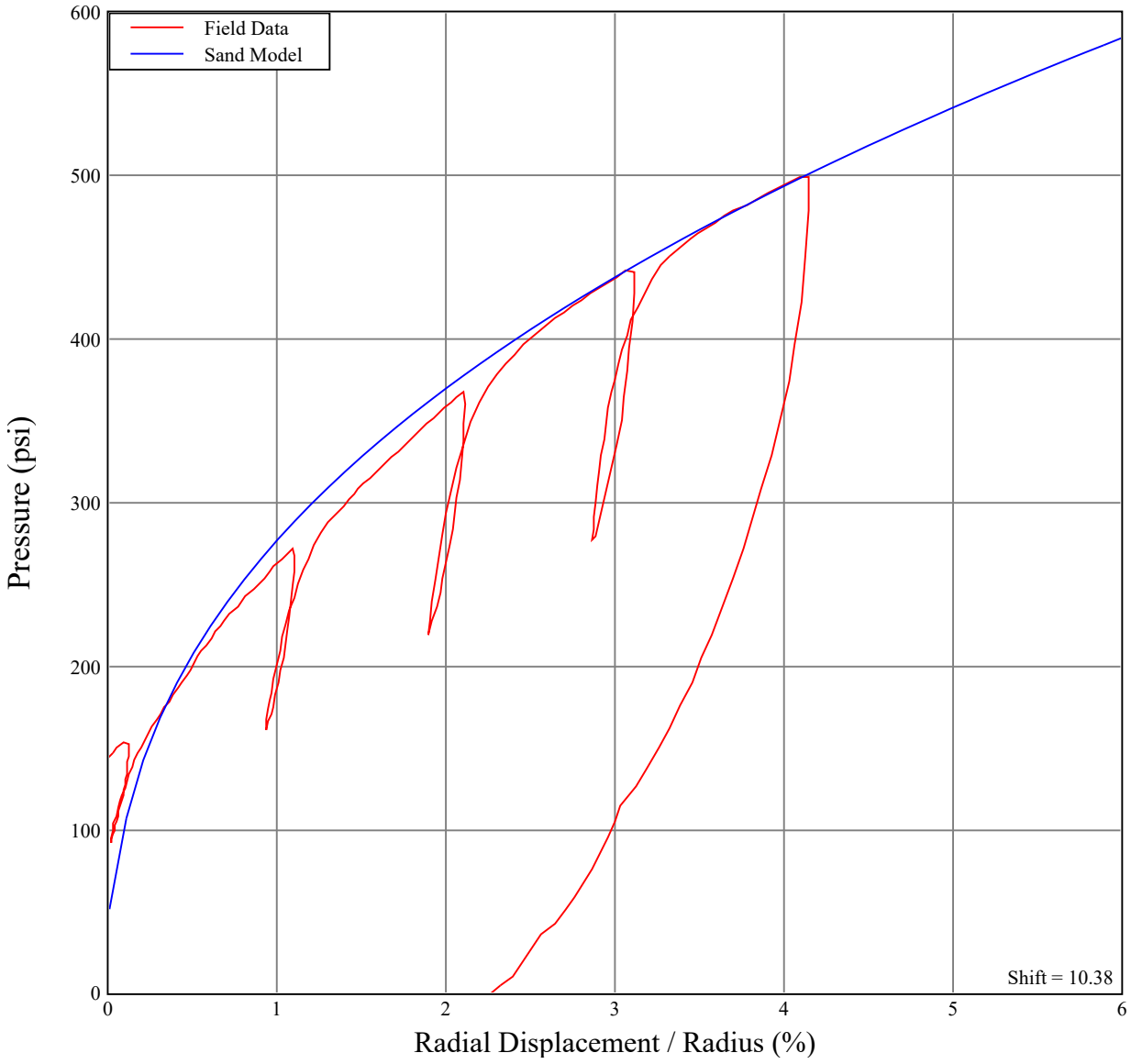
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 124.5 Depth: 124.5FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 12:59 PM Inst: 04



DATA

Water Pressure = 73 psi

Lateral Stress = 51 psi

Friction Angle = 37 deg

Shear Modulus = 29200 psi

Critical Friction Angle = 32 deg

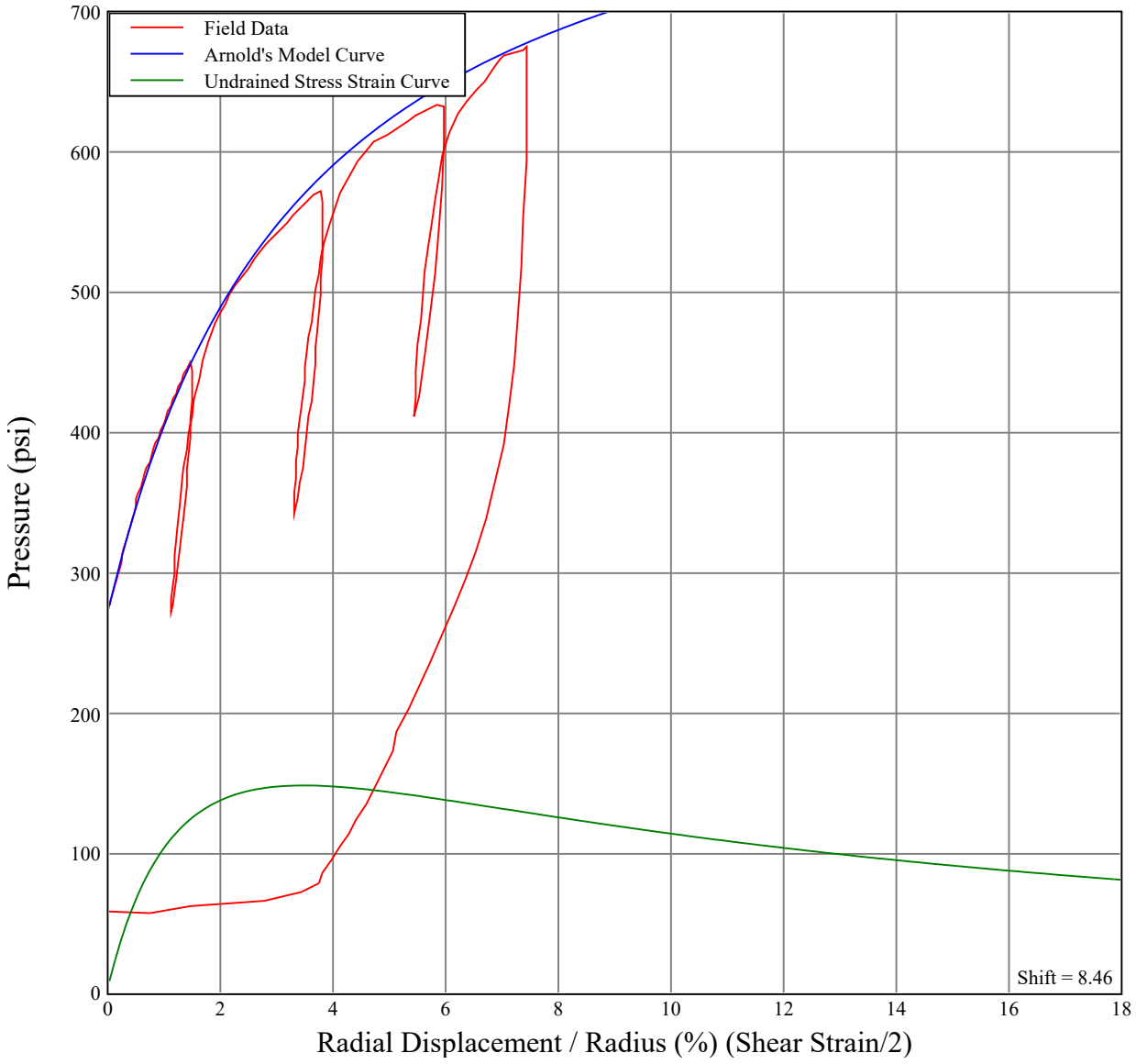
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 126 Depth: 126FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 12:36 PM Inst: 04



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 408 psi	Shear Strength at 10% Strain = 113.6 psi
Pressure at 2.5% Strain = 523 psi	Max Shear Strength = 148.0 psi
Pressure at 7.5% Strain = 680 psi	occurs at 3.5% Strain

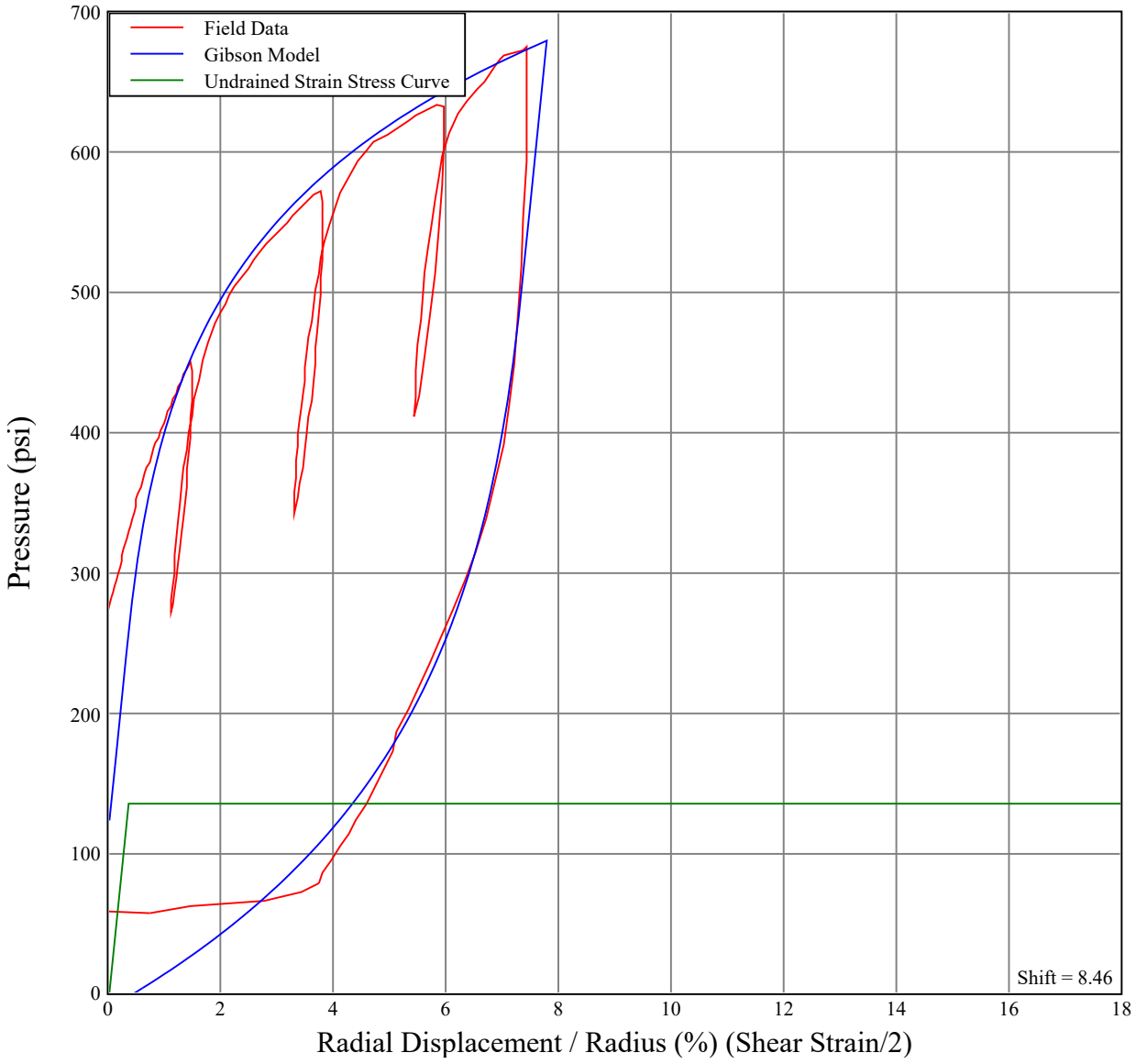
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 126 Depth: 126FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 12:36 PM Inst: 04



DATA

LOADING	UNLOADING
Shear Strength = 135 psi	Shear Strength = 180 psi
In Situ Stress = 123 psi	Shear Modulus = 19800 psi
Shear Modulus = 19800 psi	

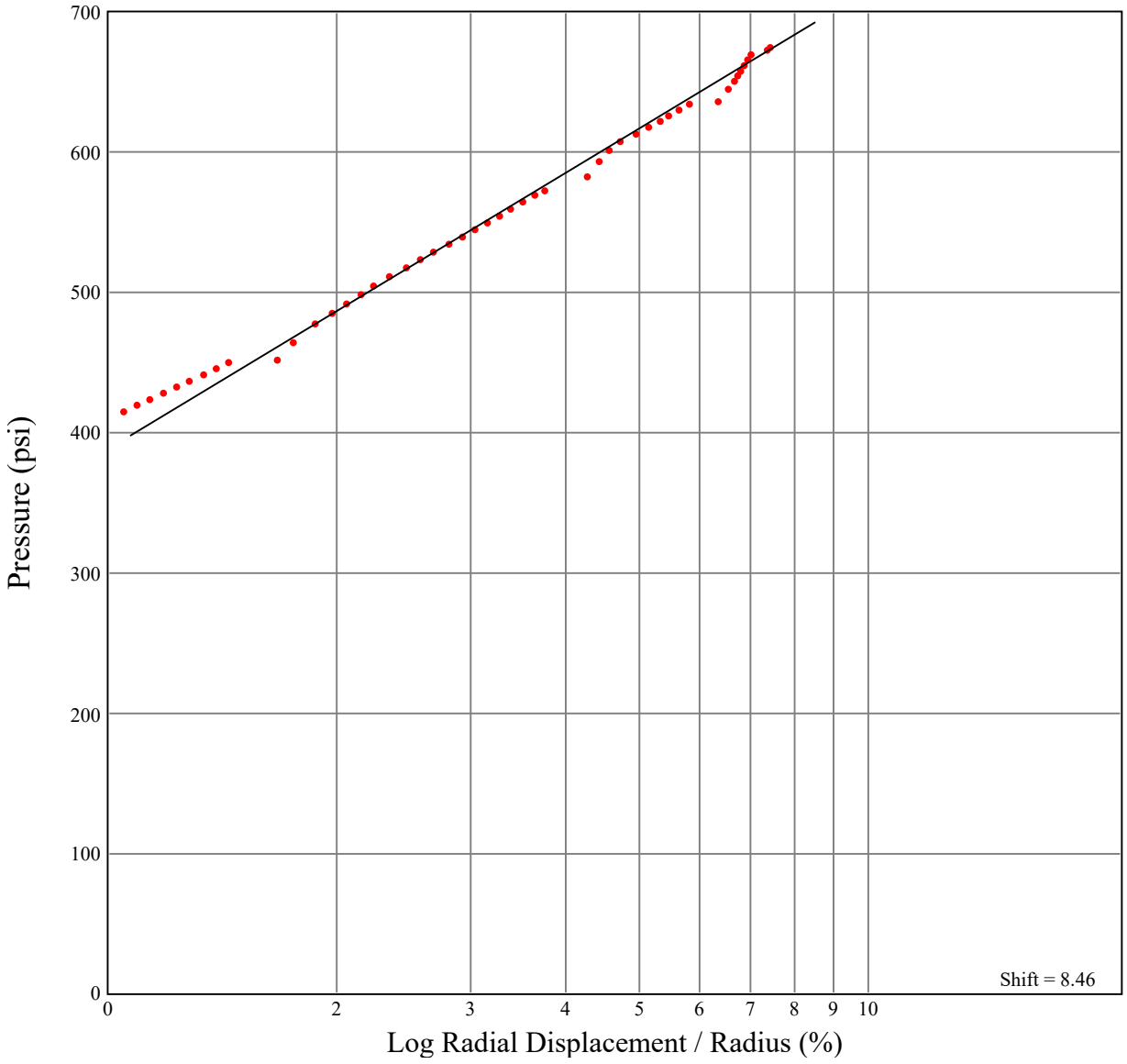
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 126 Depth: 126FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 12:36 PM Inst: 04



DATA

Shear Strength = 142 psi

Limit Pressure = 916 psi

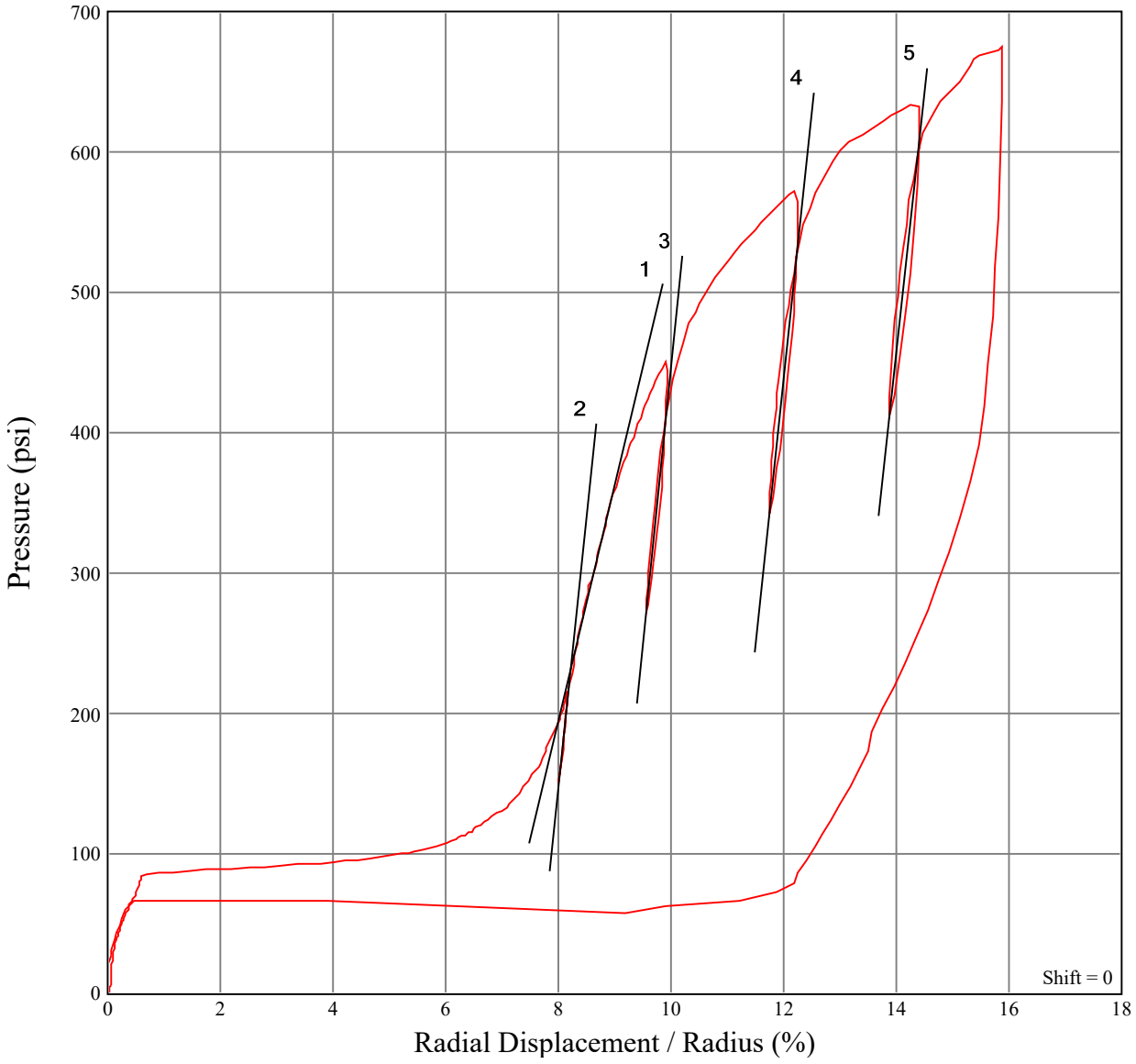
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 126 Depth: 126FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 12:36 PM Inst: 04



DATA

#1 Shear Modulus = 8400 psi

#2 Shear Modulus = 19200 psi

#3 Shear Modulus = 19800 psi

#4 Shear Modulus = 19000 psi

#5 Shear Modulus = 18500 psi

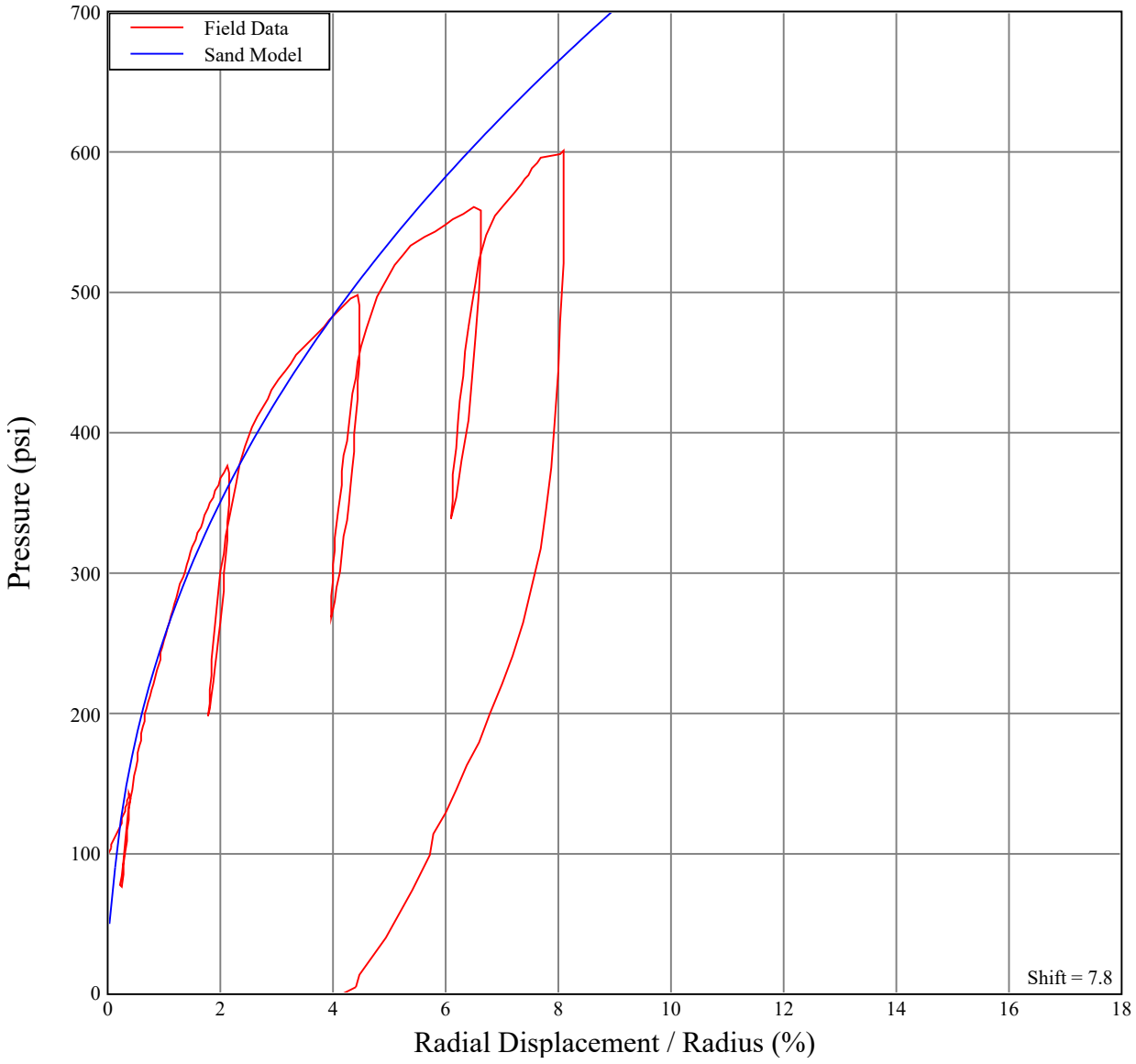
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 126 Depth: 126FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 12:36 PM Inst: 04



DATA

Water Pressure = 74 psi

Lateral Stress = 49 psi

Friction Angle = 40 deg

Shear Modulus = 19800 psi

Critical Friction Angle = 32 deg

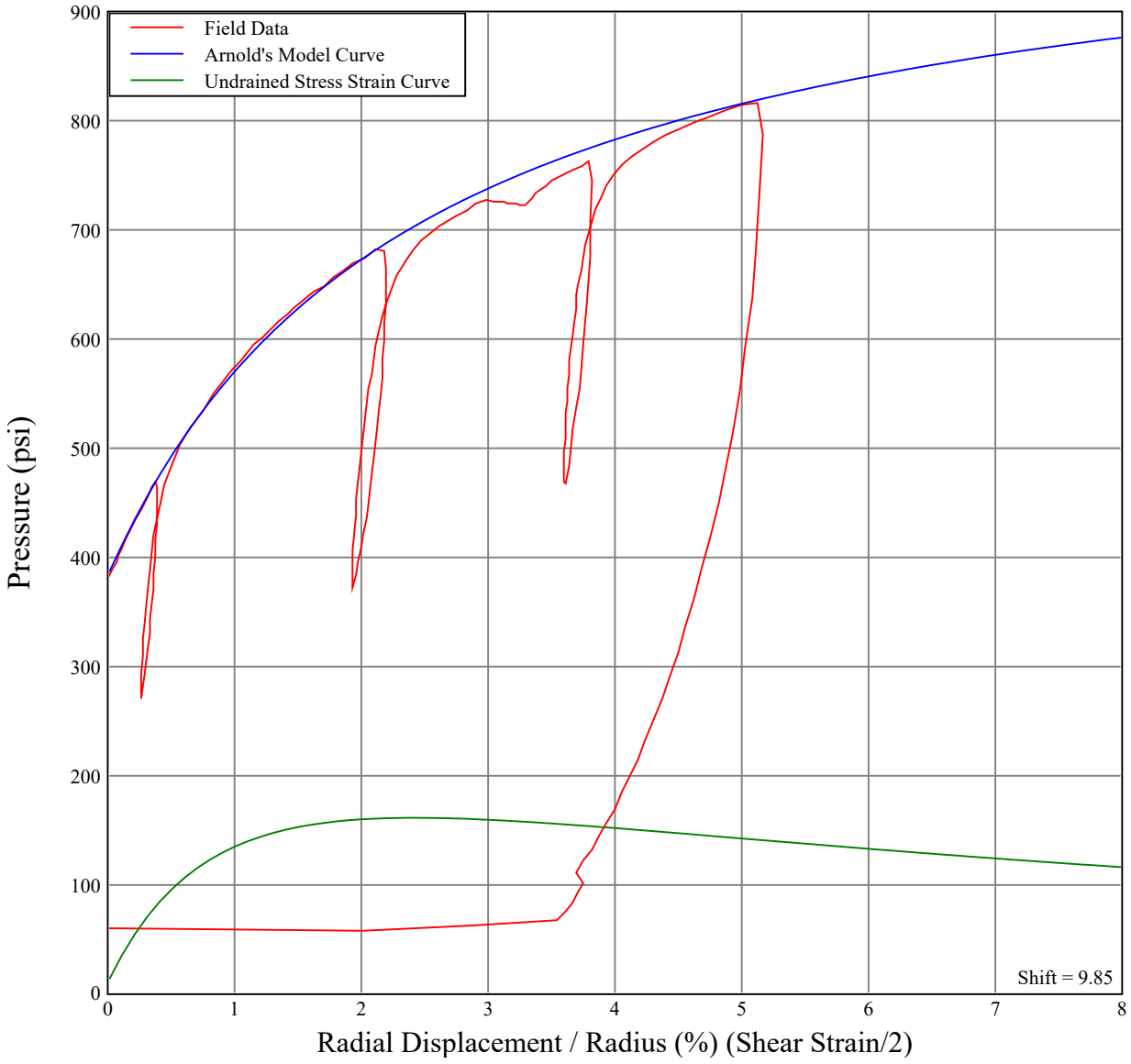
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 130.5 Depth: 130.5FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 03:00 PM Inst: 04



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 572 psi	Shear Strength at 10% Strain = 101.6 psi
Pressure at 2.5% Strain = 710 psi	Max Shear Strength = 160.6 psi
Pressure at 7.5% Strain = 870 psi	occurs at 2.4% Strain

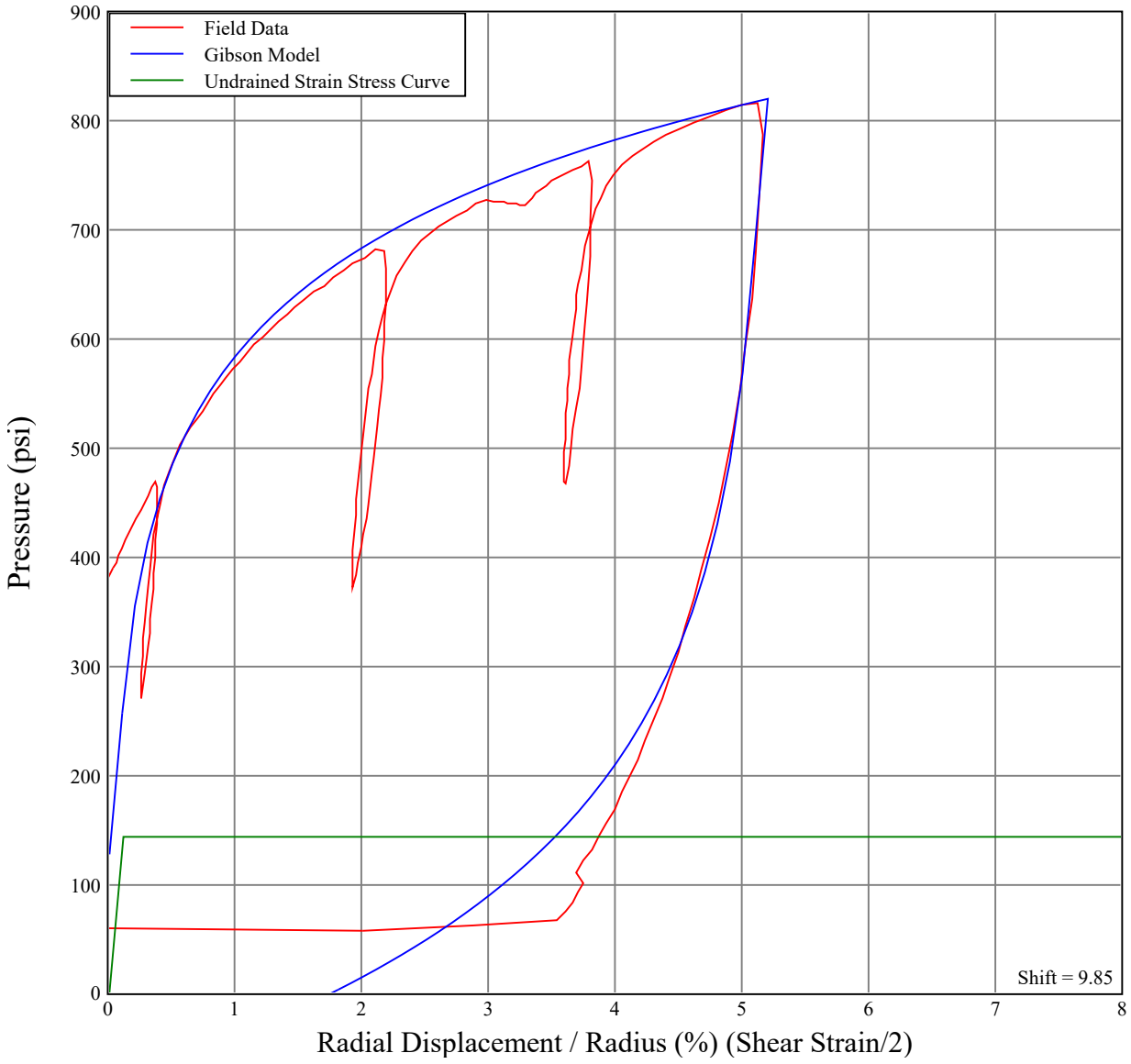
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 130.5 Depth: 130.5FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 03:00 PM Inst: 04



DATA

LOADING	UNLOADING
Shear Strength = 143 psi	Shear Strength = 200 psi
In Situ Stress = 127 psi	Shear Modulus = 64900 psi
Shear Modulus = 64900 psi	

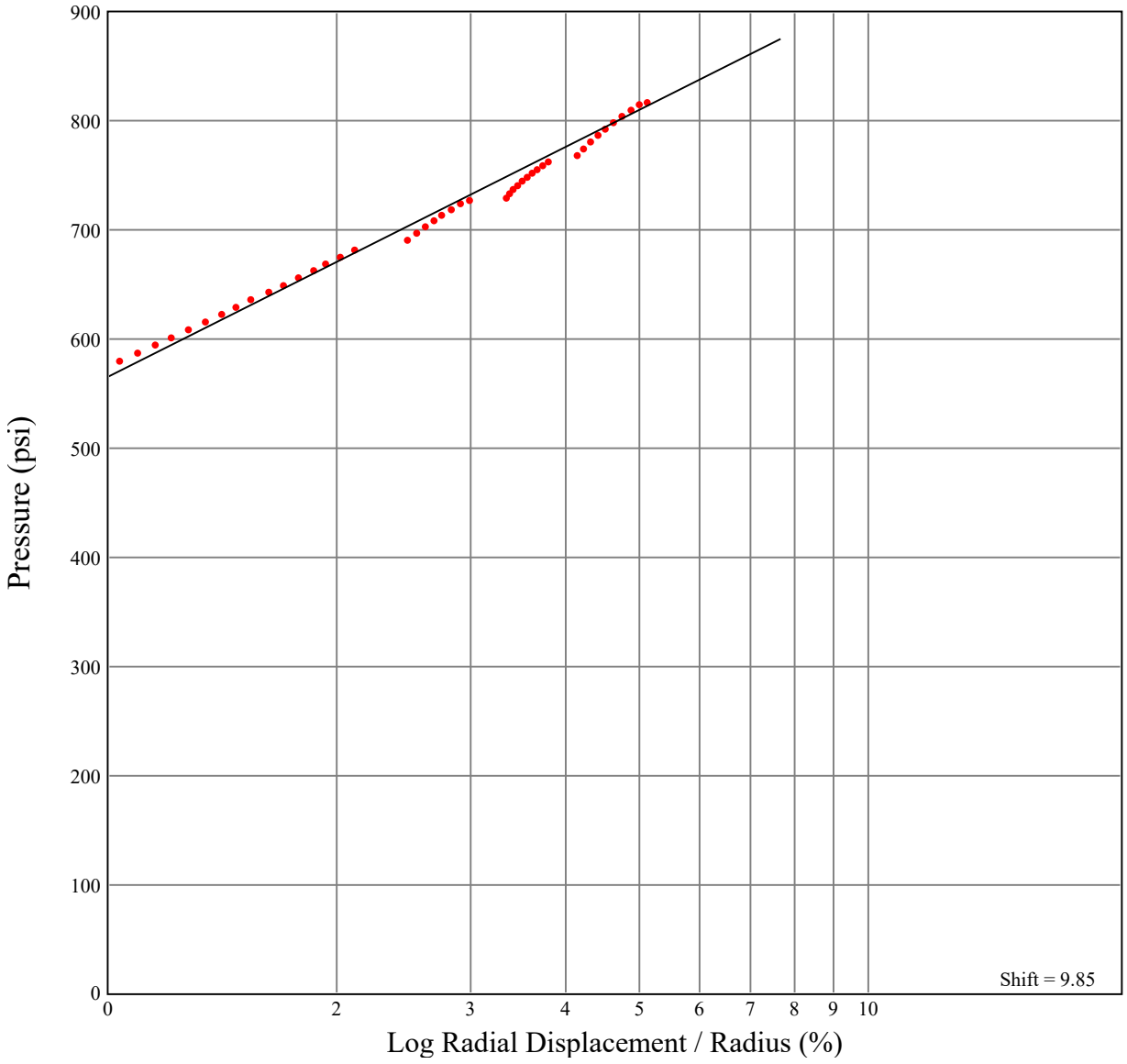
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 130.5 Depth: 130.5FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 03:00 PM Inst: 04



DATA

Shear Strength = 152 psi

Limit Pressure = 1131 psi

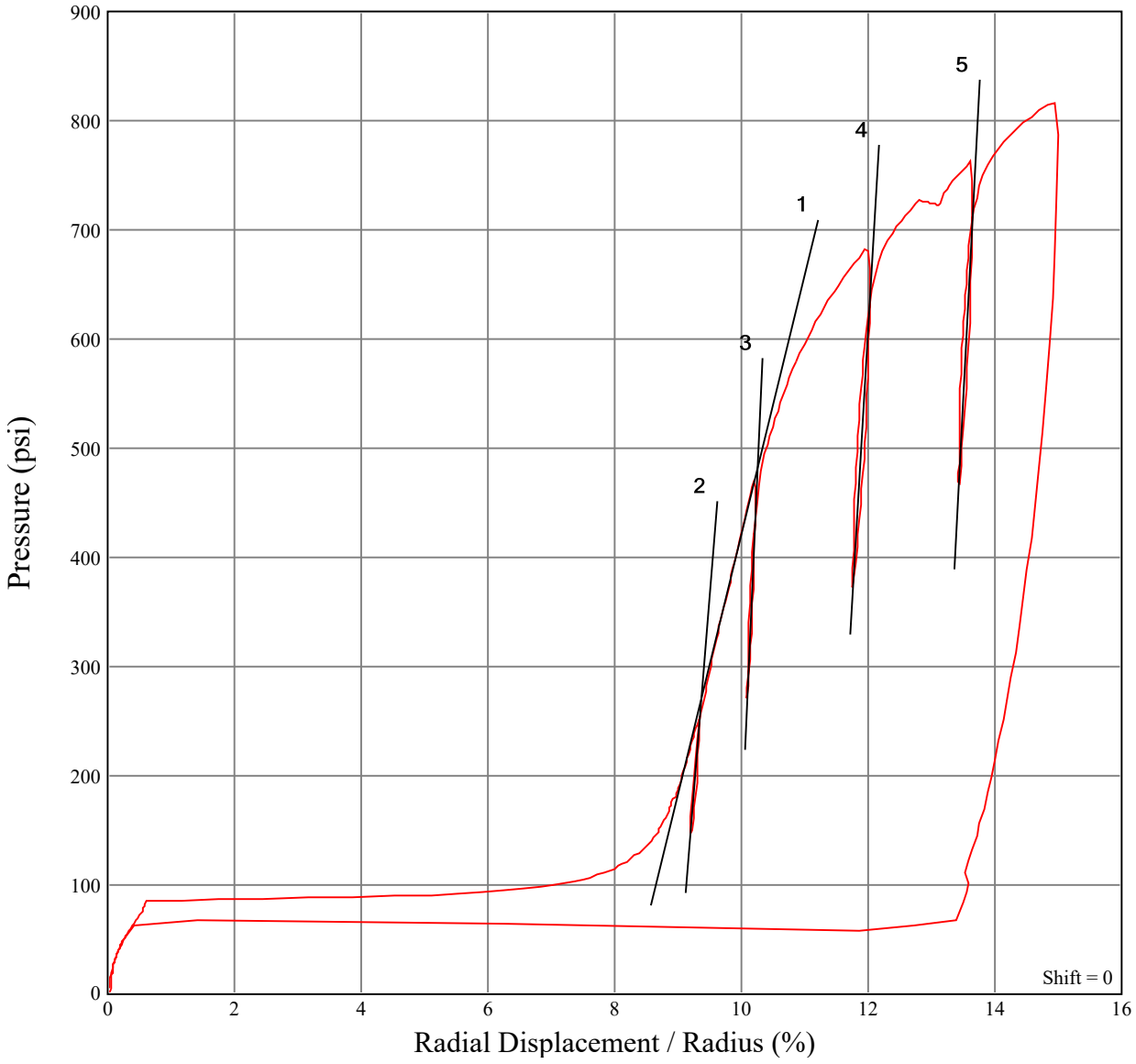
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 130.5 Depth: 130.5FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 03:00 PM Inst: 04



DATA

#1 Shear Modulus = 11900 psi

#2 Shear Modulus = 35900 psi

#3 Shear Modulus = 64900 psi

#4 Shear Modulus = 49400 psi

#5 Shear Modulus = 55900 psi

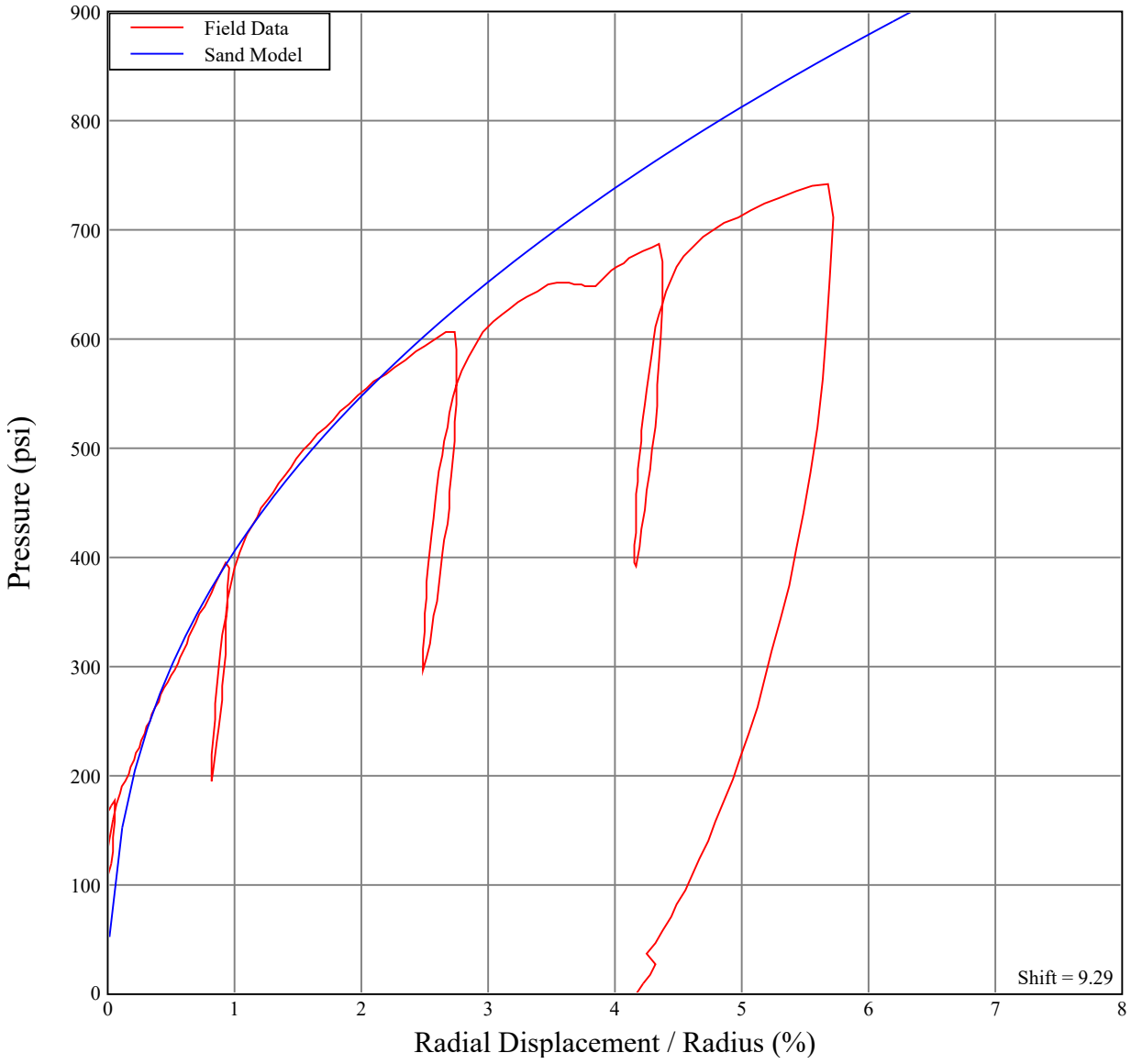
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 130.5 Depth: 130.5FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 03:00 PM Inst: 04



DATA

Water Pressure = 75 psi

Lateral Stress = 51 psi

Friction Angle = 38 deg

Shear Modulus = 64900 psi

Critical Friction Angle = 32 deg

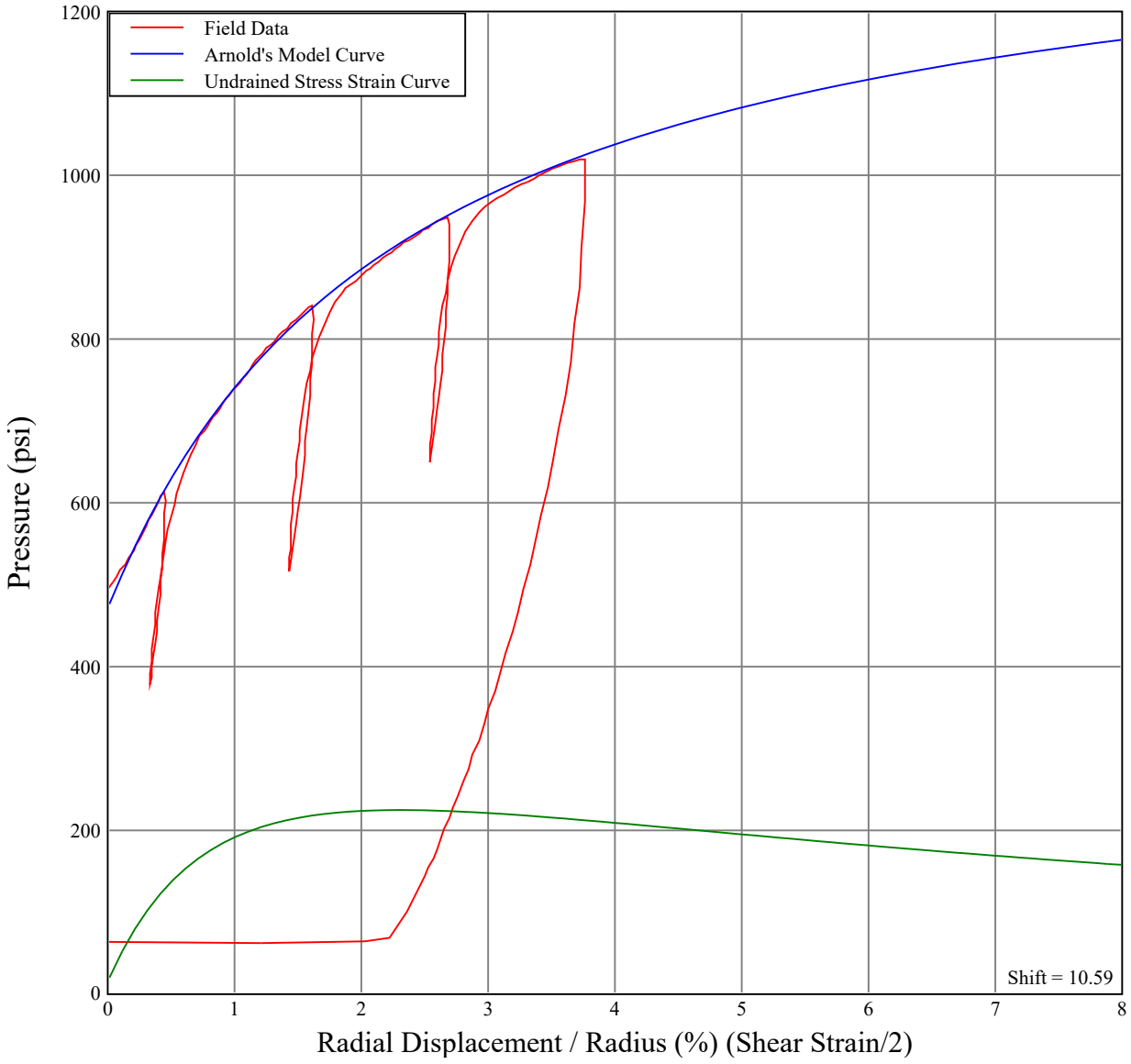
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 132 Depth: 132FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 02:30 PM Inst: 04



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 743 psi	Shear Strength at 10% Strain = 137.4 psi
Pressure at 2.5% Strain = 937 psi	Max Shear Strength = 223.6 psi
Pressure at 7.5% Strain = 1157 psi	occurs at 2.3% Strain

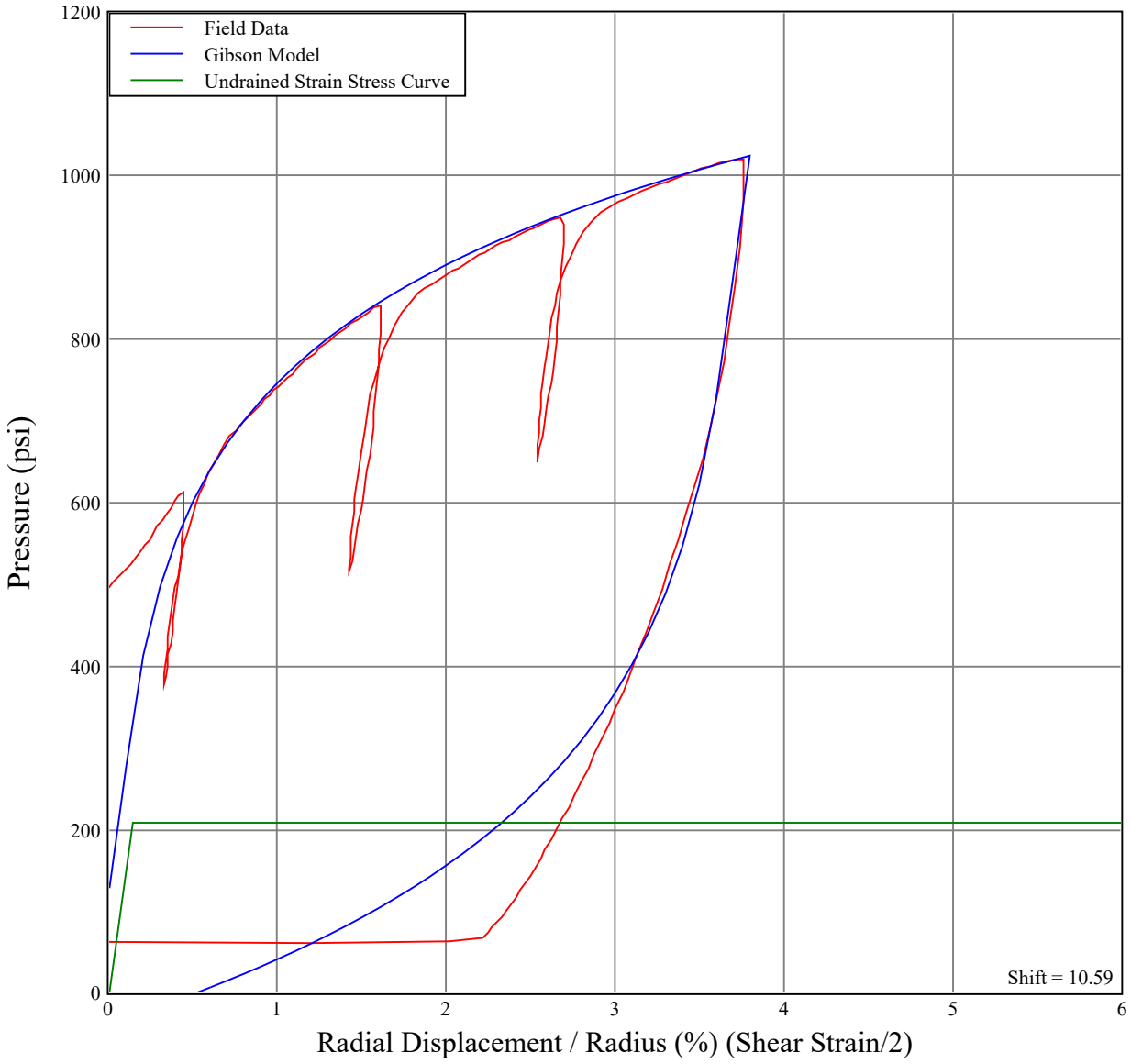
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 132 Depth: 132FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 02:30 PM Inst: 04



DATA

LOADING	UNLOADING
Shear Strength = 208 psi	Shear Strength = 260 psi
In Situ Stress = 128 psi	Shear Modulus = 75300 psi
Shear Modulus = 75300 psi	

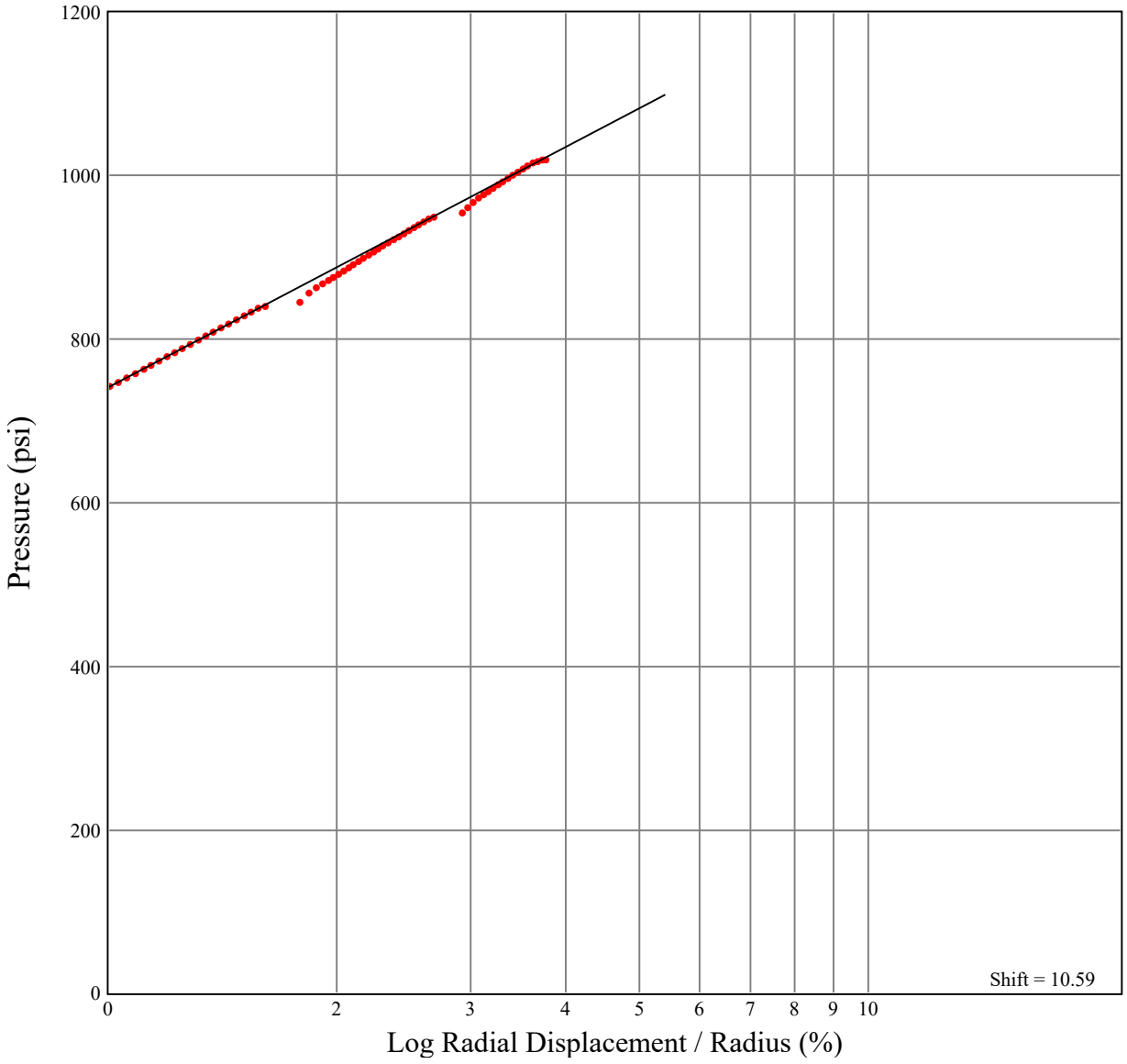
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 132 Depth: 132FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 02:30 PM Inst: 04



DATA

Shear Strength = 212 psi

Limit Pressure = 1530 psi

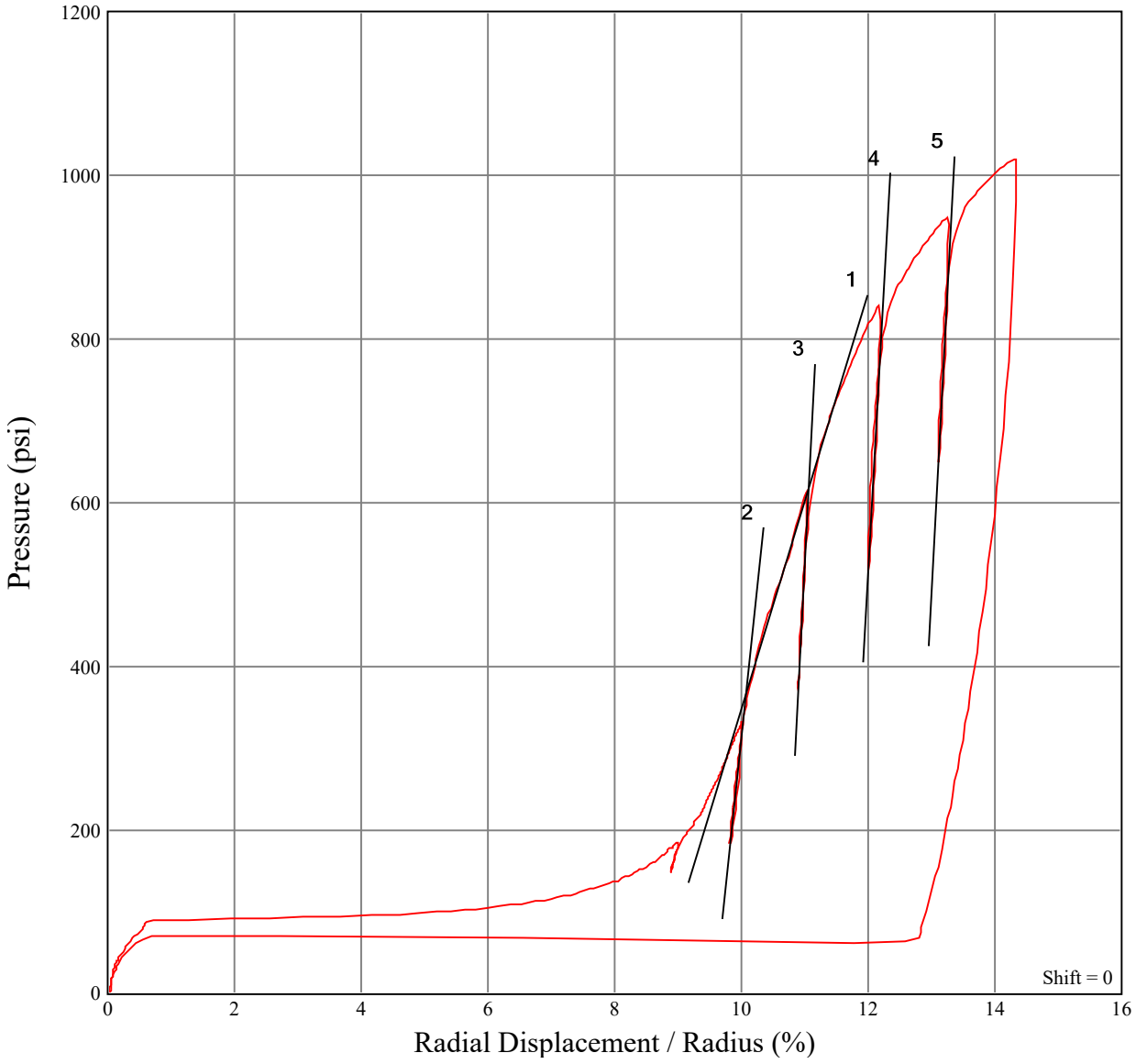
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 132 Depth: 132FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 02:30 PM Inst: 04



DATA

#1 Shear Modulus = 12700 psi

#2 Shear Modulus = 36700 psi

#3 Shear Modulus = 75300 psi

#4 Shear Modulus = 69900 psi

#5 Shear Modulus = 73700 psi

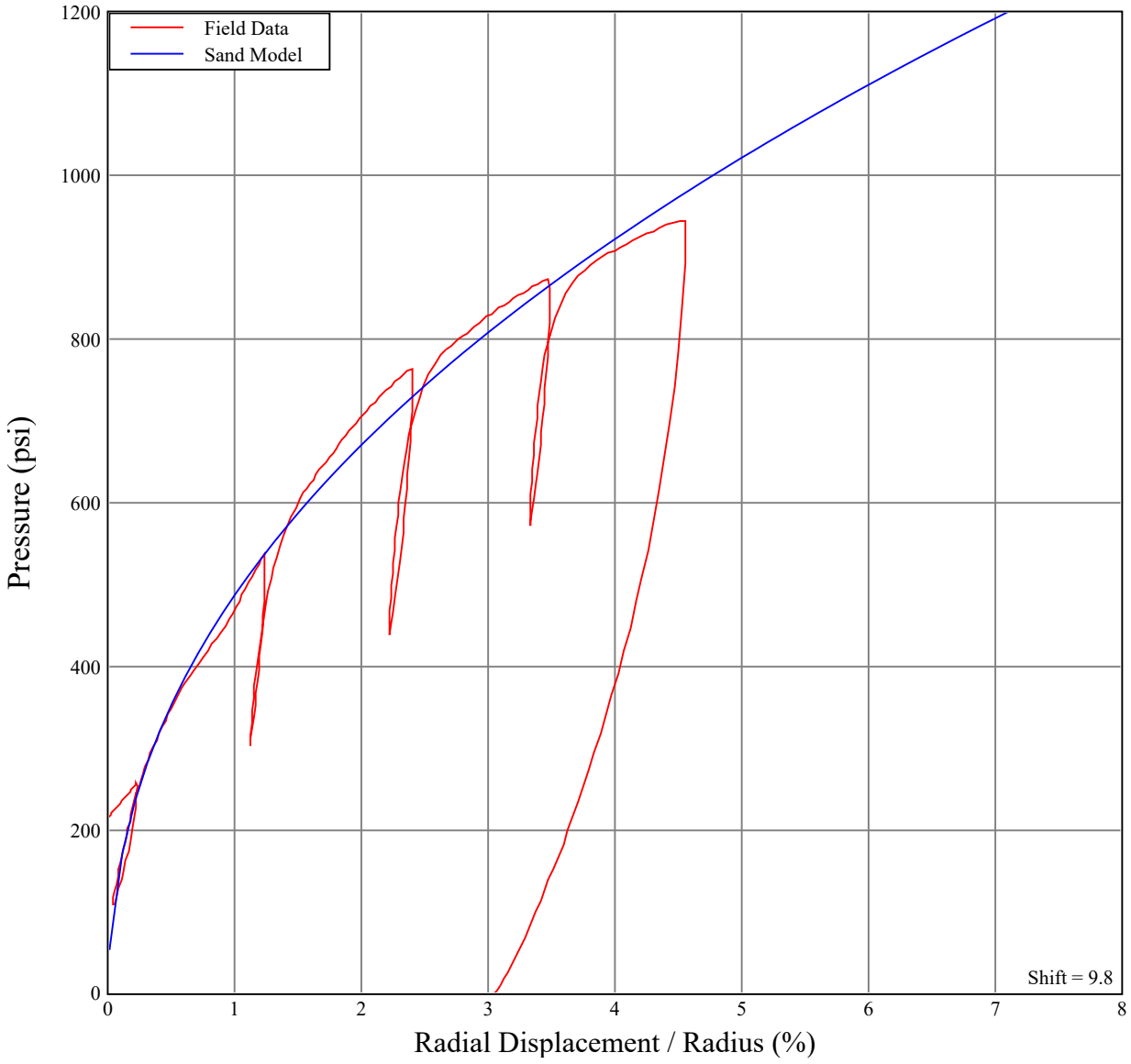
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B09 Test: EQRB-B09 132 Depth: 132FT Date: 08/18/2021

Oper: Walsh Job # 102636 Time of Test: 02:30 PM Inst: 04



DATA

Water Pressure = 76 psi

Lateral Stress = 52 psi

Friction Angle = 40 deg

Shear Modulus = 75300 psi

Critical Friction Angle = 32 deg

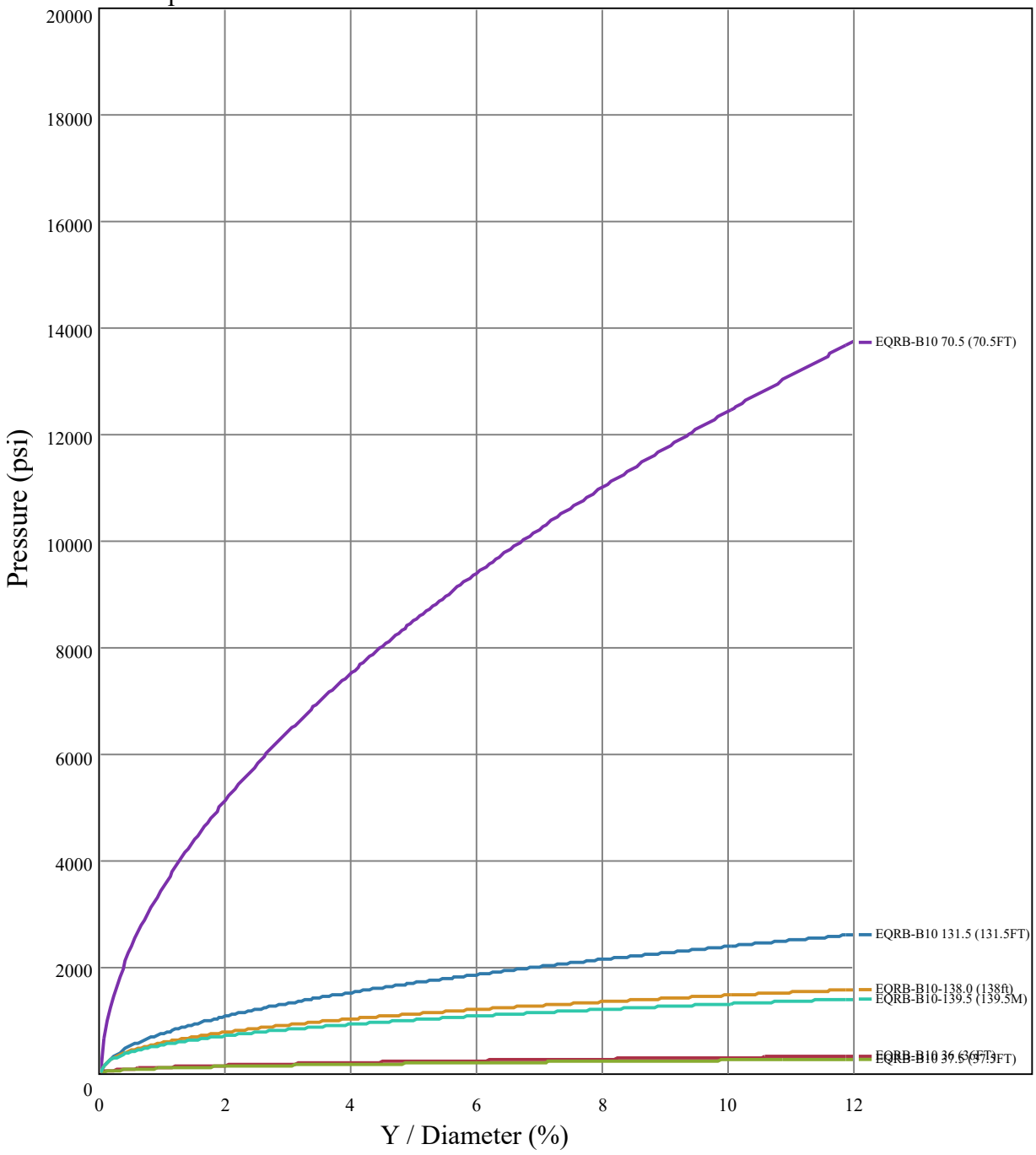
In Situ Engineering - PY Data - Frictional

Shannon and Wilson

EQRB

Boring: B10

Oper: Job # Time of Test: Inst:



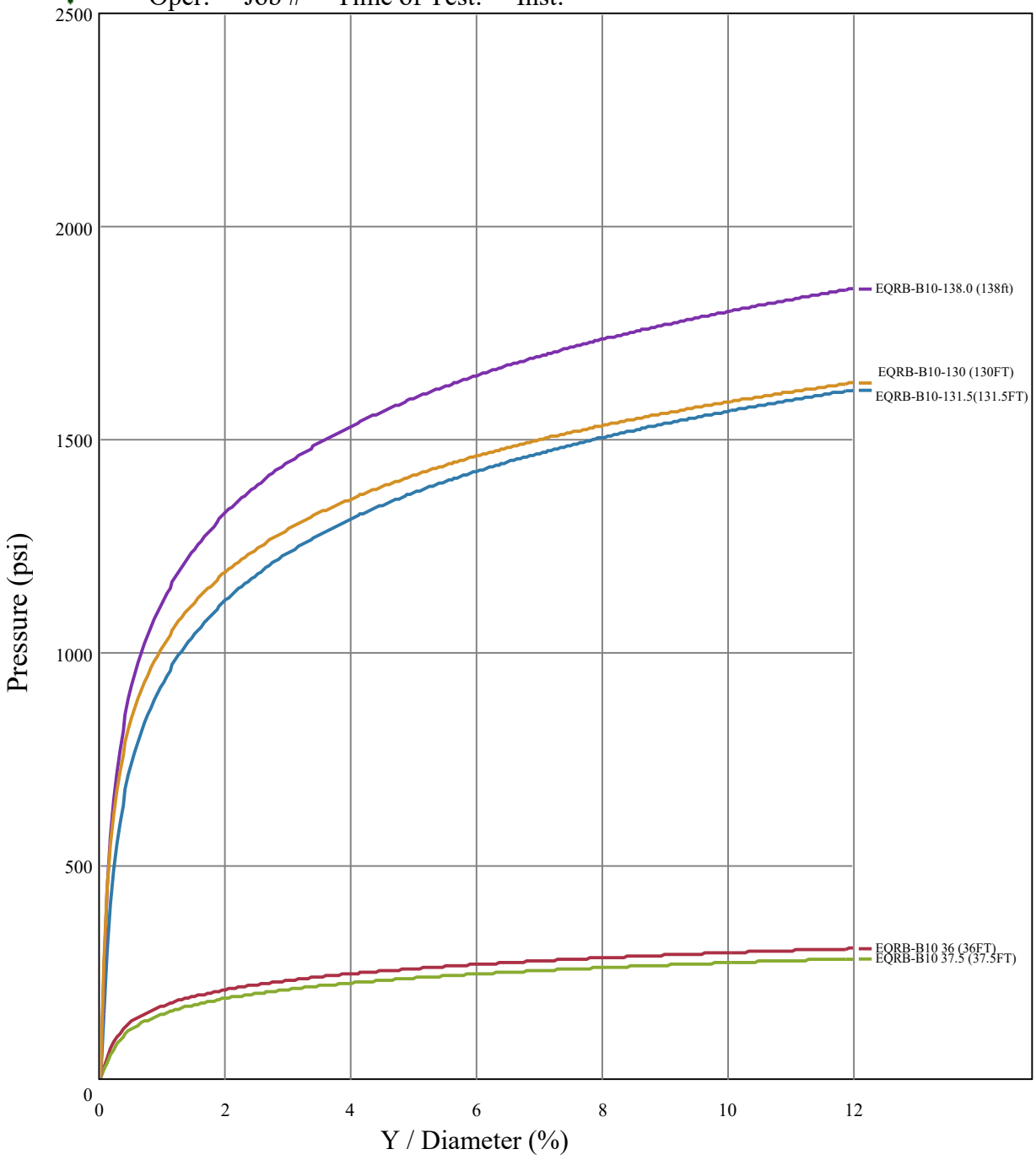
In Situ Engineering - PY Data - Cohesive

Shannon and Wilson

EQRB

Boring: B10

Oper: Job # Time of Test: Inst:



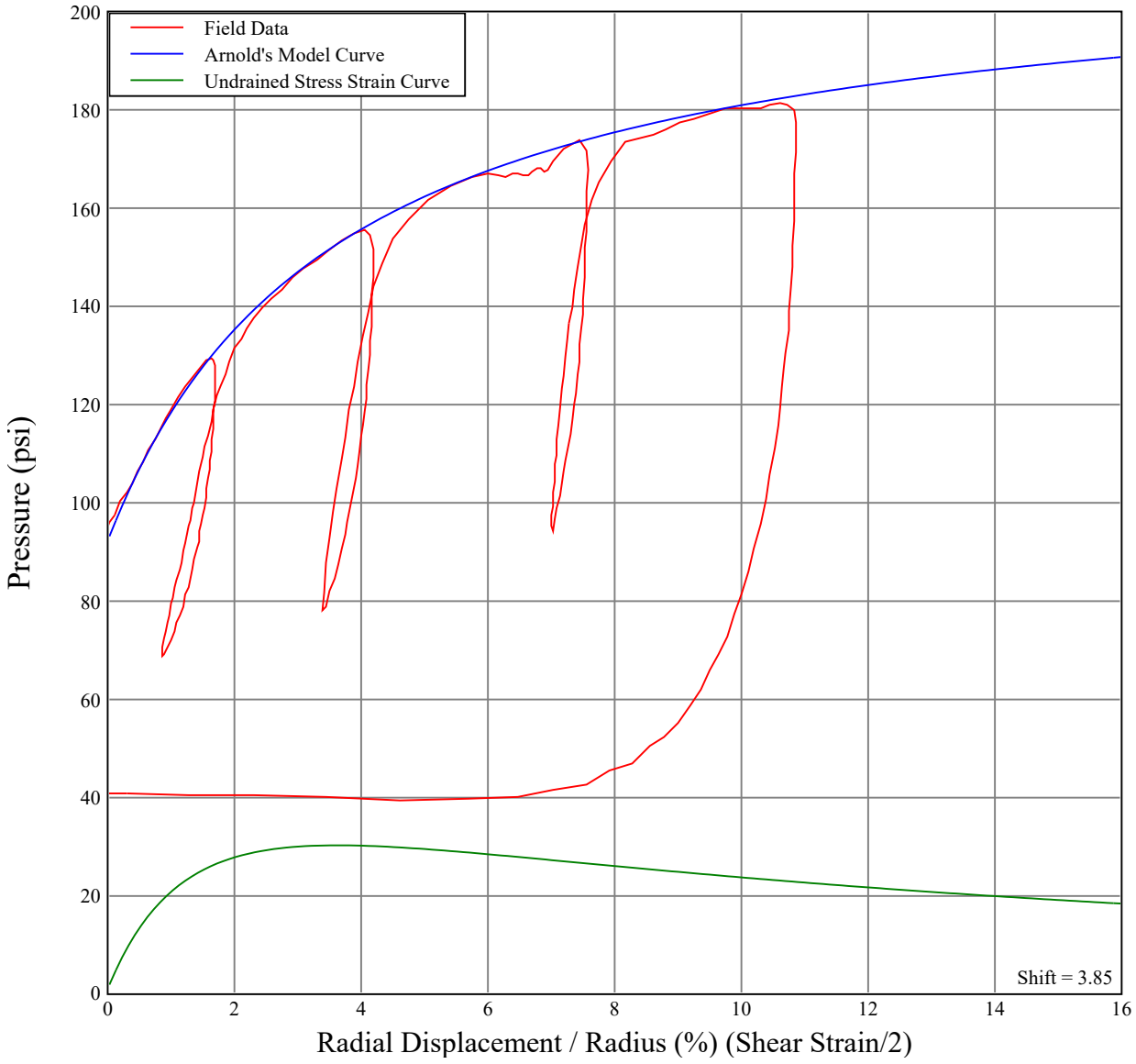
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 36 Depth: 36FT Date: 07/29/2021

Oper: Walsh Job # 102636 Time of Test: 03:59 PM Inst: 06



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 119 psi	Shear Strength at 10% Strain = 23.5 psi
Pressure at 2.5% Strain = 142 psi	Max Shear Strength = 30.1 psi
Pressure at 7.5% Strain = 174 psi	occurs at 3.6% Strain

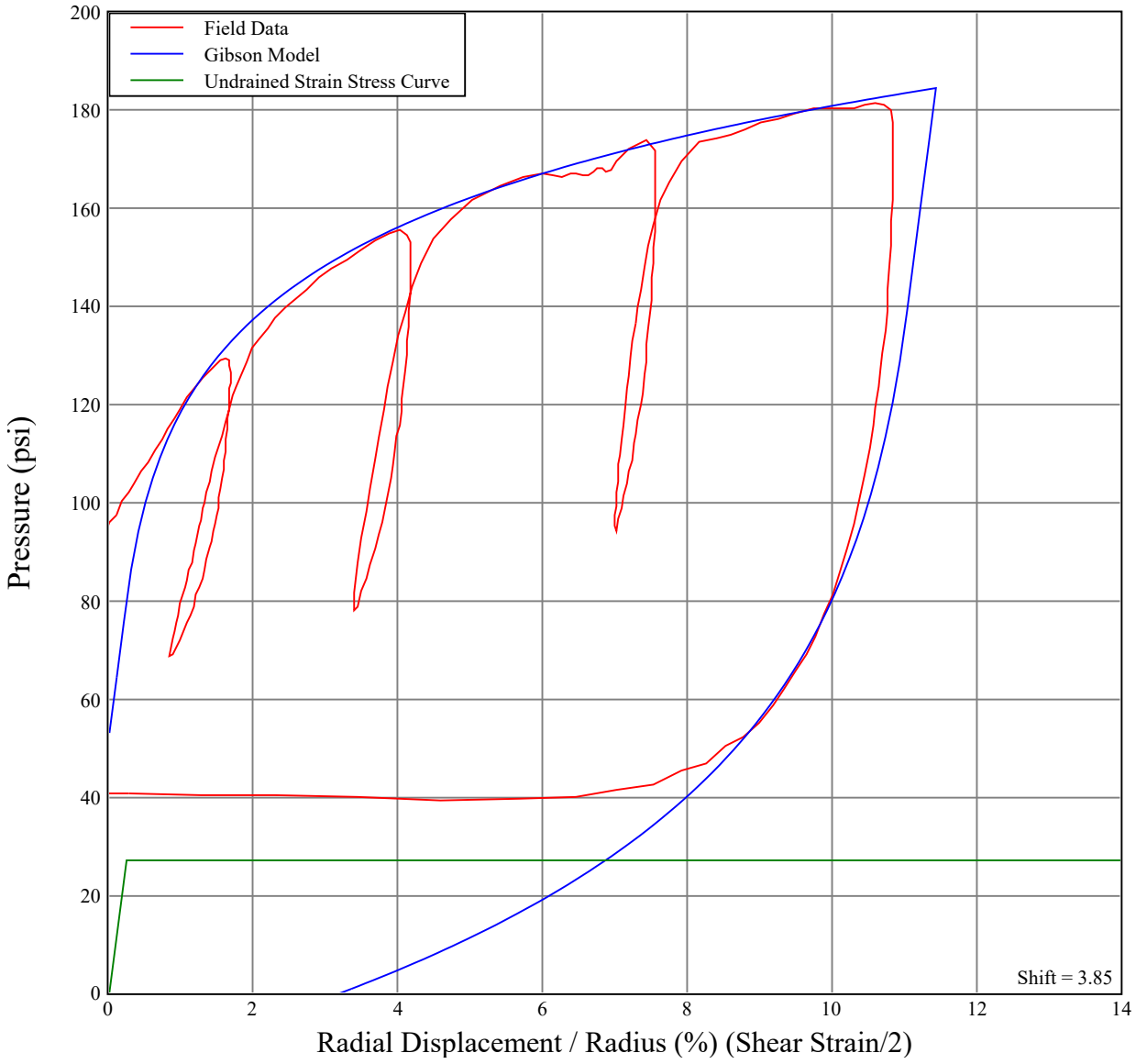
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 36 Depth: 36FT Date: 07/29/2021

Oper: Walsh Job # 102636 Time of Test: 03:59 PM Inst: 06



DATA

LOADING	UNLOADING
Shear Strength = 27 psi	Shear Strength = 46 psi
In Situ Stress = 53 psi	Shear Modulus = 5700 psi
Shear Modulus = 5700 psi	

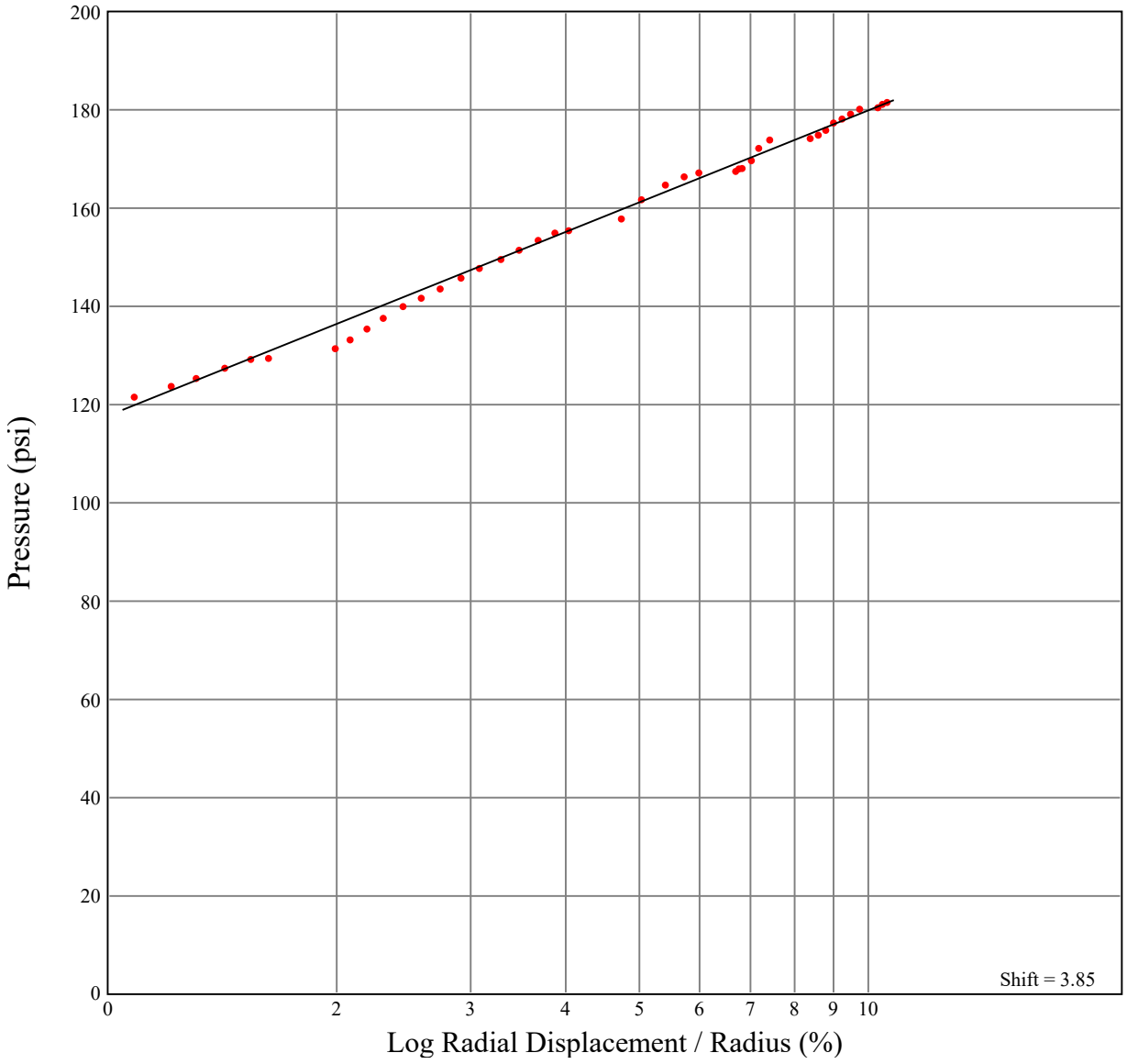
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 36 Depth: 36FT Date: 07/29/2021

Oper: Walsh Job # 102636 Time of Test: 03:59 PM Inst: 06



DATA

Shear Strength = 27 psi

Limit Pressure = 218 psi

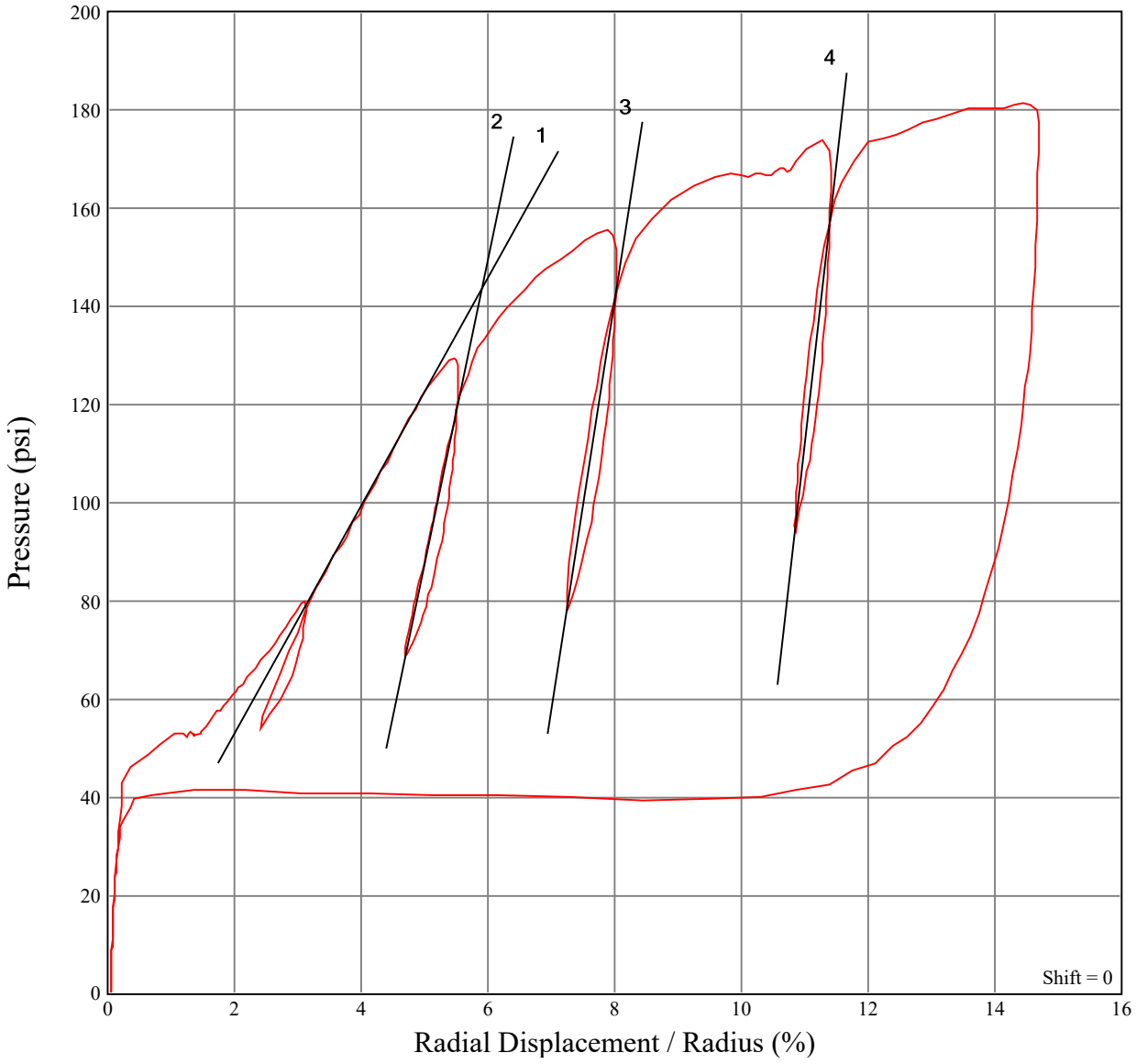
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 36 Depth: 36FT Date: 07/29/2021

Oper: Walsh Job # 102636 Time of Test: 03:59 PM Inst: 06



DATA

#1 Shear Modulus = 1160 psi

#2 Shear Modulus = 3100 psi

#3 Shear Modulus = 4170 psi

#4 Shear Modulus = 5700 psi

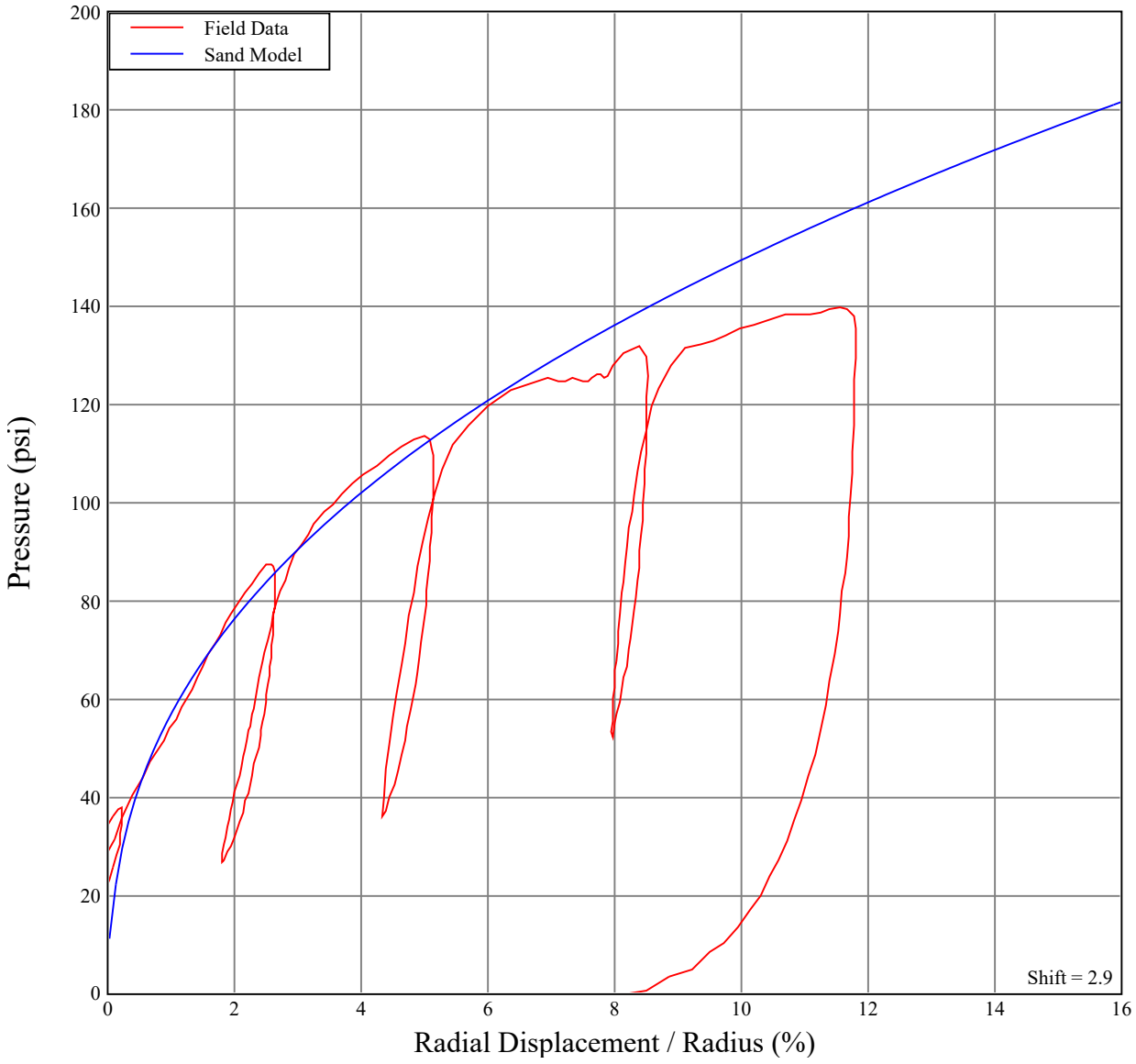
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 36 Depth: 36FT Date: 07/29/2021

Oper: Walsh Job # 102636 Time of Test: 03:59 PM Inst: 06



DATA

Water Pressure = 42 psi

Lateral Stress = 11 psi

Friction Angle = 37 deg

Shear Modulus = 5700 psi

Critical Friction Angle = 32 deg

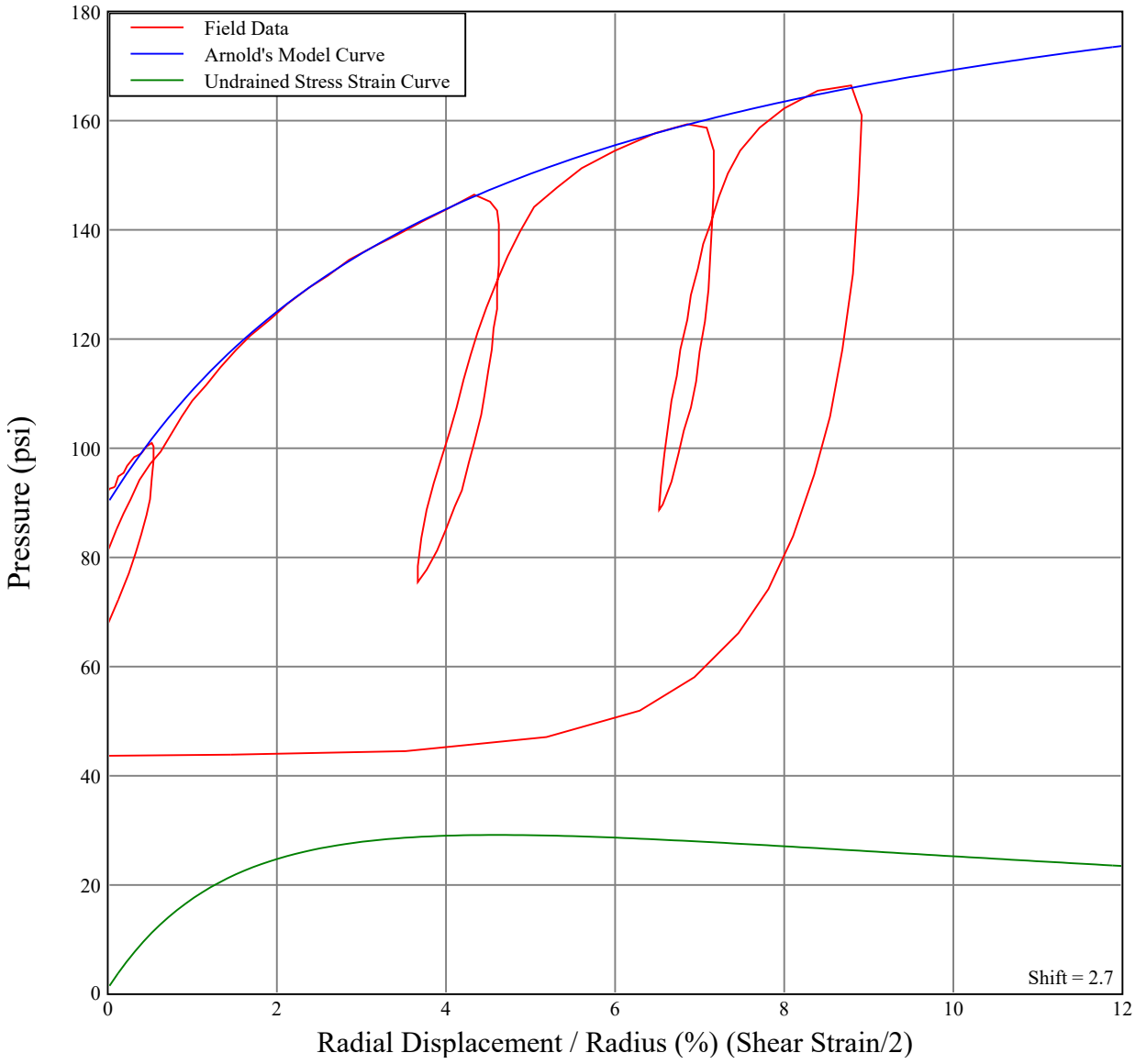
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 37.5 Depth: 37.5FT Date: 07/29/2021

Oper: Walsh Job # 102636 Time of Test: 03:40 PM Inst: 06



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 111 psi	Shear Strength at 10% Strain = 25.0 psi
Pressure at 2.5% Strain = 131 psi	Max Shear Strength = 29.0 psi
Pressure at 7.5% Strain = 162 psi	occurs at 4.6% Strain

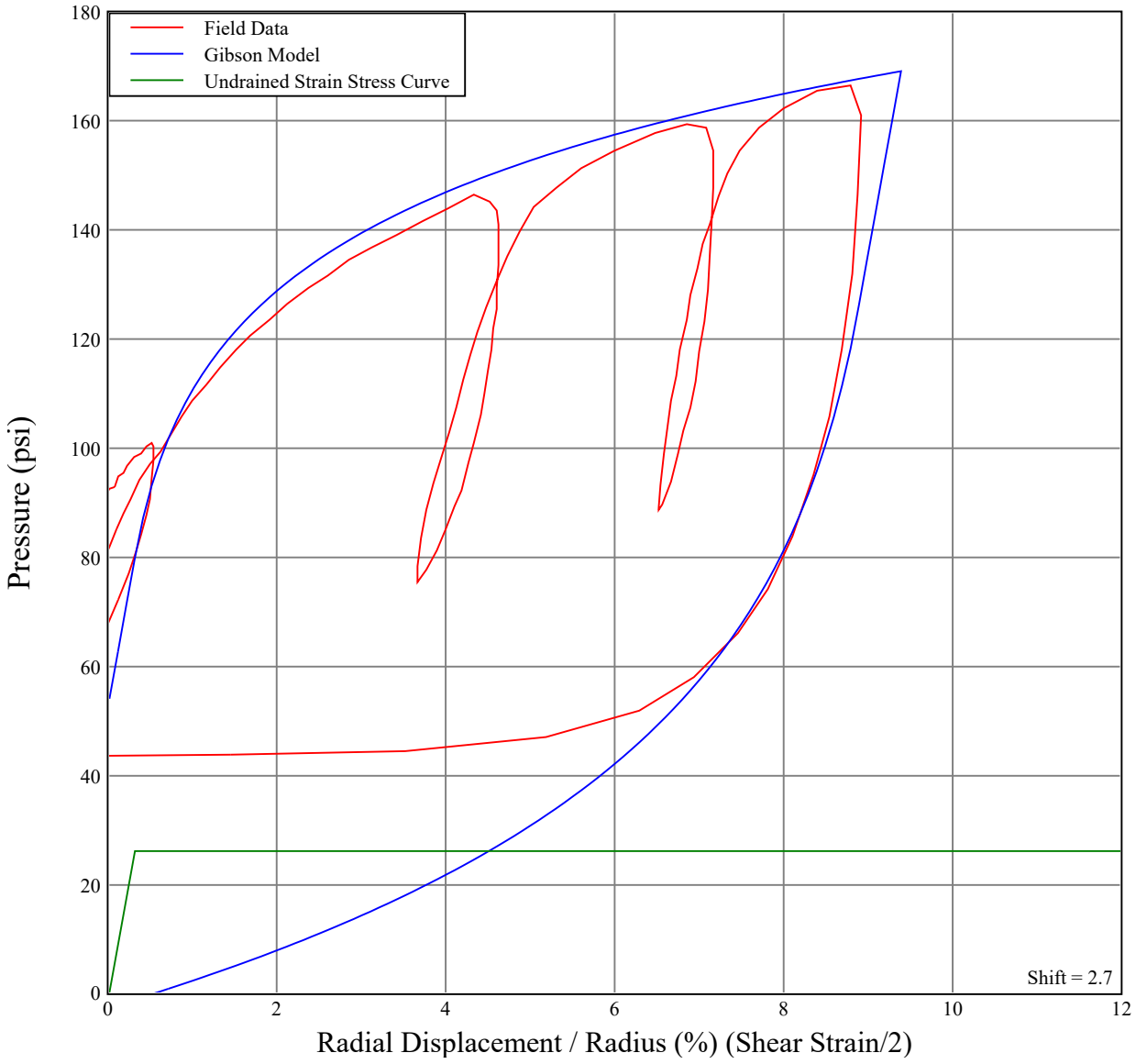
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 37.5 Depth: 37.5FT Date: 07/29/2021

Oper: Walsh Job # 102636 Time of Test: 03:40 PM Inst: 06



DATA

LOADING	UNLOADING
Shear Strength = 26 psi	Shear Strength = 44 psi
In Situ Stress = 54 psi	Shear Modulus = 4300 psi
Shear Modulus = 4300 psi	

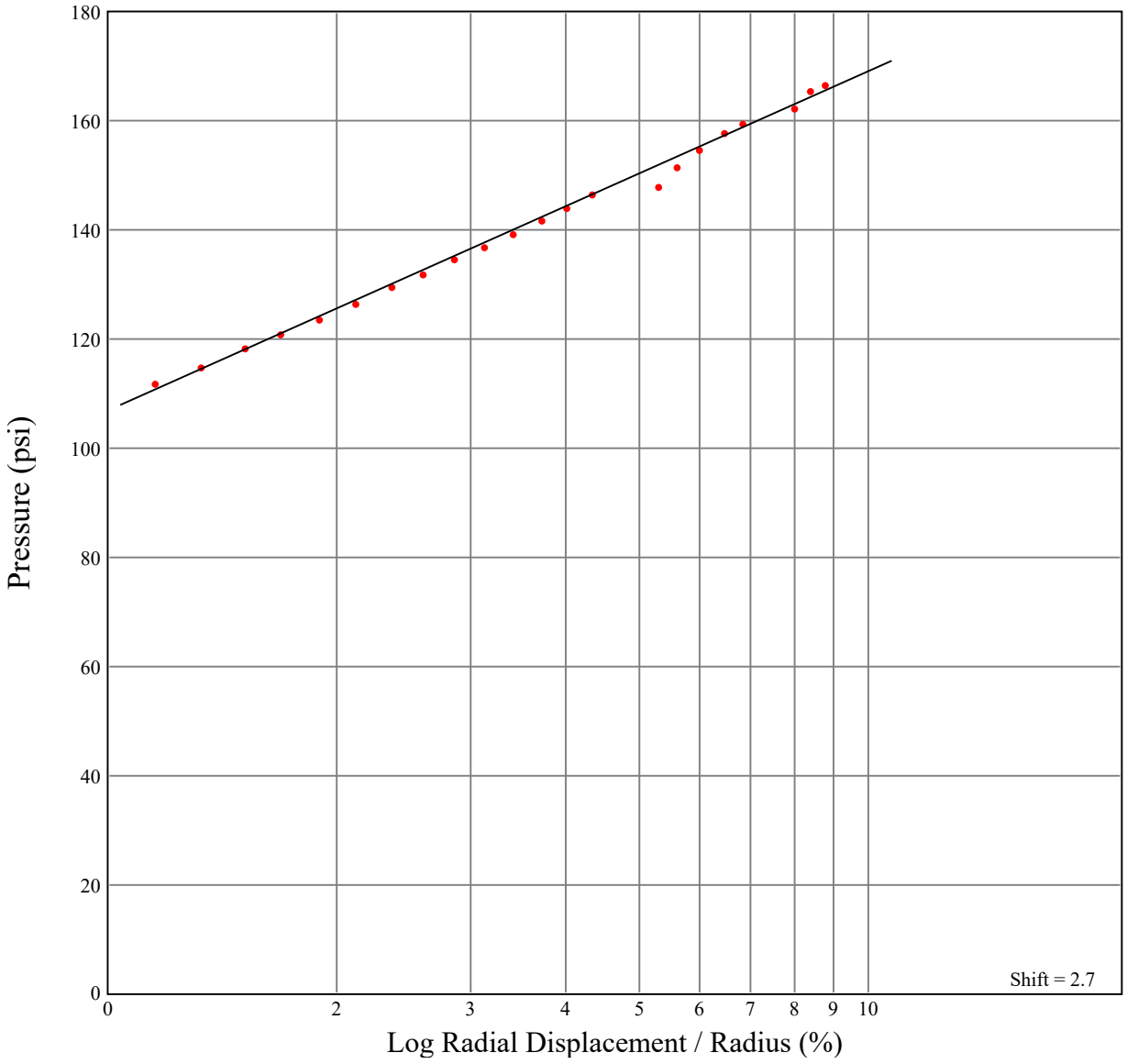
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 37.5 Depth: 37.5FT Date: 07/29/2021

Oper: Walsh Job # 102636 Time of Test: 03:40 PM Inst: 06



DATA

Shear Strength = 27 psi

Limit Pressure = 207 psi

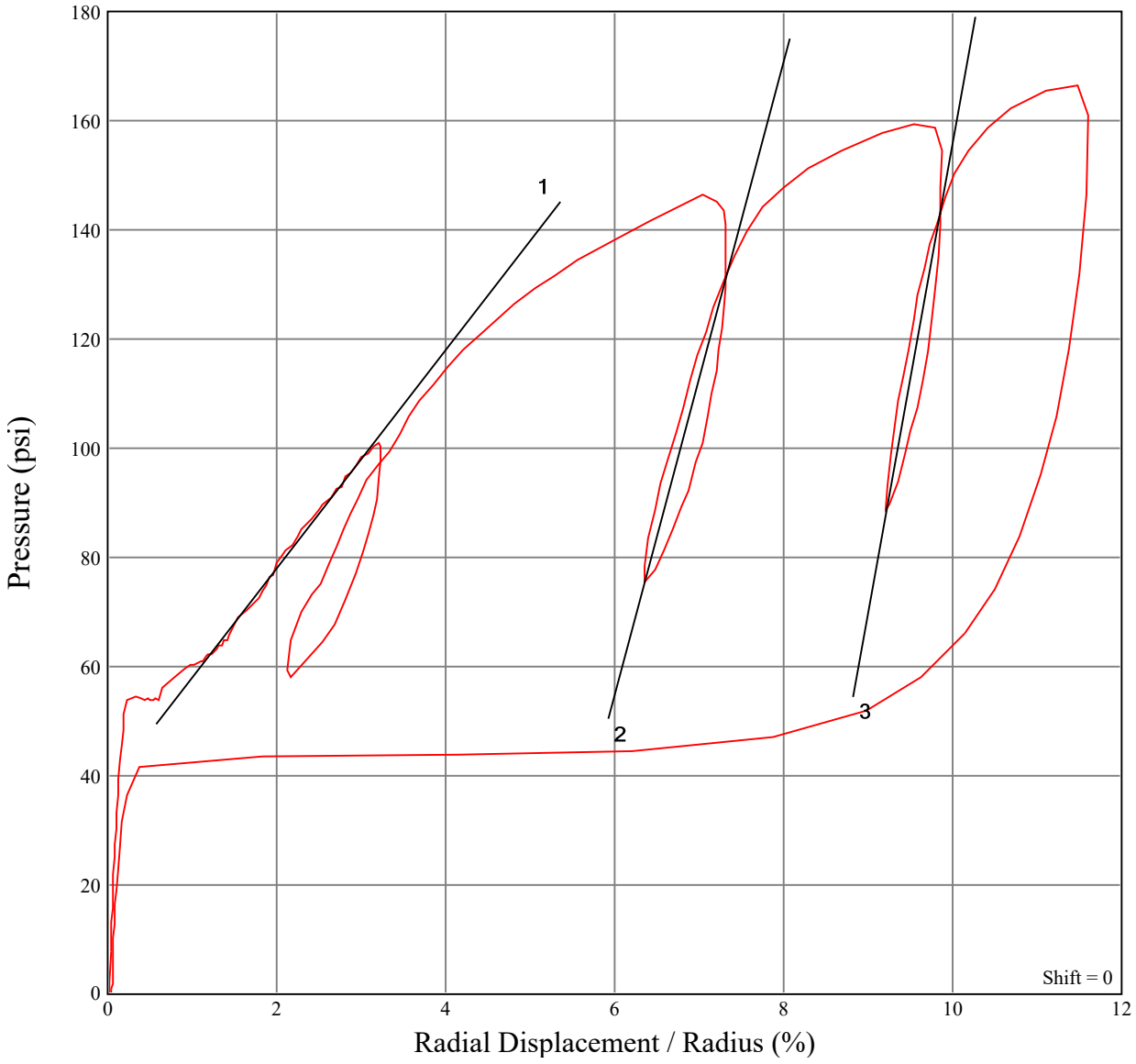
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 37.5 Depth: 37.5FT Date: 07/29/2021

Oper: Walsh Job # 102636 Time of Test: 03:40 PM Inst: 06



DATA

#1 Shear Modulus = 1000 psi

#2 Shear Modulus = 2900 psi

#3 Shear Modulus = 4300 psi

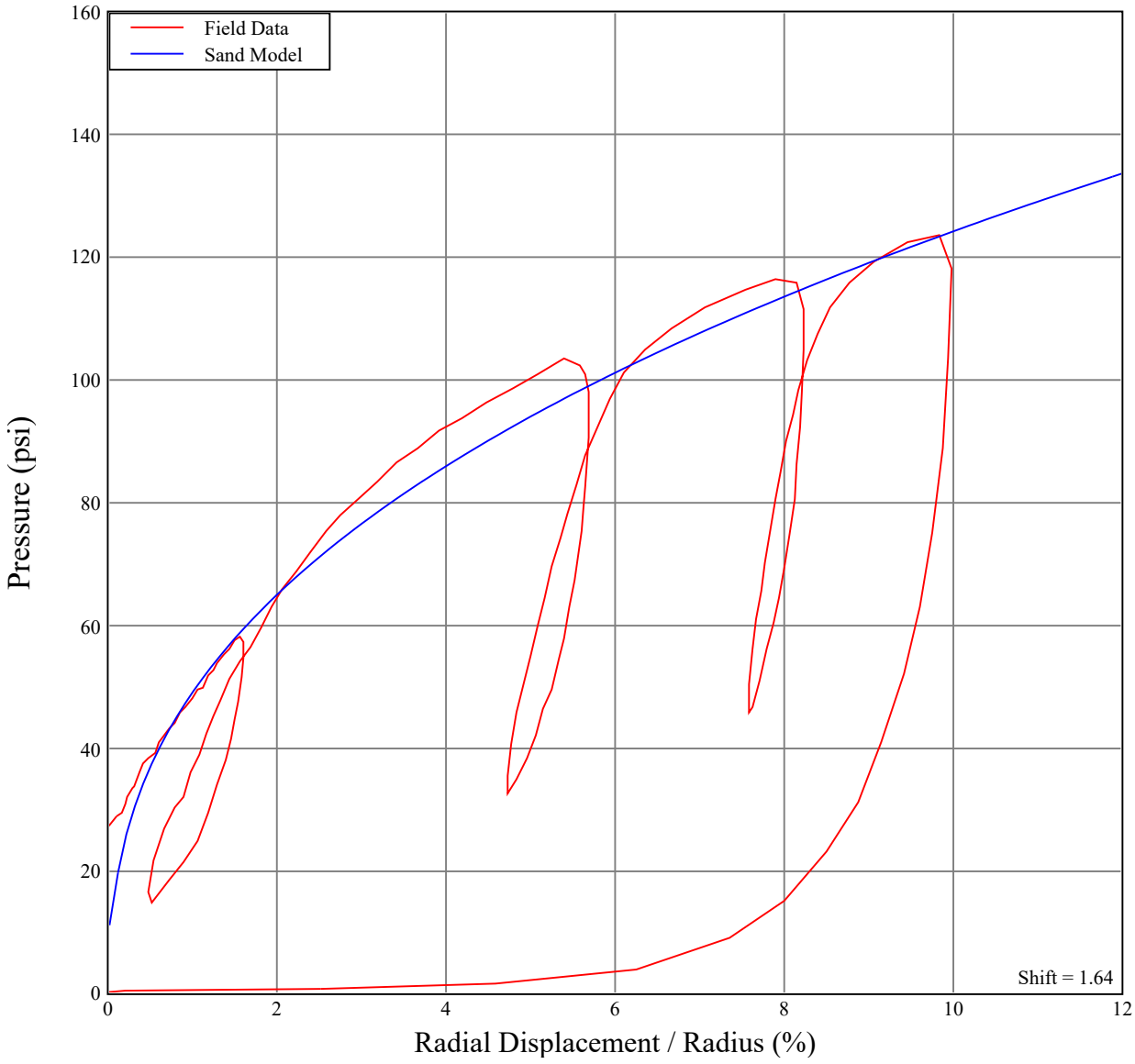
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 37.5 Depth: 37.5FT Date: 07/29/2021

Oper: Walsh Job # 102636 Time of Test: 03:40 PM Inst: 06



DATA

Water Pressure = 43 psi

Lateral Stress = 11 psi

Friction Angle = 36 deg

Shear Modulus = 4300 psi

Critical Friction Angle = 32 deg

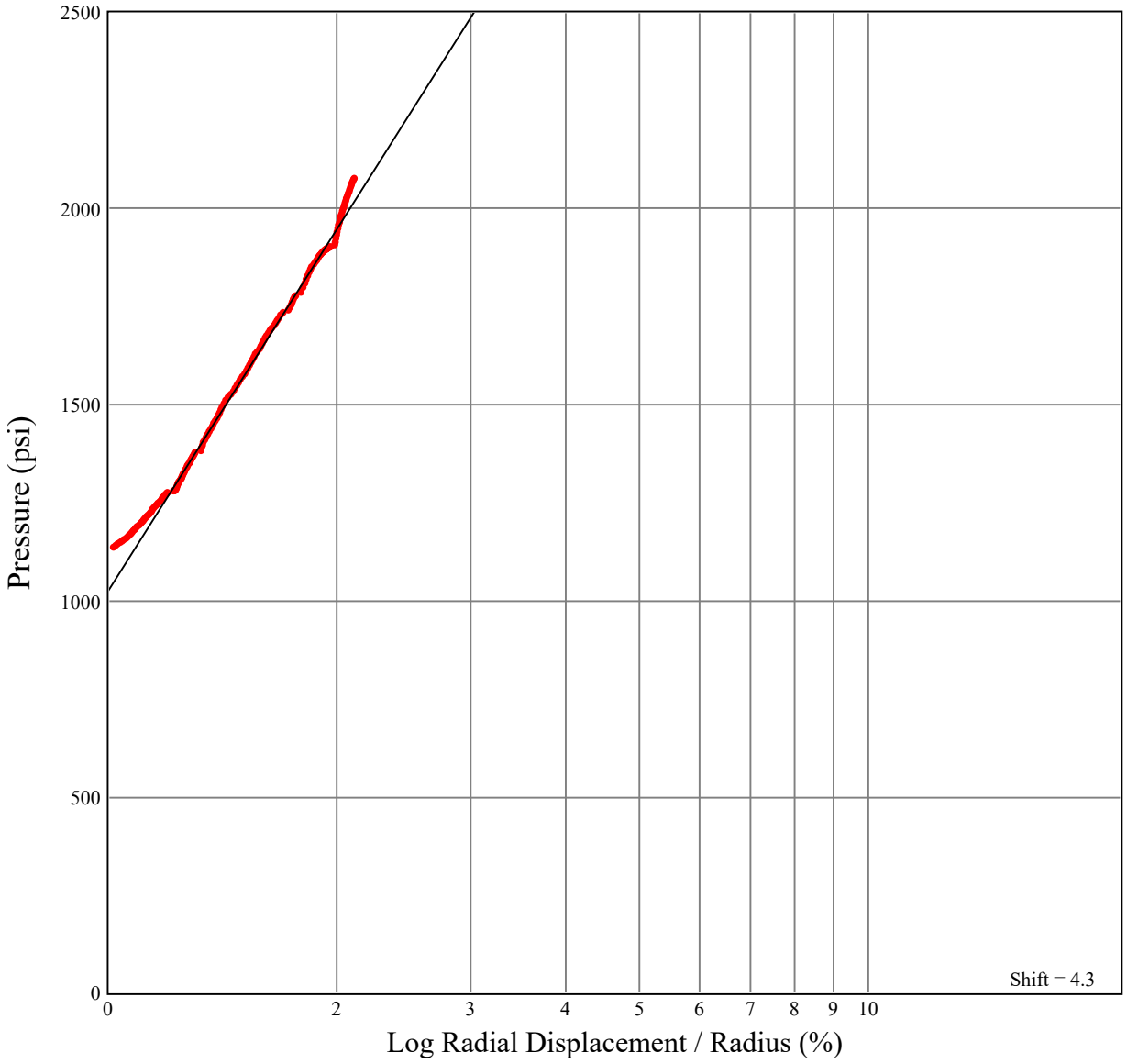
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 70.5 Depth: 70.5FT Date: 07/30/2021

Oper: Walsh Job # 102636 Time of Test: 12:22 PM Inst: 06



DATA

Shear Strength = 1329 psi

Limit Pressure = 5966 psi

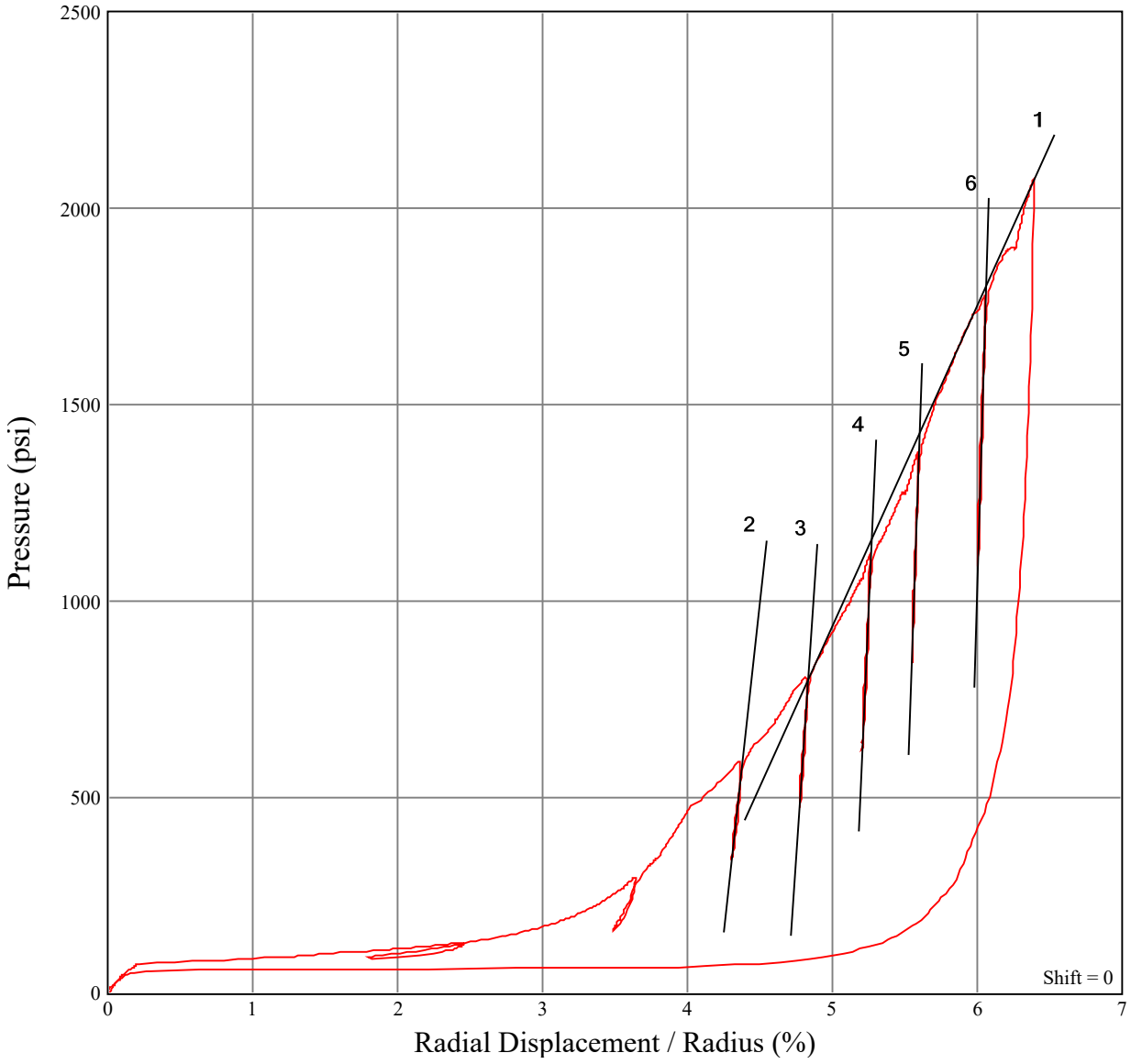
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 70.5 Depth: 70.5FT Date: 07/30/2021

Oper: Walsh Job # 102636 Time of Test: 12:22 PM Inst: 06



DATA

#1 Shear Modulus = 40800 psi

#2 Shear Modulus = 168200 psi

#3 Shear Modulus = 274000 psi

#4 Shear Modulus = 415400 psi

#5 Shear Modulus = 535500 psi

#6 Shear Modulus = 626200 psi

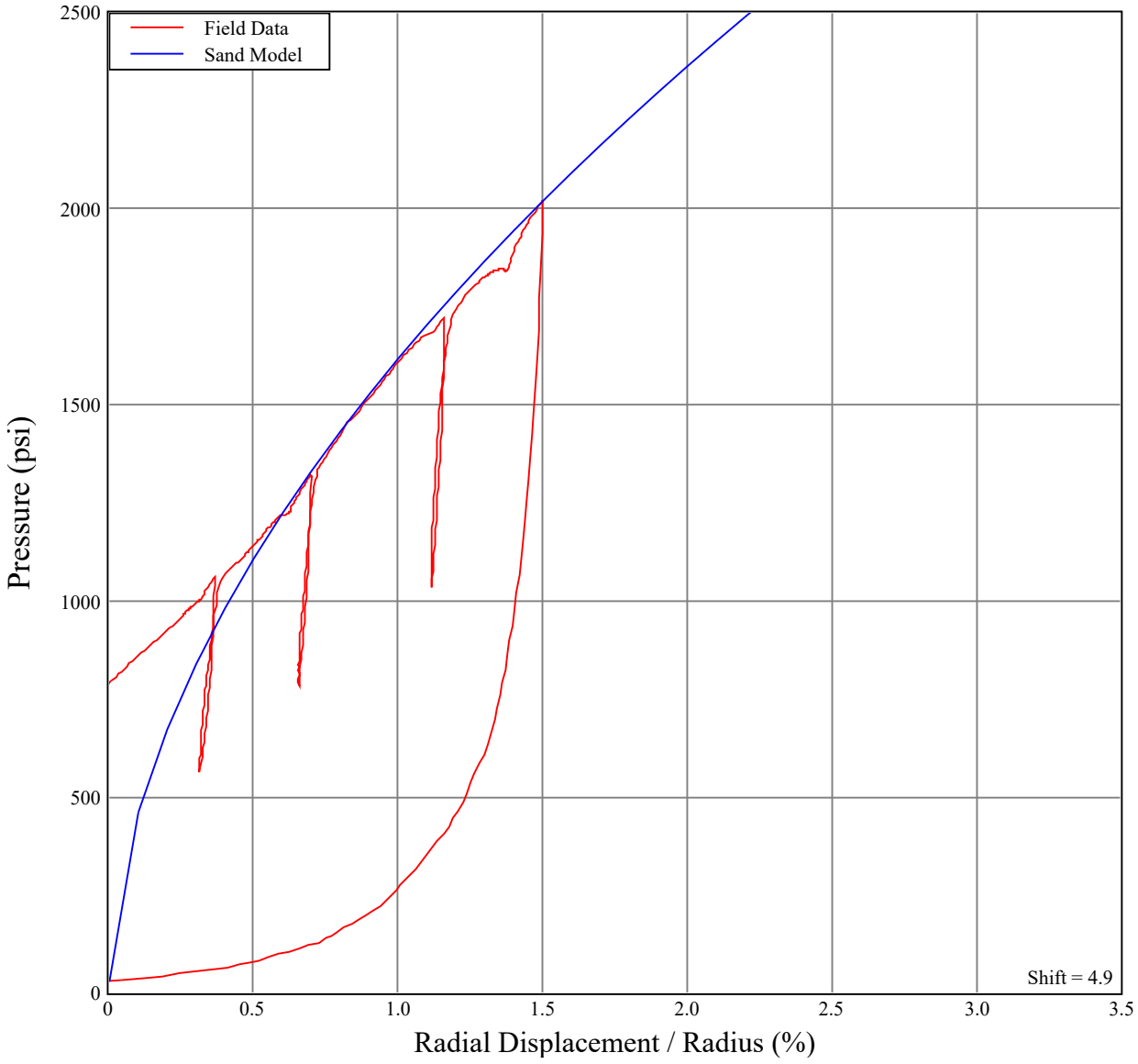
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 70.5 Depth: 70.5FT Date: 07/30/2021

Oper: Walsh Job # 102636 Time of Test: 12:22 PM Inst: 06



DATA

Water Pressure = 57 psi

Lateral Stress = 28 psi

Friction Angle = 46 deg

Shear Modulus = 626200 psi

Critical Friction Angle = 32 deg

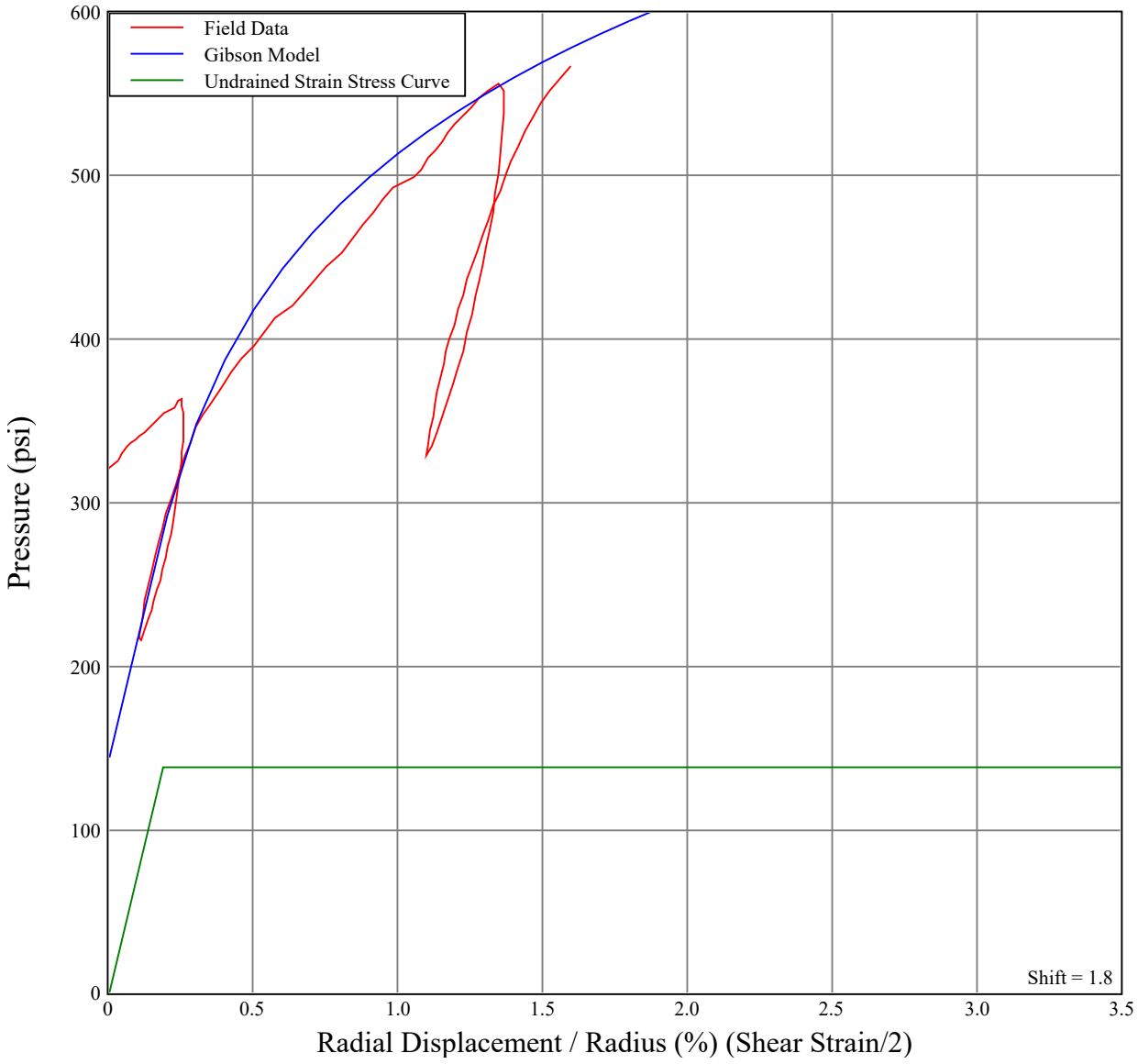
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 131.5 Depth: 131.5FT Date: 08/02/2021

Oper: Walsh Job # 102636 Time of Test: 03:57 PM Inst: 06



DATA

LOADING

Shear Strength = 138 psi

In Situ Stress = 144 psi

Shear Modulus = 37100 psi

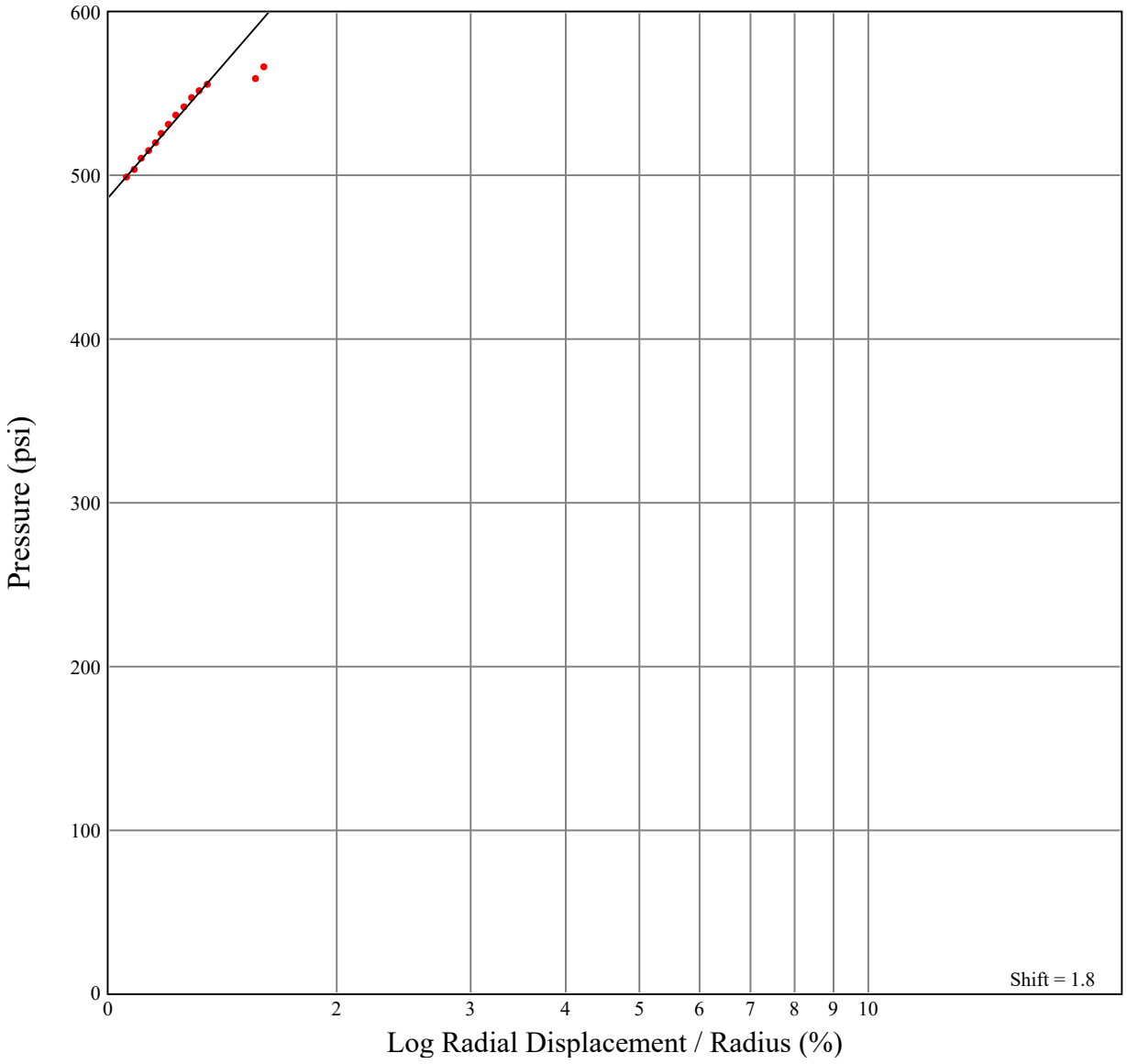
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 131.5 Depth: 131.5FT Date: 08/02/2021

Oper: Walsh Job # 102636 Time of Test: 03:57 PM Inst: 06



DATA

Shear Strength = 233 psi

Limit Pressure = 1353 psi

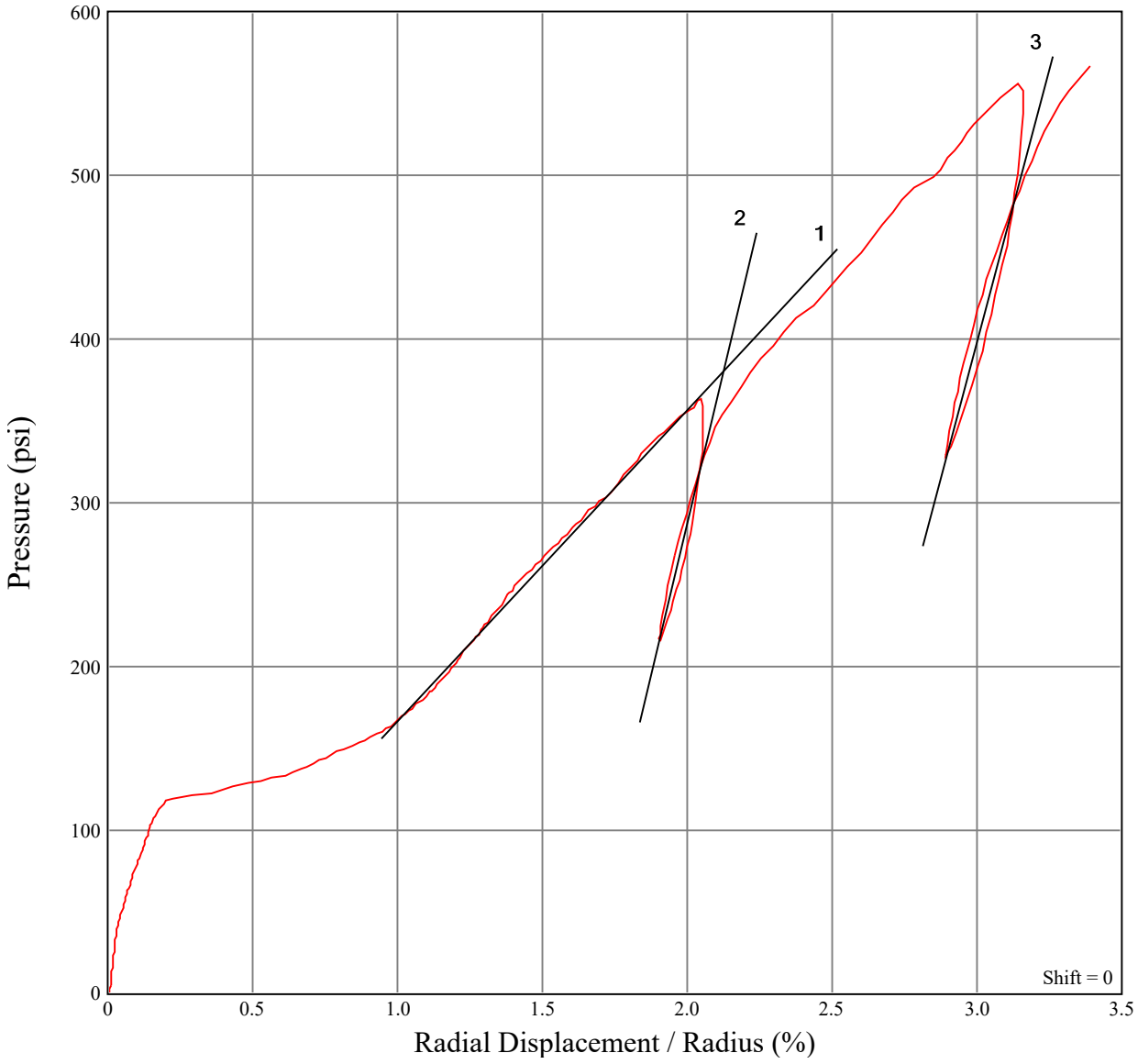
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 131.5 Depth: 131.5FT Date: 08/02/2021

Oper: Walsh Job # 102636 Time of Test: 03:57 PM Inst: 06



DATA

#1 Shear Modulus = 9500 psi

#2 Shear Modulus = 37100 psi

#3 Shear Modulus = 33300 psi

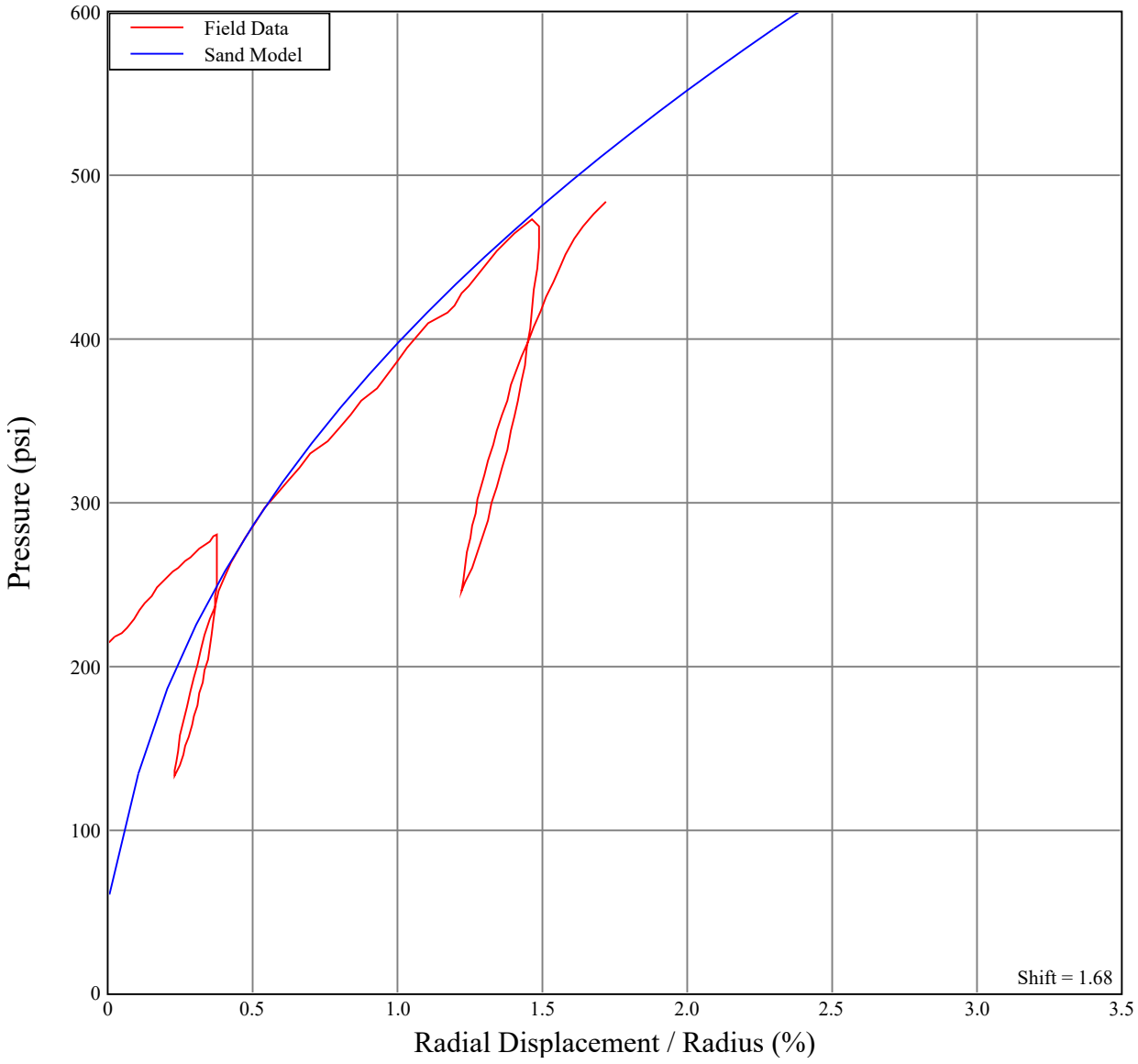
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 131.5 Depth: 131.5FT Date: 08/02/2021

Oper: Walsh Job # 102636 Time of Test: 03:57 PM Inst: 06



DATA

Water Pressure = 83 psi

Lateral Stress = 60 psi

Friction Angle = 41 deg

Shear Modulus = 37100 psi

Critical Friction Angle = 32 deg

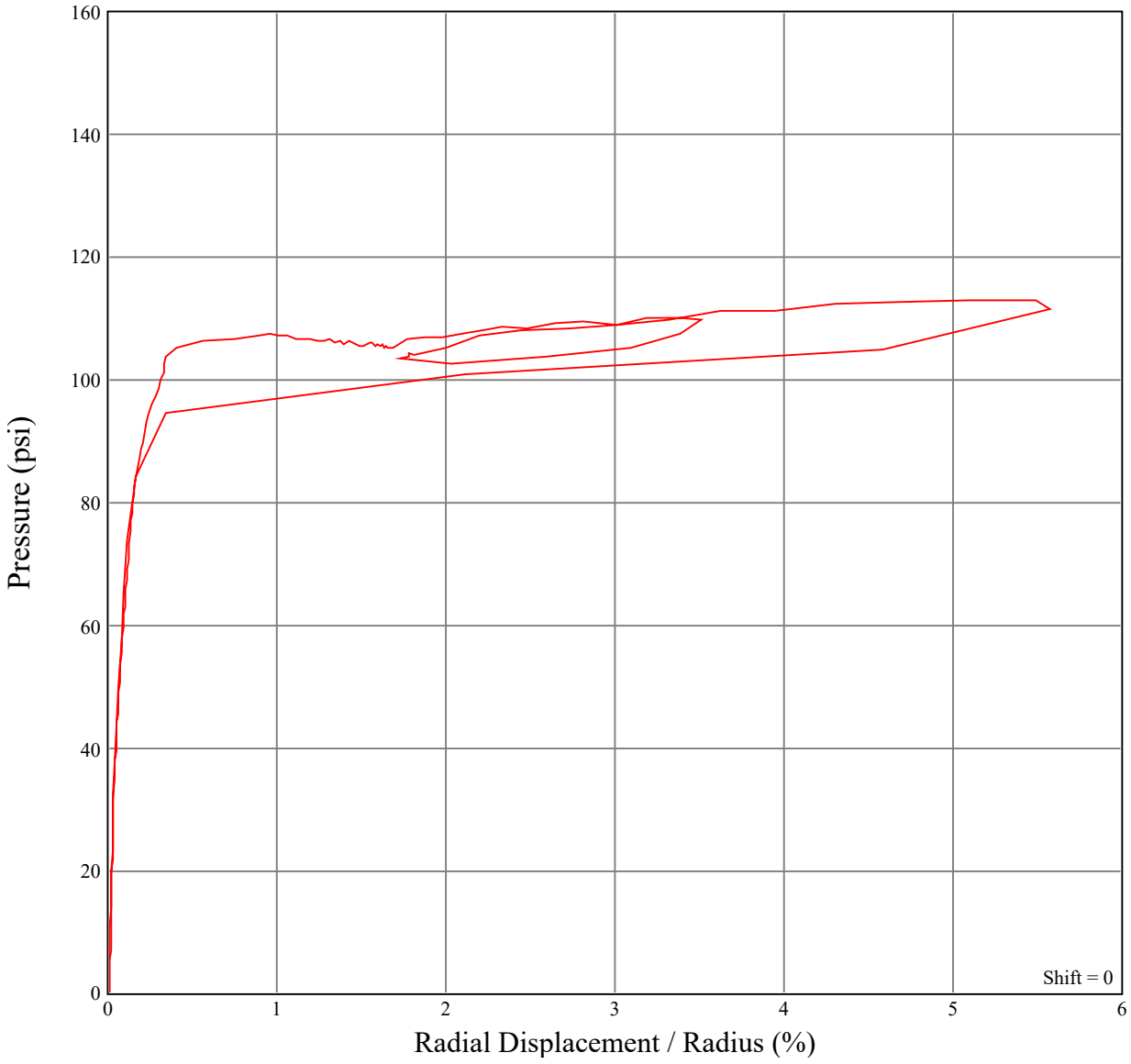
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B10 133 Depth: 133FT Date: 08/02/2021

Oper: Walsh Job # 102636 Time of Test: 03:39 PM Inst: 06



DATA

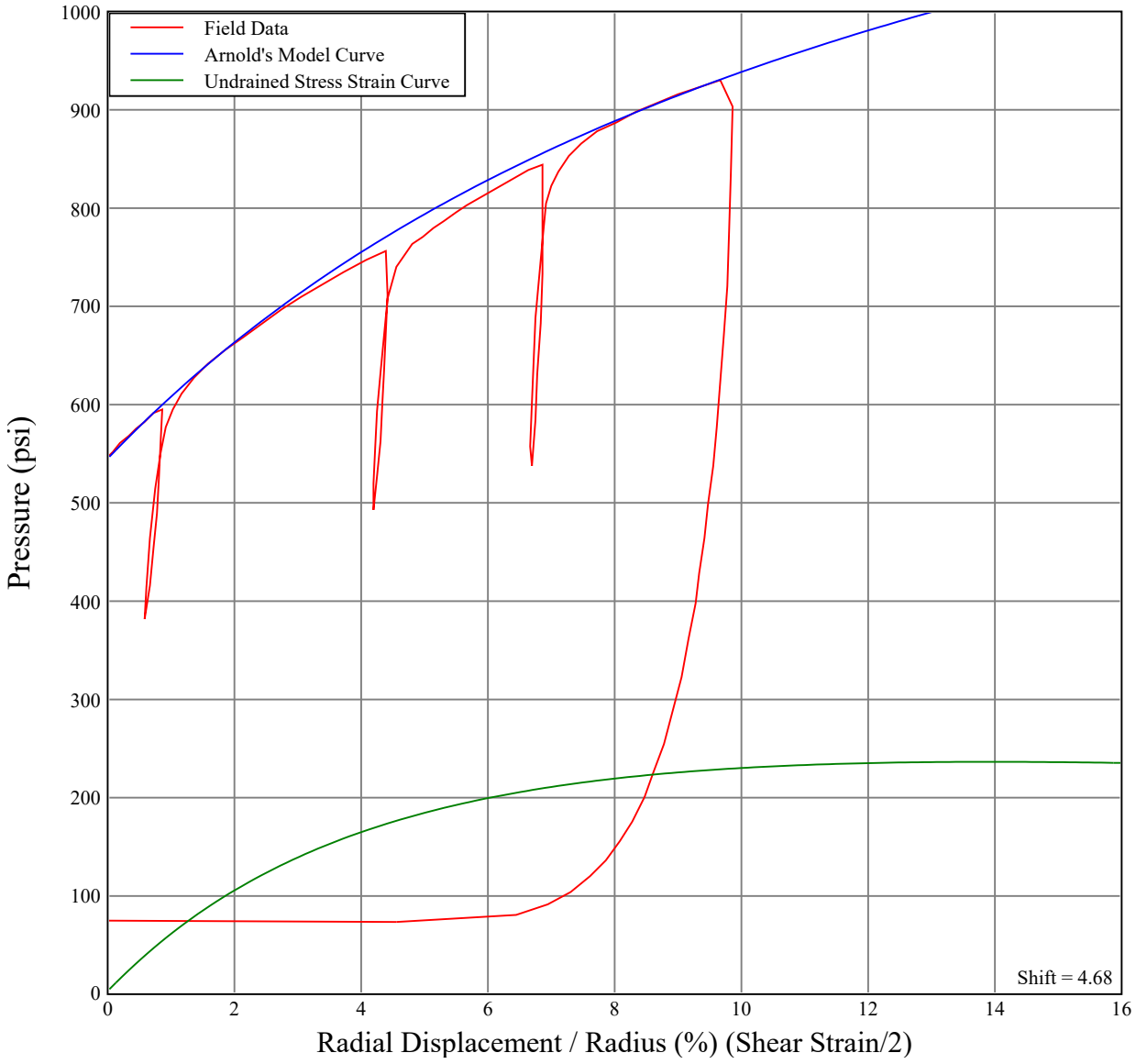
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B-10 Test: EQRB-B10-138.0 Depth: 138ft Date: 08/03/2021

Oper: Mayfield Job # 102636 Time of Test: 12:07 PM Inst: 04



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 610 psi	Shear Strength at 10% Strain = 229.2 psi
Pressure at 2.5% Strain = 690 psi	Max Shear Strength = 235.6 psi
Pressure at 7.5% Strain = 876 psi	occurs at 13.9% Strain

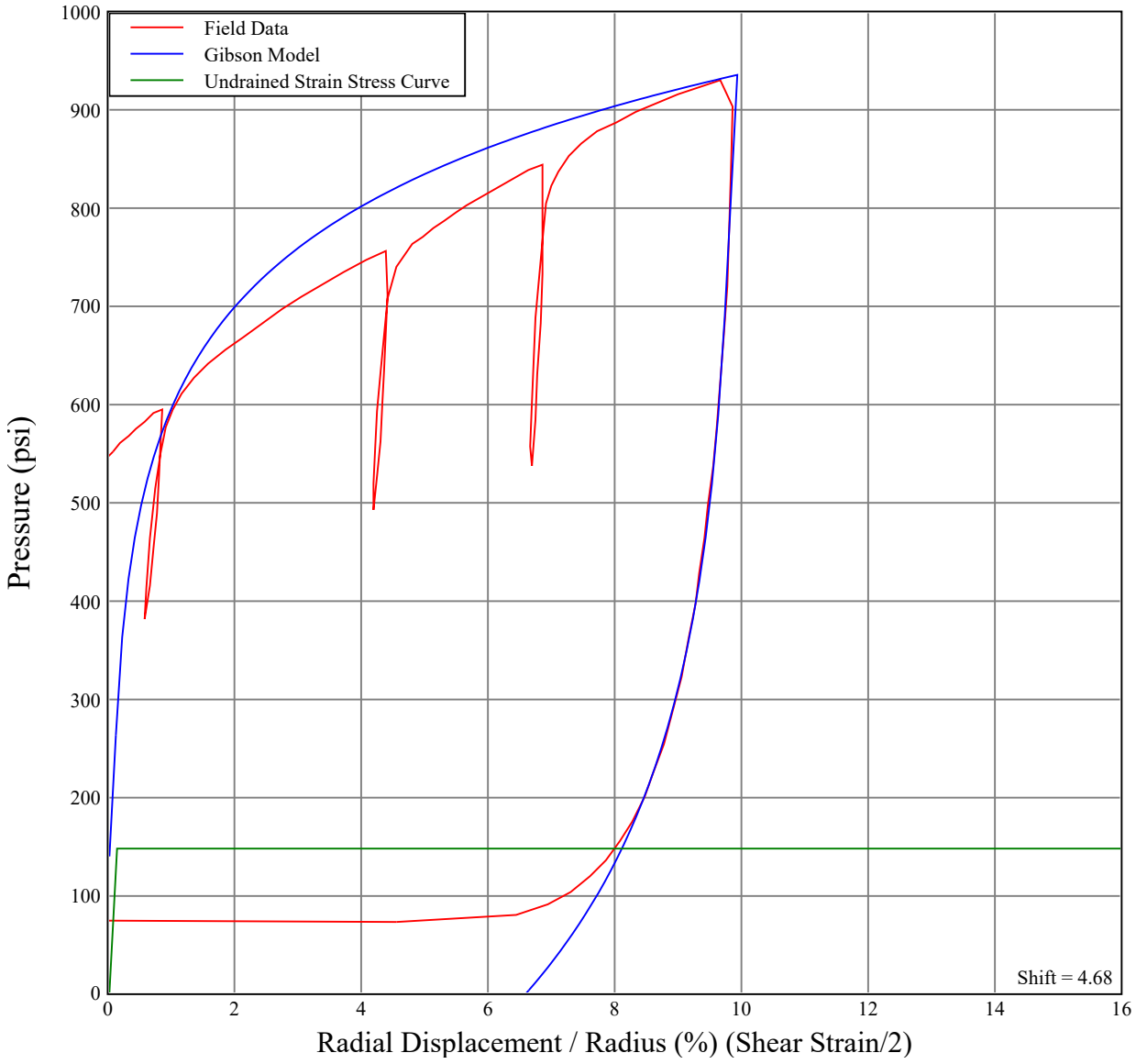
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B-10 Test: EQRB-B10-138.0 Depth: 138ft Date: 08/03/2021

Oper: Mayfield Job # 102636 Time of Test: 12:07 PM Inst: 04



DATA

LOADING	UNLOADING
Shear Strength = 147 psi	Shear Strength = 245 psi
In Situ Stress = 139 psi	Shear Modulus = 62000 psi
Shear Modulus = 62000 psi	

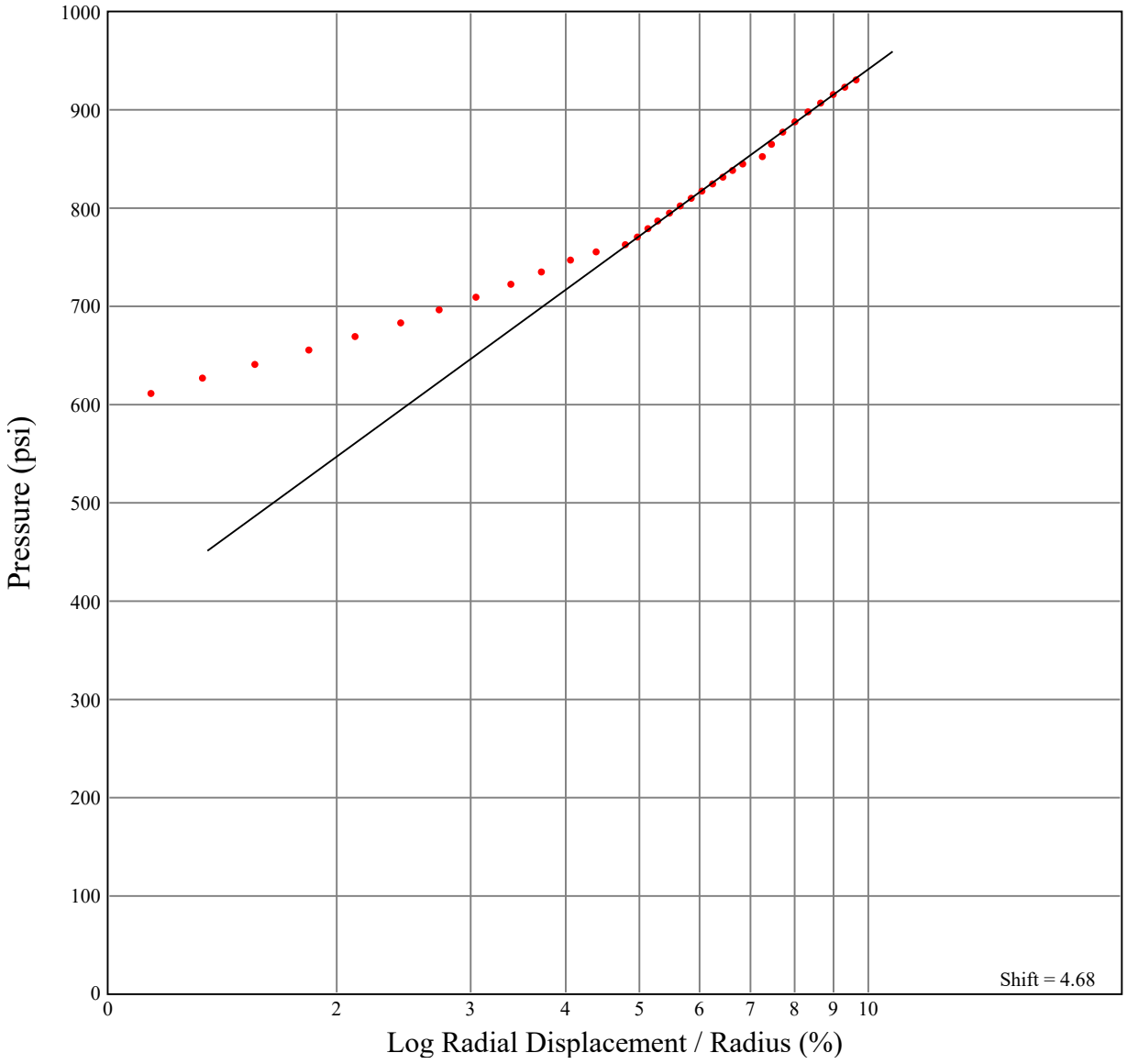
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B-10 Test: EQRB-B10-138.0 Depth: 138ft Date: 08/03/2021

Oper: Mayfield Job # 102636 Time of Test: 12:07 PM Inst: 04



DATA

Shear Strength = 245 psi

Limit Pressure = 1288 psi

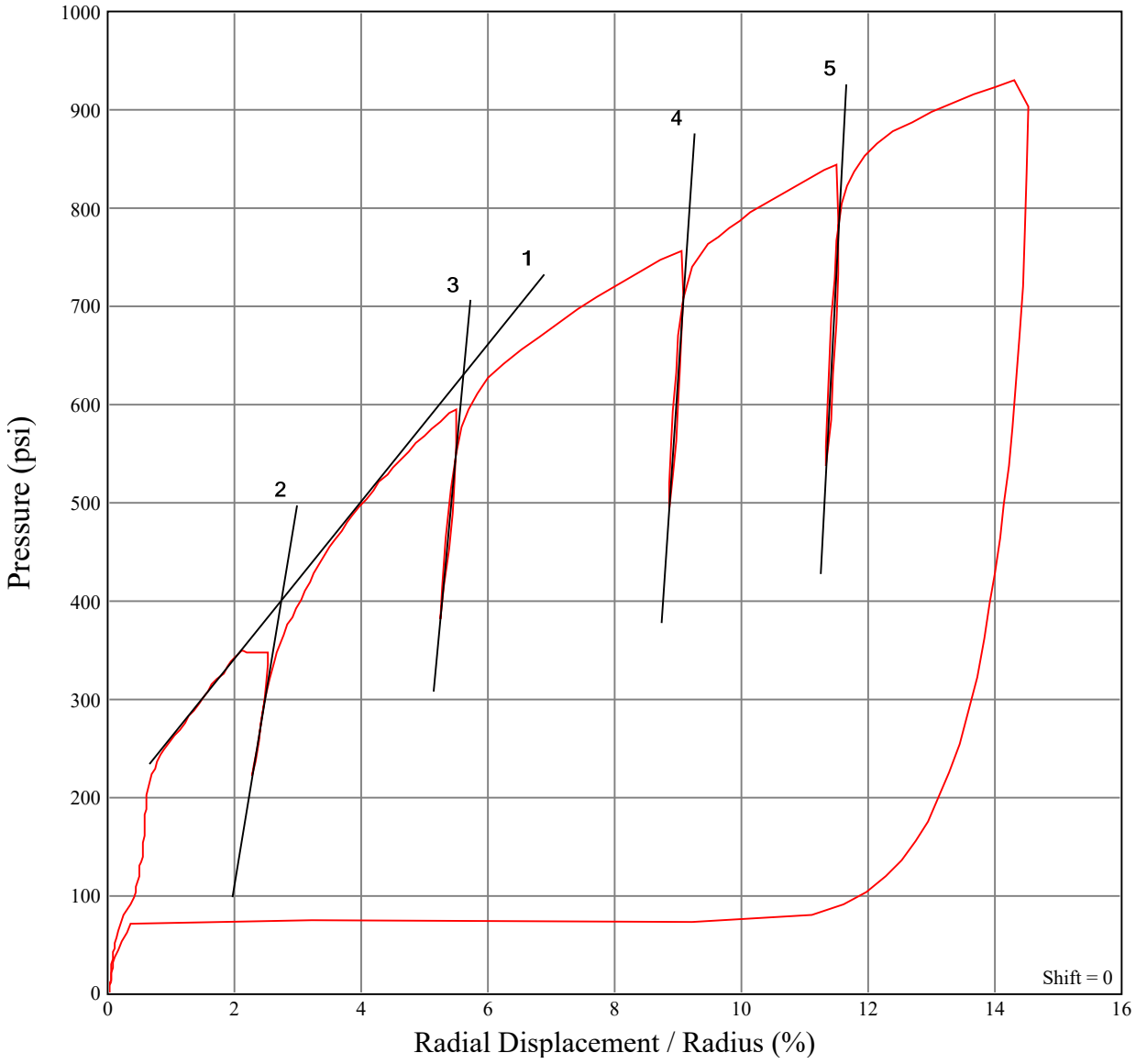
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B-10 Test: EQRB-B10-138.0 Depth: 138ft Date: 08/03/2021

Oper: Mayfield Job # 102636 Time of Test: 12:07 PM Inst: 04



DATA

#1 Shear Modulus = 4000 psi

#2 Shear Modulus = 19600 psi

#3 Shear Modulus = 34400 psi

#4 Shear Modulus = 48000 psi

#5 Shear Modulus = 62000 psi

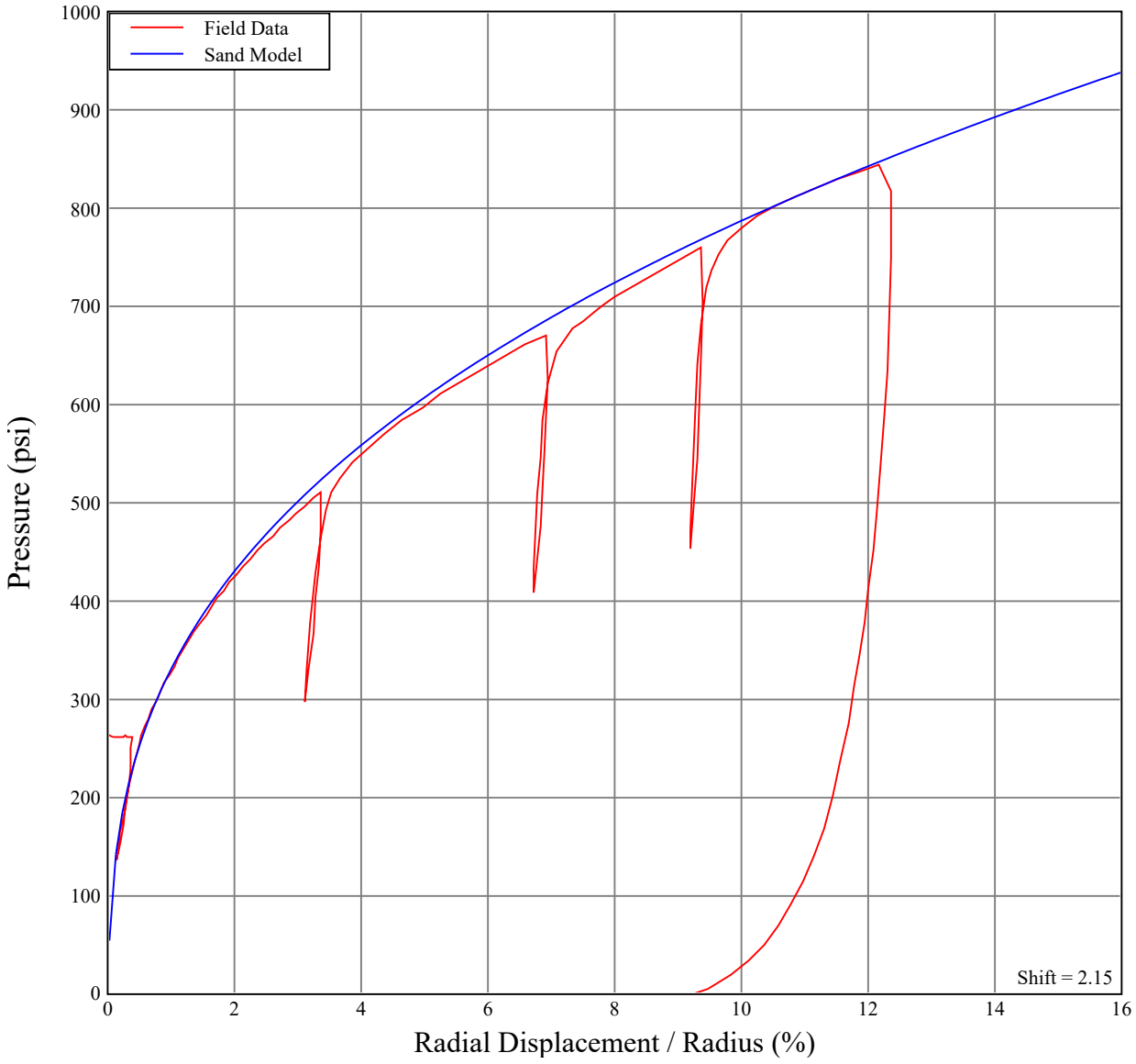
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B-10 Test: EQRB-B10-138.0 Depth: 138ft Date: 08/03/2021

Oper: Mayfield Job # 102636 Time of Test: 12:07 PM Inst: 04



DATA

Water Pressure = 86 psi

Lateral Stress = 53 psi

Friction Angle = 34 deg

Shear Modulus = 62000 psi

Critical Friction Angle = 32 deg

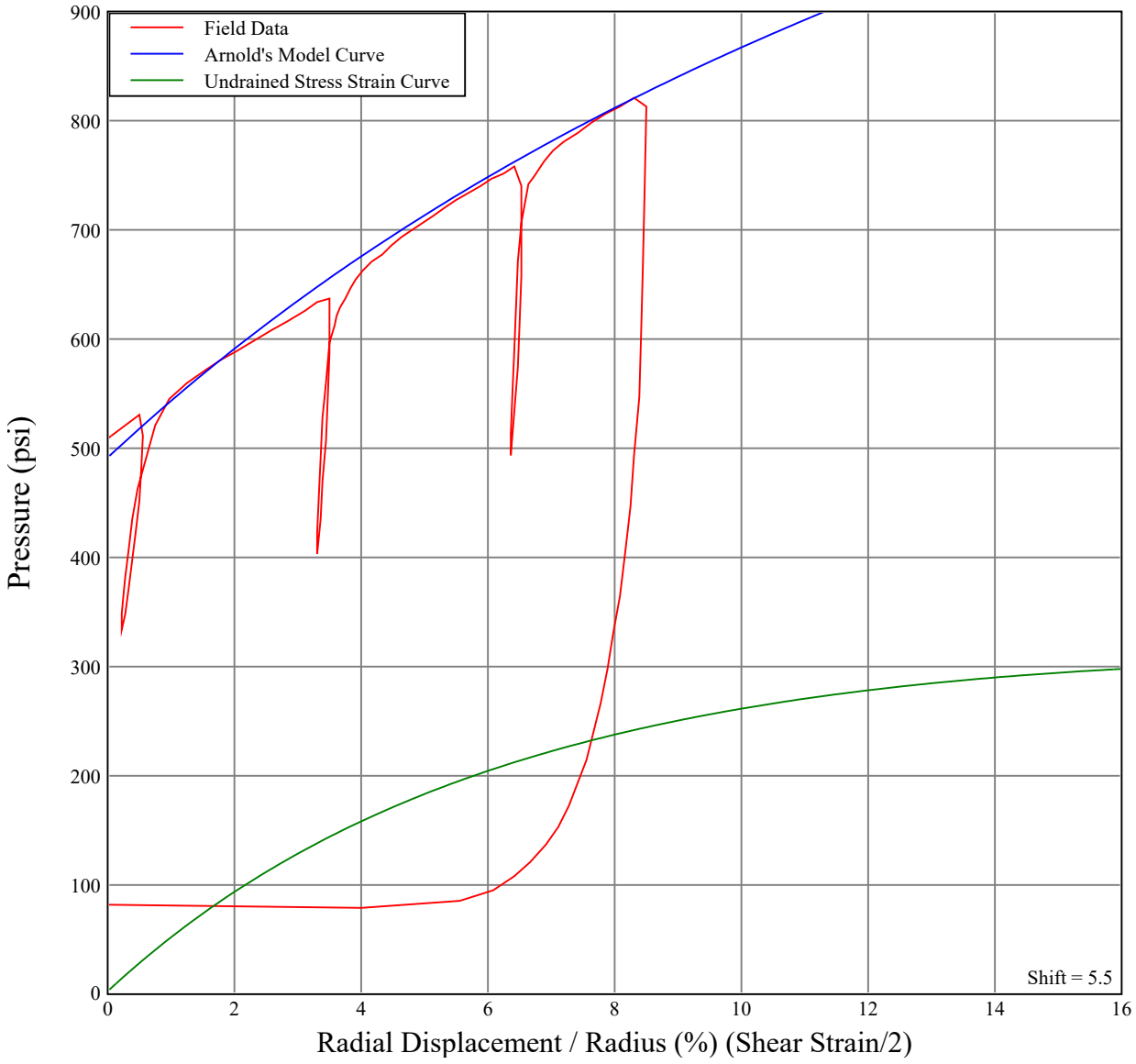
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B-10 Test: EQRB-B10-139.5 Depth: 139.5M Date: 08/03/2021

Oper: Mayfield Job # 102636 Time of Test: 11:44 AM Inst: 04



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 545 psi	Shear Strength at 10% Strain = 260.8 psi
Pressure at 2.5% Strain = 615 psi	Max Shear Strength = 304.9 psi
Pressure at 7.5% Strain = 798 psi	occurs at 19.8% Strain

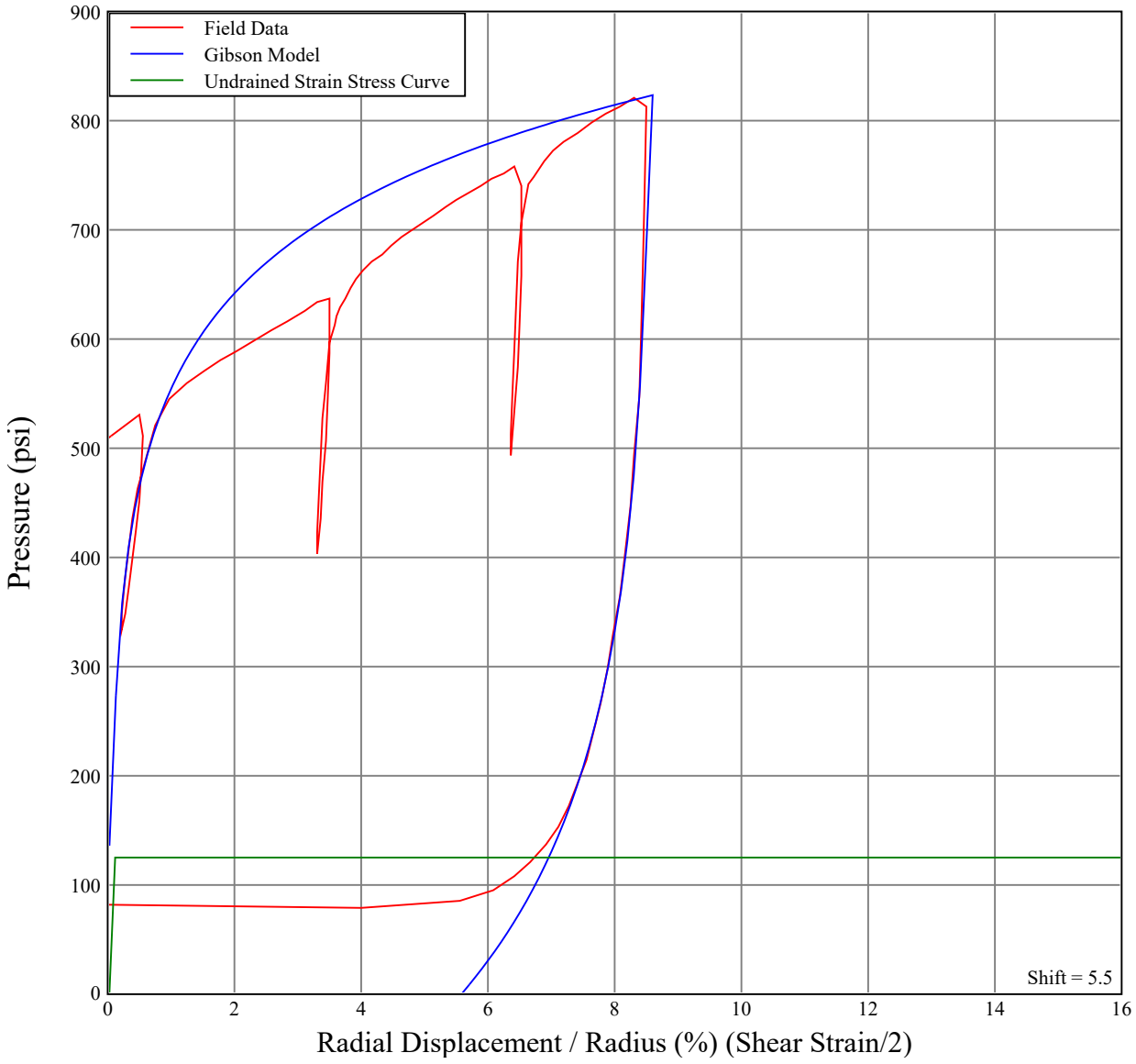
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B-10 Test: EQRB-B10-139.5 Depth: 139.5M Date: 08/03/2021

Oper: Mayfield Job # 102636 Time of Test: 11:44 AM Inst: 04



DATA

LOADING	UNLOADING
Shear Strength = 124 psi	Shear Strength = 206 psi
In Situ Stress = 135 psi	Shear Modulus = 69100 psi
Shear Modulus = 69100 psi	

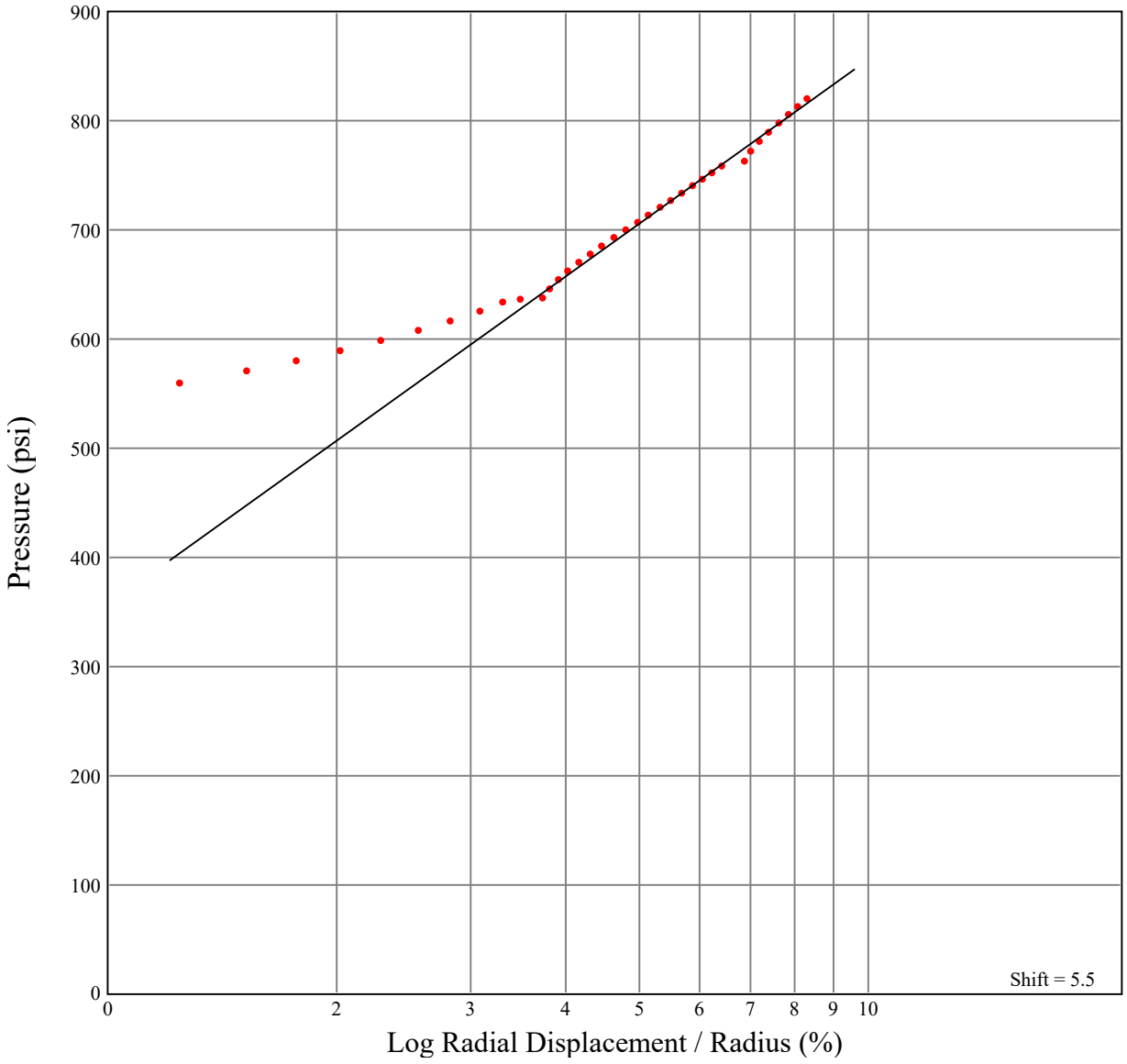
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B-10 Test: EQRB-B10-139.5 Depth: 139.5M Date: 08/03/2021

Oper: Mayfield Job # 102636 Time of Test: 11:44 AM Inst: 04



DATA

Shear Strength = 217 psi

Limit Pressure = 1163 psi

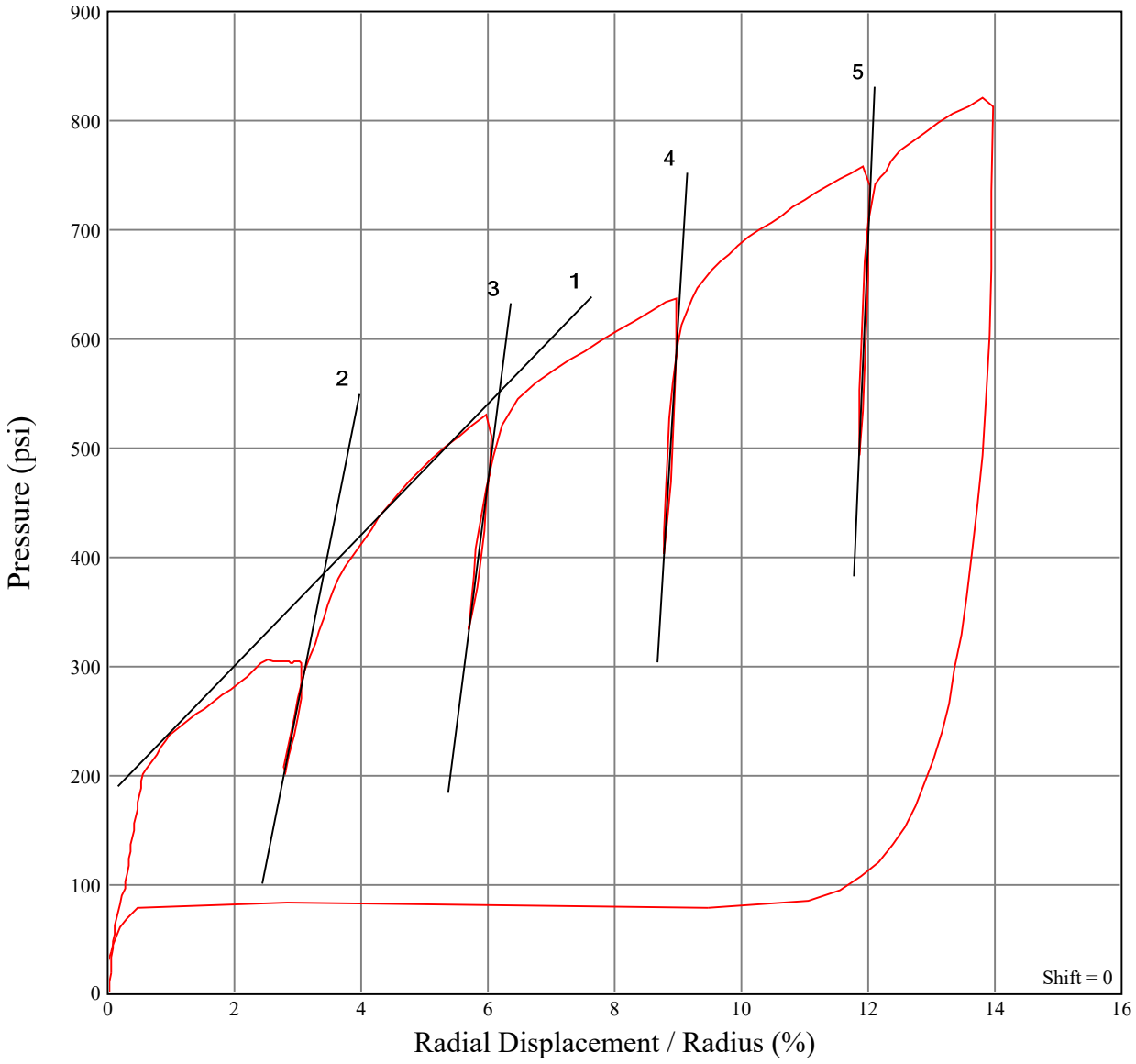
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B-10 Test: EQRB-B10-139.5 Depth: 139.5M Date: 08/03/2021

Oper: Mayfield Job # 102636 Time of Test: 11:44 AM Inst: 04



DATA

#1 Shear Modulus = 3000 psi

#2 Shear Modulus = 14600 psi

#3 Shear Modulus = 22700 psi

#4 Shear Modulus = 47900 psi

#5 Shear Modulus = 69100 psi

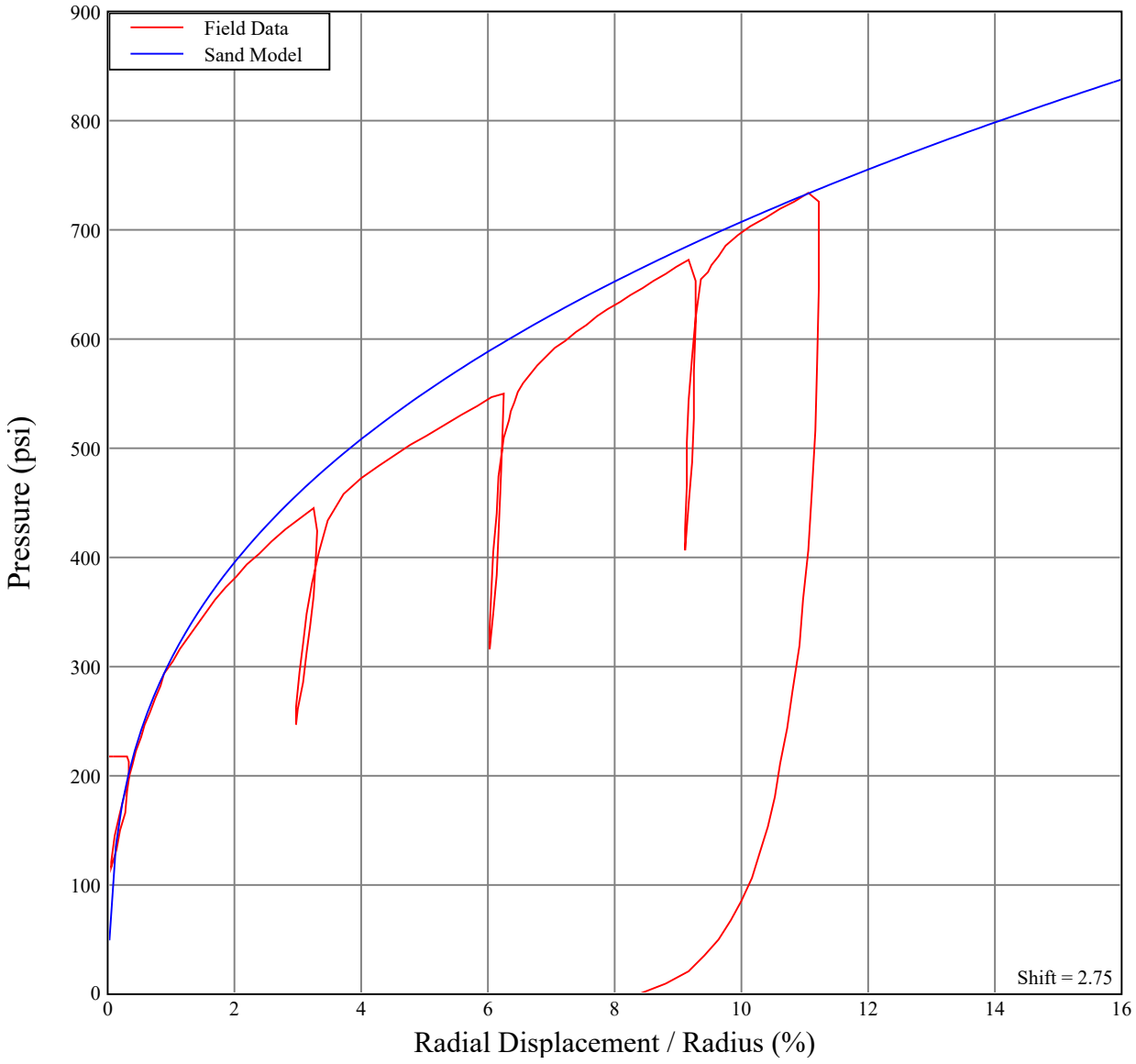
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B-10 Test: EQRB-B10-139.5 Depth: 139.5M Date: 08/03/2021

Oper: Mayfield Job # 102636 Time of Test: 11:44 AM Inst: 04



DATA

Water Pressure = 87 psi

Lateral Stress = 48 psi

Friction Angle = 33 deg

Shear Modulus = 69100 psi

Critical Friction Angle = 32 deg

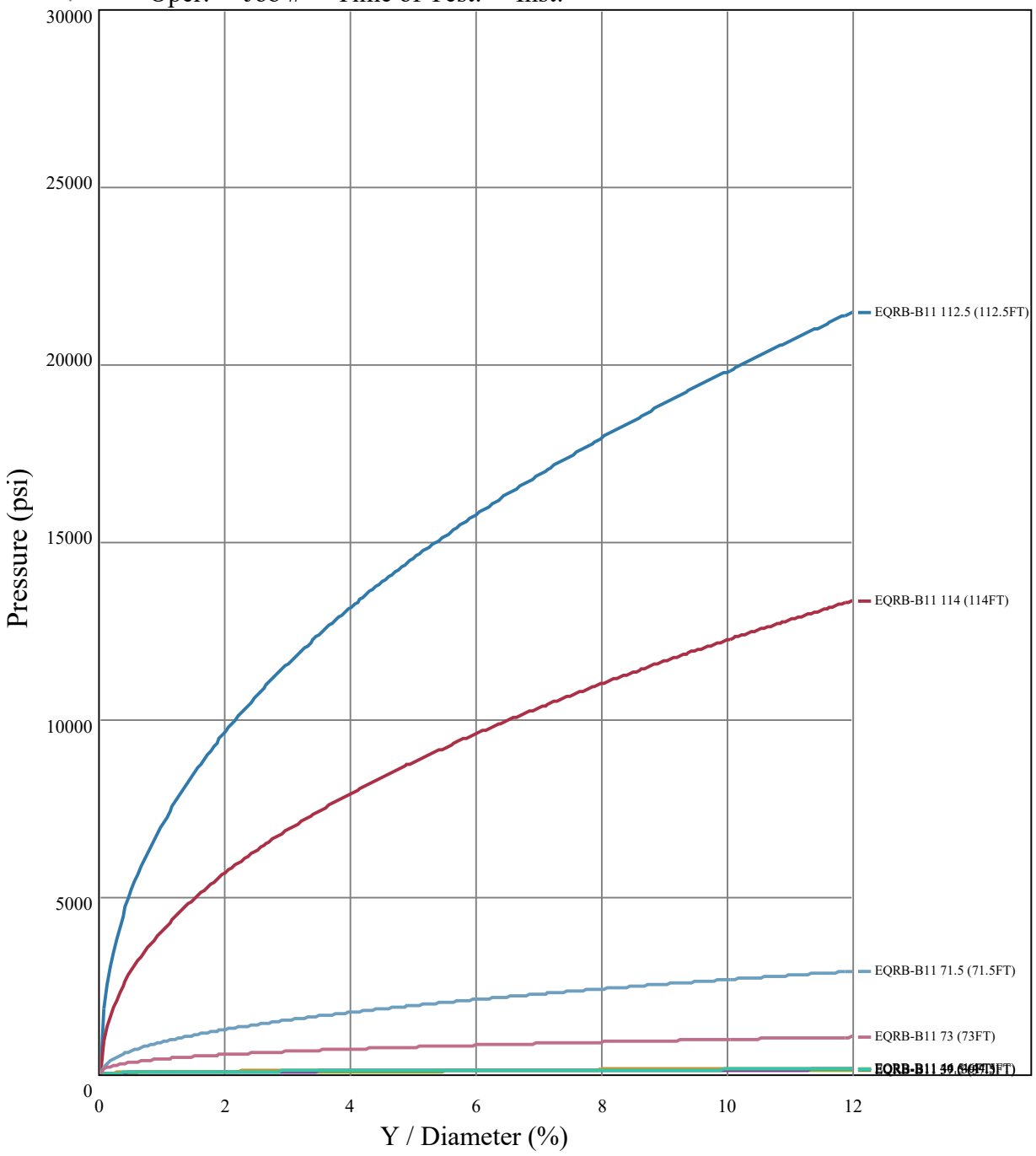
In Situ Engineering - PY Data - Frictional

Shannon and Wilson

EQRB

Boring: B11

Oper: Job # Time of Test: Inst:



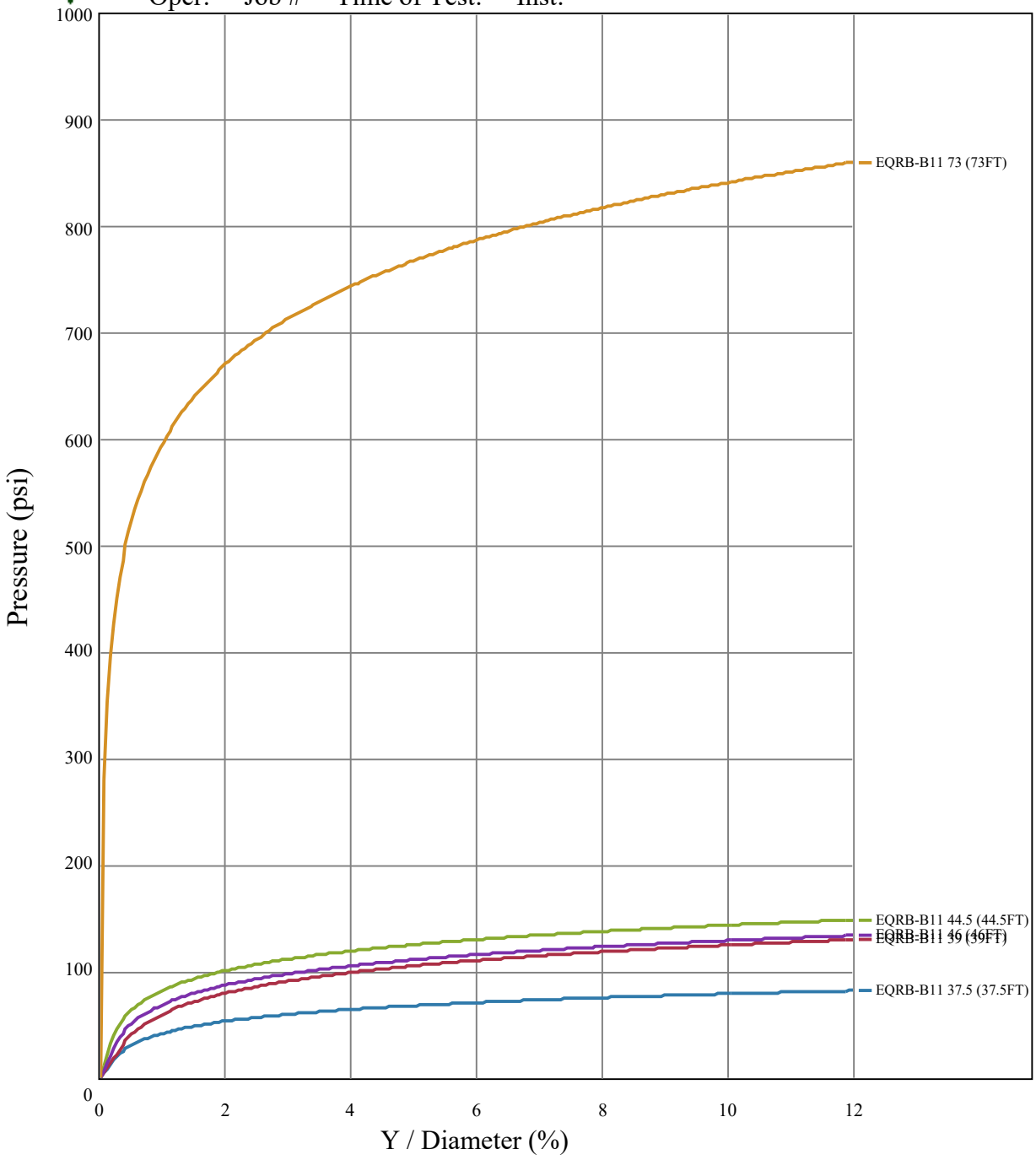
In Situ Engineering - PY Data - Cohesive

Shannon and Wilson

EQRB

Boring: B10

Oper: Job # Time of Test: Inst:



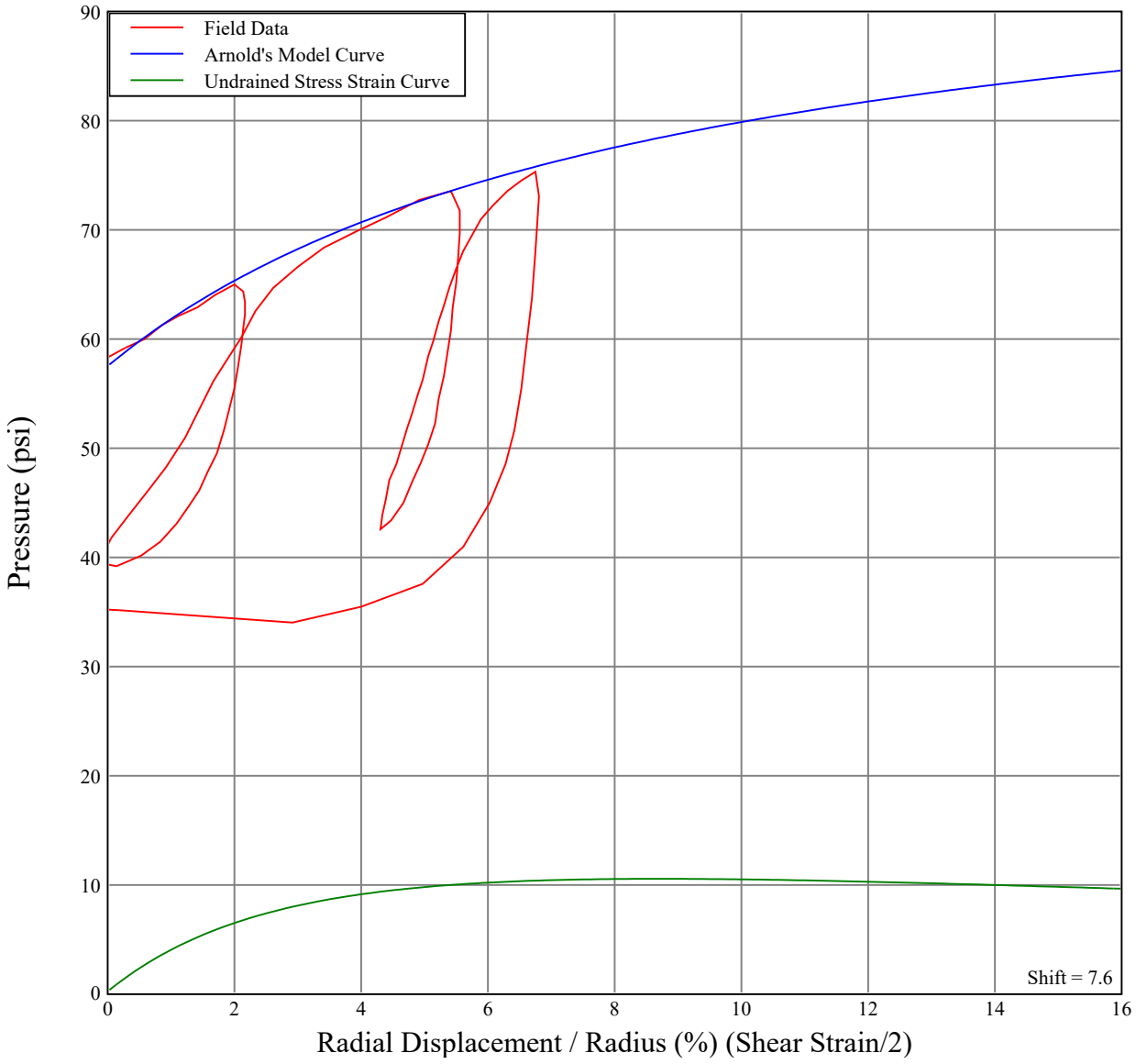
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 37.5 Depth: 37.5FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 09:45 AM Inst: 04



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 62 psi	Shear Strength at 10% Strain = 10.4 psi
Pressure at 2.5% Strain = 67 psi	Max Shear Strength = 10.4 psi
Pressure at 7.5% Strain = 77 psi	occurs at 8.7% Strain

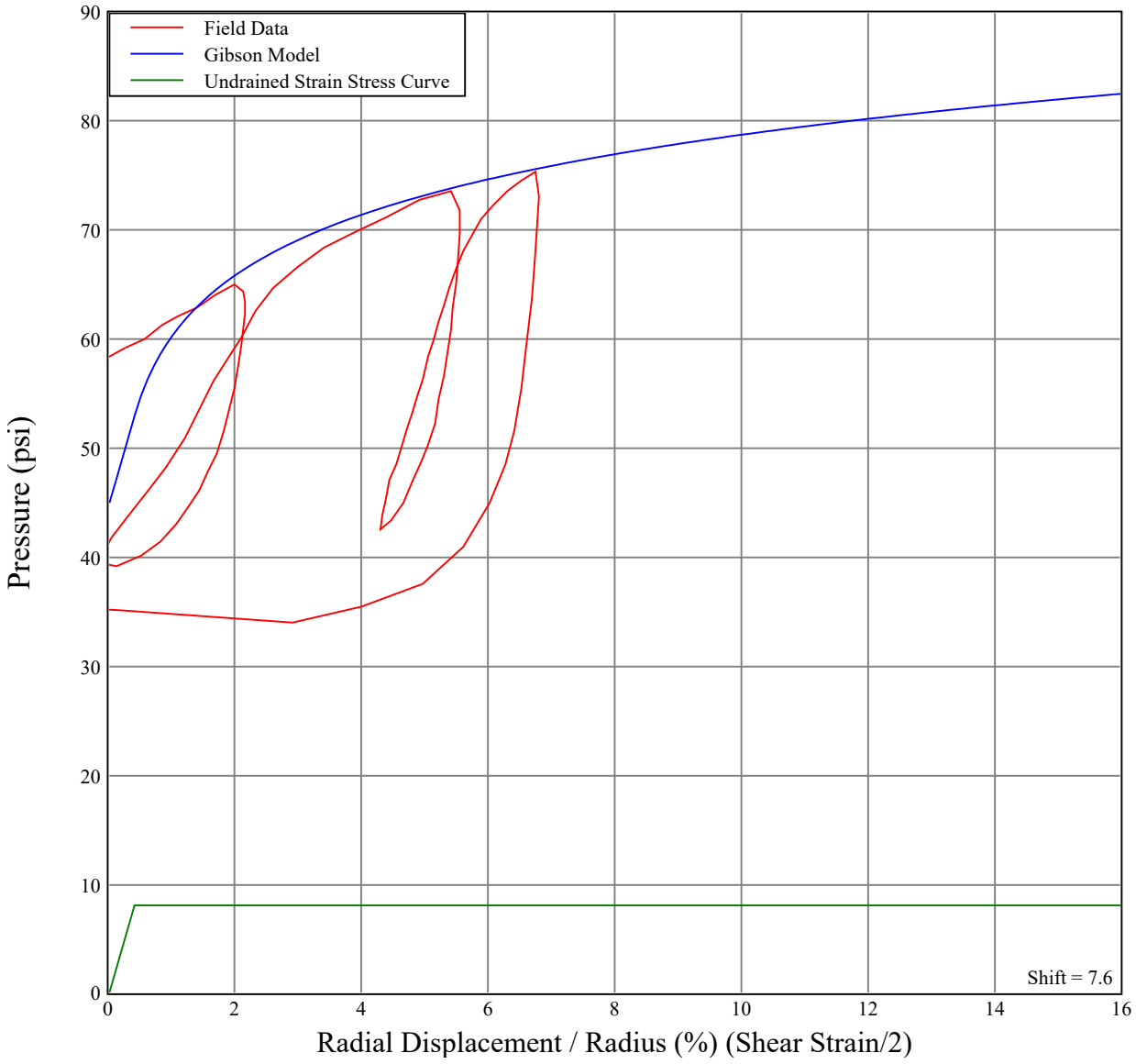
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 37.5 Depth: 37.5FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 09:45 AM Inst: 04



DATA

LOADING

Shear Strength = 8 psi

In Situ Stress = 45 psi

Shear Modulus = 1010 psi

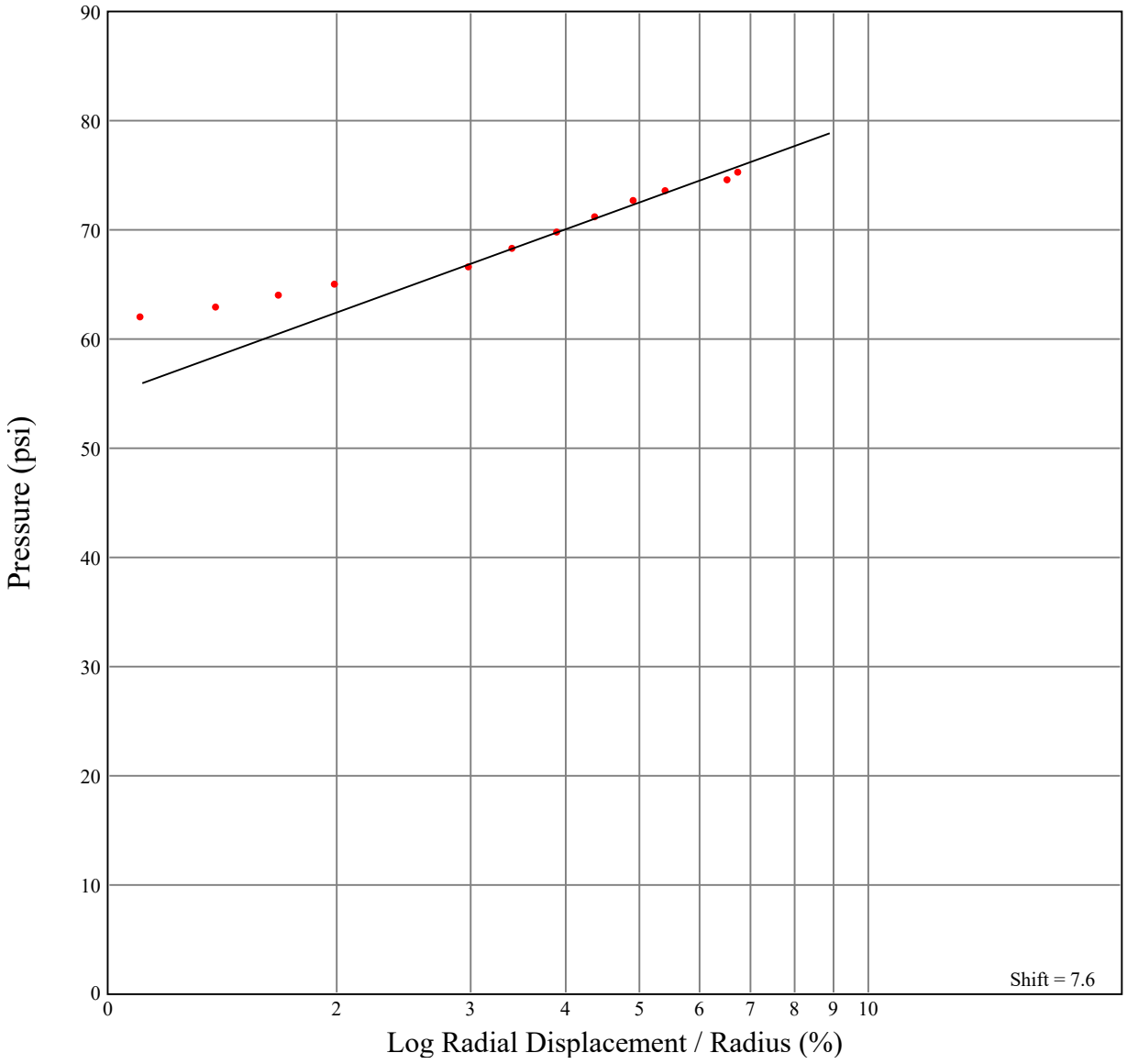
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 37.5 Depth: 37.5FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 09:45 AM Inst: 04



DATA

Shear Strength = 11 psi

Limit Pressure = 96 psi

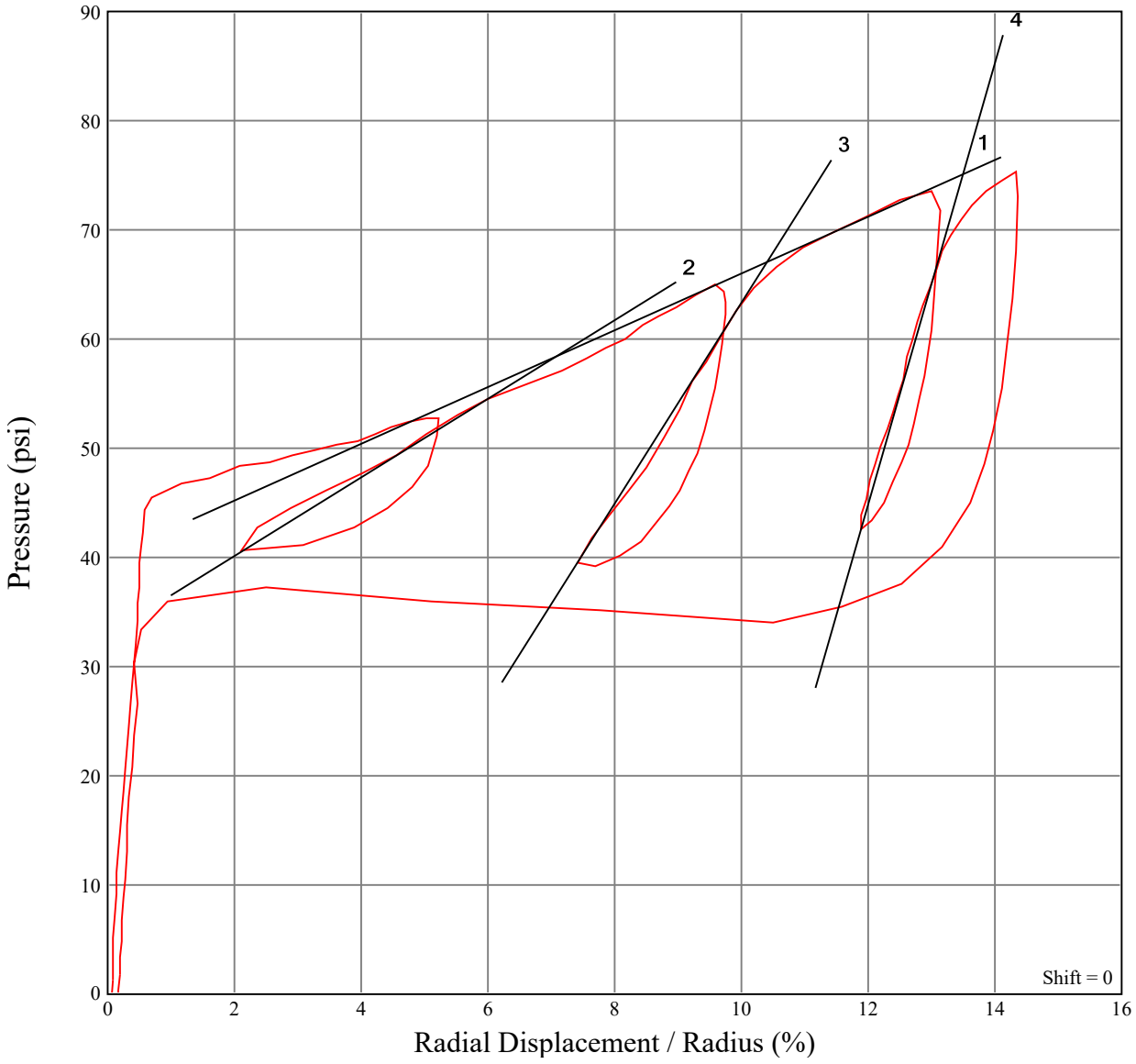
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 37.5 Depth: 37.5FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 09:45 AM Inst: 04



DATA

#1 Shear Modulus = 130 psi

#2 Shear Modulus = 180 psi

#3 Shear Modulus = 460 psi

#4 Shear Modulus = 1010 psi

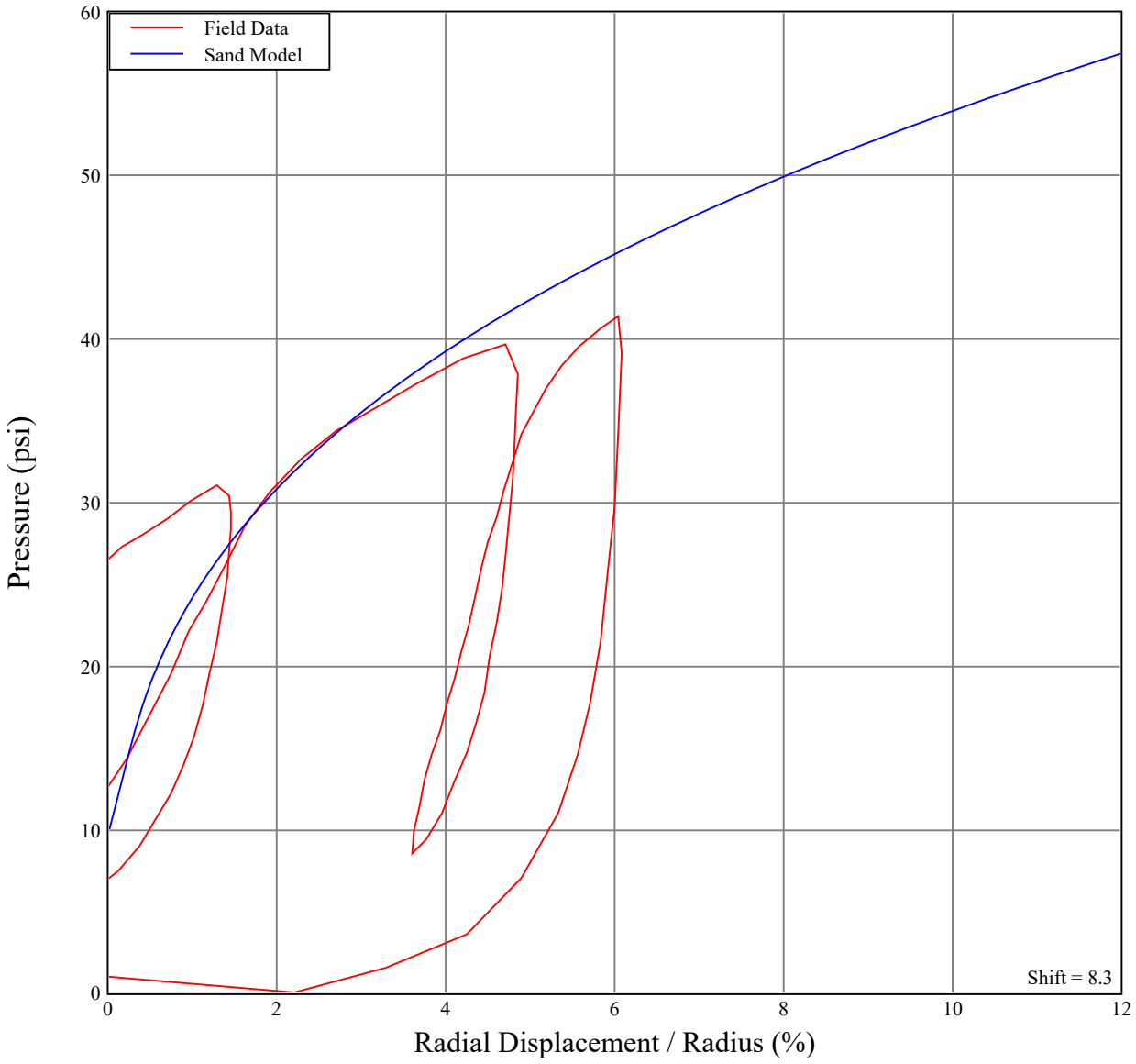
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 37.5 Depth: 37.5FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 09:45 AM Inst: 04



DATA

Water Pressure = 34 psi

Lateral Stress = 10 psi

Friction Angle = 32 deg

Shear Modulus = 1010 psi

Critical Friction Angle = 32 deg

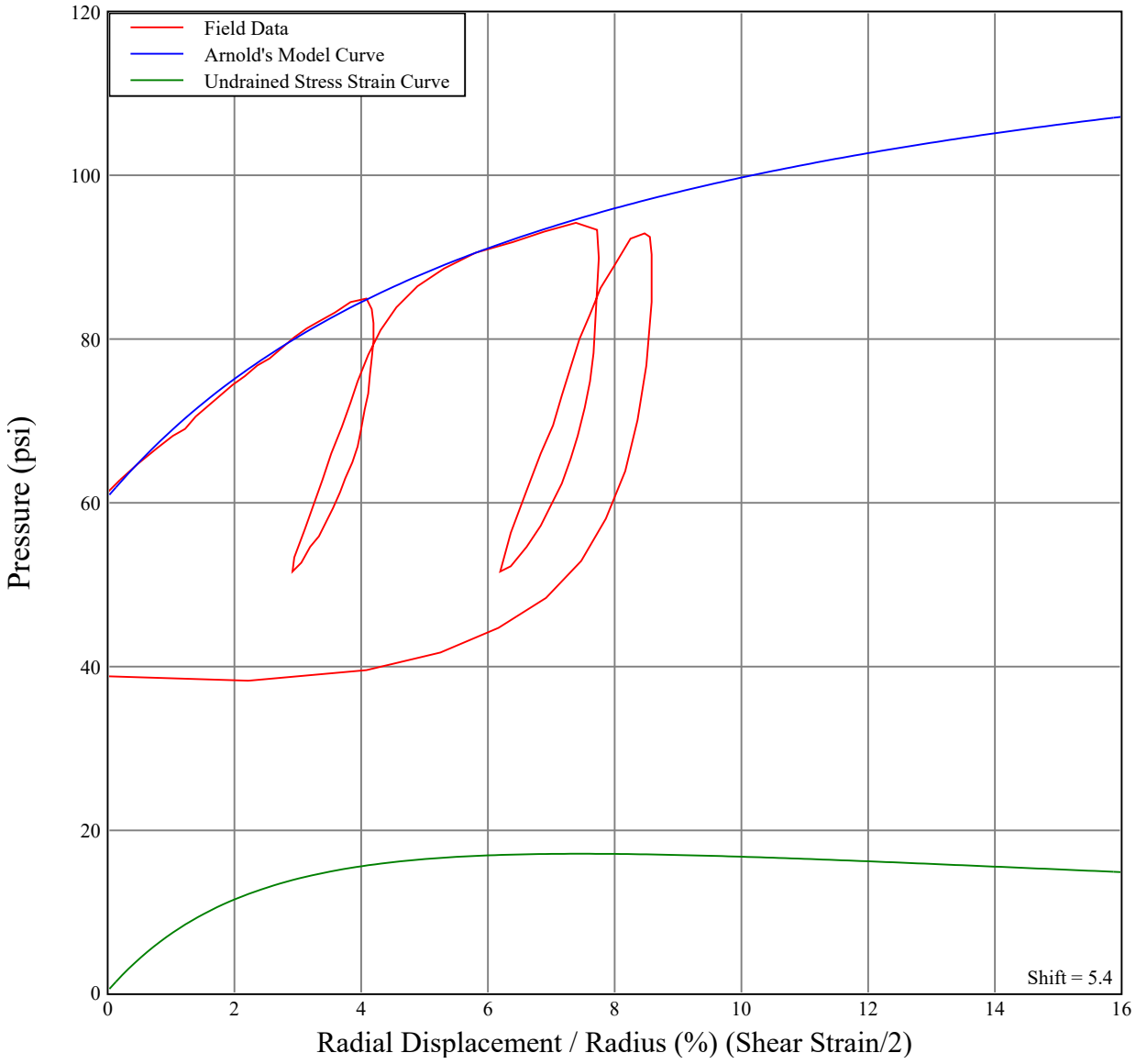
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 39 Depth: 39FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 09:30 AM Inst: 04



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 69 psi	Shear Strength at 10% Strain = 16.6 psi
Pressure at 2.5% Strain = 78 psi	Max Shear Strength = 17.0 psi
Pressure at 7.5% Strain = 95 psi	occurs at 7.5% Strain

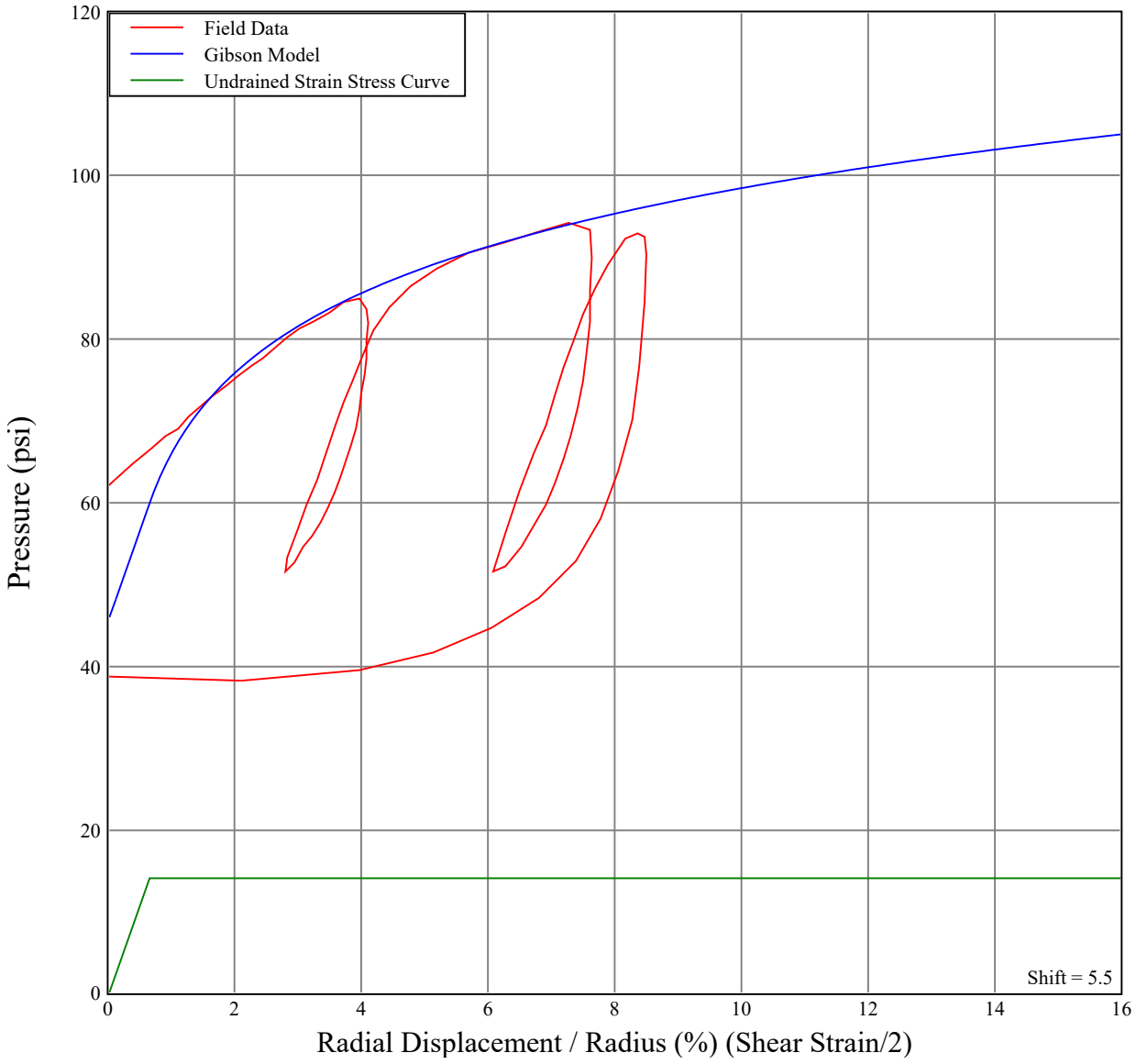
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 39 Depth: 39FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 09:30 AM Inst: 04



DATA

LOADING

Shear Strength = 14 psi

In Situ Stress = 46 psi

Shear Modulus = 1100 psi

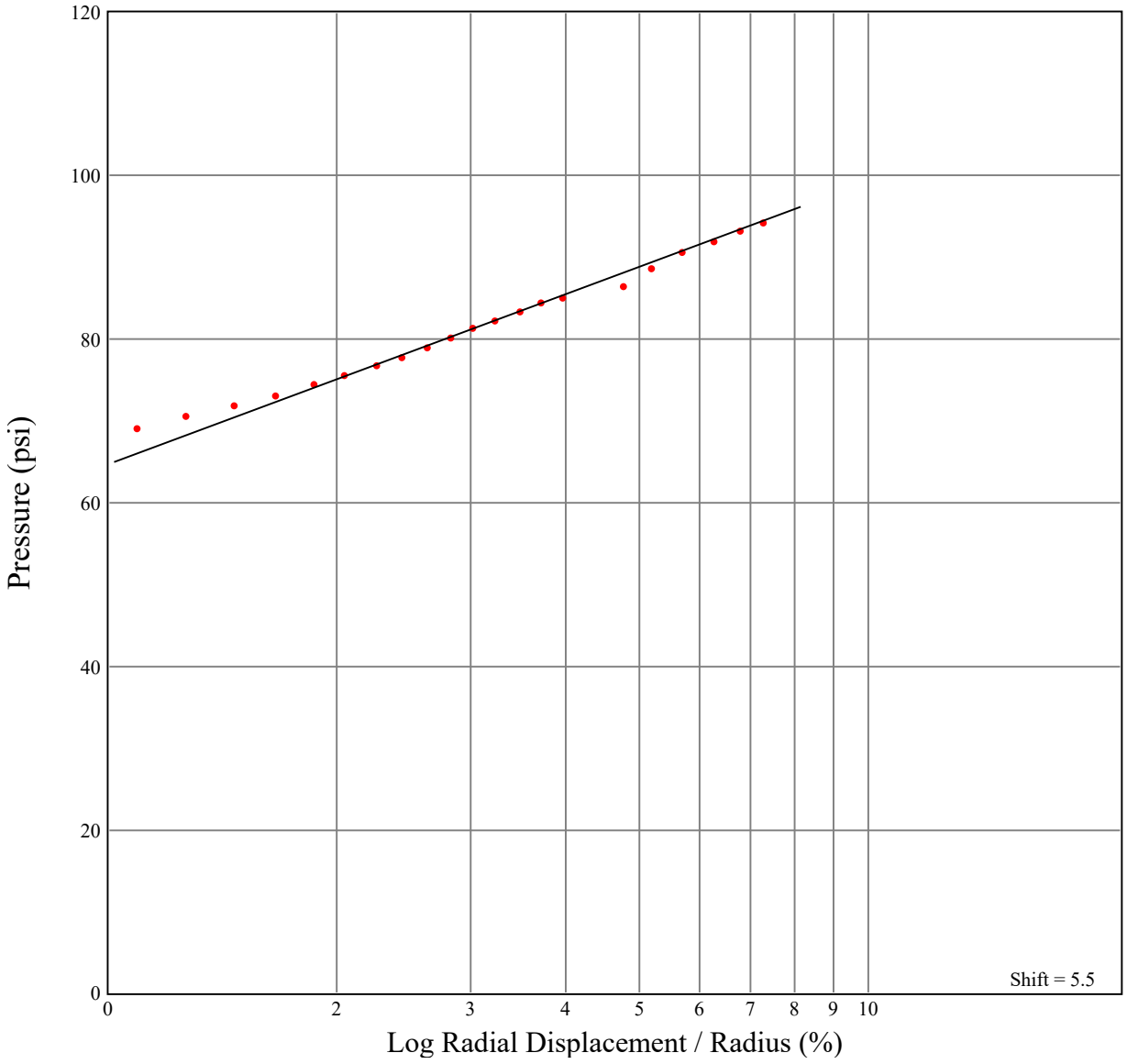
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 39 Depth: 39FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 09:30 AM Inst: 04



DATA

Shear Strength = 15 psi

Limit Pressure = 120 psi

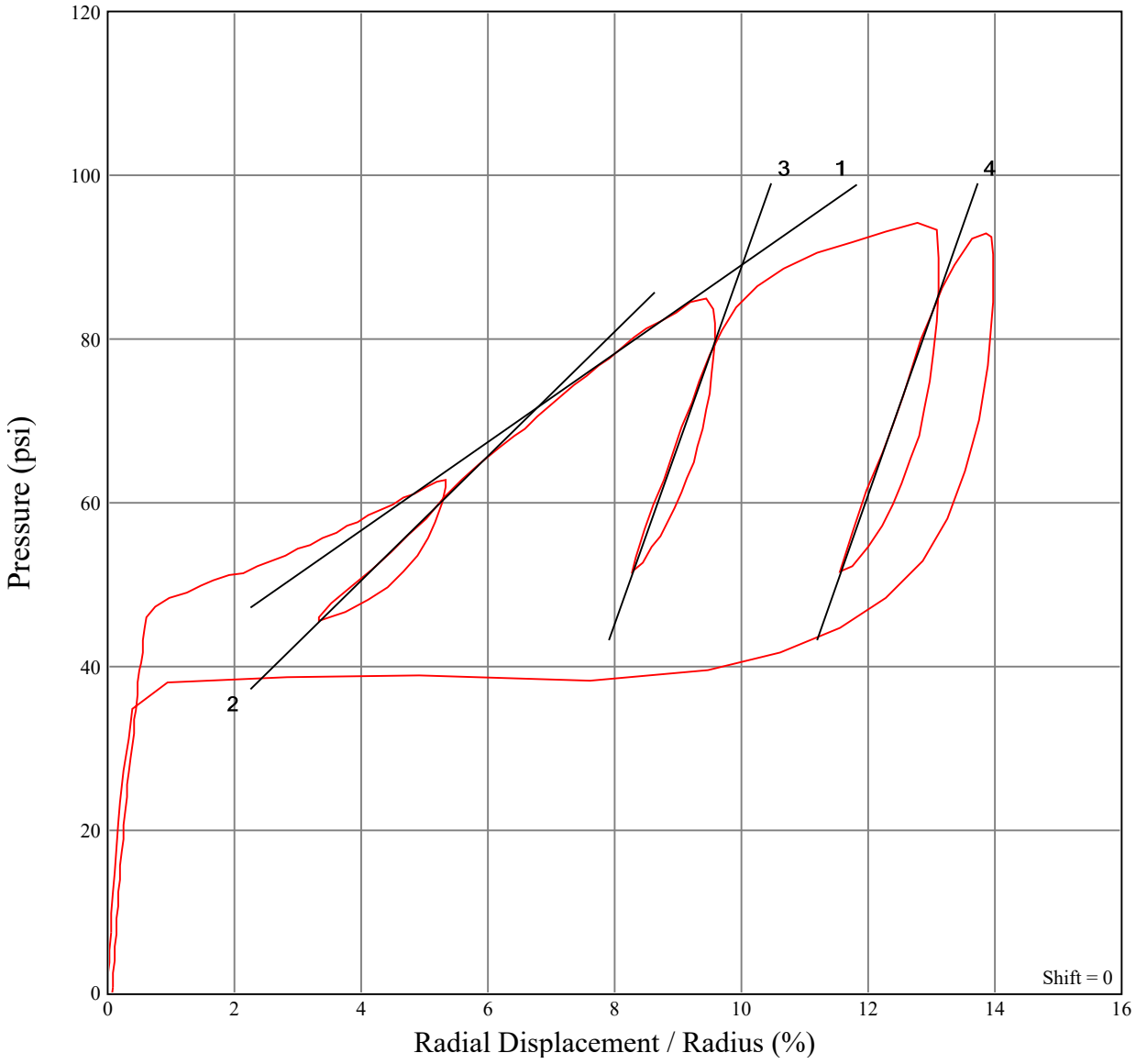
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 39 Depth: 39FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 09:30 AM Inst: 04



DATA

#1 Shear Modulus = 270 psi

#2 Shear Modulus = 380 psi

#3 Shear Modulus = 1090 psi

#4 Shear Modulus = 1100 psi

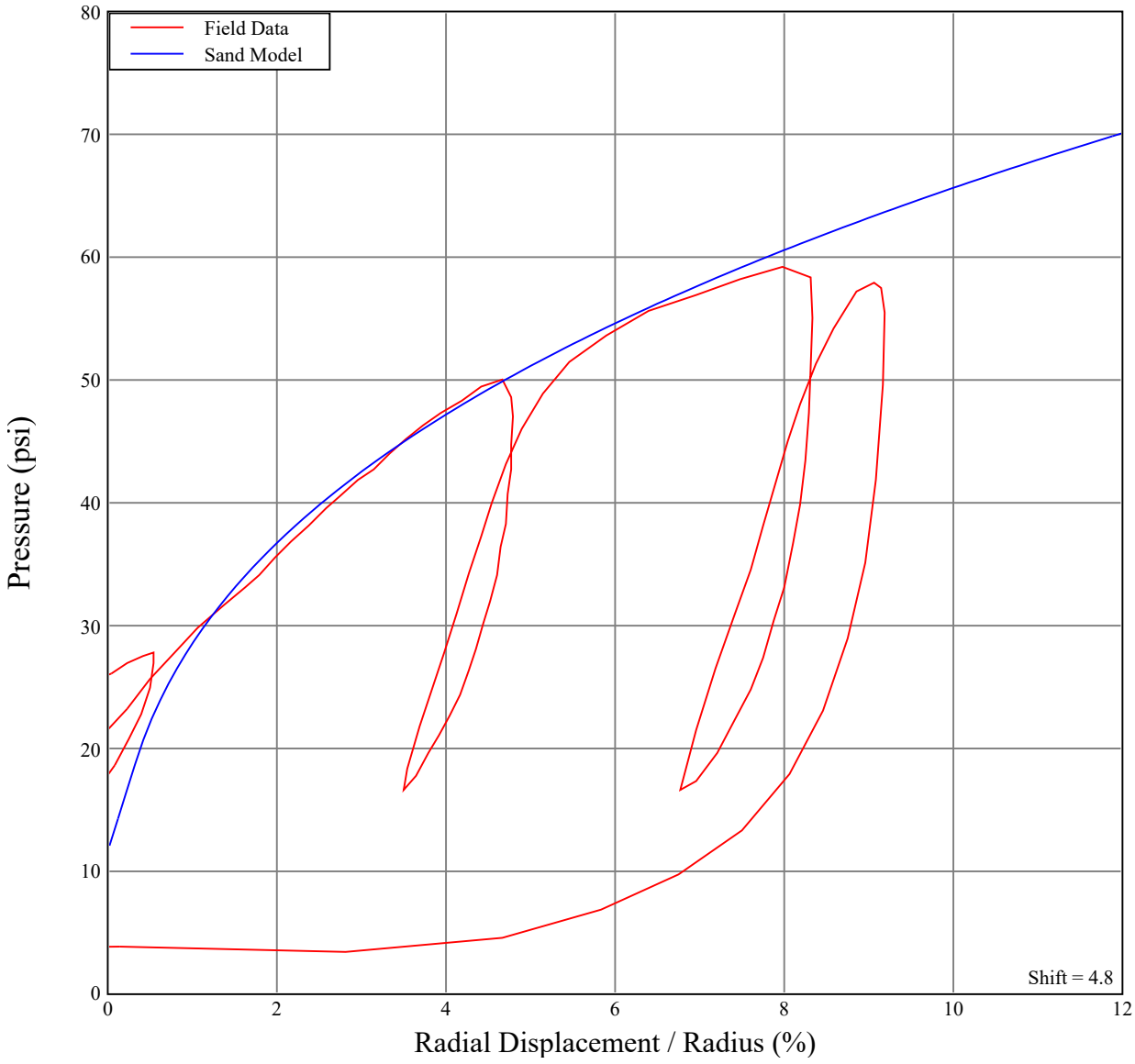
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 39 Depth: 39FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 09:30 AM Inst: 04



DATA

Water Pressure = 35 psi

Lateral Stress = 12 psi

Friction Angle = 33 deg

Shear Modulus = 1100 psi

Critical Friction Angle = 32 deg

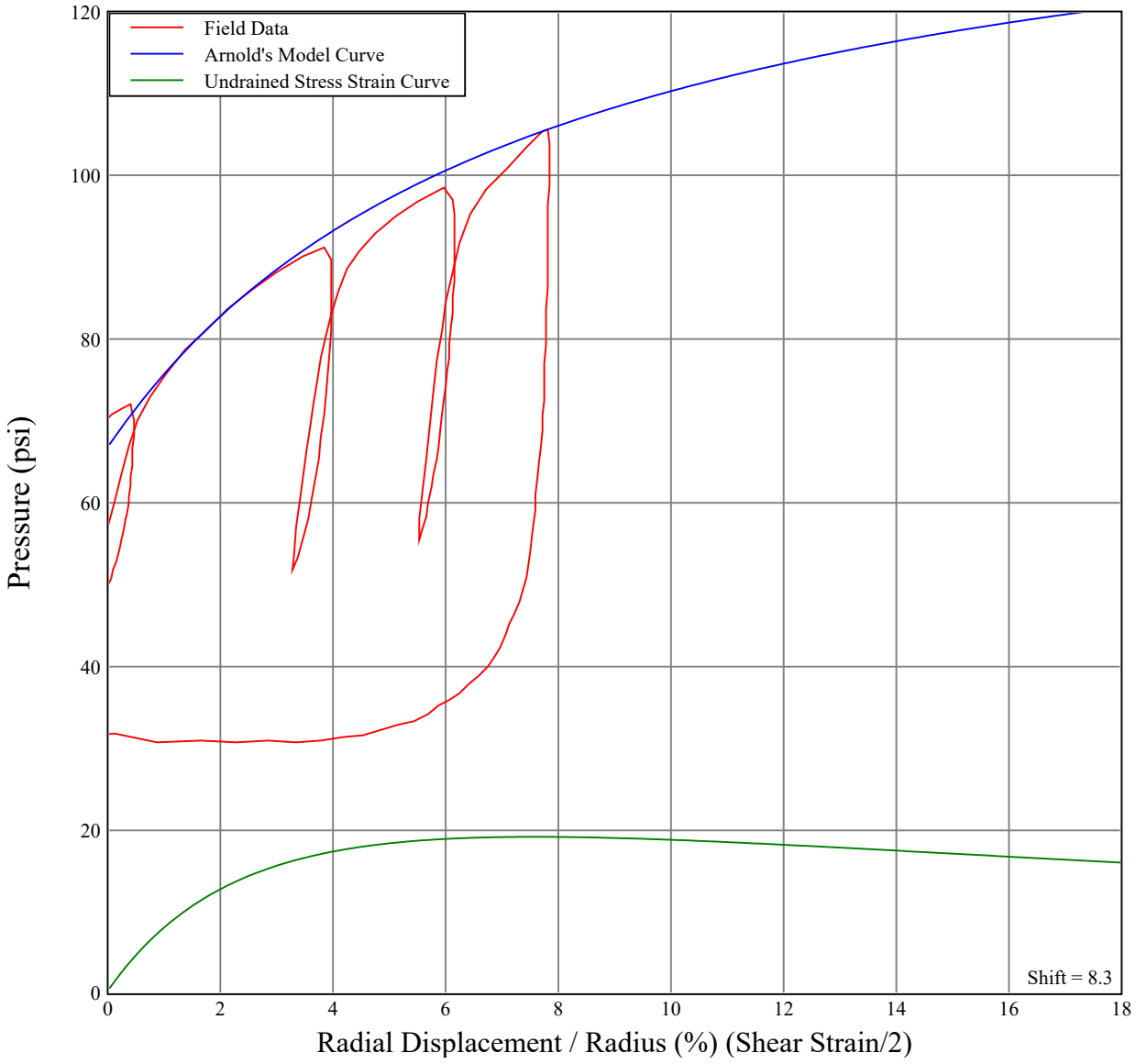
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 44.5 Depth: 44.5FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 10:59 AM Inst: 04



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 76 psi	Shear Strength at 10% Strain = 18.7 psi
Pressure at 2.5% Strain = 86 psi	Max Shear Strength = 19.1 psi
Pressure at 7.5% Strain = 105 psi	occurs at 7.6% Strain

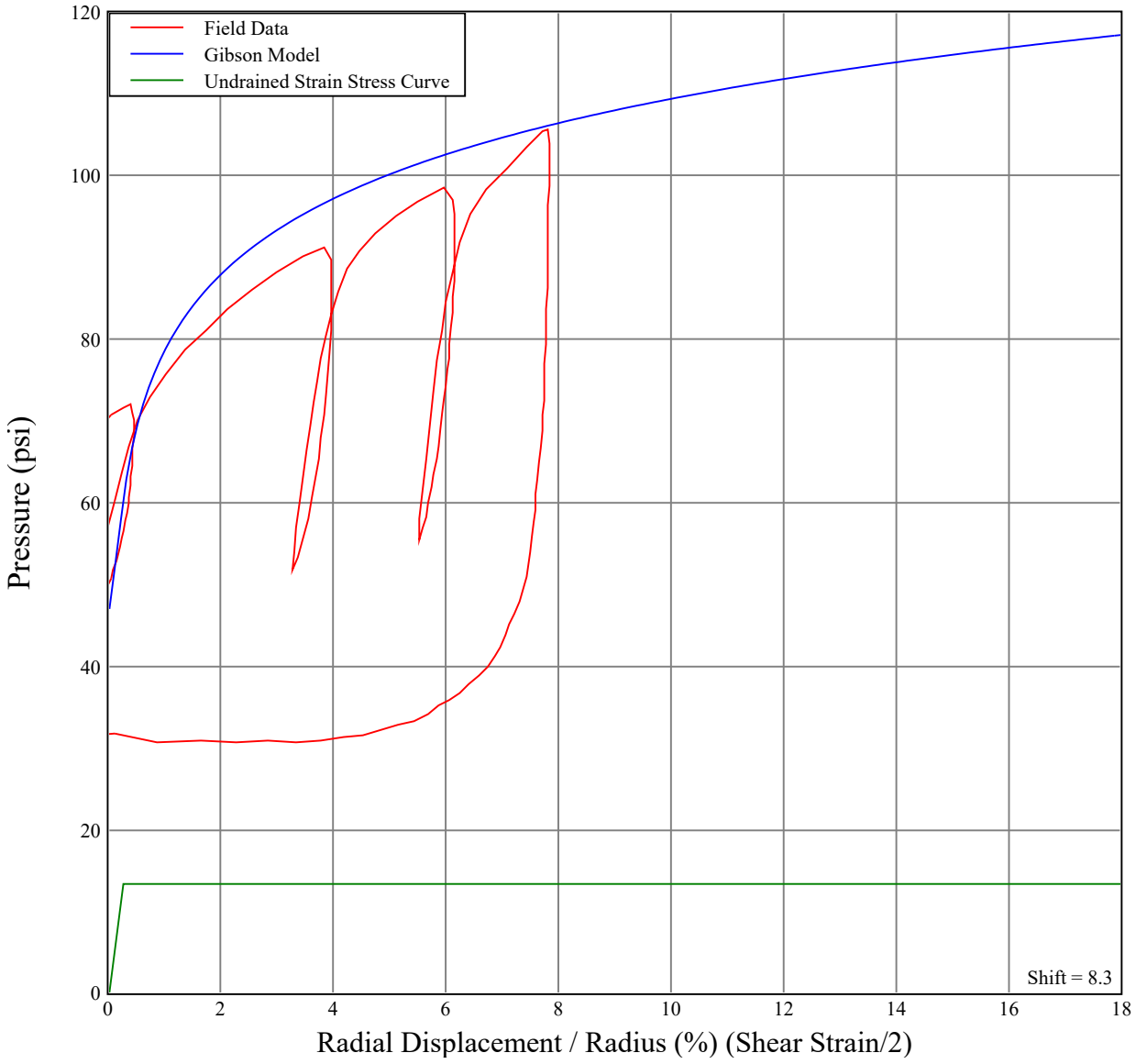
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 44.5 Depth: 44.5FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 10:59 AM Inst: 04



DATA

LOADING

Shear Strength = 13.3 psi

In Situ Stress = 47 psi

Shear Modulus = 2690 psi

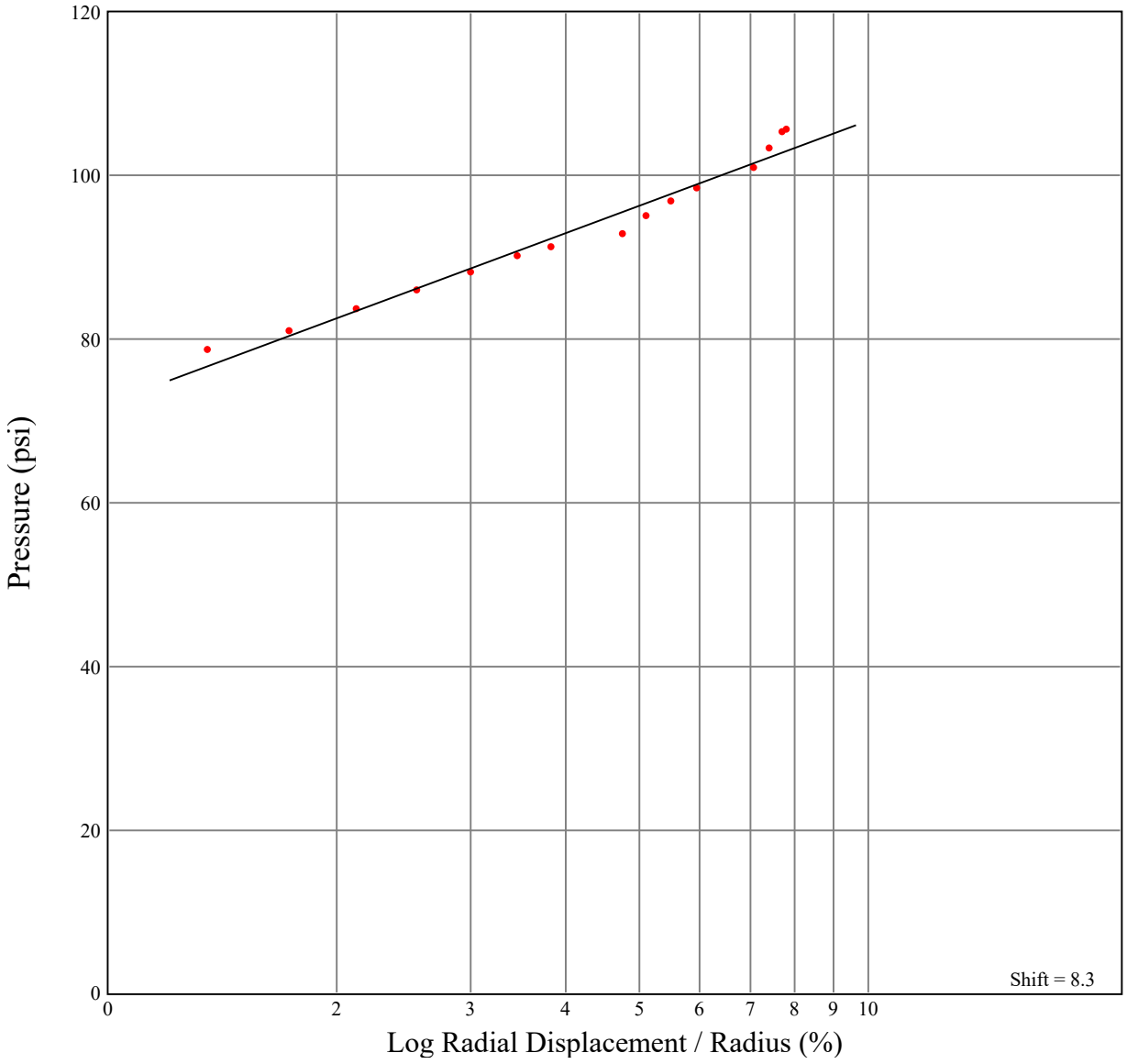
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 44.5 Depth: 44.5FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 10:59 AM Inst: 04



DATA

Shear Strength = 15 psi

Limit Pressure = 128 psi

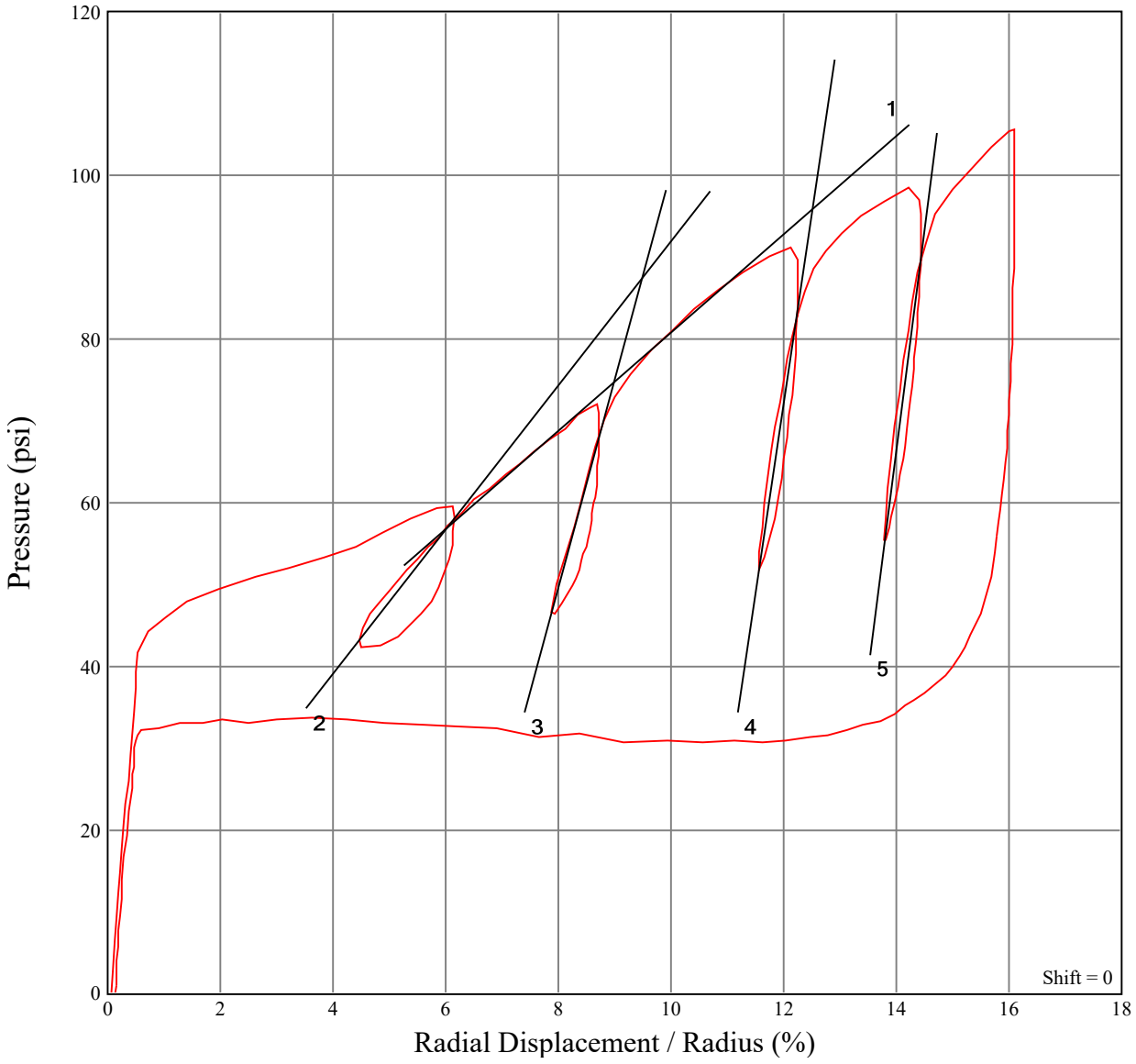
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 44.5 Depth: 44.5FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 10:59 AM Inst: 04



DATA

#1 Shear Modulus = 300 psi

#2 Shear Modulus = 440 psi

#3 Shear Modulus = 1270 psi

#4 Shear Modulus = 2320 psi

#5 Shear Modulus = 2690 psi

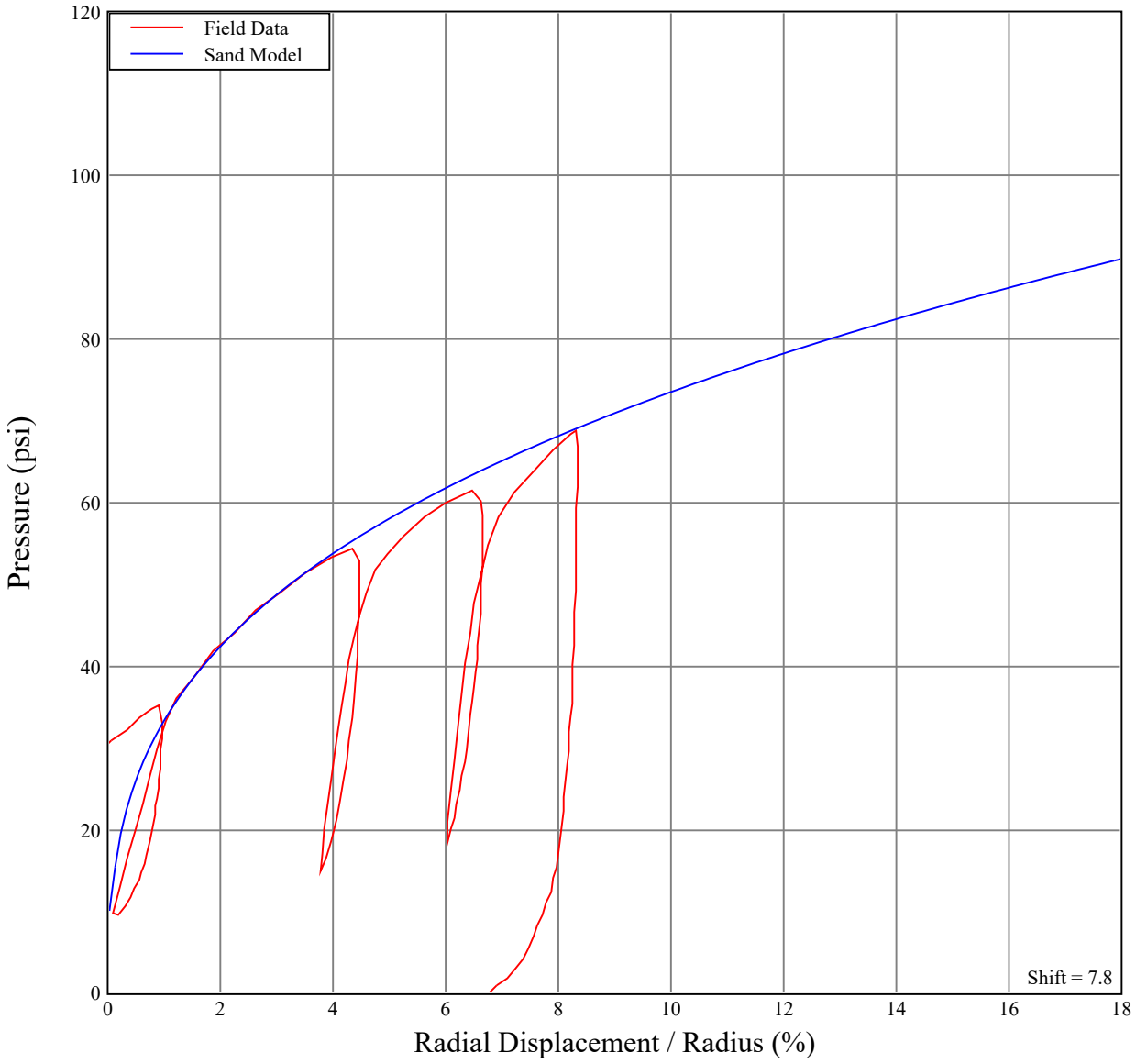
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 44.5 Depth: 44.5FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 10:59 AM Inst: 04



DATA

Water Pressure = 37 psi

Lateral Stress = 10 psi

Friction Angle = 31 deg

Shear Modulus = 2690 psi

Critical Friction Angle = 31 deg

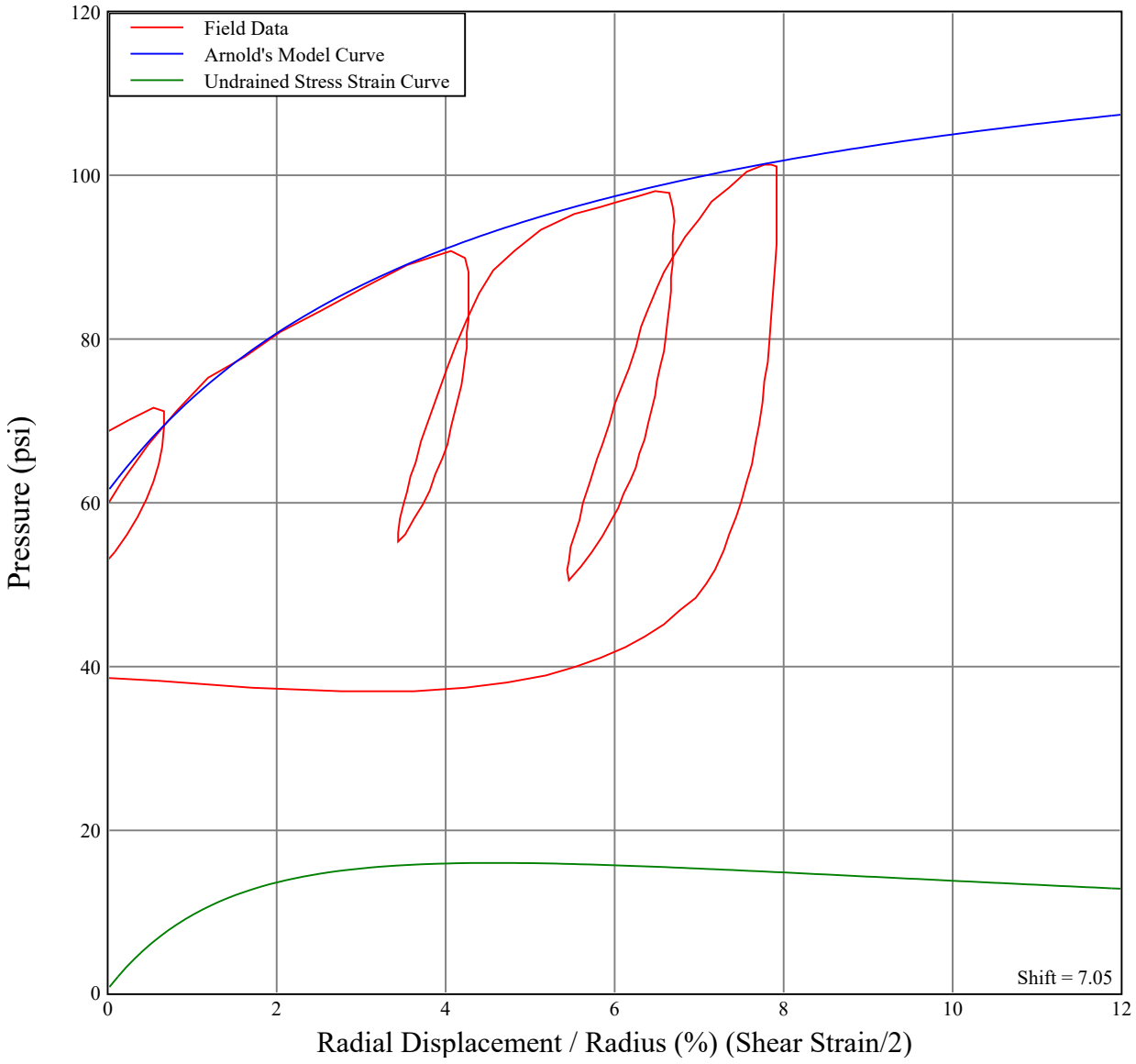
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 46 Depth: 46FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 10:42 AM Inst: 04



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 73 psi	Shear Strength at 10% Strain = 13.7 psi
Pressure at 2.5% Strain = 84 psi	Max Shear Strength = 15.9 psi
Pressure at 7.5% Strain = 101 psi	occurs at 4.6% Strain

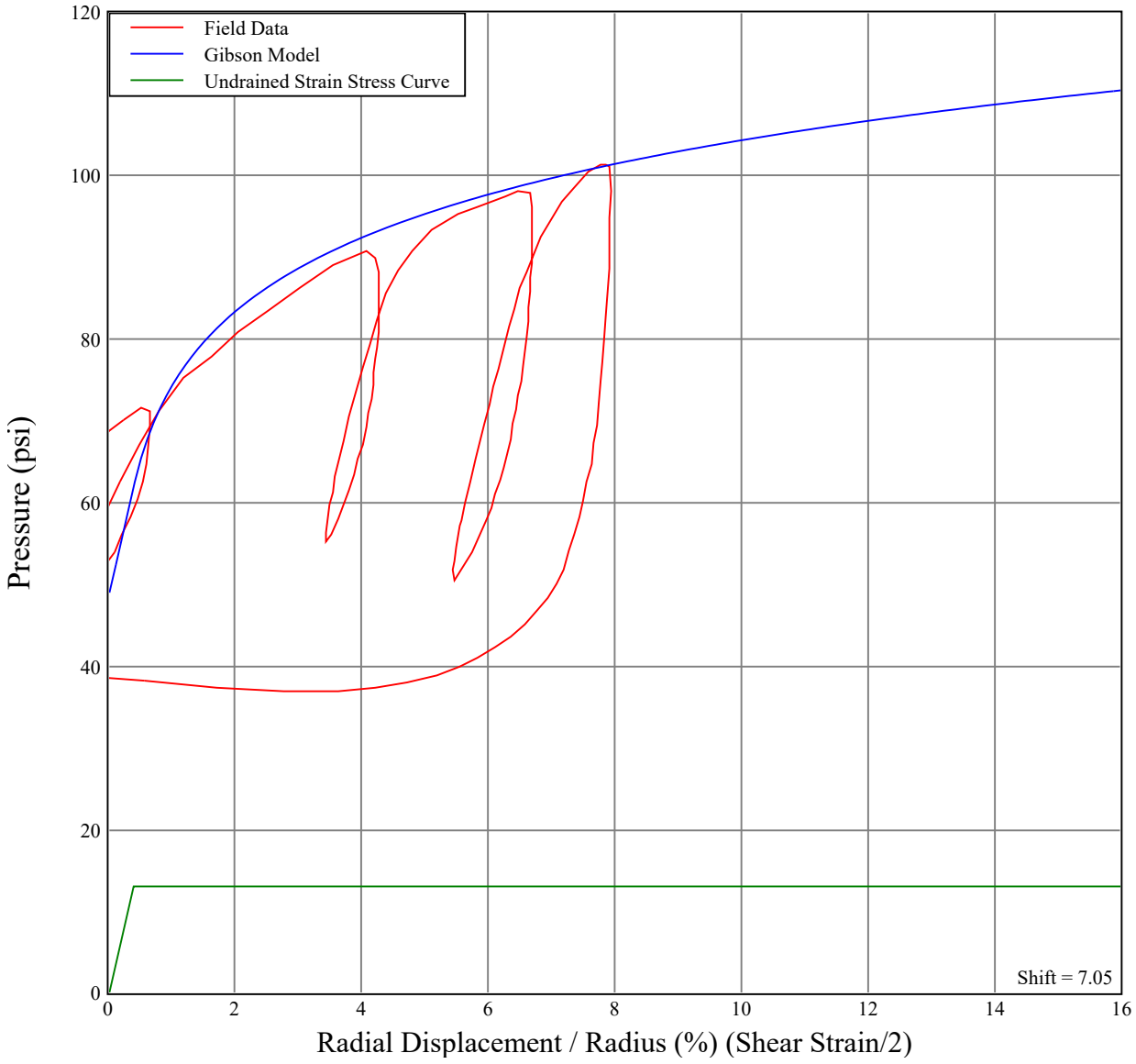
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 46 Depth: 46FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 10:42 AM Inst: 04



DATA

LOADING

Shear Strength = 13 psi

In Situ Stress = 49 psi

Shear Modulus = 1700 psi

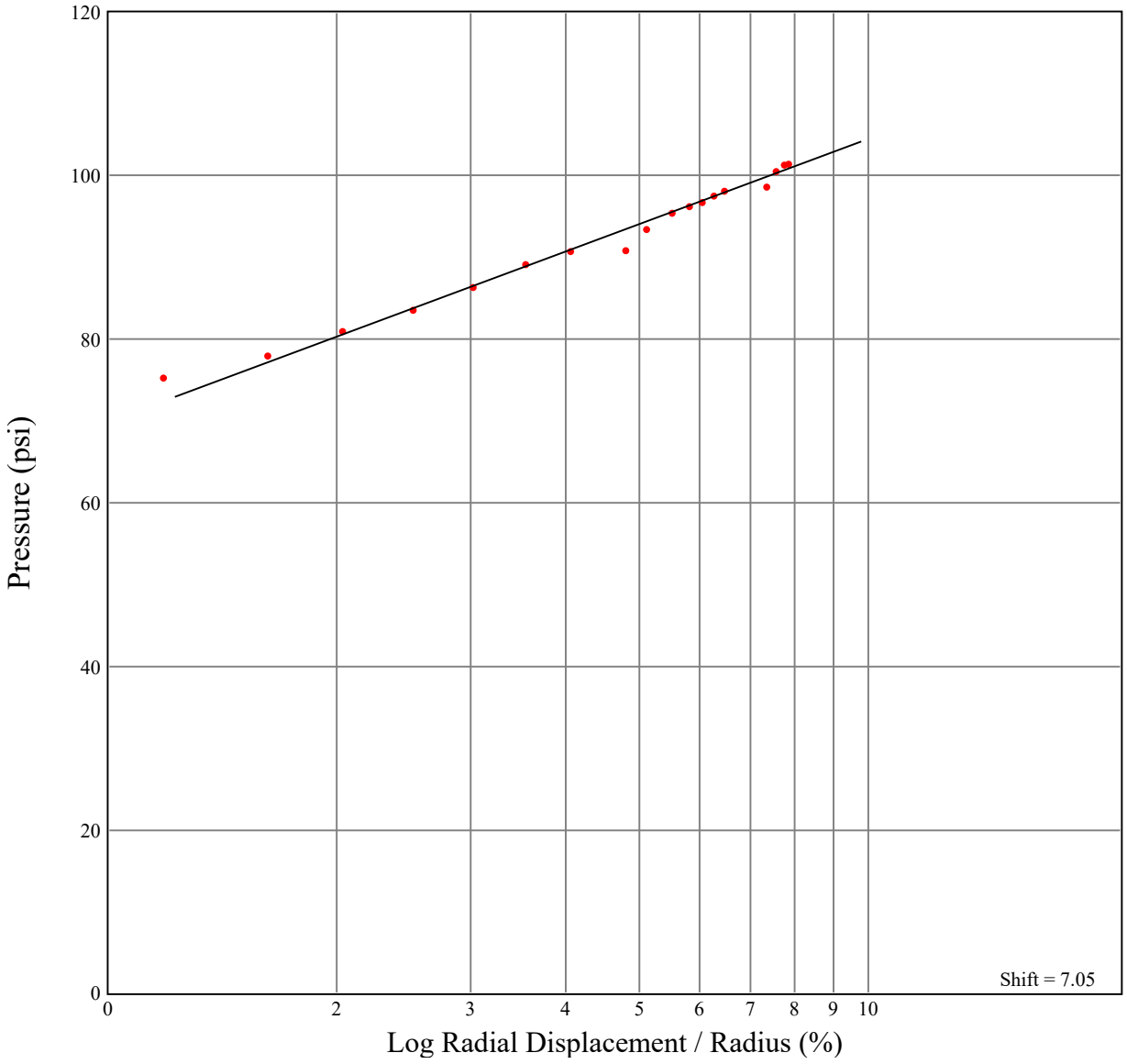
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 46 Depth: 46FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 10:42 AM Inst: 04



DATA

Shear Strength = 15 psi

Limit Pressure = 126 psi

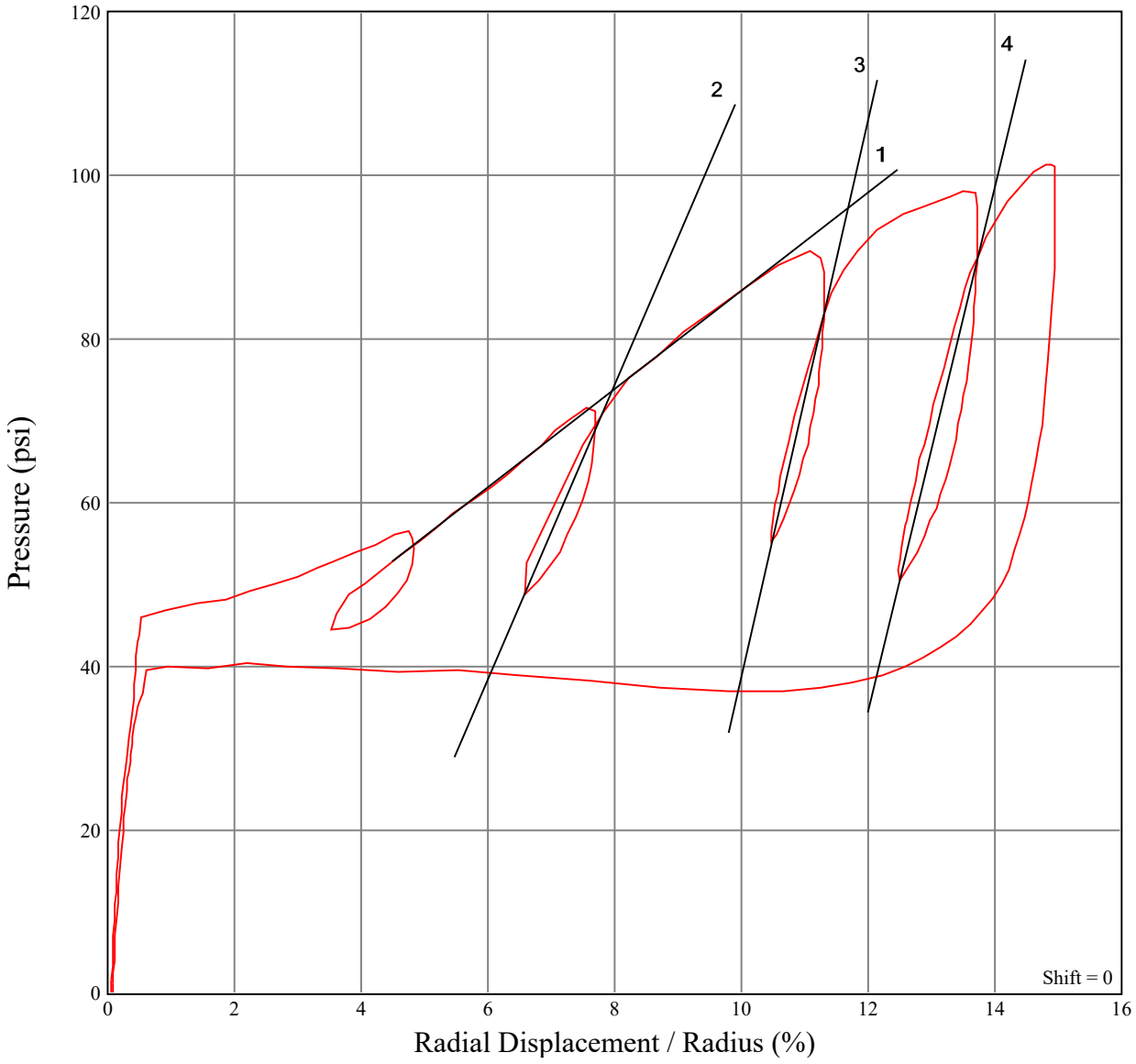
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 46 Depth: 46FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 10:42 AM Inst: 04



DATA

#1 Shear Modulus = 300 psi

#2 Shear Modulus = 900 psi

#3 Shear Modulus = 1700 psi

#4 Shear Modulus = 1600 psi

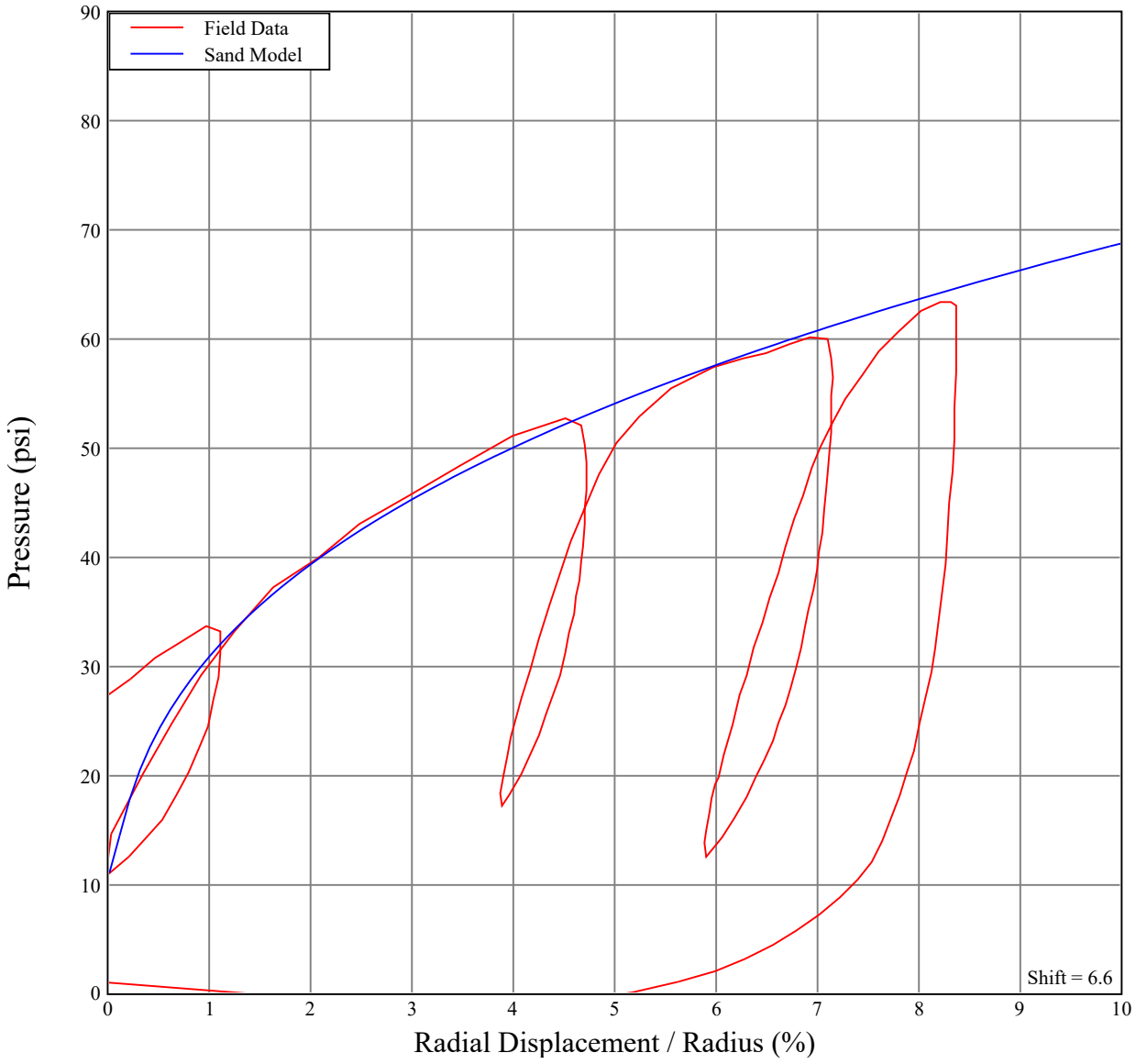
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 46 Depth: 46FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 10:42 AM Inst: 04



DATA

Water Pressure = 38 psi

Lateral Stress = 11 psi

Friction Angle = 32 deg

Shear Modulus = 1700 psi

Critical Friction Angle = 32 deg

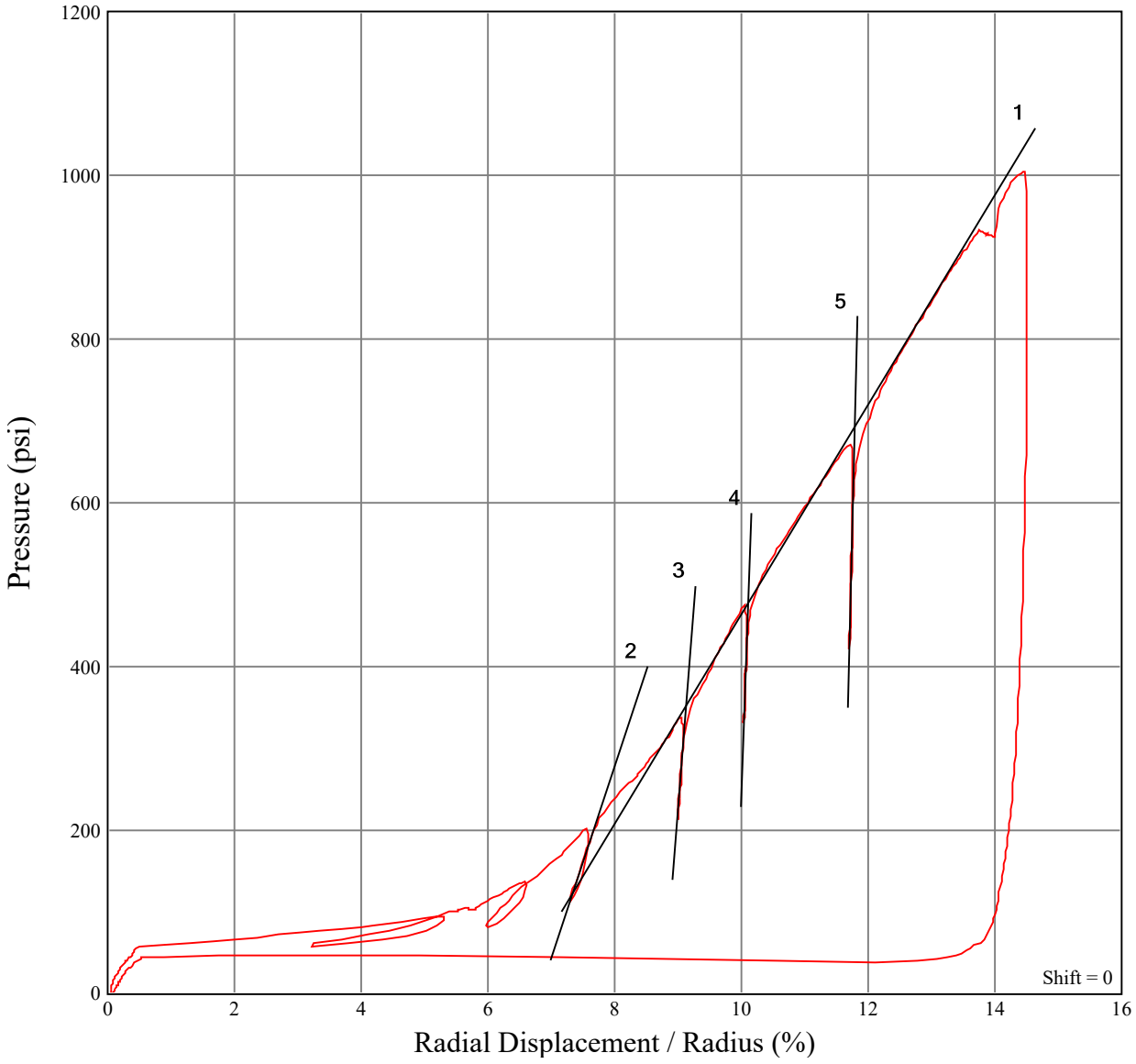
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 71.5 Depth: 71.5FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 03:13 PM Inst: 04



DATA

#1 Shear Modulus = 6400 psi

#2 Shear Modulus = 11700 psi

#3 Shear Modulus = 49300 psi

#4 Shear Modulus = 109200 psi

#5 Shear Modulus = 159700 psi

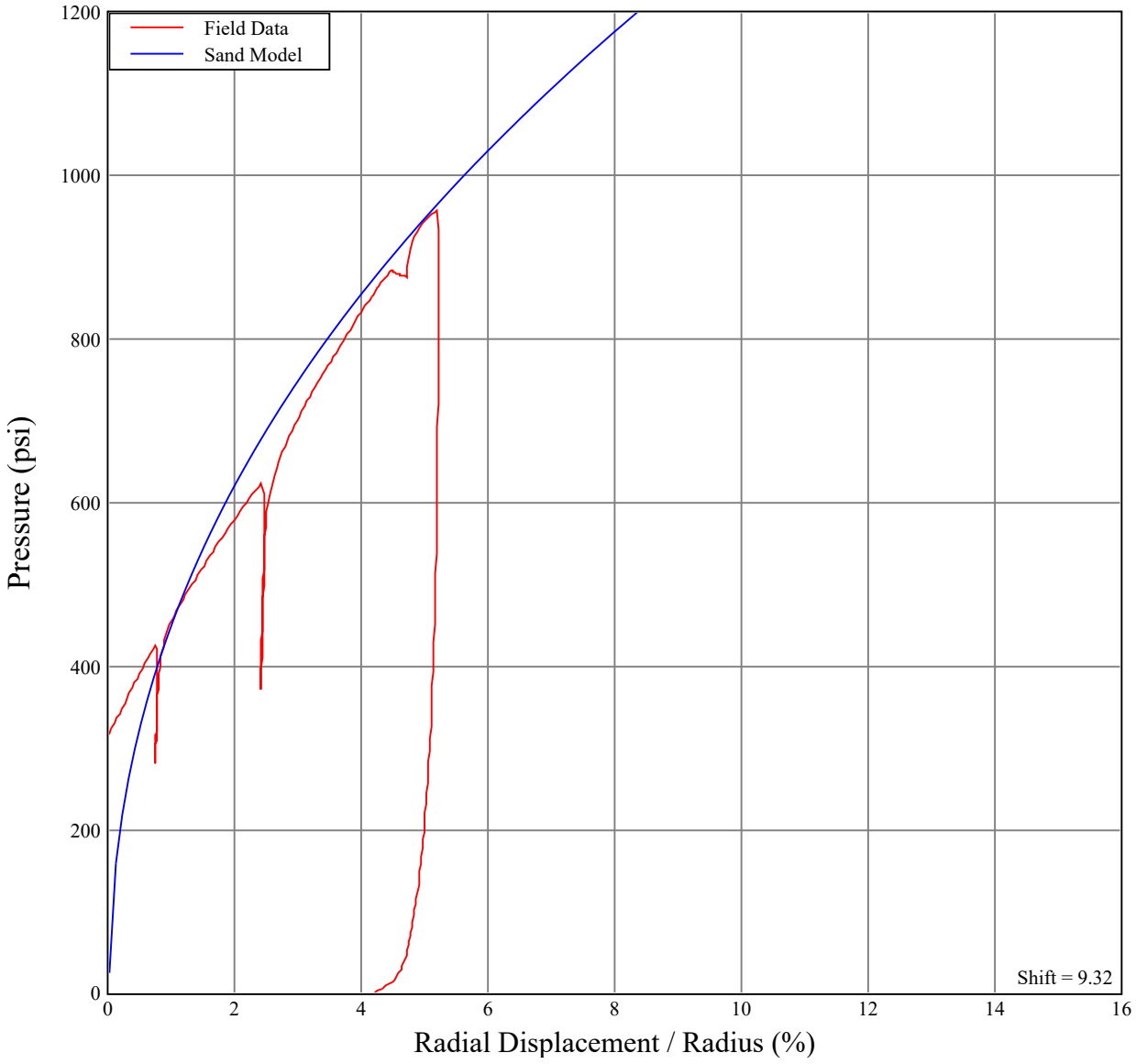
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 71.5 Depth: 71.5FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 03:13 PM Inst: 04



DATA

Water Pressure = 49 psi

Lateral Stress = 24 psi

Friction Angle = 40 deg

Shear Modulus = 159700 psi

Critical Friction Angle = 32 deg

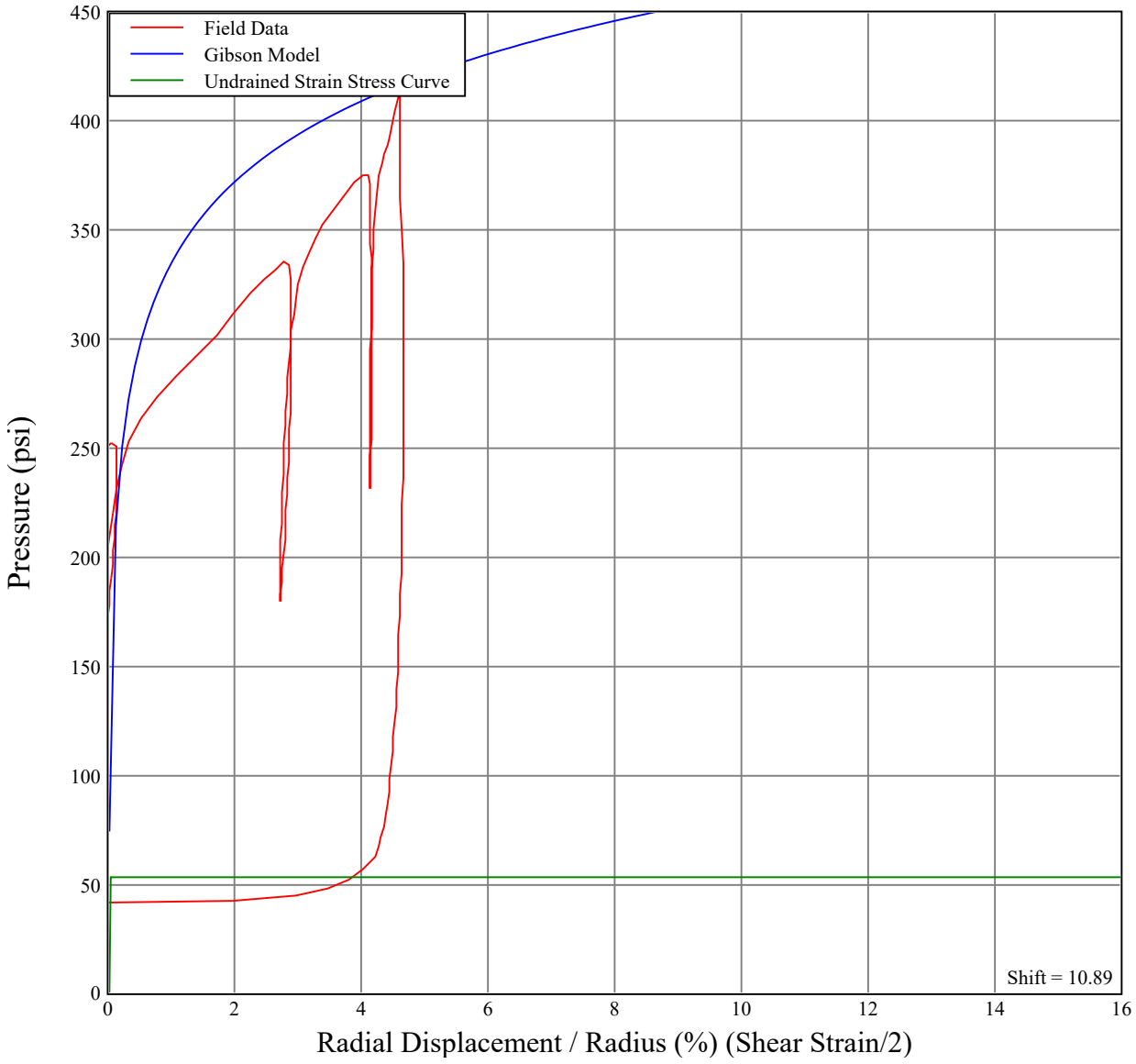
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 73 Depth: 73FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 02:50 PM Inst: 04



DATA

LOADING

Shear Strength = 53 psi

In Situ Stress = 74 psi

Shear Modulus = 137500 psi

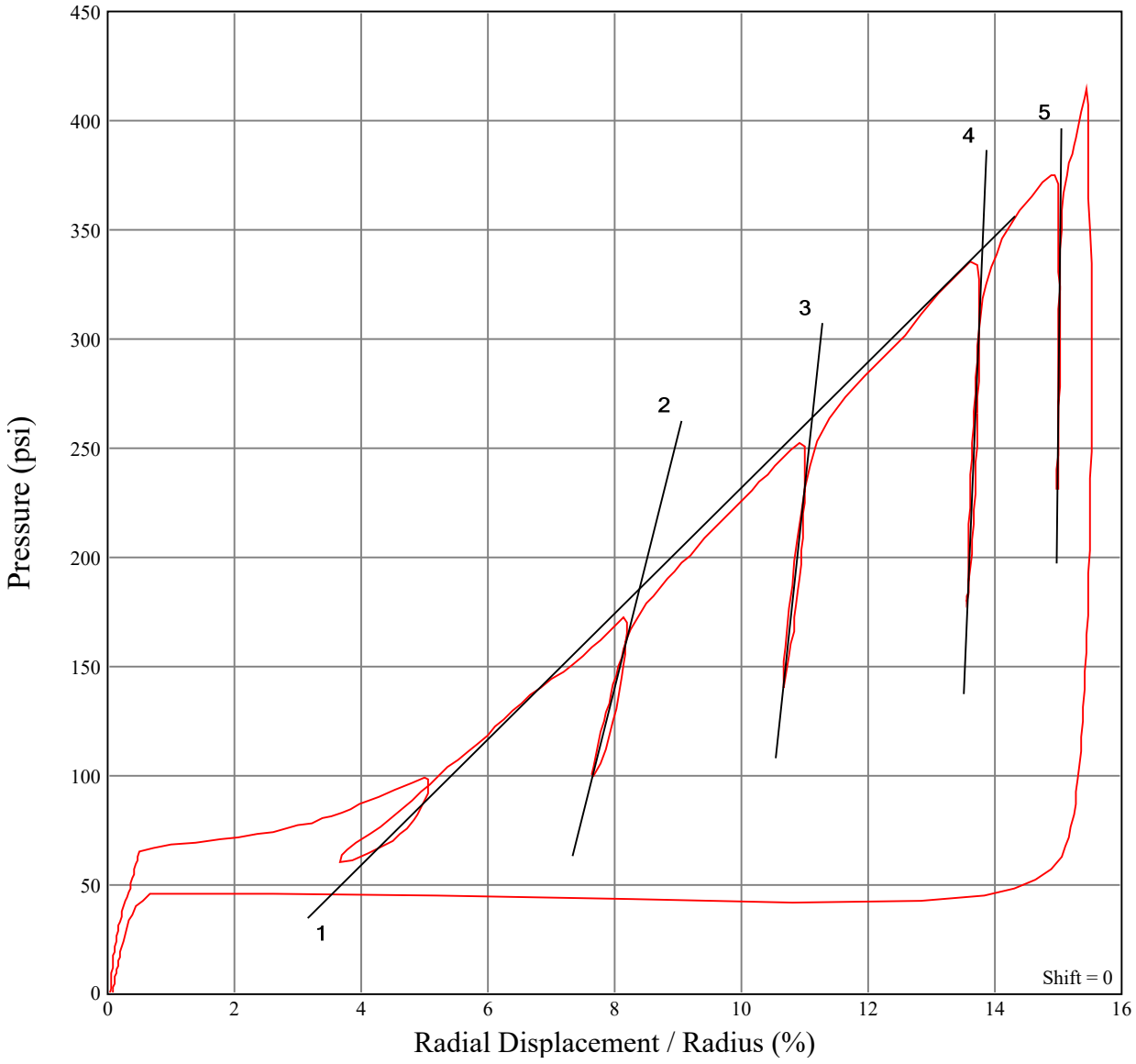
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 73 Depth: 73FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 02:50 PM Inst: 04



DATA

#1 Shear Modulus = 1440 psi

#2 Shear Modulus = 5800 psi

#3 Shear Modulus = 13500 psi

#4 Shear Modulus = 34700 psi

#5 Shear Modulus = 137500 psi

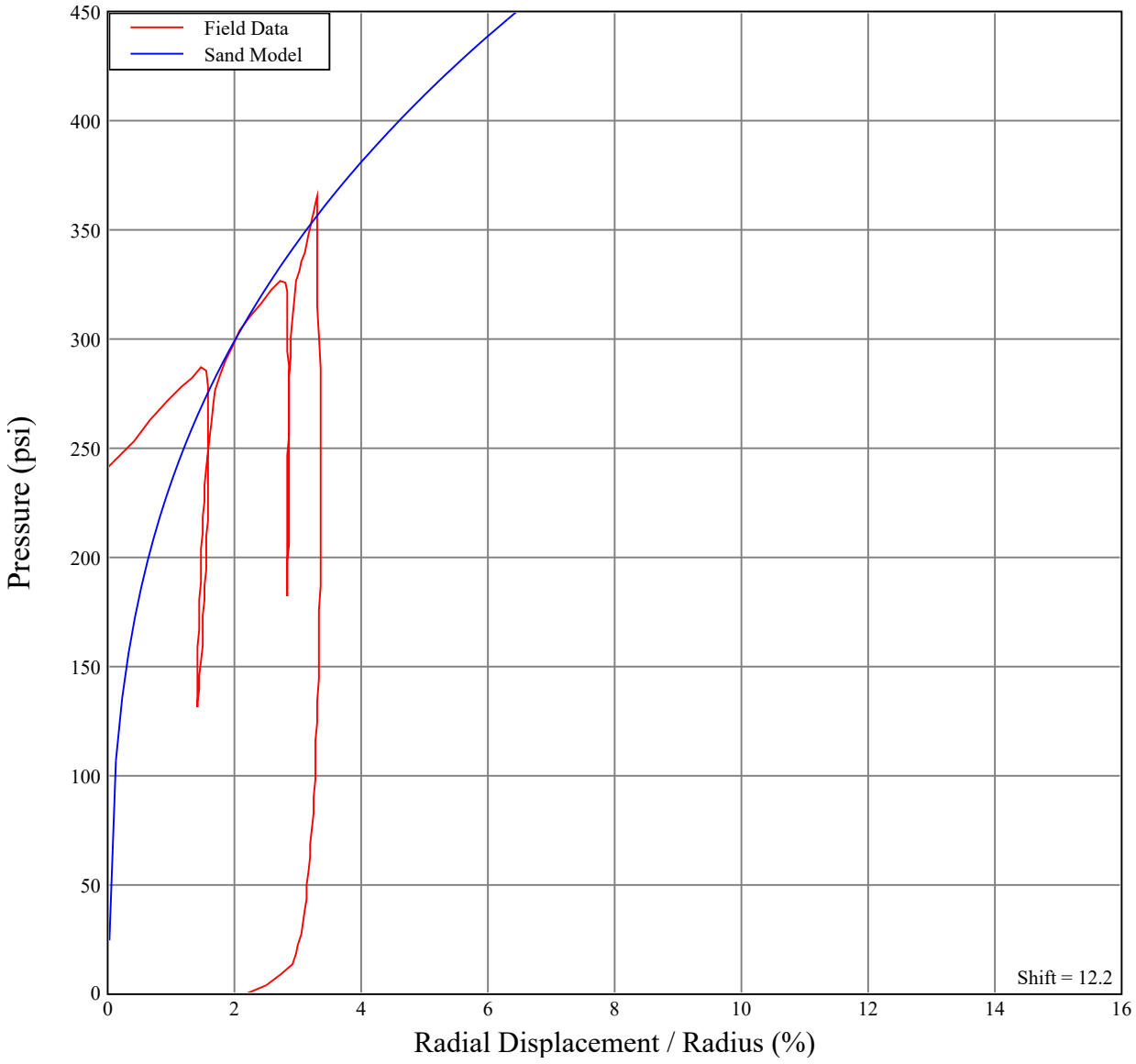
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B10 Test: EQRB-B11 73 Depth: 73FT Date: 08/05/2021

Oper: Walsh Job # 102636 Time of Test: 02:50 PM Inst: 04



DATA

Water Pressure = 49 psi

Lateral Stress = 24 psi

Friction Angle = 32 deg

Shear Modulus = 137500 psi

Critical Friction Angle = 32 deg

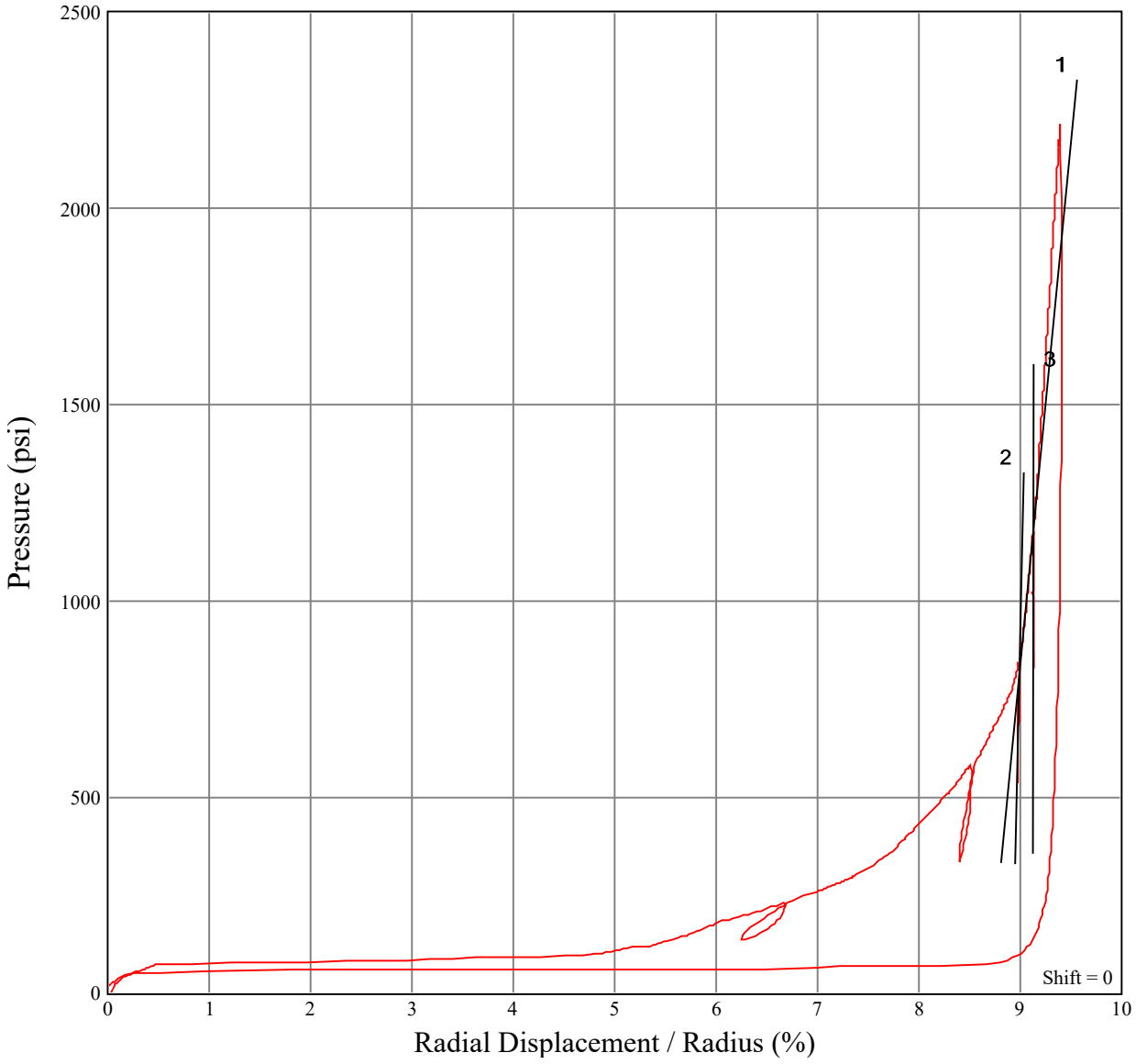
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B11 Test: EQRB-B11 112.5 Depth: 112.5FT Date: 08/12/2021

Oper: Walsh Job # 102636 Time of Test: 09:44 AM Inst: 04



DATA

#1 Shear Modulus = 133000 psi

#2 Shear Modulus = 592000 psi

#3 Shear Modulus = 8394700 psi

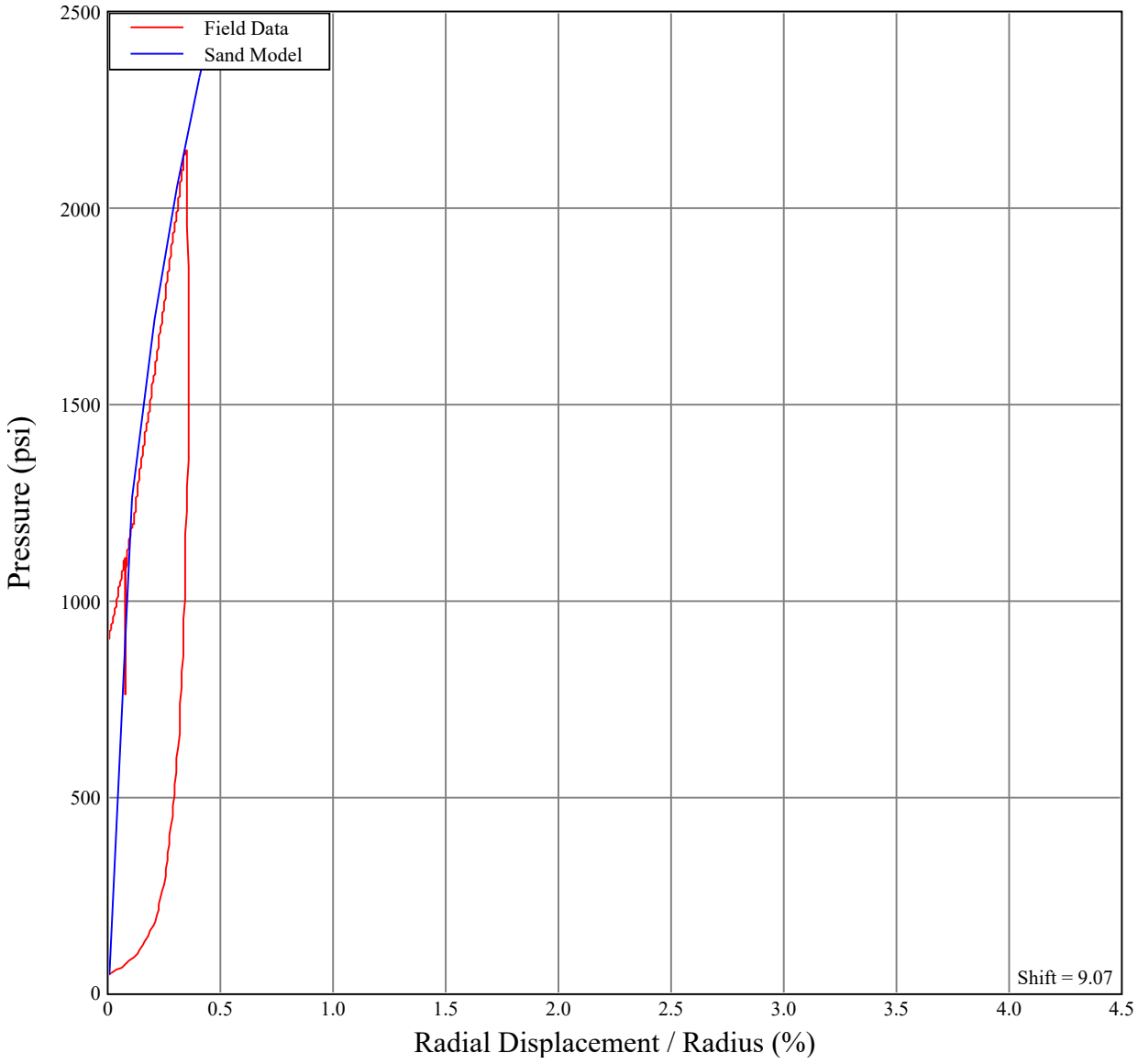
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B11 Test: EQRB-B11 112.5 Depth: 112.5FT Date: 08/12/2021

Oper: Walsh Job # 102636 Time of Test: 09:44 AM Inst: 04



DATA

Water Pressure = 66 psi

Lateral Stress = 46 psi

Friction Angle = 39 deg

Shear Modulus = 8394700 psi

Critical Friction Angle = 32 deg

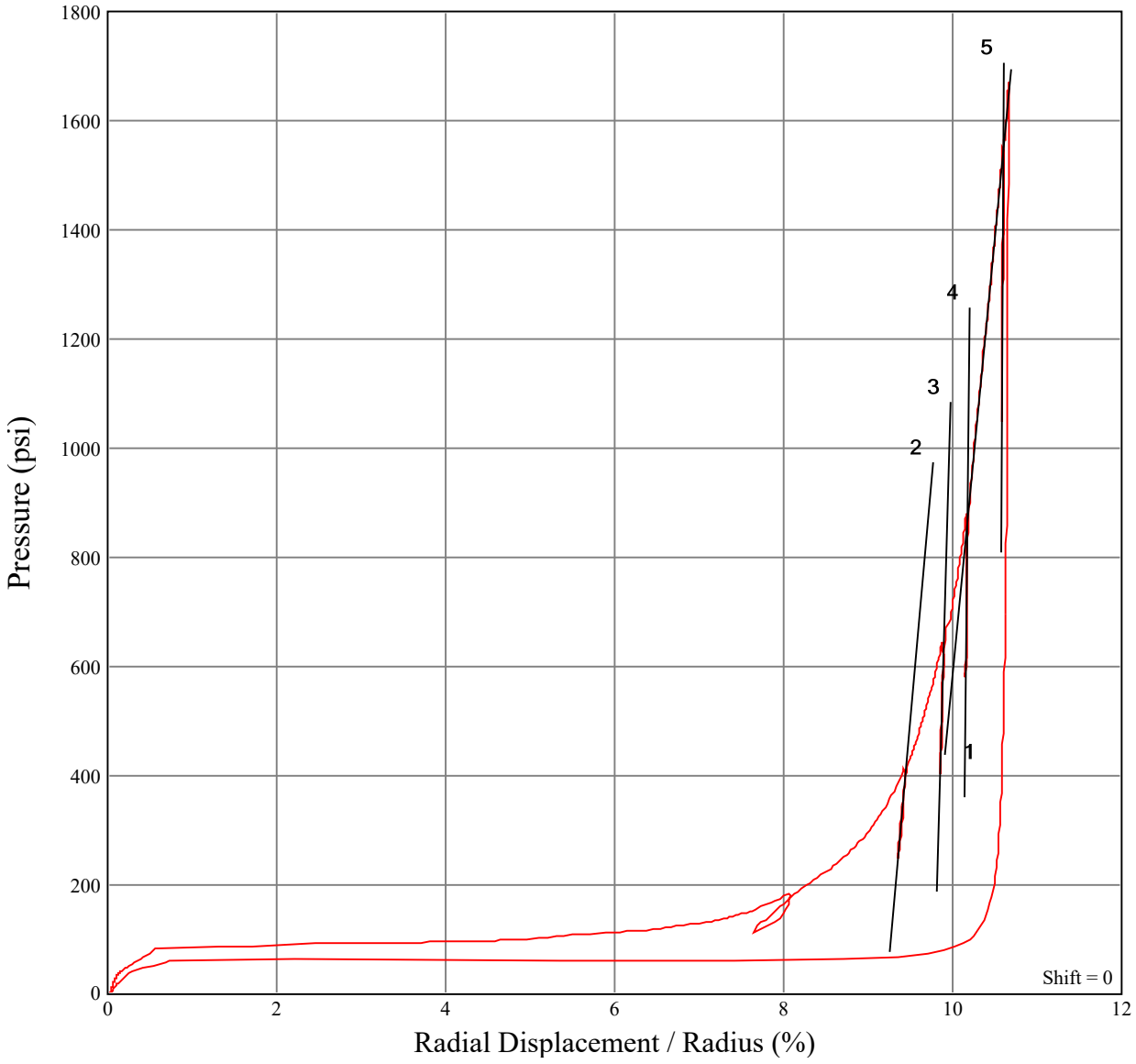
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B11 Test: EQRB-B11 114 Depth: 114FT Date: 08/12/2021

Oper: Walsh Job # 102636 Time of Test: 08:54 AM Inst: 04



DATA

#1 Shear Modulus = 80000 psi

#2 Shear Modulus = 87000 psi

#3 Shear Modulus = 274000 psi

#4 Shear Modulus = 742000 psi

#5 Shear Modulus = 1432000 psi

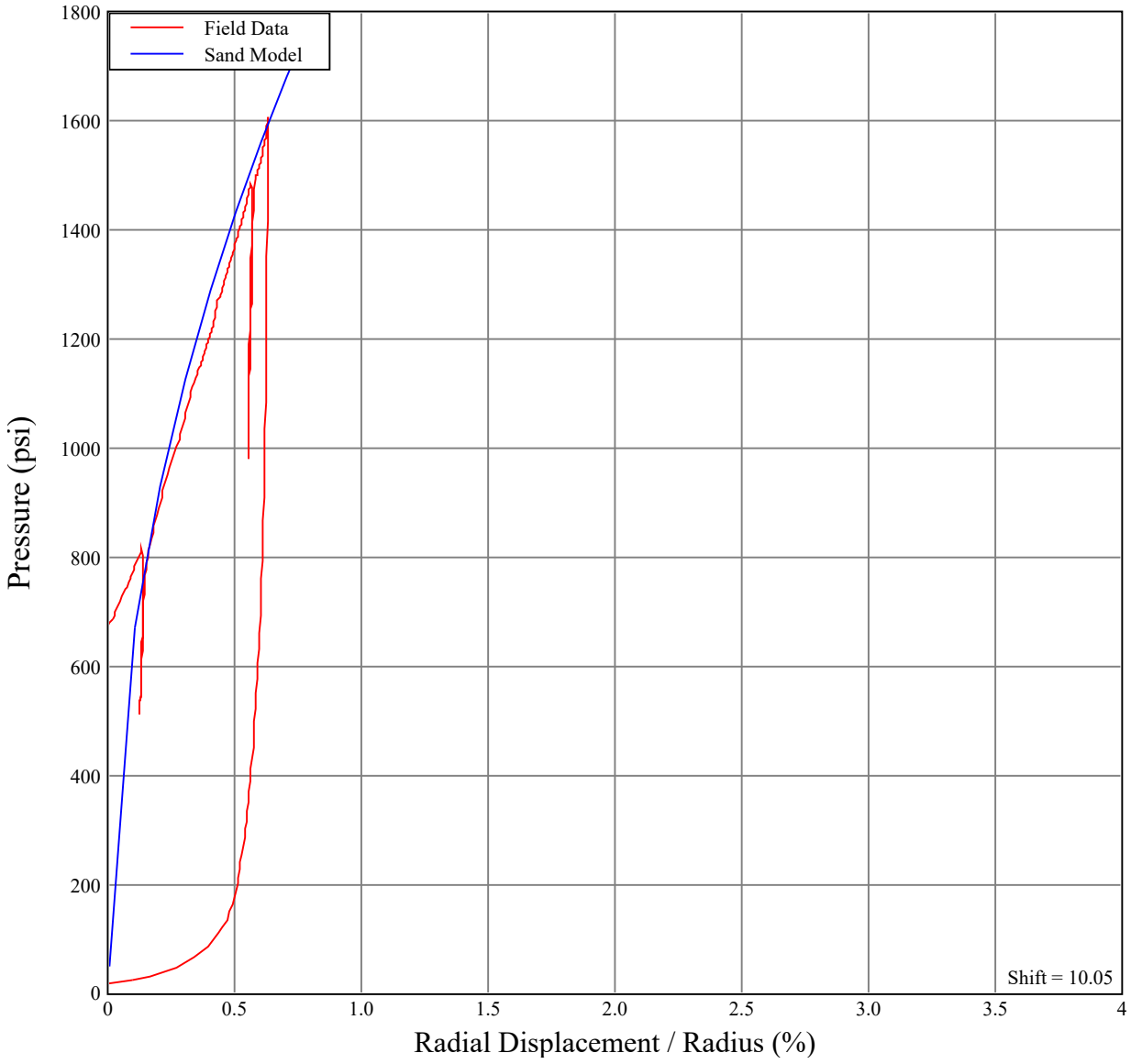
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B11 Test: EQRB-B11 114 Depth: 114FT Date: 08/12/2021

Oper: Walsh Job # 102636 Time of Test: 08:54 AM Inst: 04



DATA

Water Pressure = 67 psi

Lateral Stress = 48 psi

Friction Angle = 41 deg

Shear Modulus = 1432000 psi

Critical Friction Angle = 32 deg

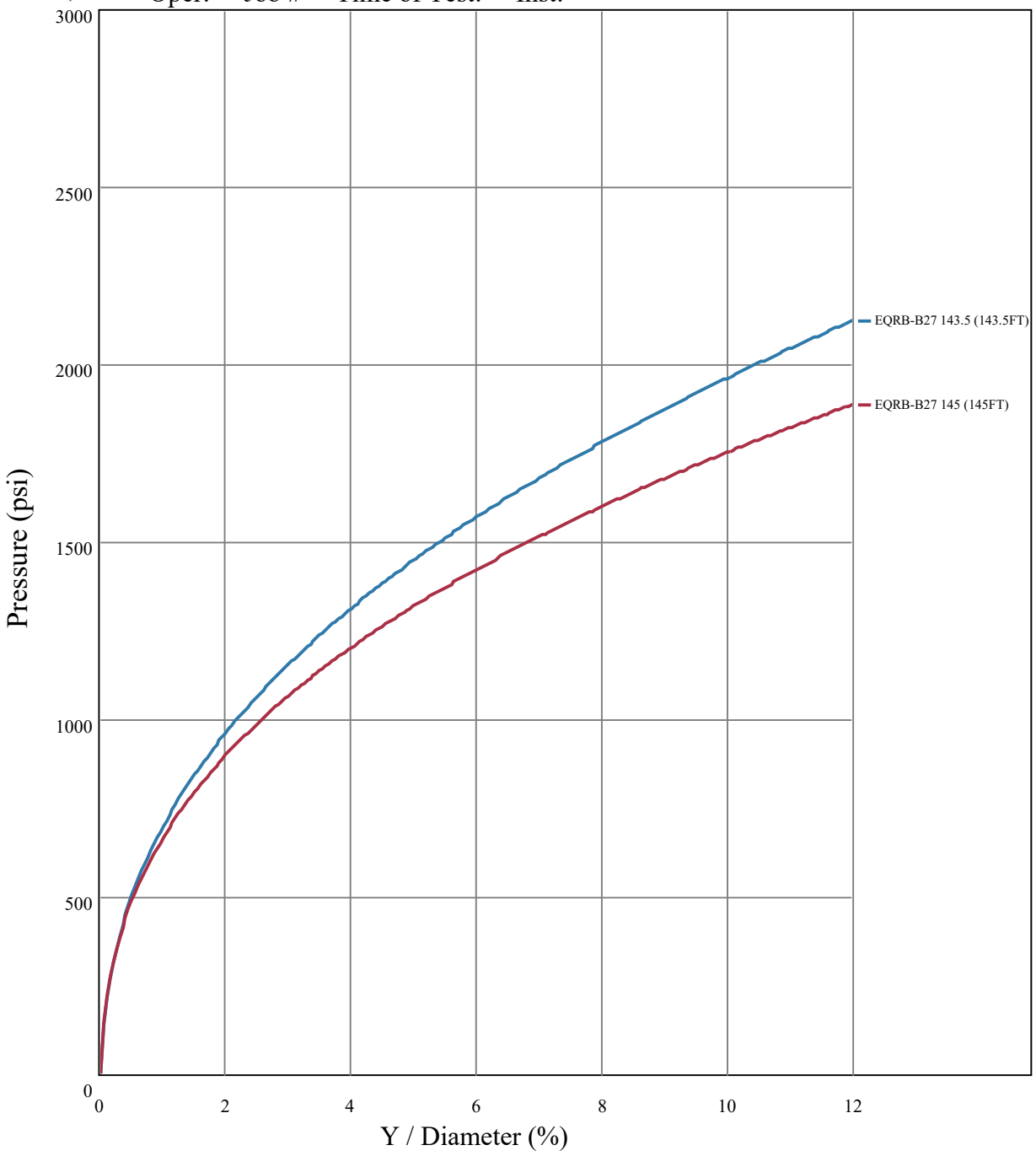
In Situ Engineering - PY Data - Frictional

Shannon and Wilson

EQRB

Boring: B27

Oper: Job # Time of Test: Inst:



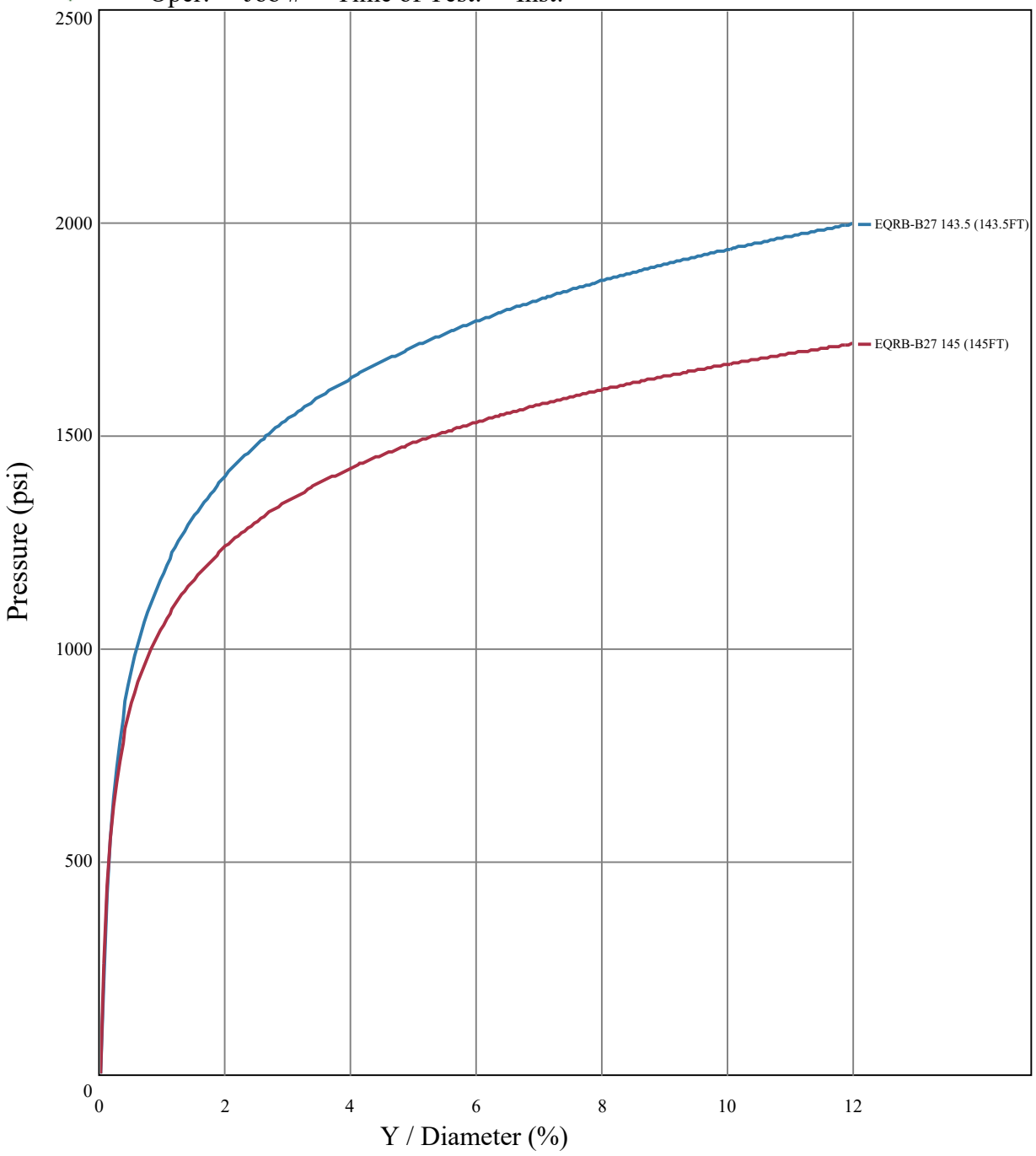
In Situ Engineering - PY Data - Cohesive

Shannon and Wilson

EQRB

Boring: B27

Oper: Job # Time of Test: Inst:



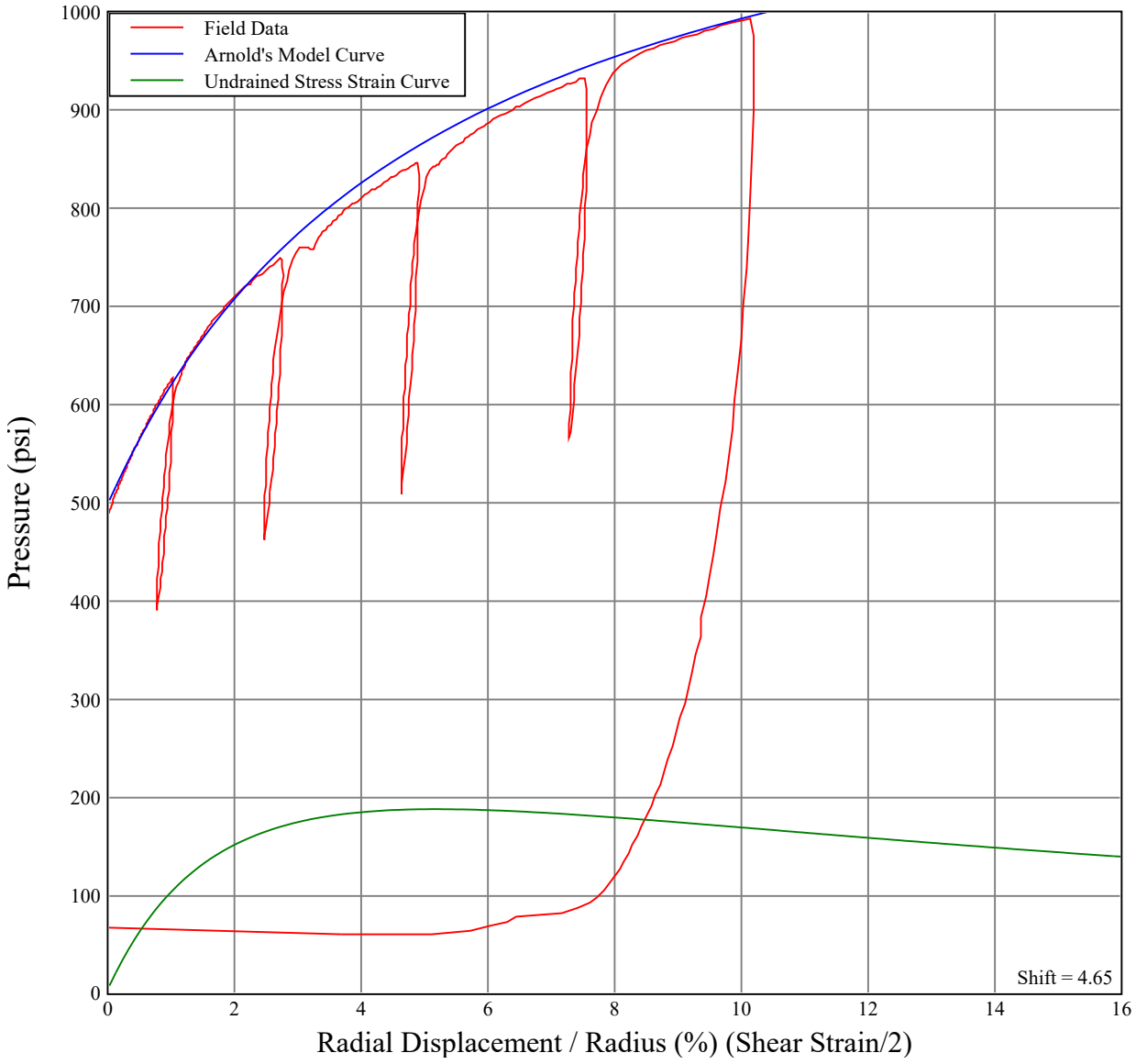
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B27 Test: EQRB-B27 143.5 Depth: 143.5FT Date: 08/10/2021

Oper: Walsh Job # 102636 Time of Test: 11:54 AM Inst: 04



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 623 psi	Shear Strength at 10% Strain = 168.6 psi
Pressure at 2.5% Strain = 745 psi	Max Shear Strength = 187.2 psi
Pressure at 7.5% Strain = 944 psi	occurs at 5.2% Strain

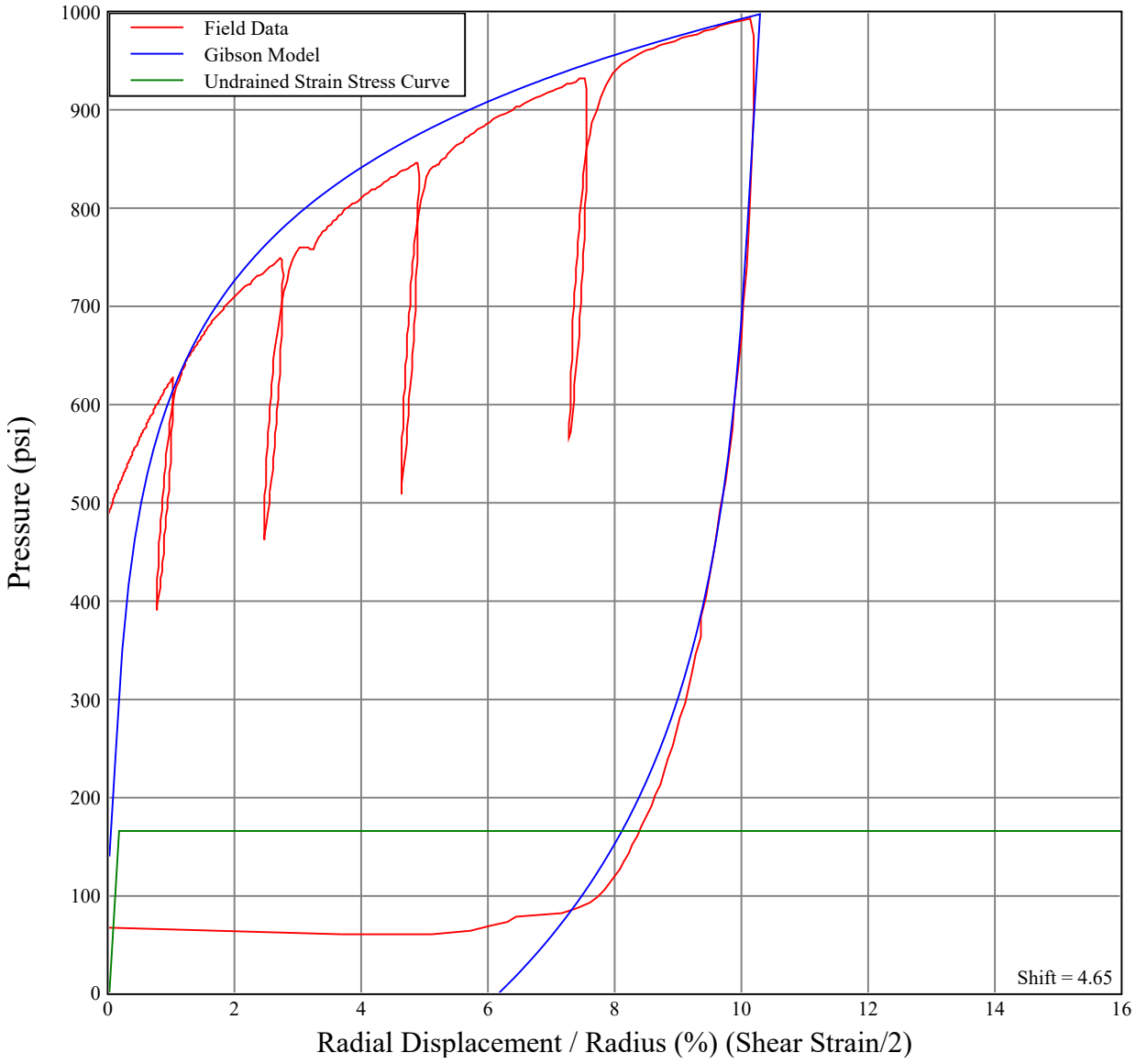
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B27 Test: EQRB-B27 143.5 Depth: 143.5FT Date: 08/10/2021

Oper: Walsh Job # 102636 Time of Test: 11:54 AM Inst: 04



DATA

LOADING	UNLOADING
Shear Strength = 165 psi	Shear Strength = 260 psi
In Situ Stress = 139 psi	Shear Modulus = 54100 psi
Shear Modulus = 54100 psi	

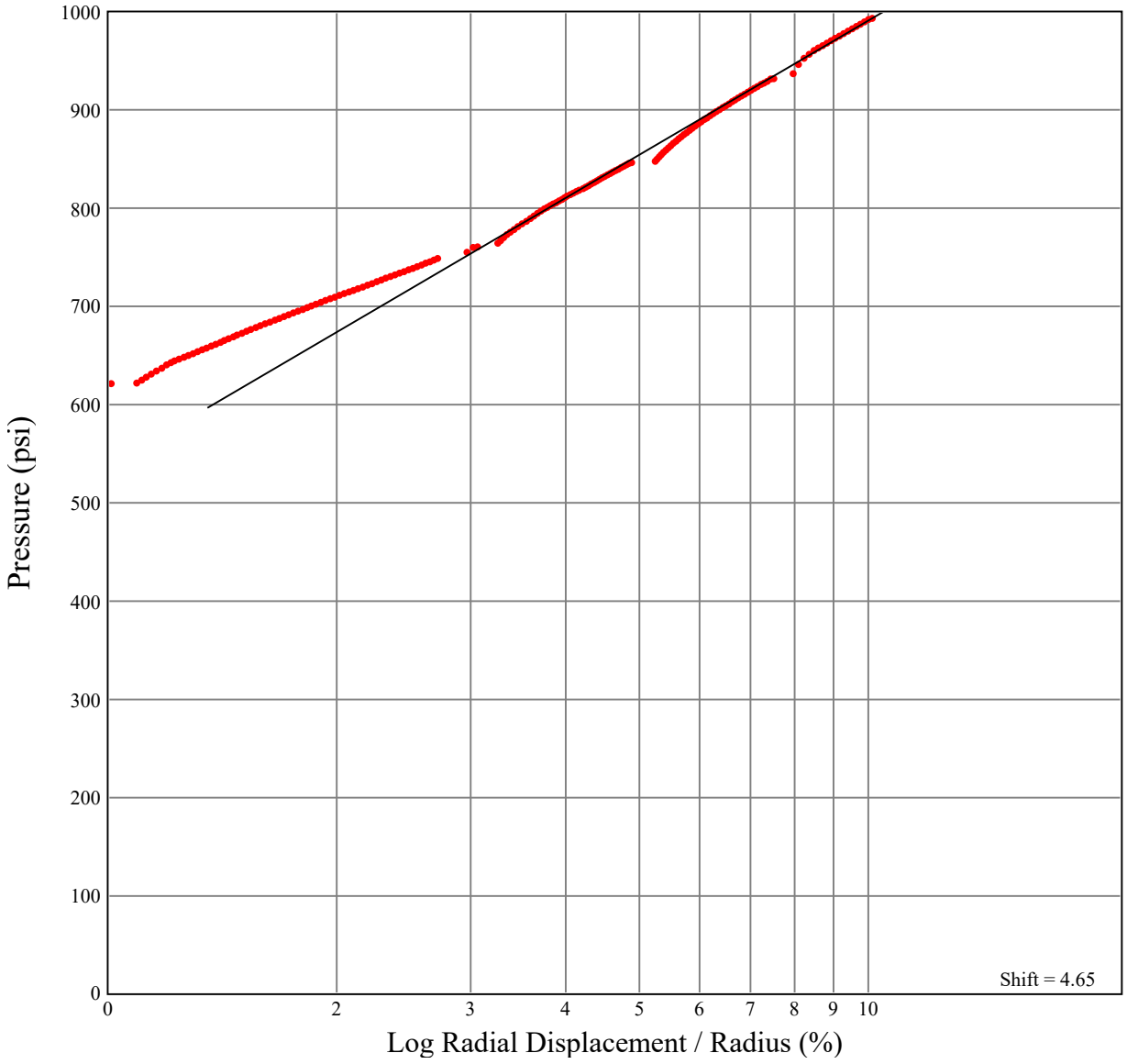
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B27 Test: EQRB-B27 143.5 Depth: 143.5FT Date: 08/10/2021

Oper: Walsh Job # 102636 Time of Test: 11:54 AM Inst: 04



DATA

Shear Strength = 197 psi

Limit Pressure = 1270 psi

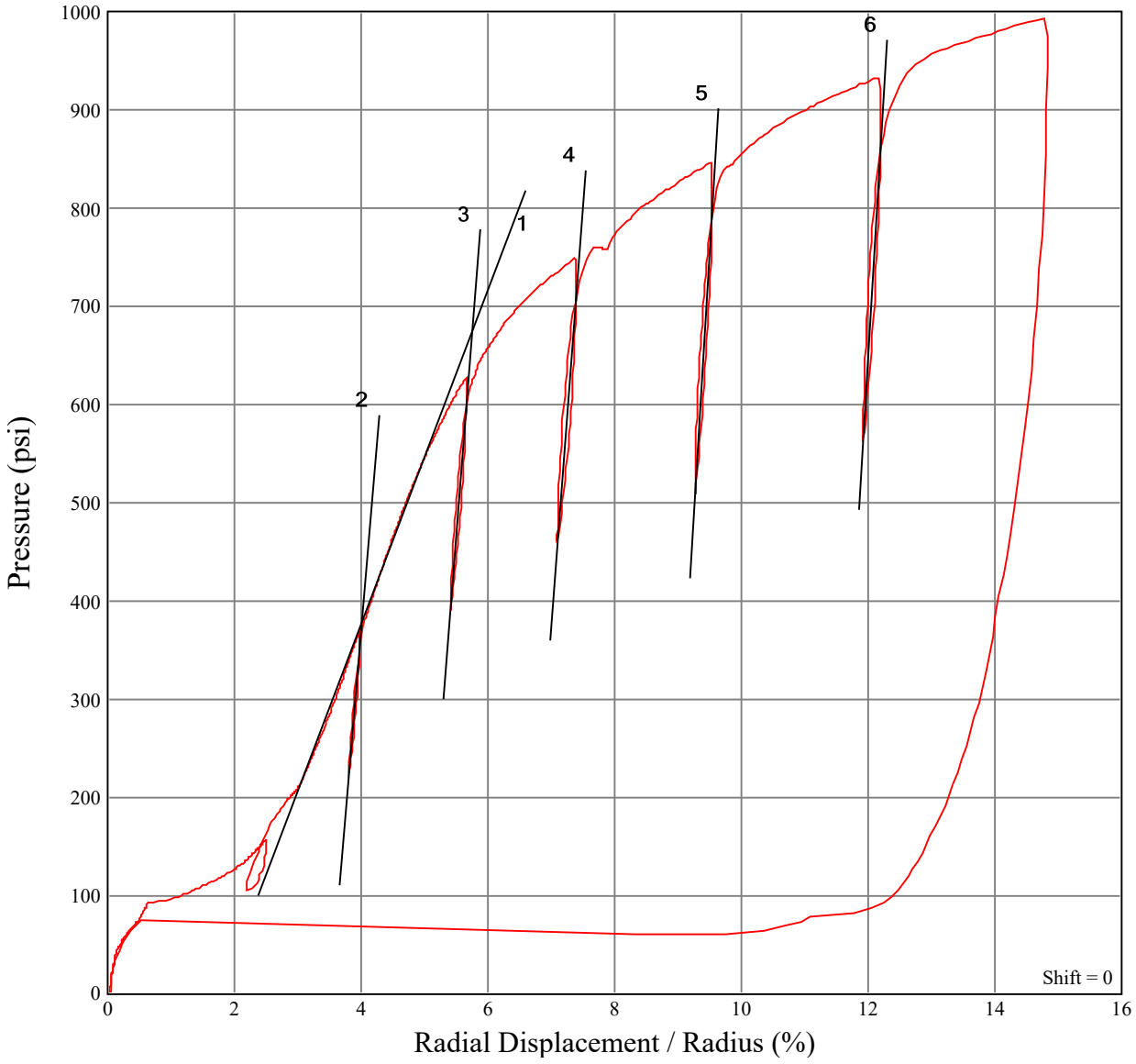
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B27 Test: EQRB-B27 143.5 Depth: 143.5FT Date: 08/10/2021

Oper: Walsh Job # 102636 Time of Test: 11:54 AM Inst: 04



DATA

#1 Shear Modulus = 8500 psi	#5 Shear Modulus = 53500 psi
#2 Shear Modulus = 38100 psi	#6 Shear Modulus = 54100 psi
#3 Shear Modulus = 41100 psi	
#4 Shear Modulus = 42700 psi	

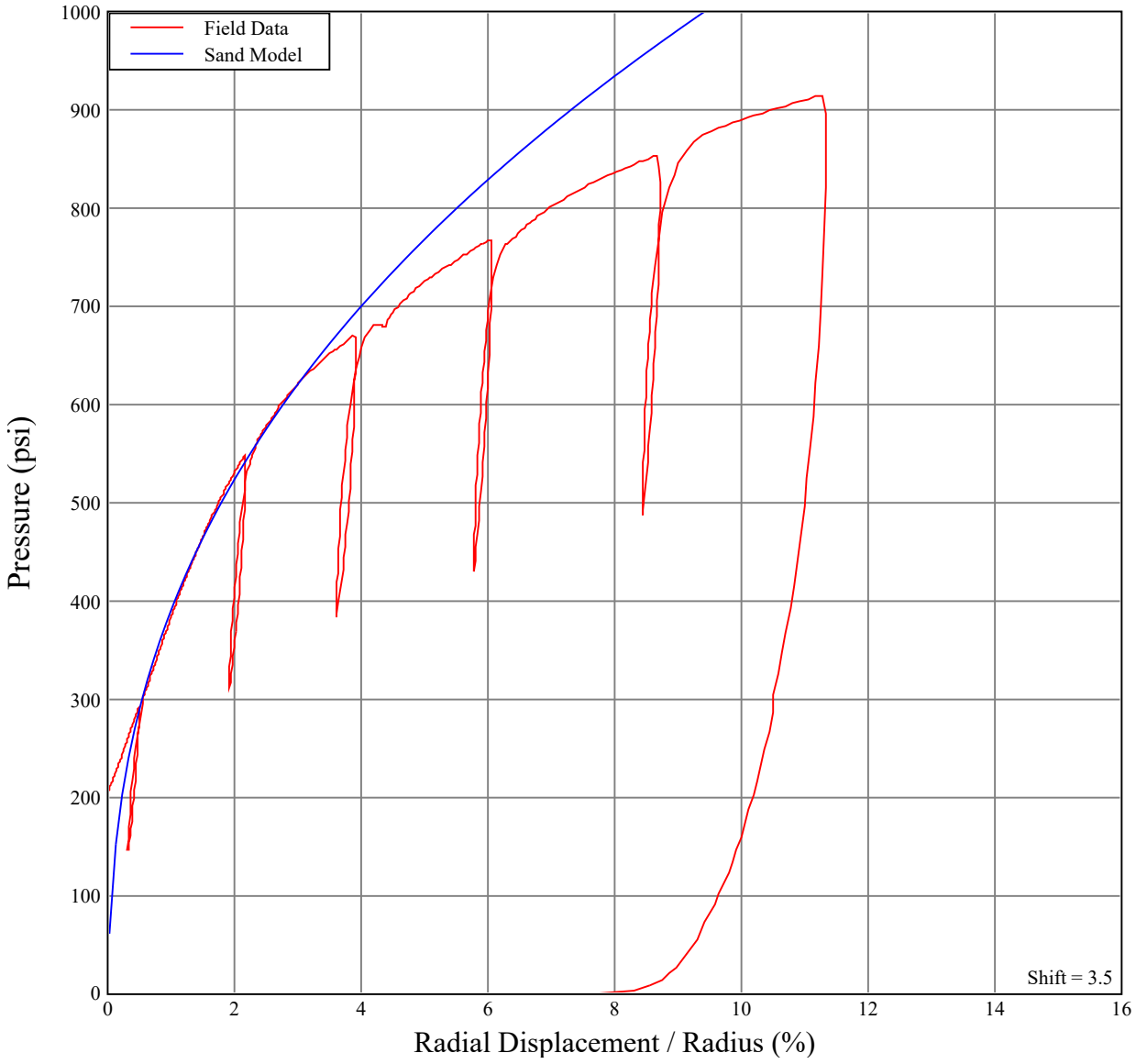
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B27 Test: EQRB-B27 143.5 Depth: 143.5FT Date: 08/10/2021

Oper: Walsh Job # 102636 Time of Test: 11:54 AM Inst: 04



DATA

Water Pressure = 79 psi

Lateral Stress = 60 psi

Friction Angle = 37 deg

Shear Modulus = 54100 psi

Critical Friction Angle = 32 deg

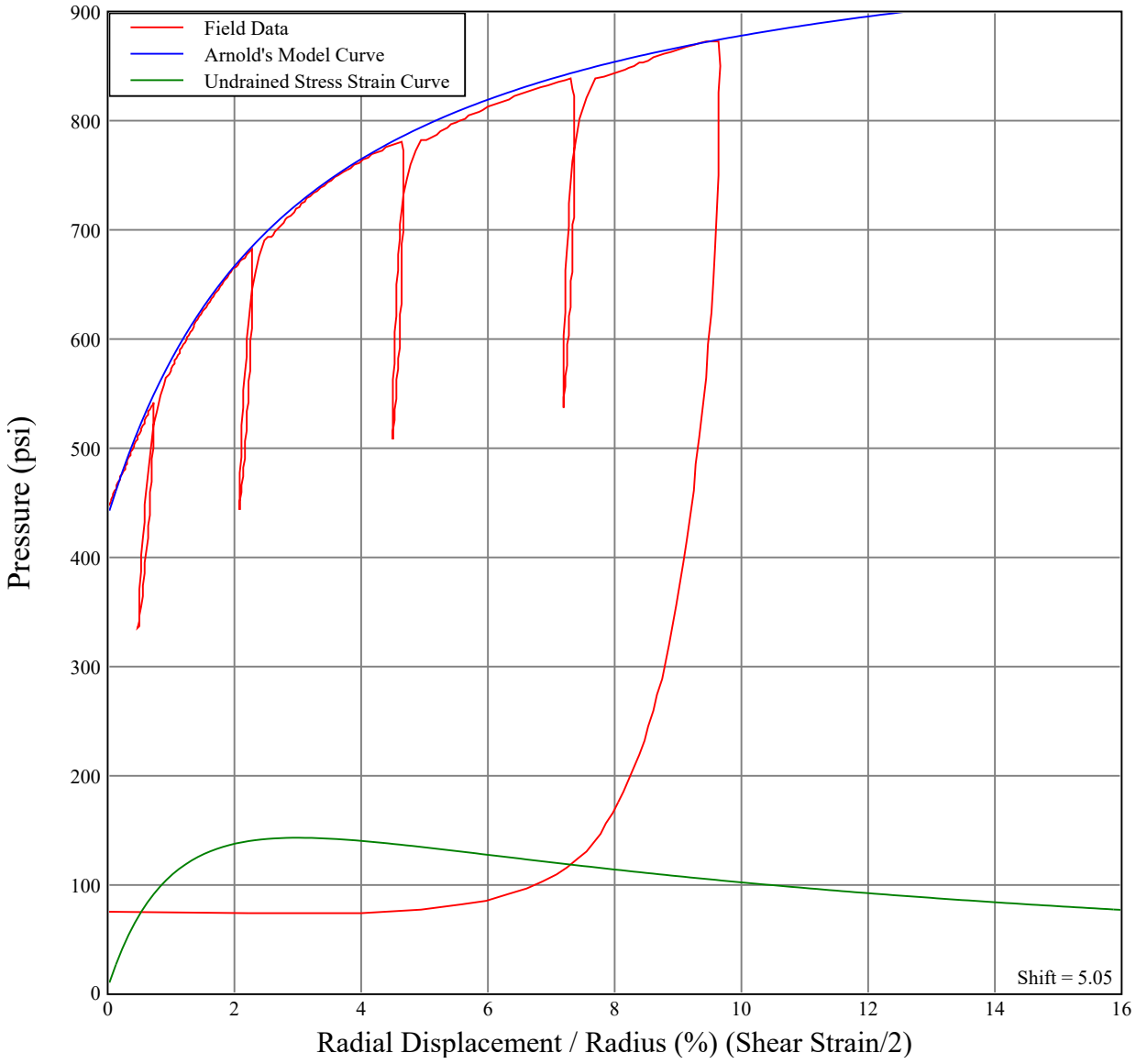
In Situ Engineering - Arnold's Clay Model

Shannon and Wilson

EQRB

Boring: B27 Test: EQRB-B27 145 Depth: 145FT Date: 08/10/2021

Oper: Walsh Job # 102636 Time of Test: 11:13 AM Inst: 04



DATA

INPUTS	OUTPUT
Pressure at 1% Strain = 584 psi	Shear Strength at 10% Strain = 101.3 psi
Pressure at 2.5% Strain = 700 psi	Max Shear Strength = 142.2 psi
Pressure at 7.5% Strain = 848 psi	occurs at 3% Strain

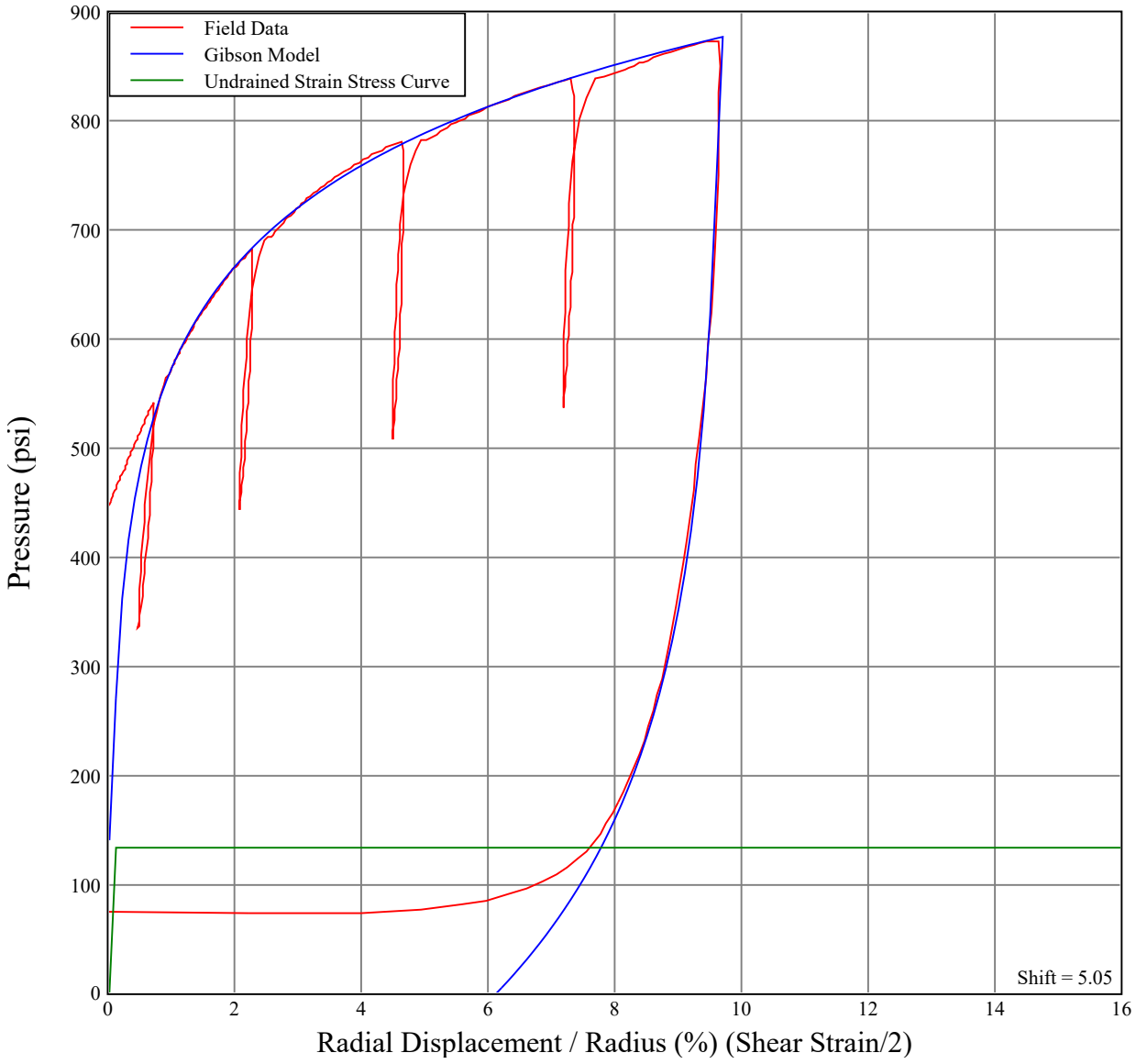
In Situ Engineering - Gibson's Clay Model

Shannon and Wilson

EQRB

Boring: B27 Test: EQRB-B27 145 Depth: 145FT Date: 08/10/2021

Oper: Walsh Job # 102636 Time of Test: 11:13 AM Inst: 04



DATA

LOADING	UNLOADING
Shear Strength = 133 psi	Shear Strength = 216 psi
In Situ Stress = 140 psi	Shear Modulus = 64900 psi
Shear Modulus = 64900 psi	

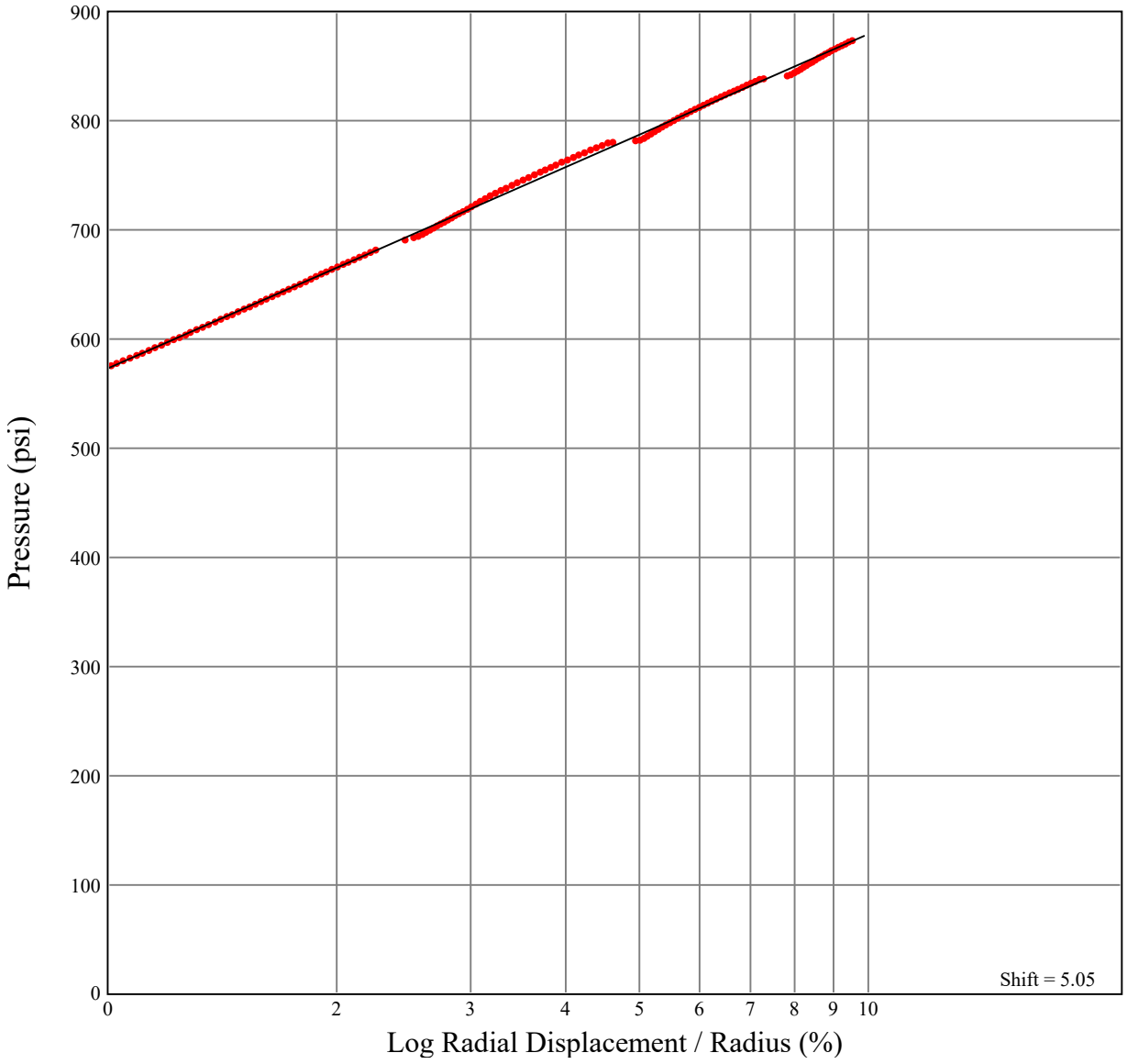
In Situ Engineering - Logarithm Plot

Shannon and Wilson

EQRB

Boring: B27 Test: EQRB-B27 145 Depth: 145FT Date: 08/10/2021

Oper: Walsh Job # 102636 Time of Test: 11:13 AM Inst: 04



DATA

Shear Strength = 133 psi

Limit Pressure = 1068 psi

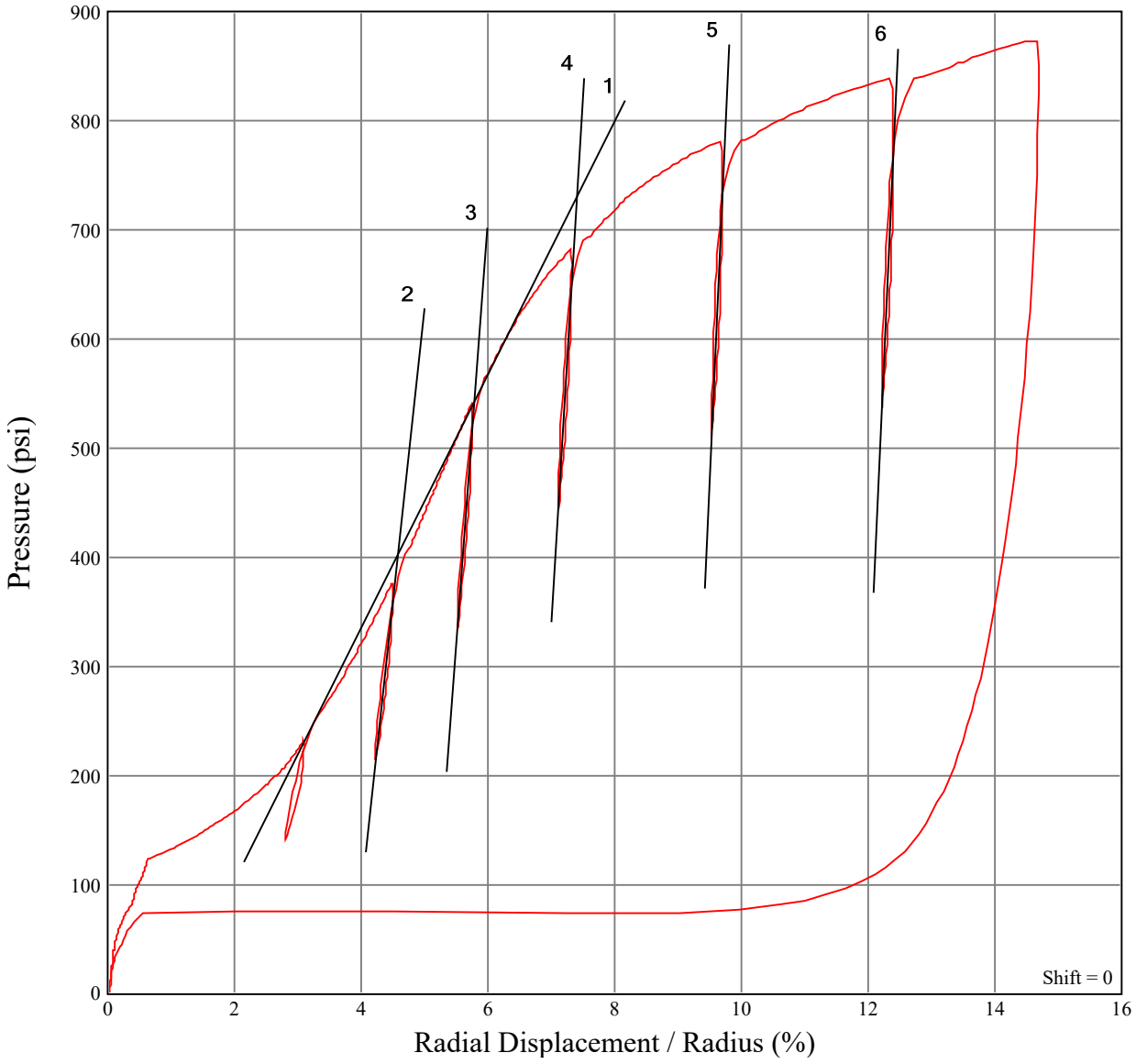
In Situ Engineering - Shear Modulus Plot

Shannon and Wilson

EQRB

Boring: B27 Test: EQRB-B27 145 Depth: 145FT Date: 08/10/2021

Oper: Walsh Job # 102636 Time of Test: 11:13 AM Inst: 04



DATA

#1 Shear Modulus = 5800 psi

#2 Shear Modulus = 26900 psi

#3 Shear Modulus = 38800 psi

#4 Shear Modulus = 48400 psi

#5 Shear Modulus = 64900 psi

#6 Shear Modulus = 64500 psi

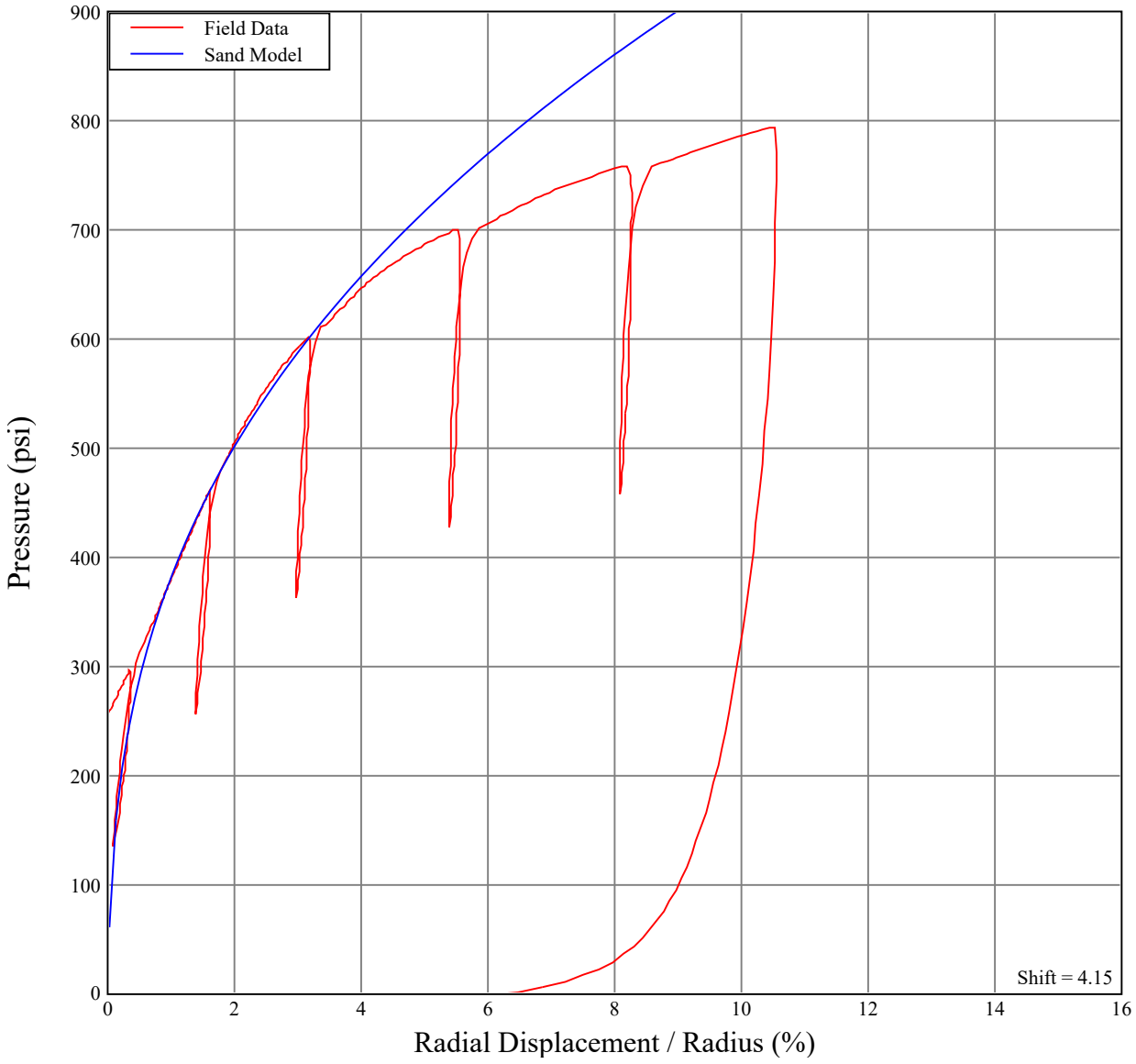
In Situ Engineering - Hughes' Sand Model

Shannon and Wilson

EQRB

Boring: B27 Test: EQRB-B27 145 Depth: 145FT Date: 08/10/2021

Oper: Walsh Job # 102636 Time of Test: 11:13 AM Inst: 04



DATA

Water Pressure = 80 psi

Lateral Stress = 60 psi

Friction Angle = 35 deg

Shear Modulus = 64900 psi

Critical Friction Angle = 32 deg

APPENDIX D: CONE PENETRATION TEST RESULTS

Appendix D

Cone Penetration Test Results

CONTENTS

D.1 Cone Penetration Testing D-1

Table

Table D1: Cone Penetration Testing Summary

Attachment

ConeTec Report, dated September 23, 2021

APPENDIX D: CONE PENETRATION TEST RESULTS

D.1 CONE PENETRATION TESTING

The field exploration program included eight (8) cone penetration tests (CPTs). CPT designations, coordinates, elevations, and depths are shown on Table D1, Cone Penetration Test Summary. CPT locations were measured using a handheld GPS unit and/or relative to existing site features using a tape measure. Approximate CPT coordinates (OCRS Portland Zone) and elevations (NAVD88) are presented in Table D1. Approximate CPT locations are also shown graphically on the Site and Exploration Plan and Interpretive Subsurface Profile A-A', Figure 2-2.

The CPTs were completed by ConeTec, Inc., of Auburn, Washington. ConeTec provided and operated a 30-ton truck-mounted CPT rig. During a CPT, a specialized cone assembly at the end of a steel probe is hydraulically pushed down through the subsurface. The cone assembly contains load cells and associated strain gauges which monitor the deformation of the load cells. One set of load cells deforms with increasing resistance to cone tip penetration. Another set of load cells deforms with increasing frictional resistance encountered on a sleeve on the outside of the assembly. The cone assembly also contains a piezometer which measures pore pressure. Data from the strain gauges and from the piezometer are transmitted from the cone assembly back through extension rods to a CPT recording device via a cable. Analysis software using industry standard calculations then converts the raw data signals from the instruments into cone resistance, sleeve friction, and pore pressure.

Pore pressure is useful in estimating soil behavior type because penetration has varying effects on pore pressure, depending on the type of material being penetrated. Dissipation of pore pressure can also be measured if the cone advance is temporarily halted. Pore pressure dissipation tests were performed in all eight CPTs and can be used to estimate the static groundwater level and to estimate the soil hydraulic conductivity at the test locations.

Shear wave velocity measurements were also made in all eight CPTs. This is accomplished by applying a seismic source at the surface, such as a sledgehammer pounded on a metal plate, and recording the arrival times of resultant seismic waves using a geophone in the cone assembly in the subsurface.

All CPT data reduction and correlation was performed by ConeTec. A summary report, provided by ConeTec, is attached to the end of this appendix.

All CPT holes were backfilled in accordance with Oregon Water Resource Department regulations and penetrated surfaces were repaired in accordance with local permitting requirements.

APPENDIX D: CONE PENETRATION TEST RESULTS

Table D1 - Cone Penetration Testing Summary

Designation	Northing (ft)[1,3]	Easting (ft)[1,3]	Elevation (ft)[2]	Date Completed	Total Depth (ft)
CPT-01	172407	348331	32	9/16/2021	29.53
CPT-02	172412	348436	33	9/16/2021	29.77
CPT-03	172491	349820	31	9/13/2021	145.67
CPT-04	172388	349887	32	9/13/2021	141.81
CPT-05	172465	350069	34	9/14/2021	149.03
CPT-06	172354	350116	31	9/14/2021	145.67
CPT-07	172380	349980	34	9/15/2021	140.25
CPT-08	172464	350208	34	9/16/2021	128.20

NOTES:
1 Oregon Coordinate Reference System (OCRS), Portland Zone, 2011
2 North American Vertical Datum of 1988 (NAVD88)
3 Locations not surveyed; locations based on GPS and/or field measurements relative to existing site features.

PRESENTATION OF SITE INVESTIGATION RESULTS

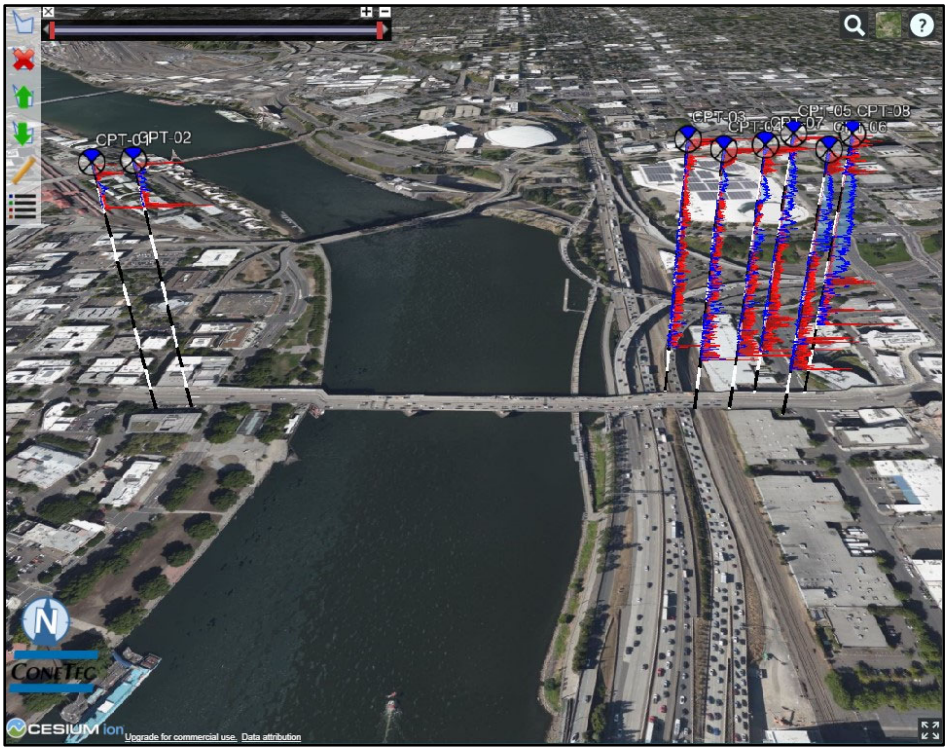
Burnside Bridge Portland CPT

Prepared for:

Shannon & Wilson, Inc.

ConeTec Job No: 21-59-23000

Project Start Date: 13-SEP-2021
Project End Date: 16-SEP-2021
Report Date: 23-SEP-2021



Prepared by:

ConeTec Inc.
1508 O Street SW, Unit 103-104
Auburn, WA 98001

Tel: (253) 397-4861

ConeTecWA@conetec.com
www.conetec.com
www.conetecdataservices.com

Introduction

The enclosed report presents the results of the site investigation program conducted by ConeTec Inc. for Shannon & Wilson, Inc. at the Burnside Bridge in Portland OR. The program consisted of seismic cone penetration tests.

Project Information

Project	
Client	Shannon & Wilson, Inc.
Project	Burnside Bridge Portland CPT
ConeTec project number	21-59-23000

An aerial overview from Google Earth including the CPTu test locations is presented below.



Rig Description	Deployment System	Test Type
C20-30Ton Truck Rig	Integrated Push Cylinders	CPTu

Coordinates		
Test Type	Collection Method	EPSG Number
CPTu	Consumer grade GPS	4326

Cone Penetrometers Used for this Project						
Cone Description	Cone Number	Cross Sectional Area (cm^2)	Sleeve Area (cm^2)	Tip Capacity (bar)	Sleeve Capacity (bar)	Pore Pressure Capacity (bar)
780:T1500F15U35	780	15	225	1500	15	35
781:T1500F15U35	781	15	225	1500	15	35
The CPTu summary indicates which cone was used for each sounding.						

Cone Penetration Test (CPTu)	
Depth reference	Depths are referenced to the existing ground surface at the time of each test.
Tip and sleeve data offset	0.1 meter This has been accounted for in the CPT data files.
Additional plots	• Normalized plots with Qtn and Norm: Fr(%) • Advanced plots with Ic, Su, phi and N(60)/N1(60) • Soil Behaviour Type (SBT) scatter plots • Seismic shear wave (Vs) plots • Seismic shear wave (Vs) Wave Trace plots

Calculated Geotechnical Parameter Tables	
Additional information	The Normalized Soil Behaviour Type Chart based on Q_{tn} (SBT Q_{tn}) (Robertson, 2009) was used to classify the soil for this project. A detailed set of calculated CPTu parameters have been generated and are provided in Excel format files in the release folder. The CPTu parameter calculations are based on values of corrected tip resistance (q_t) sleeve friction (f_s) and pore pressure (u_2). Effective stresses are calculated based on unit weights that have been assigned to the individual soil behaviour type zones and the assumed equilibrium pore pressure profile.

Limitations

This report has been prepared for the exclusive use of Shannon & Wilson, Inc. (Client) for the project titled "Burnside Bridge Portland CPT". The report's contents may not be relied upon by any other party without the express written permission of ConeTec Inc. (ConeTec). ConeTec has provided site investigation services, prepared the factual data reporting and provided geotechnical parameter calculations consistent with current best practices. No other warranty, expressed or implied, is made.

The information presented in the report document and the accompanying data set pertain to the specific project, site conditions and objectives described to ConeTec by the Client. In order to properly understand the factual data, assumptions and calculations, reference must be made to the documents provided and their accompanying data sets, in their entirety.

Cone penetration tests (CPTu) are conducted using an integrated electronic piezocone penetrometer and data acquisition system manufactured by Adara Systems Ltd., a subsidiary of ConeTec.

ConeTec's piezocone penetrometers are compression type designs in which the tip and friction sleeve load cells are independent and have separate load capacities. The piezocones use strain gauged load cells for tip and sleeve friction and a strain gauged diaphragm type transducer for recording pore pressure. The piezocones also have a platinum resistive temperature device (RTD) for monitoring the temperature of the sensors, an accelerometer type dual axis inclinometer and two geophone sensors for recording seismic signals. All signals are amplified and measured with minimum sixteen-bit resolution down hole within the cone body, and the signals are sent to the surface using a high bandwidth, error corrected digital interface through a shielded cable.

ConeTec penetrometers are manufactured with various tip, friction and pore pressure capacities in both 10 cm^2 and 15 cm^2 tip base area configurations in order to maximize signal resolution for various soil conditions. The specific piezocone used for each test is described in the CPT summary table presented in the first appendix. The 15 cm^2 penetrometers do not require friction reducers as they have a diameter larger than the deployment rods. The 10 cm^2 piezocones use a friction reducer consisting of a rod adapter extension behind the main cone body with an enlarged cross sectional area (typically 44 millimeters diameter over a length of 32 millimeters with tapered leading and trailing edges) located at a distance of 585 millimeters above the cone tip.

The penetrometers are designed with equal end area friction sleeves, a net end area ratio of 0.8 and cone tips with a 60 degree apex angle.

All ConeTec piezocones can record pore pressure at various locations. Unless otherwise noted, the pore pressure filter is located directly behind the cone tip in the "u_2" position (ASTM Type 2). The filter is six millimeters thick, made of porous plastic (polyethylene) having an average pore size of 125 microns (90-160 microns). The function of the filter is to allow rapid movements of extremely small volumes of water needed to activate the pressure transducer while preventing soil ingress or blockage.

The piezocone penetrometers are manufactured with dimensions, tolerances and sensor characteristics that are in general accordance with the current ASTM D5778 standard. ConeTec's calibration criteria also meets or exceeds those of the current ASTM D5778 standard. An illustration of the piezocone penetrometer is presented in Figure CPTu.

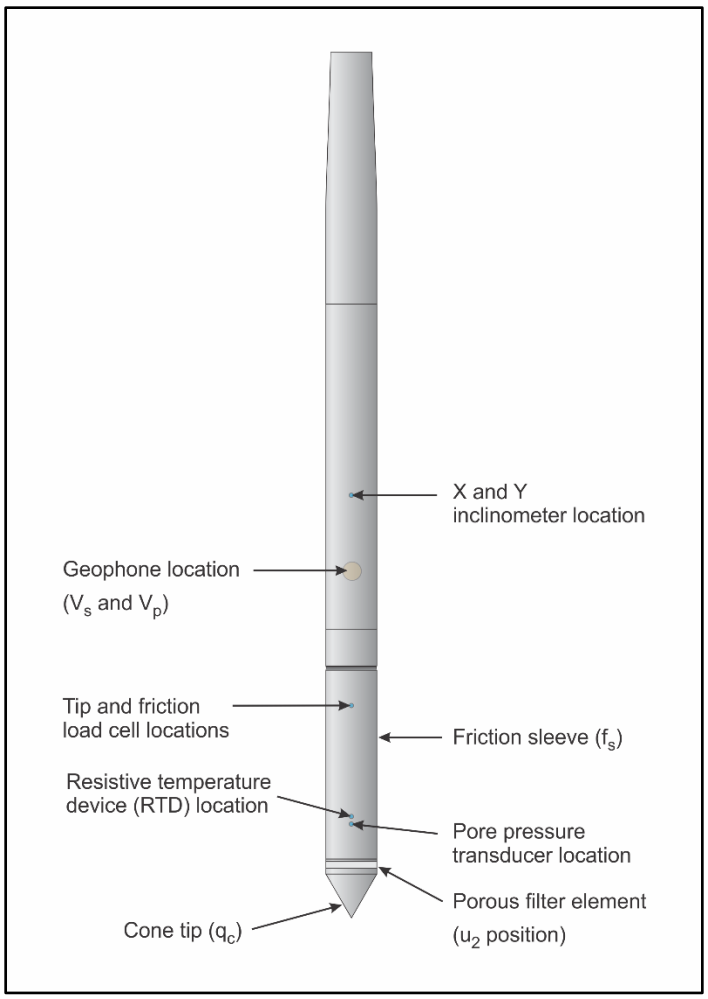


Figure CPTu. Piezocone Penetrometer (15 cm^2)

The ConeTec data acquisition systems consist of a Windows based computer and a signal interface box and power supply. The signal interface combines depth increment signals, seismic trigger signals and the downhole digital data. This combined data is then sent to the Windows based computer for collection and presentation. The data is recorded at fixed depth increments using a depth wheel attached to the push cylinders or by using a spring loaded rubber depth wheel that is held against the cone rods. The typical recording interval is 2.5 centimeters; custom recording intervals are possible.

The system displays the CPTu data in real time and records the following parameters to a storage media during penetration:

- Depth
- Uncorrected tip resistance (q_c)
- Sleeve friction (f_s)
- Dynamic pore pressure (u)
- Additional sensors such as resistivity, passive gamma, ultra violet induced fluorescence, if applicable

All testing is performed in accordance to ConeTec's CPTu operating procedures which are in general accordance with the current ASTM D5778 standard.

Prior to the start of a CPTu sounding a suitable cone is selected, the cone and data acquisition system are powered on, the pore pressure system is saturated with silicone oil and the baseline readings are recorded with the cone hanging freely in a vertical position.

The CPTu is conducted at a steady rate of two centimeters per second, within acceptable tolerances. Typically one meter length rods with an outer diameter of 1.5 inches (38.1 millimeters) are added to advance the cone to the sounding termination depth. After cone retraction final baselines are recorded.

Additional information pertaining to ConeTec's cone penetration testing procedures:

- Each filter is saturated in silicone oil under vacuum pressure prior to use
- Baseline readings are compared to previous readings
- Soundings are terminated at the client's target depth or at a depth where an obstruction is encountered, excessive rod flex occurs, excessive inclination occurs, equipment damage is likely to take place, or a dangerous working environment arises
- Differences between initial and final baselines are calculated to ensure zero load offsets have not occurred and to ensure compliance with ASTM standards

The interpretation of piezocone data for this report is based on the corrected tip resistance (q_t), sleeve friction (f_s) and pore water pressure (u). The interpretation of soil type is based on the correlations developed by Robertson et al. (1986) and Robertson (1990, 2009). It should be noted that it is not always possible to accurately identify a soil behavior type based on these parameters. In these situations, experience, judgment and an assessment of other parameters may be used to infer soil behavior type.

The recorded tip resistance (q_c) is the total force acting on the piezocone tip divided by its base area. The tip resistance is corrected for pore pressure effects and termed corrected tip resistance (q_t) according to the following expression presented in Robertson et al. (1986):

$$q_t = q_c + (1\text{-}a) \bullet u_2$$

where: q_t is the corrected tip resistance
q_c is the recorded tip resistance
u_2 is the recorded dynamic pore pressure behind the tip (u_2 position)
a is the Net Area Ratio for the piezocone (0.8 for ConeTec probes)

The sleeve friction (f_s) is the frictional force on the sleeve divided by its surface area. As all ConeTec piezocones have equal end area friction sleeves, pore pressure corrections to the sleeve data are not required.

The dynamic pore pressure (u) is a measure of the pore pressures generated during cone penetration. To record equilibrium pore pressure, the penetration must be stopped to allow the dynamic pore pressures to stabilize. The rate at which this occurs is predominantly a function of the permeability of the soil and the diameter of the cone.

The friction ratio (R_f) is a calculated parameter. It is defined as the ratio of sleeve friction to the tip resistance expressed as a percentage. Generally, saturated cohesive soils have low tip resistance, high friction ratios and generate large excess pore water pressures. Cohesionless soils have higher tip resistances, lower friction ratios and do not generate significant excess pore water pressure.

A summary of the CPTu soundings along with test details and individual plots are provided in the appendices. A set of files with calculated geotechnical parameters were generated for each sounding based on published correlations and are provided in Excel format in the data release folder. Information regarding the methods used is also included in the data release folder.

For additional information on CPTu interpretations and calculated geotechnical parameters, refer to Robertson et al. (1986), Lunne et al. (1997), Robertson (2009), Mayne (2013, 2014) and Mayne and Peuchen (2012).

Shear wave velocity (Vs) testing is performed in conjunction with the piezocone penetration test (SCPTu) in order to collect interval velocities. For some projects seismic compression wave velocity (Vp) testing is also performed.

ConeTec's piezocone penetrometers are manufactured with one horizontally active geophone (28 hertz) and one vertically active geophone (28 hertz). Both geophones are rigidly mounted in the body of the cone penetrometer, 0.2 meters behind the cone tip. The vertically mounted geophone is more sensitive to compression waves.

Shear waves are typically generated by using an impact hammer horizontally striking a beam that is held in place by a normal load. In some instances, an auger source or an imbedded impulsive source may be used for both shear waves and compression waves. The hammer and beam act as a contact trigger that initiates the recording of the seismic wave traces. For impulsive devices an accelerometer trigger may be used. The traces are recorded in the memory of the cone using a fast analog to digital converter. The seismic trace is then transmitted digitally uphole to a Windows based computer through a signal interface box for recording and analysis. An illustration of the shear wave testing configuration is presented in Figure SCPTu-1.

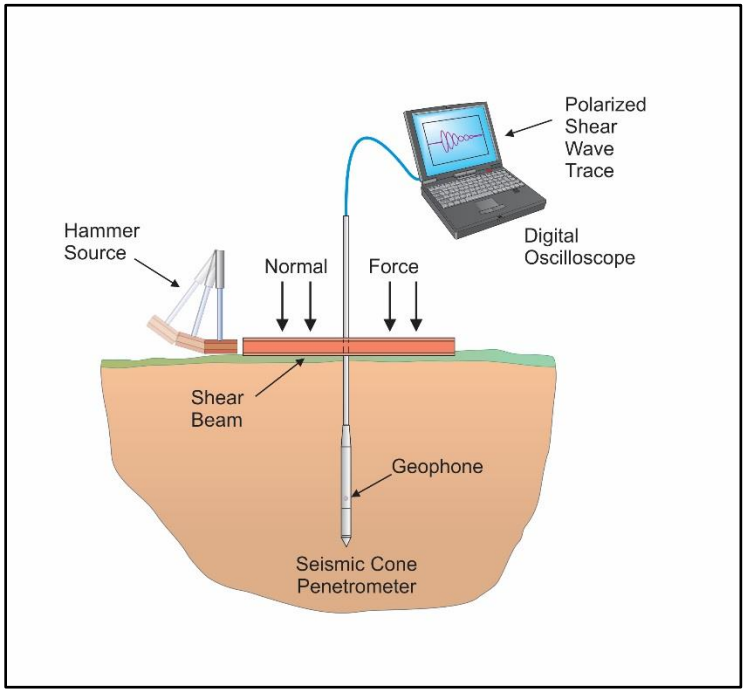


Figure SCPTu-1. Illustration of the SCPTu system

All testing is performed in accordance to ConeTec's SCPTu operating procedures which are in general accordance with the current ASTM D5778 and ASTM D7400 standards.

Prior to the start of a SCPTu sounding, the procedures described in the Cone Penetration Test section are followed. In addition, the active axis of the geophone is aligned parallel to the beam (or source) and the horizontal offset between the cone and the source is measured and recorded.

Prior to recording seismic waves at each test depth, cone penetration is stopped and the rods are decoupled from the rig to avoid transmission of rig energy down the rods. Typically, five wave traces for

each orientation are recorded for quality control and uncertainty analysis purposes. After reviewing wave traces for consistency the cone is pushed to the next test depth (typically one meter intervals or as requested by the client). Figure SCPTu-2 presents an illustration of a SCPTu test.

For additional information on seismic cone penetration testing refer to Robertson et al. (1986).

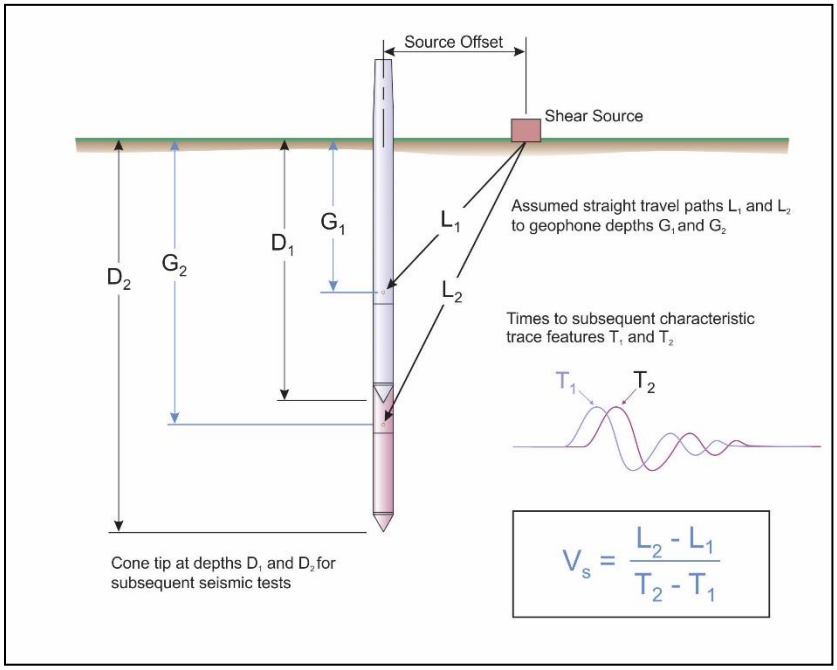


Figure SCPTu-2. Illustration of a seismic cone penetration test

Calculation of the interval velocities are performed by visually picking a common feature (e.g. the first characteristic peak, trough, or crossover) on all of the recorded wave sets and taking the difference in ray path divided by the time difference between subsequent features. Ray path is defined as the straight line distance from the seismic source to the geophone, accounting for beam offset, source depth and geophone offset from the cone tip.

For all SCPTu soundings that have achieved a depth of at least 100 feet (30 meters), the average shear wave velocity to a depth of 100 feet ($\bar{v}_s$) has been calculated and provided for all applicable soundings using the following equation presented in ASCE (2010).

$$\bar{v}_s = \frac{\sum_{i=1}^{n} d_i}{\sum_{i=1}^{n} \frac{d_i}{v_{si}}}$$

where: $\bar{v}_s$ = average shear wave velocity ft/s (m/s)
d_i = the thickness of any layer between 0 and 100 ft (30 m)
v_{si} = the shear wave velocity in ft/s (m/s)
$\sum_{i=1}^{n} d_i$ = the total thickness of all layers between 0 and 100 ft (30 m)

Average shear wave velocity, $\bar{v}_s$ is also referenced to V_{s100} or V_{s30}.

The layer travel times refers to the travel times propagating in the vertical direction, not the measured travel times from an offset source.

Tabular results and SCPTu plots are presented in the relevant appendix.

The cone penetration test is halted at specific depths to carry out pore pressure dissipation (PPD) tests, shown in Figure PPD-1. For each dissipation test the cone and rods are decoupled from the rig and the data acquisition system measures and records the variation of the pore pressure (u) with time (t).

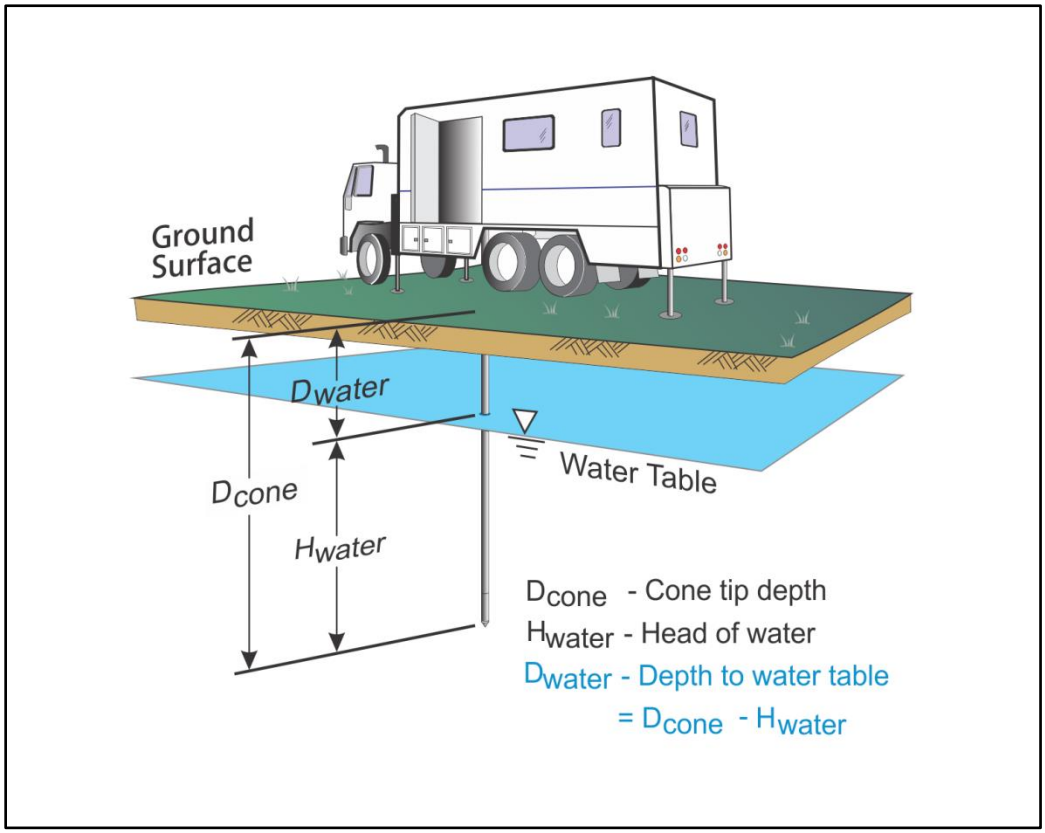


Figure PPD-1. Pore pressure dissipation test setup

Pore pressure dissipation data can be interpreted to provide estimates of ground water conditions, permeability, consolidation characteristics and soil behavior.

The typical shapes of dissipation curves shown in Figure PPD-2 are very useful in assessing soil type, drainage, in situ pore pressure and soil properties. A flat curve that stabilizes quickly is typical of a freely draining sand. Undrained soils such as clays will typically show positive excess pore pressure and have long dissipation times. Dilative soils will often exhibit dynamic pore pressures below equilibrium that then rise over time. Overconsolidated fine-grained soils will often exhibit an initial dilatory response where there is an initial rise in pore pressure before reaching a peak and dissipating.

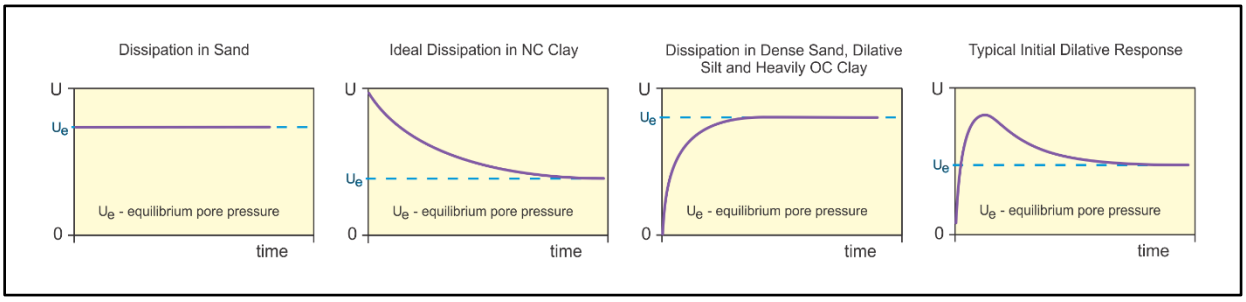


Figure PPD-2. Pore pressure dissipation curve examples

In order to interpret the equilibrium pore pressure (u_{eq}) and the apparent phreatic surface, the pore pressure should be monitored until such time as there is no variation in pore pressure with time as shown for each curve in Figure PPD-2.

In fine grained deposits the point at which 100% of the excess pore pressure has dissipated is known as t_{100}. In some cases this can take an excessive amount of time and it may be impractical to take the dissipation to t_{100}. A theoretical analysis of pore pressure dissipations by Teh and Houlsby (1991) showed that a single curve relating degree of dissipation versus theoretical time factor (T*) may be used to calculate the coefficient of consolidation (c_h) at various degrees of dissipation resulting in the expression for c_h shown below.

$$c_h = \frac{T^* \cdot a^2 \cdot \sqrt{I_r}}{t}$$

Where:
T* is the dimensionless time factor (Table Time Factor)
a is the radius of the cone
I_r is the rigidity index
t is the time at the degree of consolidation

Table Time Factor. T* versus degree of dissipation (Teh and Houlsby (1991))

Degree of Dissipation (%)	20	30	40	50	60	70	80
T* (u_2)	0.038	0.078	0.142	0.245	0.439	0.804	1.60

The coefficient of consolidation is typically analyzed using the time (t_{50}) corresponding to a degree of dissipation of 50% (u_{50}). In order to determine t_{50}, dissipation tests must be taken to a pressure less than u_{50}. The u_{50} value is half way between the initial maximum pore pressure and the equilibrium pore pressure value, known as u_{100}. To estimate u_{50}, both the initial maximum pore pressure and u_{100} must be known or estimated. Other degrees of dissipations may be considered, particularly for extremely long dissipations.

At any specific degree of dissipation the equilibrium pore pressure (u at t_{100}) must be estimated at the depth of interest. The equilibrium value may be determined from one or more sources such as measuring the value directly (u_{100}), estimating it from other dissipations in the same profile, estimating the phreatic surface and assuming hydrostatic conditions, from nearby soundings, from client provided information, from site observations and/or past experience, or from other site instrumentation.

For calculations of c_h (Teh and Houlsby (1991)), t_{50} values are estimated from the corresponding pore pressure dissipation curve and a rigidity index (I_r) is assumed. For curves having an initial dilatory response in which an initial rise in pore pressure occurs before reaching a peak, the relative time from the peak value is used in determining t_{50}. In cases where the time to peak is excessive, t_{50} values are not calculated.

Due to possible inherent uncertainties in estimating I_r, the equilibrium pore pressure and the effect of an initial dilatory response on calculating t_{50}, other methods should be applied to confirm the results for c_h.

Additional published methods for estimating the coefficient of consolidation from a piezocone test are described in Burns and Mayne (1998, 2002), Jones and Van Zyl (1981), Robertson et al. (1992) and Sully et al. (1999).

A summary of the pore pressure dissipation tests and dissipation plots are presented in the relevant appendix.

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Robertson, P.K., 1990, “Soil Classification Using the Cone Penetration Test”, Canadian Geotechnical Journal, Volume 27: 151-158. DOI: 10.1139/T90-014.

Robertson, P.K., Sully, J.P., Woeller, D.J., Lunne, T., Powell, J.J.M. and Gillespie, D.G., 1992, “Estimating coefficient of consolidation from piezocone tests”, Canadian Geotechnical Journal, 29(4): 539-550. DOI: 10.1139/T92-061.

Robertson, P.K., 2009, “Interpretation of cone penetration tests – a unified approach”, Canadian Geotechnical Journal, Volume 46: 1337-1355. DOI: 10.1139/T09-065.

Sully, J.P., Robertson, P.K., Campanella, R.G. and Woeller, D.J., 1999, “An approach to evaluation of field CPTU dissipation data in overconsolidated fine-grained soils”, Canadian Geotechnical Journal, 36(2): 369-381. DOI: 10.1139/T98-105.

Teh, C.I., and Houlsby, G.T., 1991, “An analytical study of the cone penetration test in clay”, Geotechnique, 41(1): 17-34. DOI: 10.1680/geot.1991.41.1.17.

The appendices listed below are included in the report:

- Cone Penetration Test Summary and Standard Cone Penetration Test Plots
- Normalized Cone Penetration Test Plots
- Advanced Cone Penetration Test Plots with Ic, Su(Nkt), Phi and N(60)Ic/N1(60)Ic
- Seismic Cone Penetration Test Plots
- Seismic Cone Penetration Test Shear Wave (Vs) Tabular Results
- Seismic Cone Penetration Test Shear Wave (Vs) Traces
- Soil Behavior Type (SBT) Scatter Plots
- Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots

Cone Penetration Test Summary and Standard Cone Penetration Test Plots

CONETEC

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Start Date:	13-Sep-2021
End Date:	16-Sep-2021

CONE PENETRATION TEST SUMMARY

Sounding ID	File Name	Date	Cone	Assumed Phreatic Surface[2] (ft)	Final Depth (ft)	Shear Wave Velocity Tests	Latitude[1] (deg)	Longitude[1] (deg)
CPT-01	21-59-23000_SP01.COR	2021-09-16	781:T1500F15U35	22.6	29.5	9	45.52292	-122.67103
CPT-02	21-59-23000_SP02.COR	2021-09-16	781:T1500F15U35	22.6	29.8	9	45.52293	-122.67062
CPT-03	21-59-23000_SP03.COR	2021-09-13	780:T1500F15U35	23.9	145.7	38	45.52315	-122.66522
CPT-04	21-59-23000_SP04.COR	2021-09-13	780:T1500F15U35	25.3	141.8	39	45.52286	-122.66496
CPT-05	21-59-23000_SP05.COR	2021-09-14	780:T1500F15U35	27.3	149.0	45	45.52308	-122.66425
CPT-06	21-59-23000_SP06.COR	2021-09-14	780:T1500F15U35	23.3	145.7	45	45.52277	-122.66405
CPT-07	21-59-23000_SP07.COR	2021-09-15	780:T1500F15U35	27.1	140.3	43	45.52285	-122.66459
CPT-08	21-59-23000_SP08.COR	2021-09-16	780:T1500F15U35	23.4	128.2	39	45.52307	-122.66370
Totals	8 soundings				909.9	267		

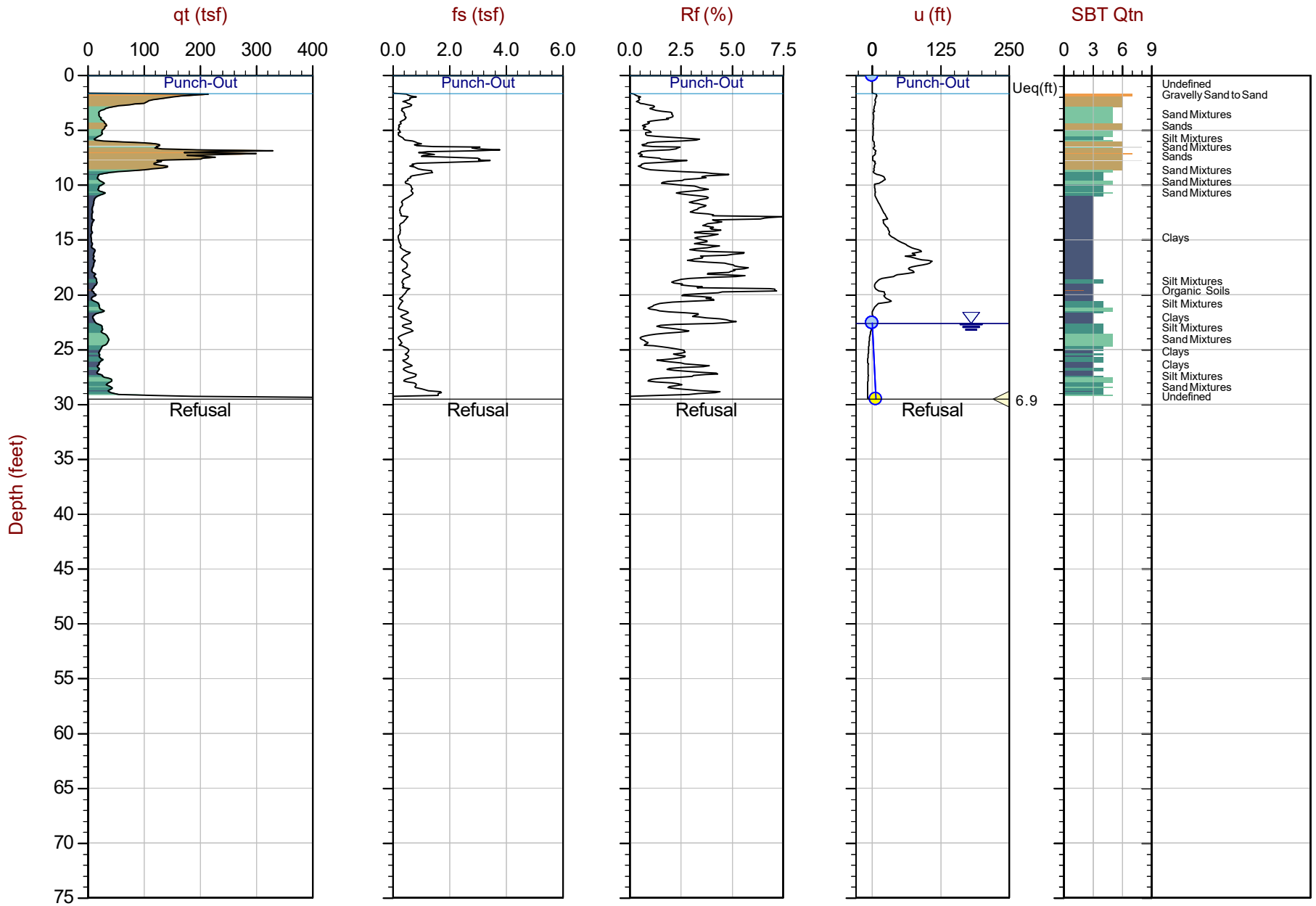
1. Coordinates were provided by the client - WGS 84 Lat/Long
2. Phreatic surface based on pore pressure dissipation test unless otherwise noted. Hydrostatic profile applied to interpretation tables

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 11:01
Site: Burnside Bridge Portland CPT

Sounding: CPT-01
Cone: 781:T1500F15U35



Max Depth: 9.000 m / 29.53 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP01.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52292 Long: -122.67103

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

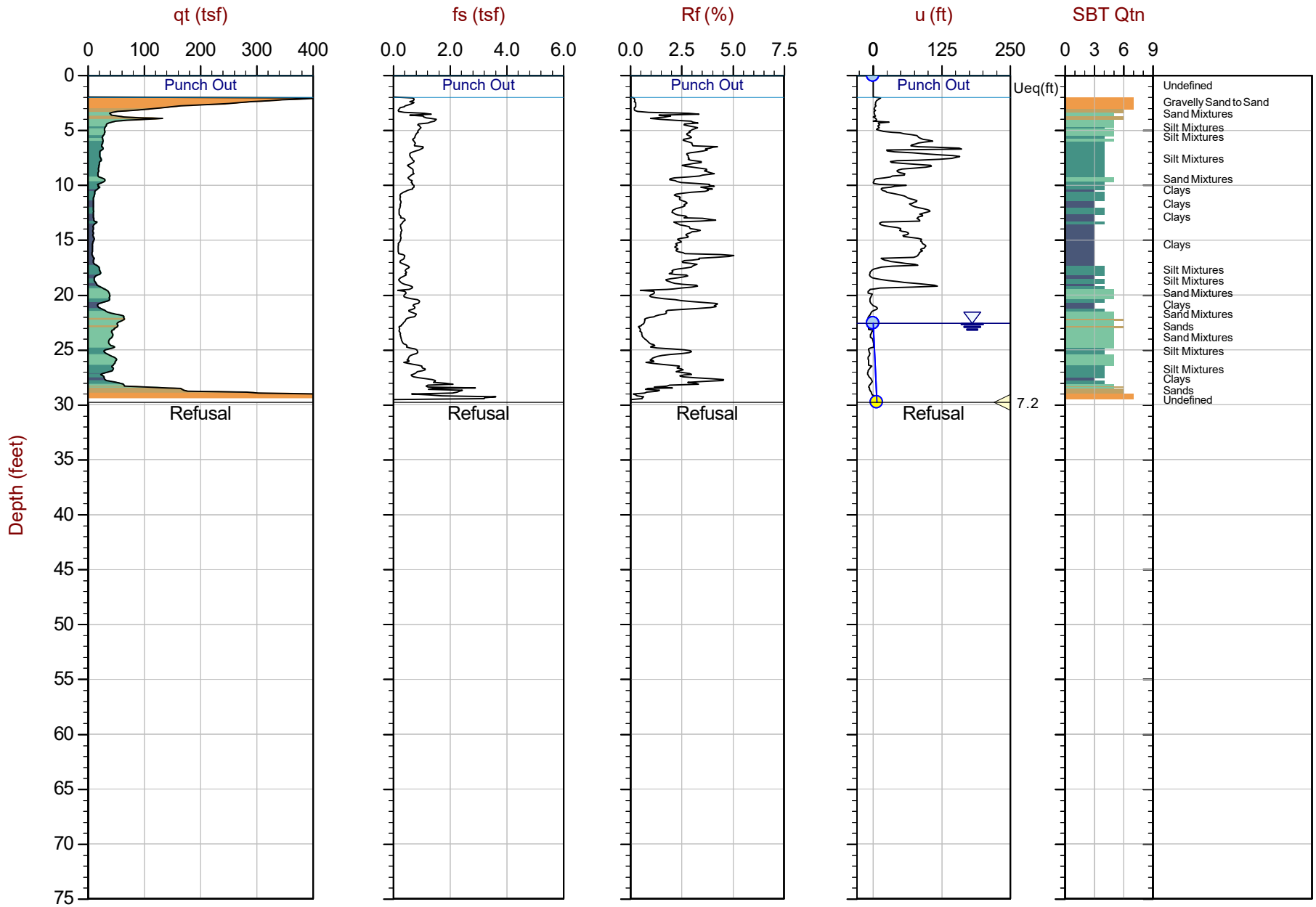
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 12:17
Site: Burnside Bridge Portland CPT

Sounding: CPT-02
Cone: 781:T1500F15U35



Max Depth: 9.075 m / 29.77 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP02.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52293 Long: -122.67062

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

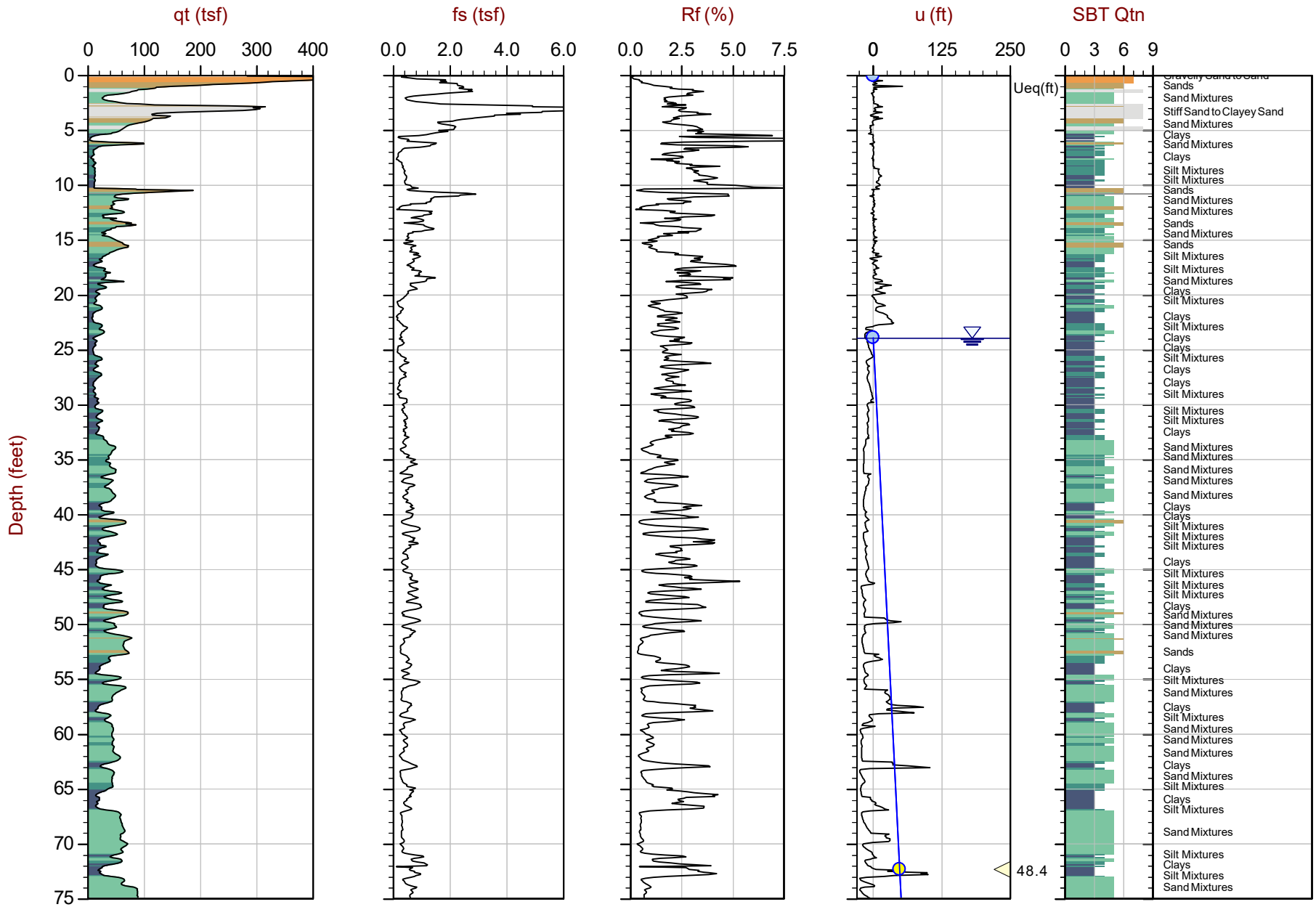
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 11:00
Site: Burnside Bridge Portland CPT

Sounding: CPT-03
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP03.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52314 Long: -122.66522

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

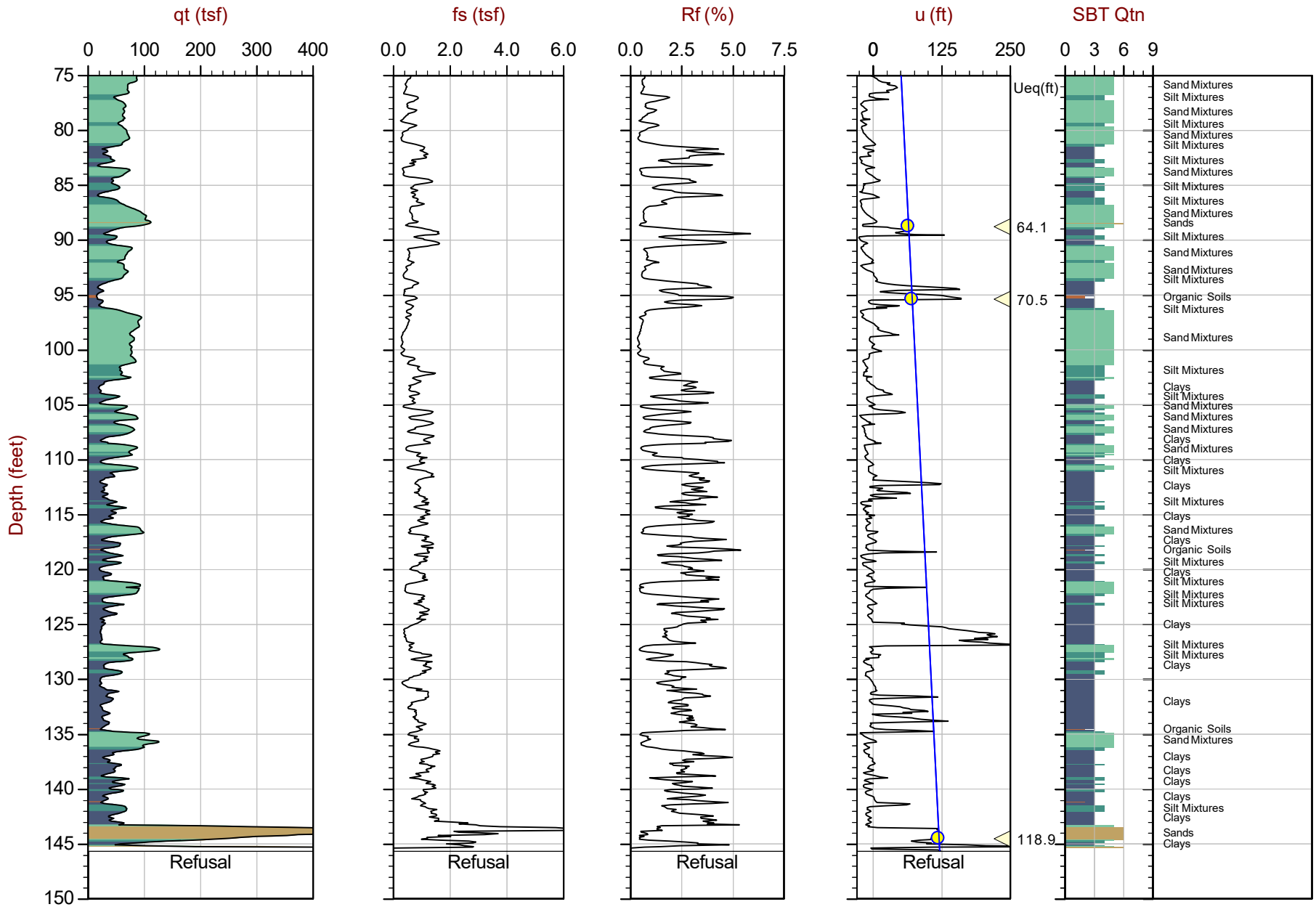
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 11:00
Site: Burnside Bridge Portland CPT

Sounding: CPT-03
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP03.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52314 Long: -122.66522

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

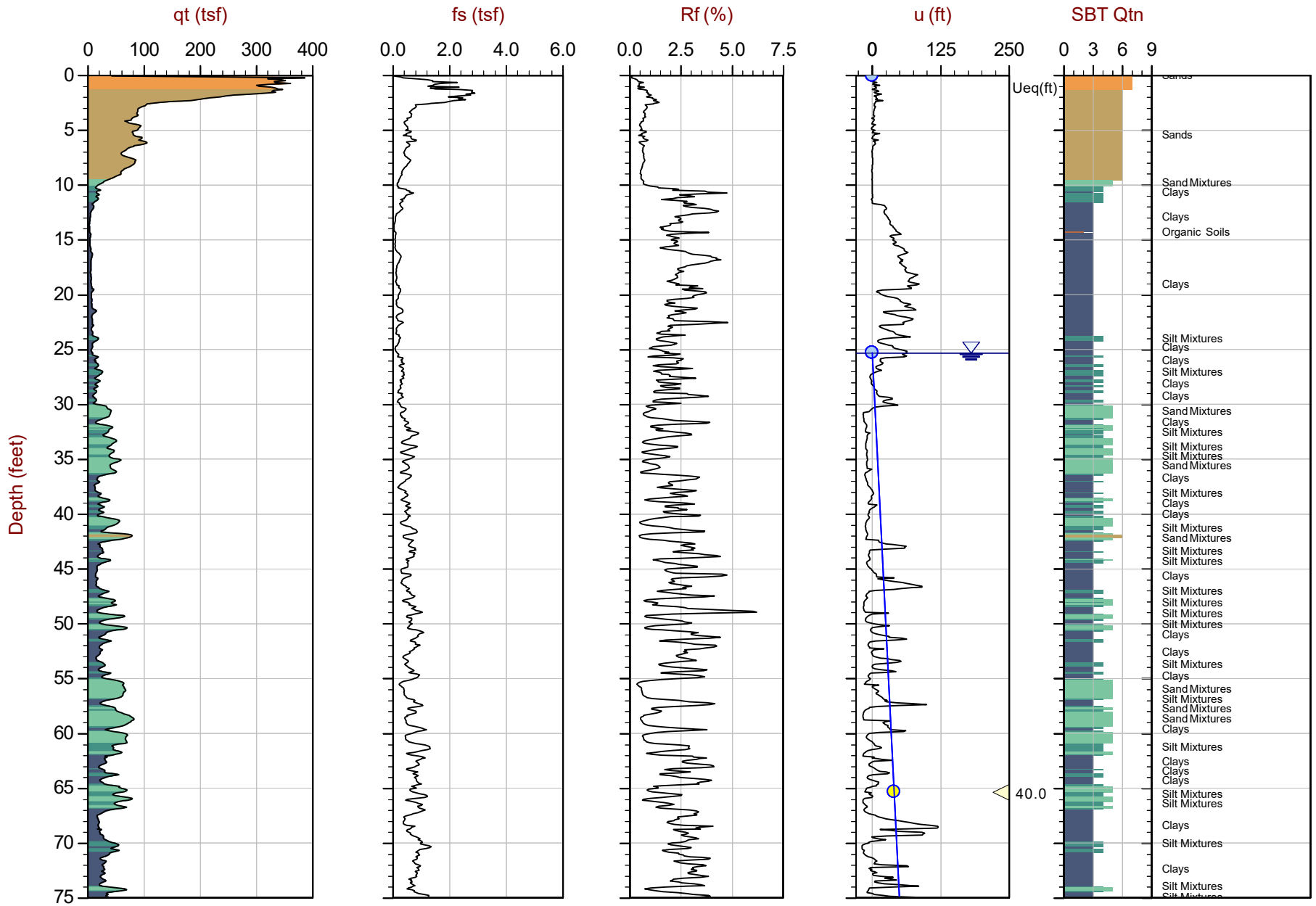
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 14:50
Site: Burnside Bridge Portland CPT

Sounding: CPT-04
Cone: 780:T1500F15U35



Max Depth: 43.225 m / 141.81 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP04.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52286 Long: -122.66496

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

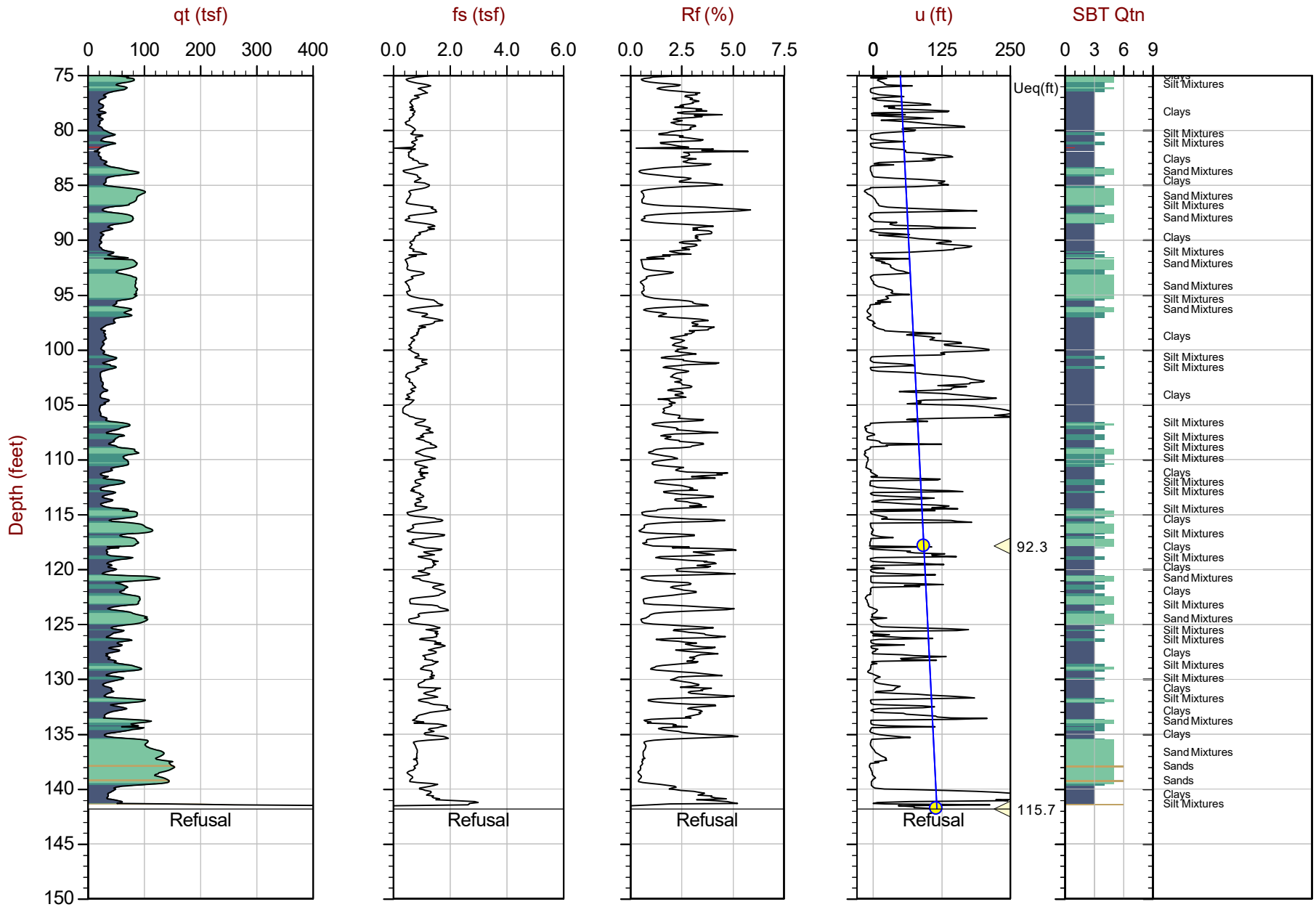
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 14:50
Site: Burnside Bridge Portland CPT

Sounding: CPT-04
Cone: 780:T1500F15U35



Max Depth: 43.225 m / 141.81 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP04.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52286 Long: -122.66496

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

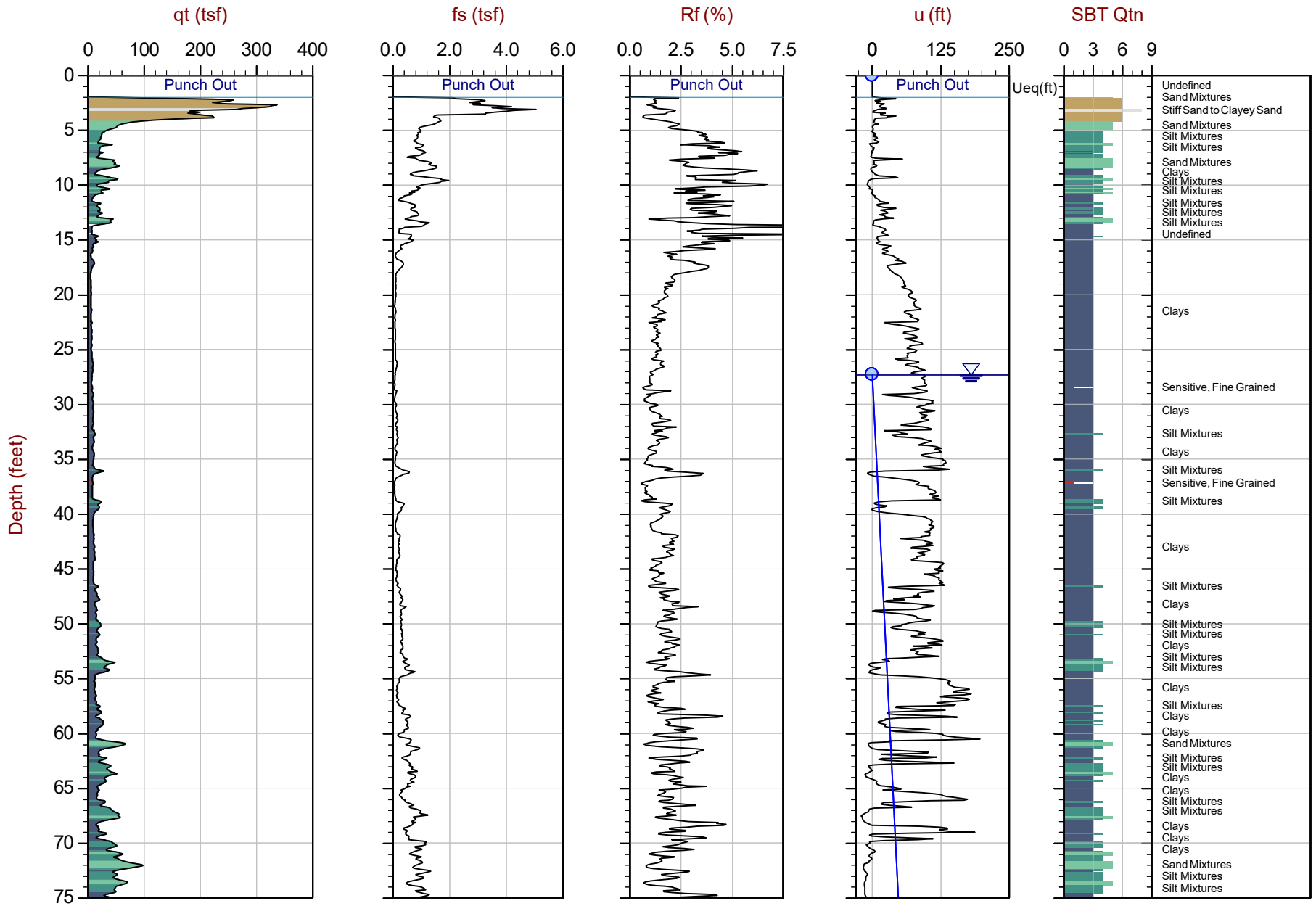
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 08:06
Site: Burnside Bridge Portland CPT

Sounding: CPT-05
Cone: 780:T1500F15U35



Max Depth: 45.425 m / 149.03 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP05.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52308 Long: -122.66425

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

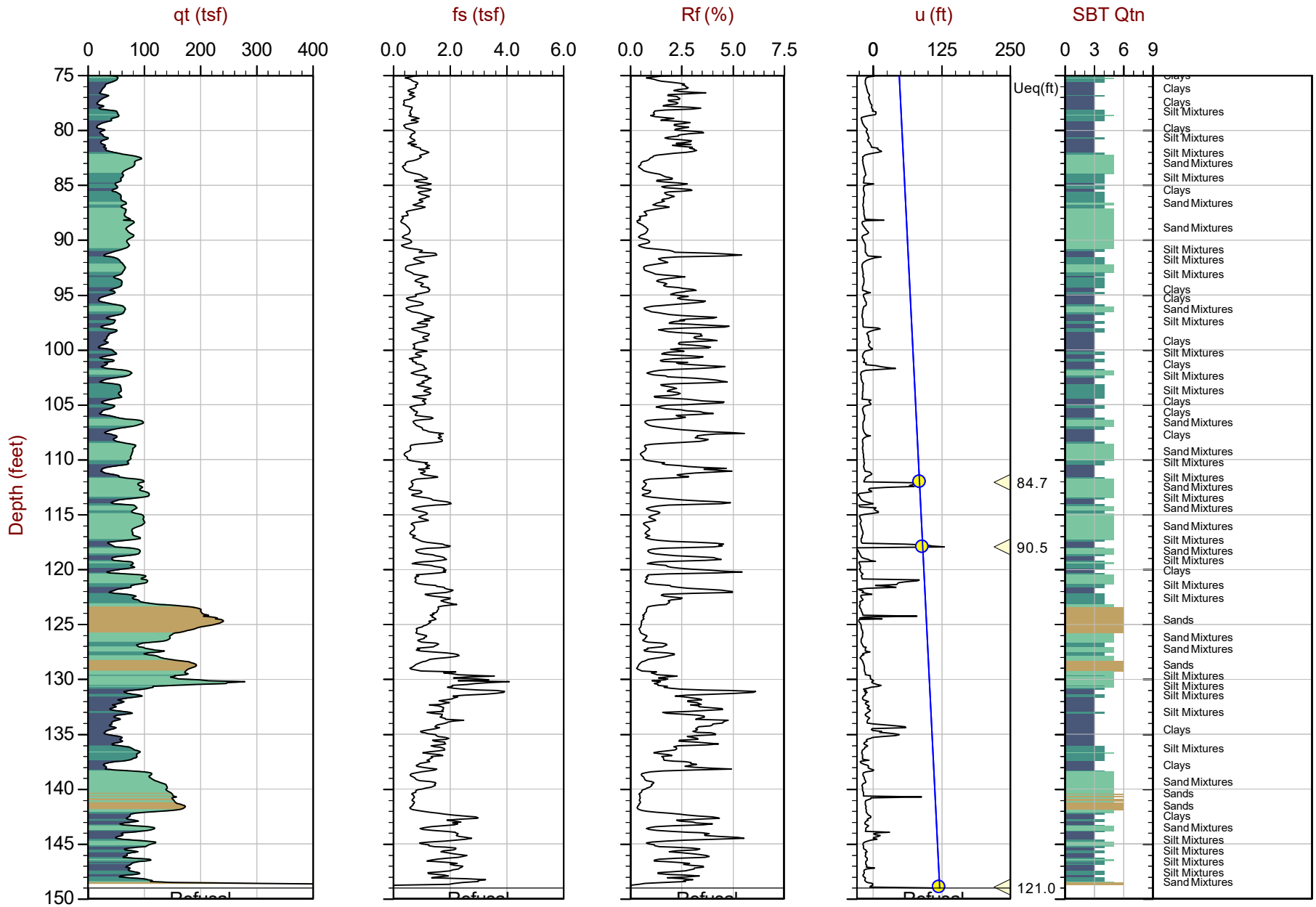
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 08:06
Site: Burnside Bridge Portland CPT

Sounding: CPT-05
Cone: 780:T1500F15U35



Max Depth: 45.425 m / 149.03 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP05.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52308 Long: -122.66425

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

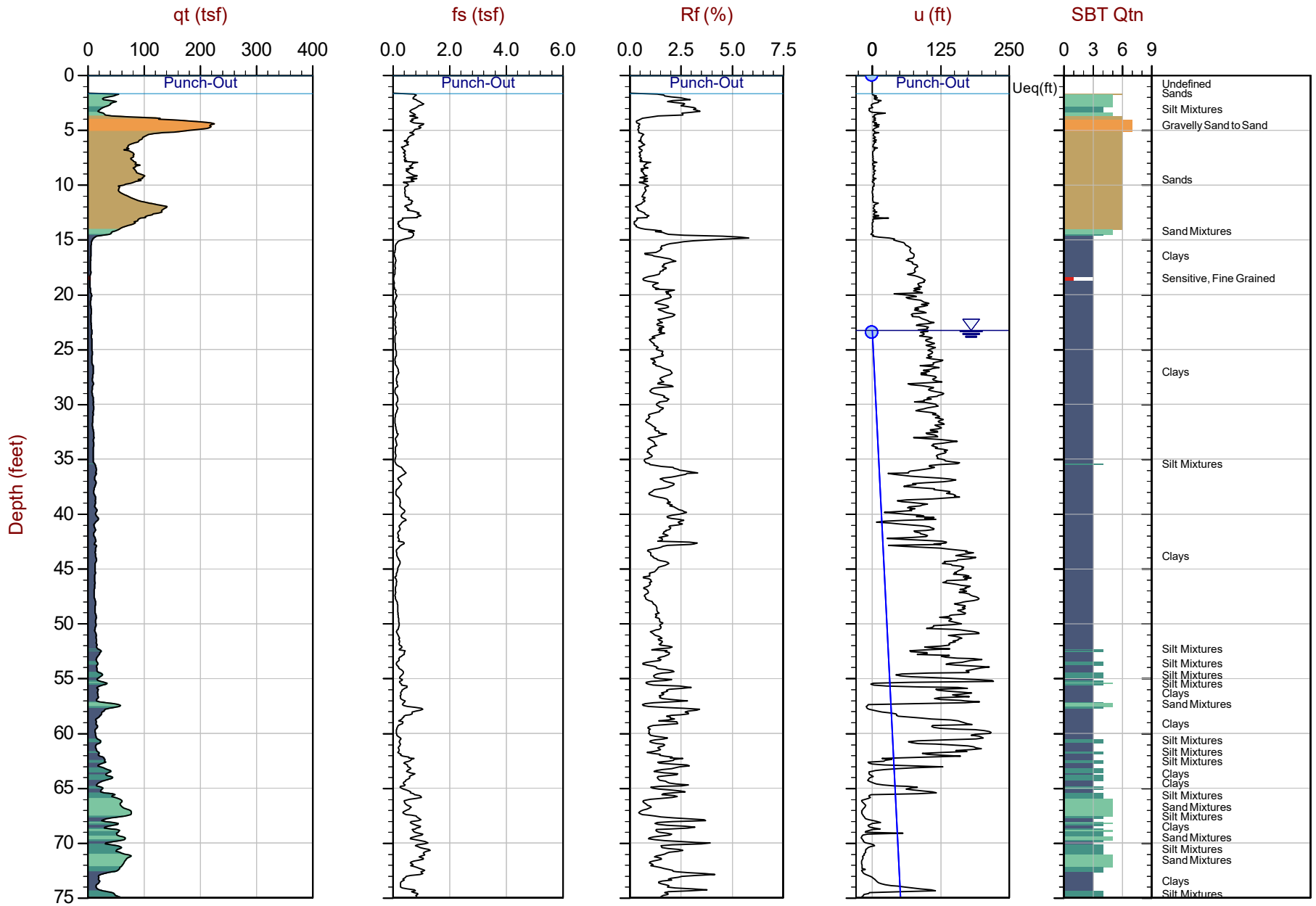
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 12:43
Site: Burnside Bridge Portland CPT

Sounding: CPT-06
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP06.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52277 Long: -122.66405

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

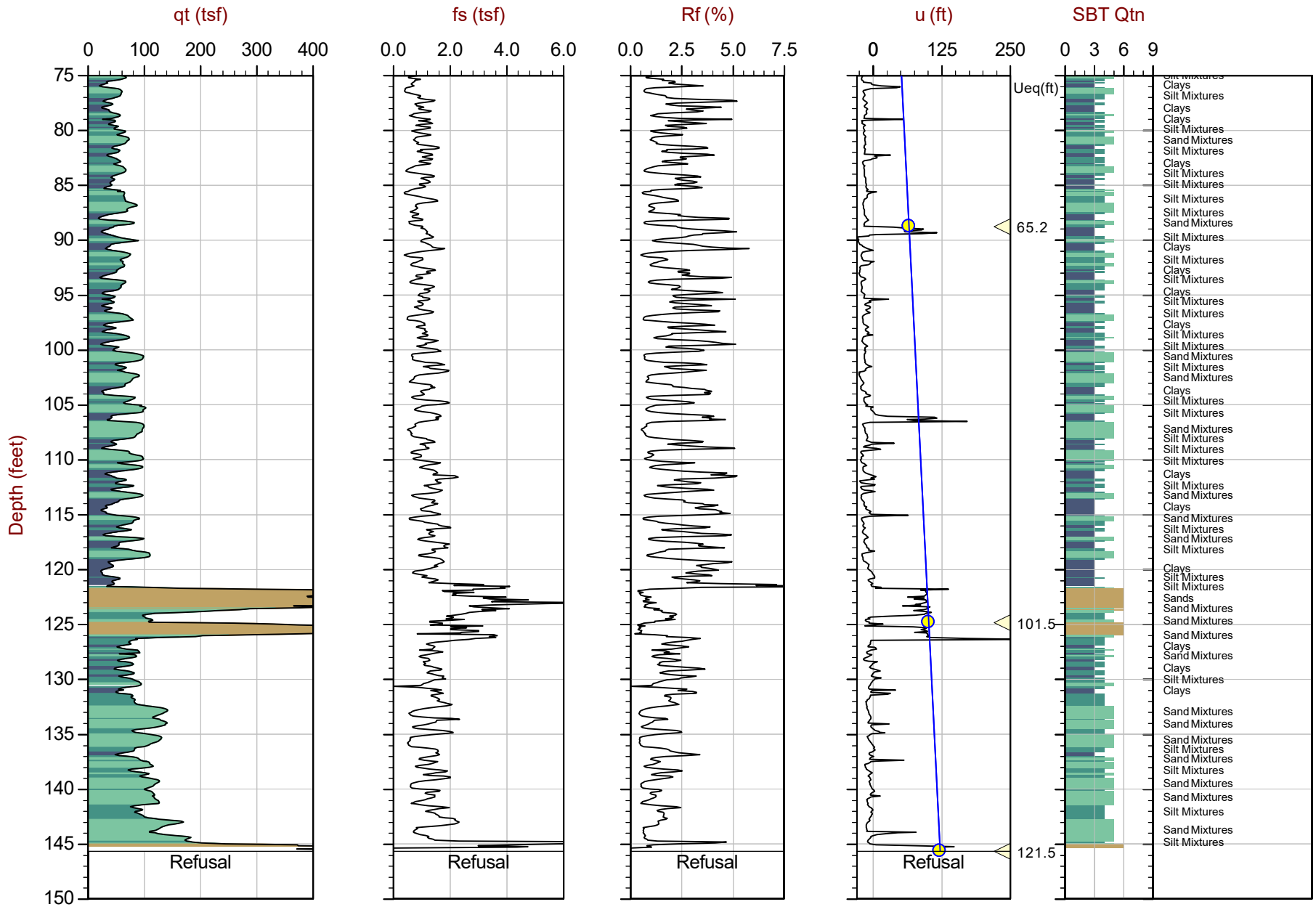
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 12:43
Site: Burnside Bridge Portland CPT

Sounding: CPT-06
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP06.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52277 Long: -122.66405

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

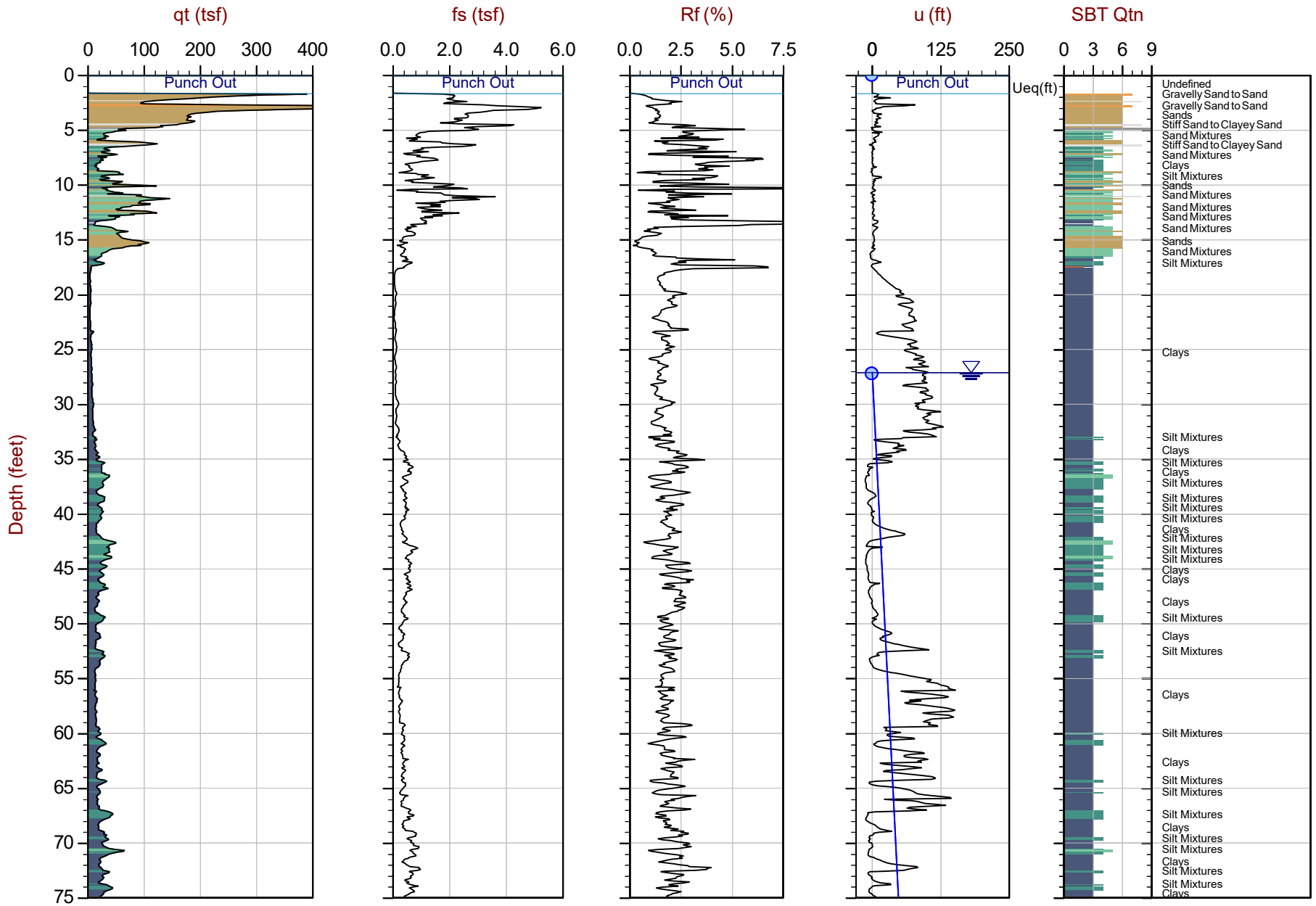
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-15 08:28
Site: Burnside Bridge Portland CPT

Sounding: CPT-07
Cone: 780:T1500F15U35



Max Depth: 42.750 m / 140.25 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP07.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52285 Long: -122.66459

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

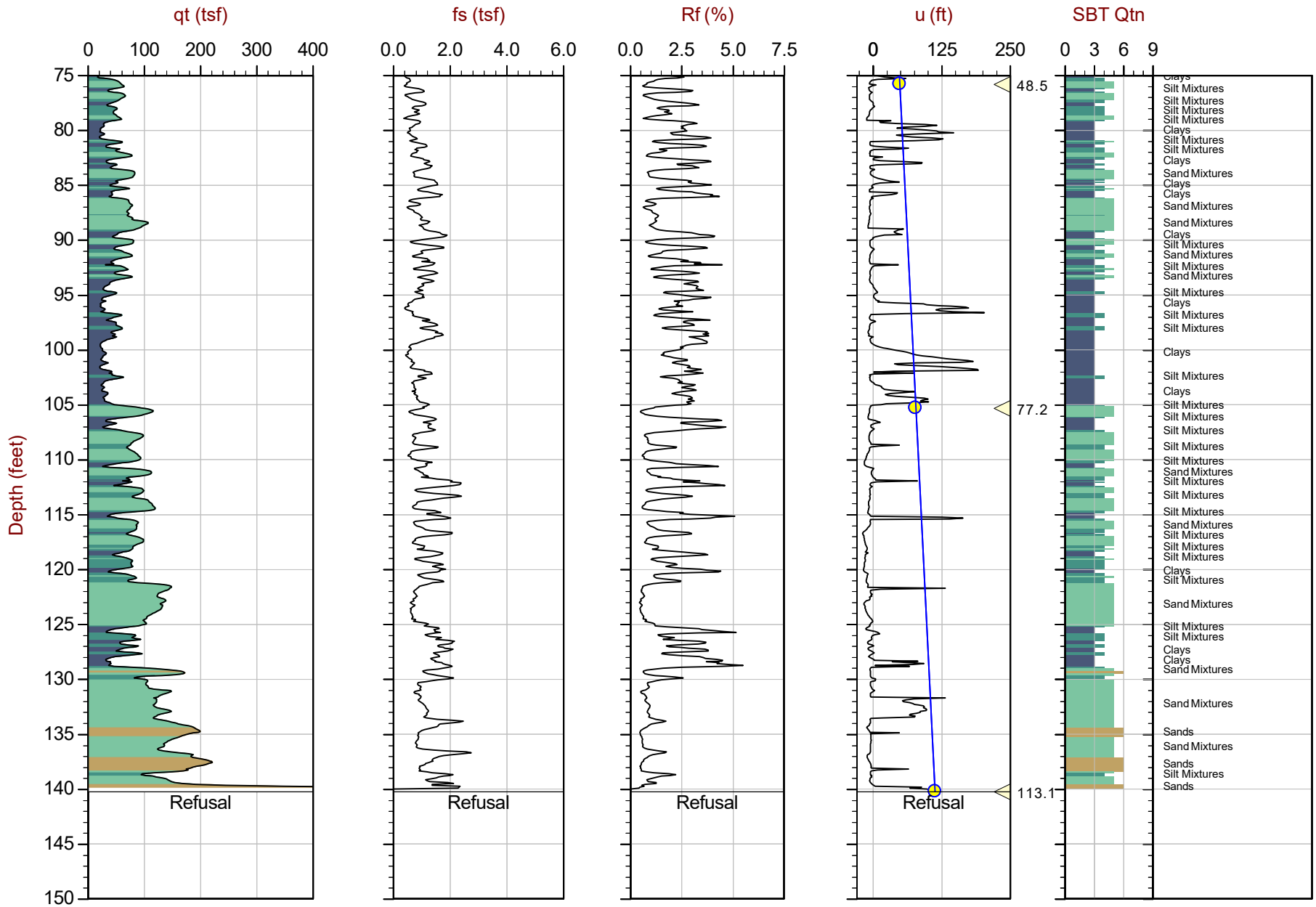
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-15 08:28
Site: Burnside Bridge Portland CPT

Sounding: CPT-07
Cone: 780:T1500F15U35



Max Depth: 42.750 m / 140.25 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP07.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52285 Long: -122.66459

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

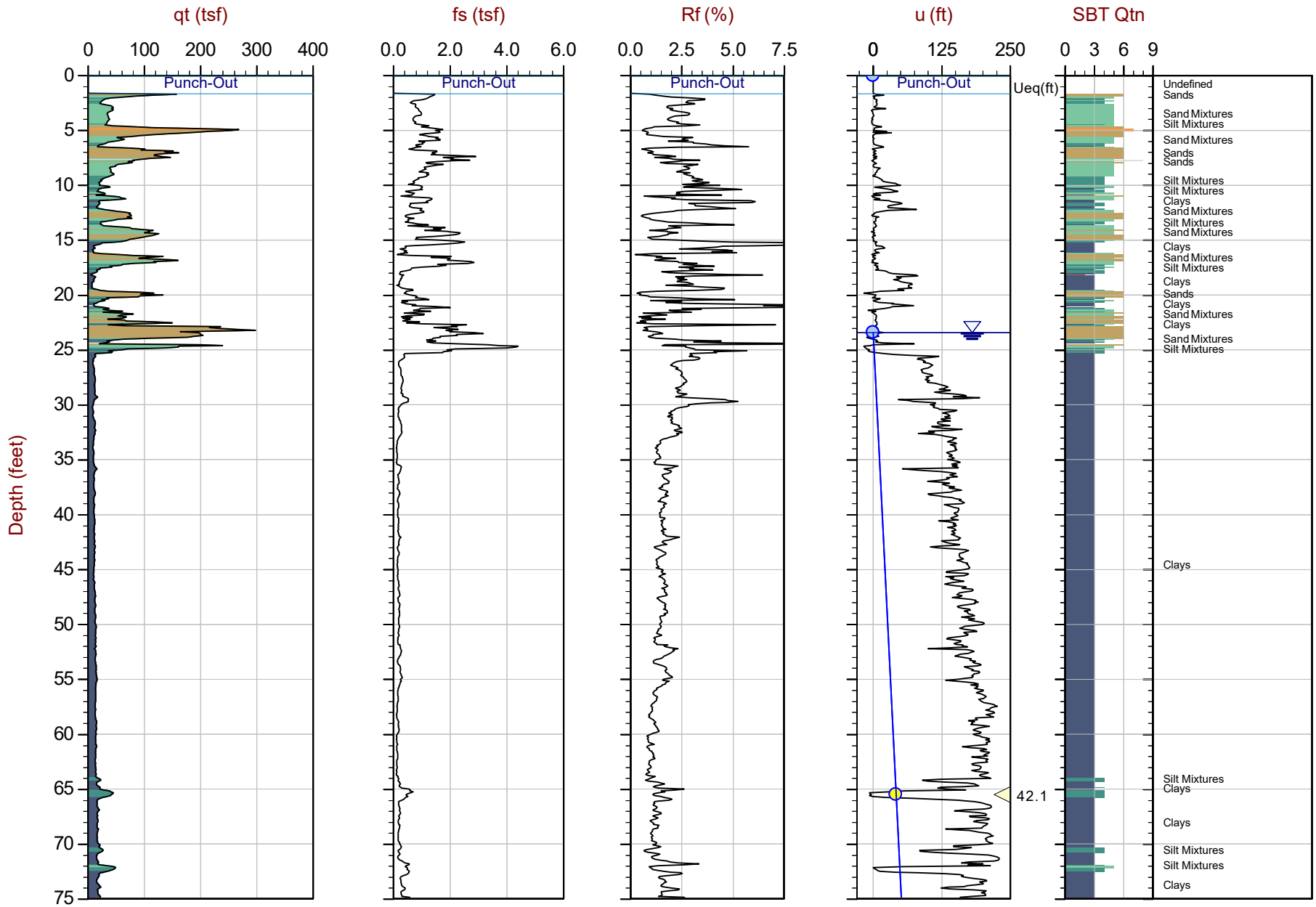
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 07:19
Site: Burnside Bridge Portland CPT

Sounding: CPT-08
Cone: 780:T1500F15U35



Max Depth: 39.075 m / 128.20 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP08.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52307 Long: -122.66370

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

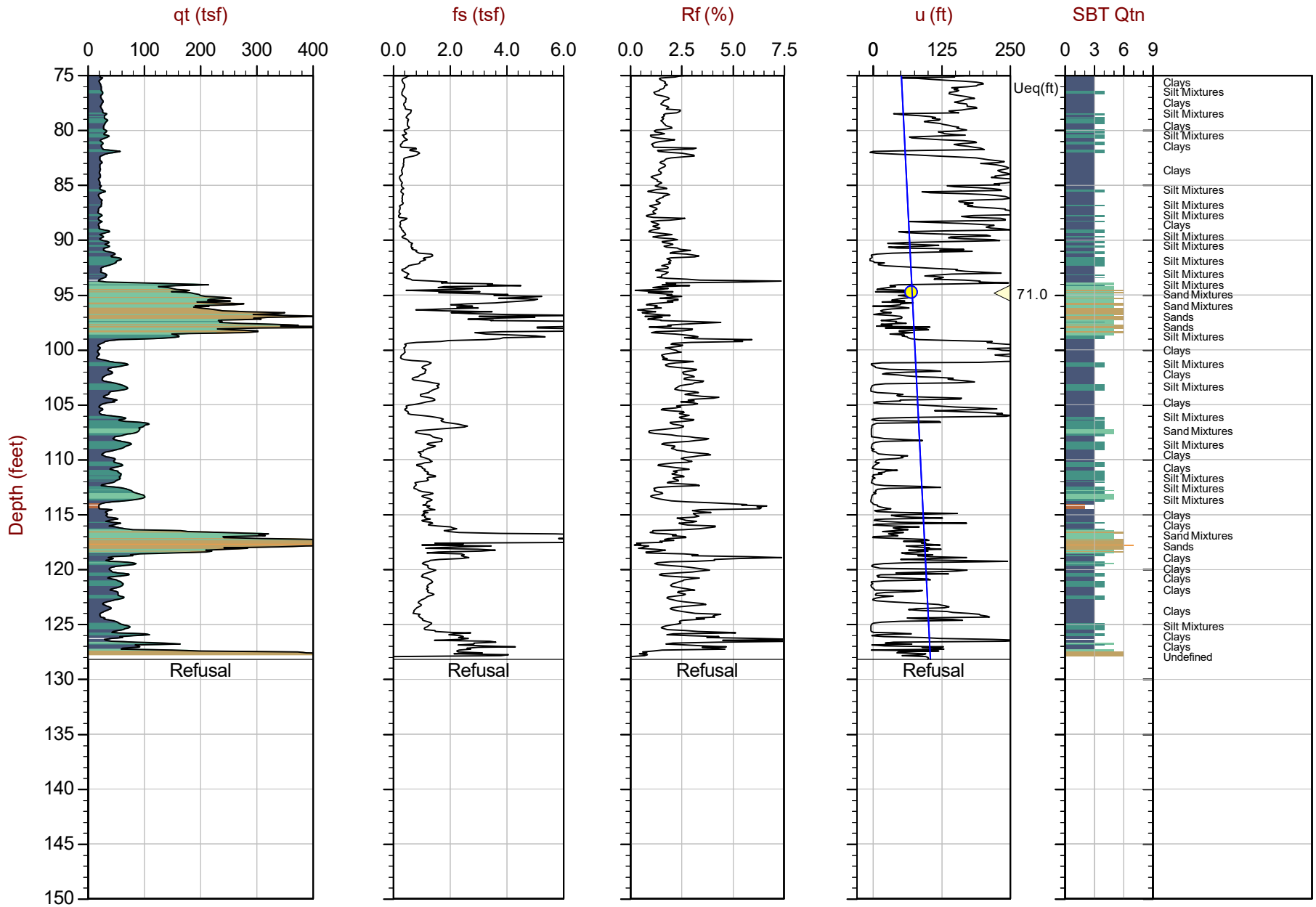
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 07:19
Site: Burnside Bridge Portland CPT

Sounding: CPT-08
Cone: 780:T1500F15U35



Max Depth: 39.075 m / 128.20 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP08.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52307 Long: -122.66370

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Normalized Cone Penetration Test Plots

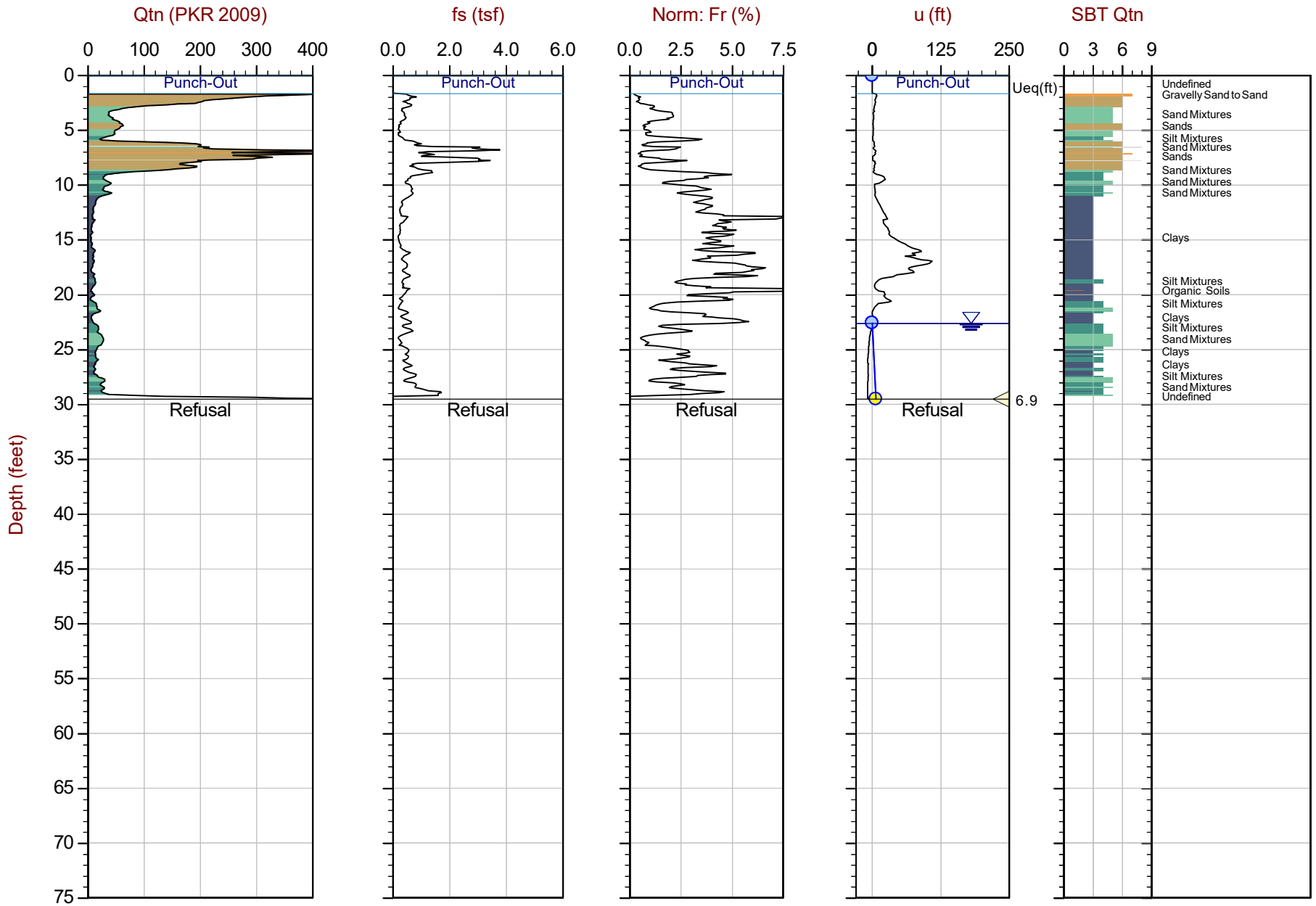
CONETEC

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 11:01
Site: Burnside Bridge Portland CPT

Sounding: CPT-01
Cone: 781:T1500F15U35



Max Depth: 9.000 m / 29.53 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP01.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52292 Long: -122.67103

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

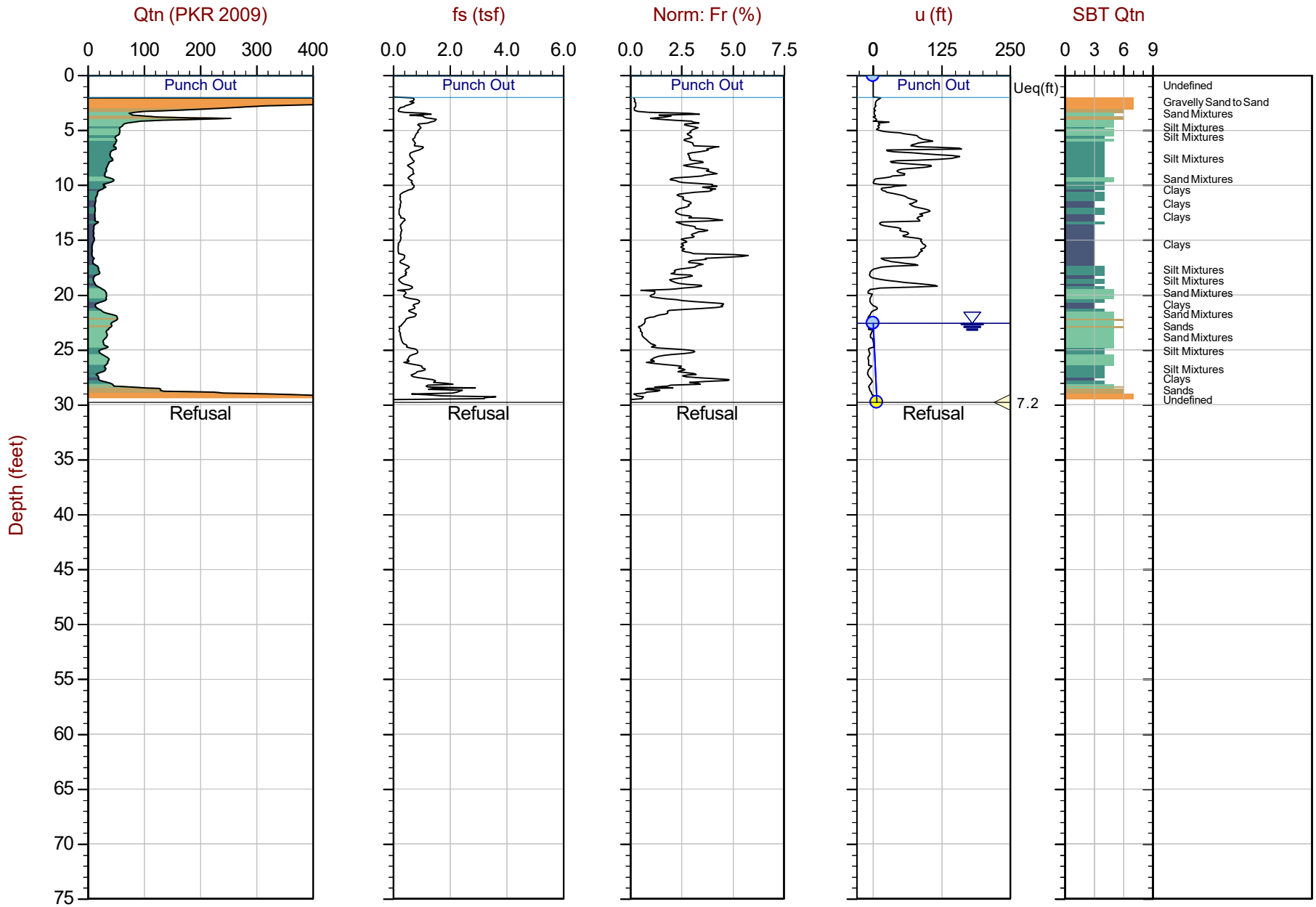
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 12:17
Site: Burnside Bridge Portland CPT

Sounding: CPT-02
Cone: 781:T1500F15U35



Max Depth: 9.075 m / 29.77 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP02.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52293 Long: -122.67062

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

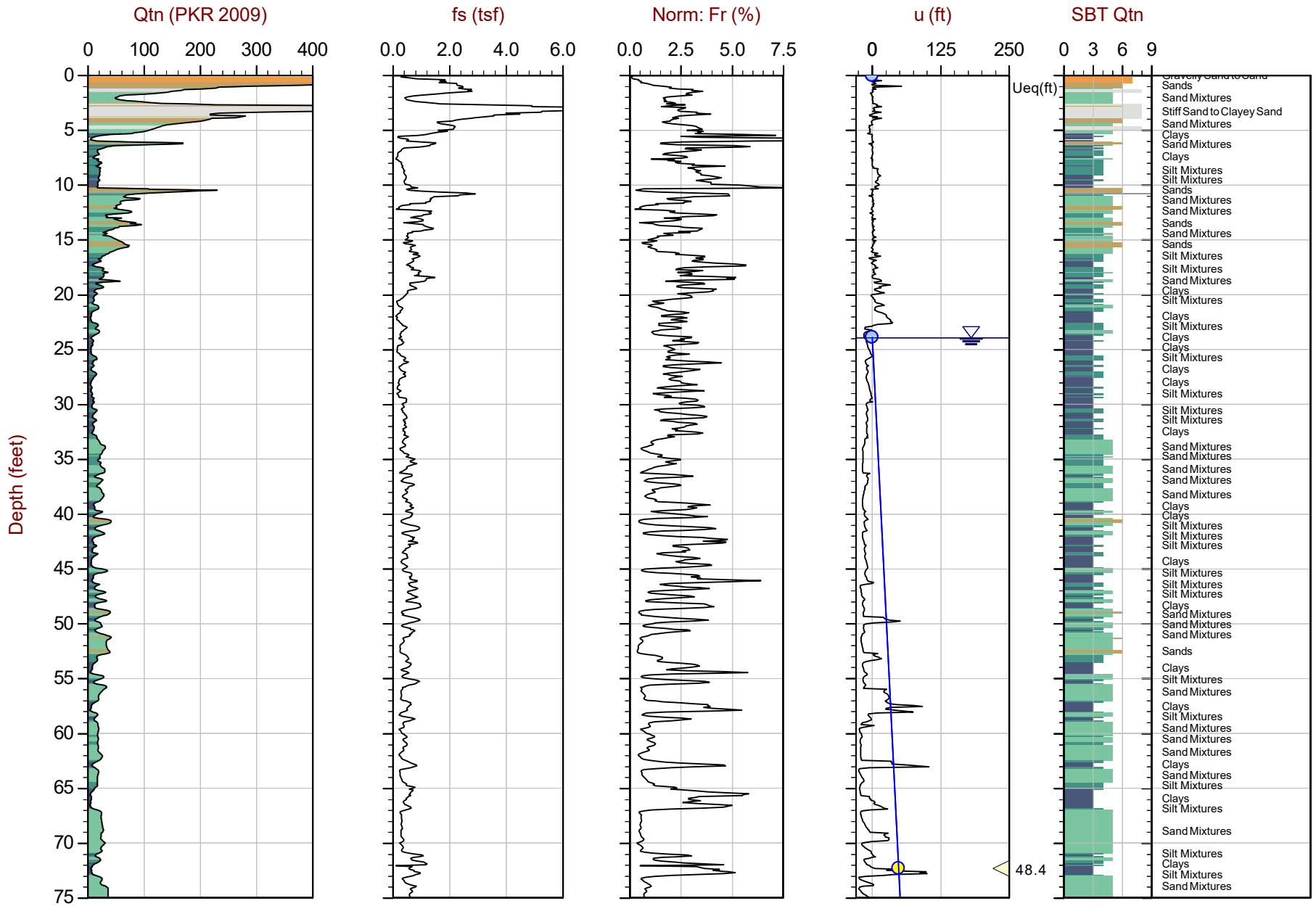
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 11:00
Site: Burnside Bridge Portland CPT

Sounding: CPT-03
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP03.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52314 Long: -122.66522

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

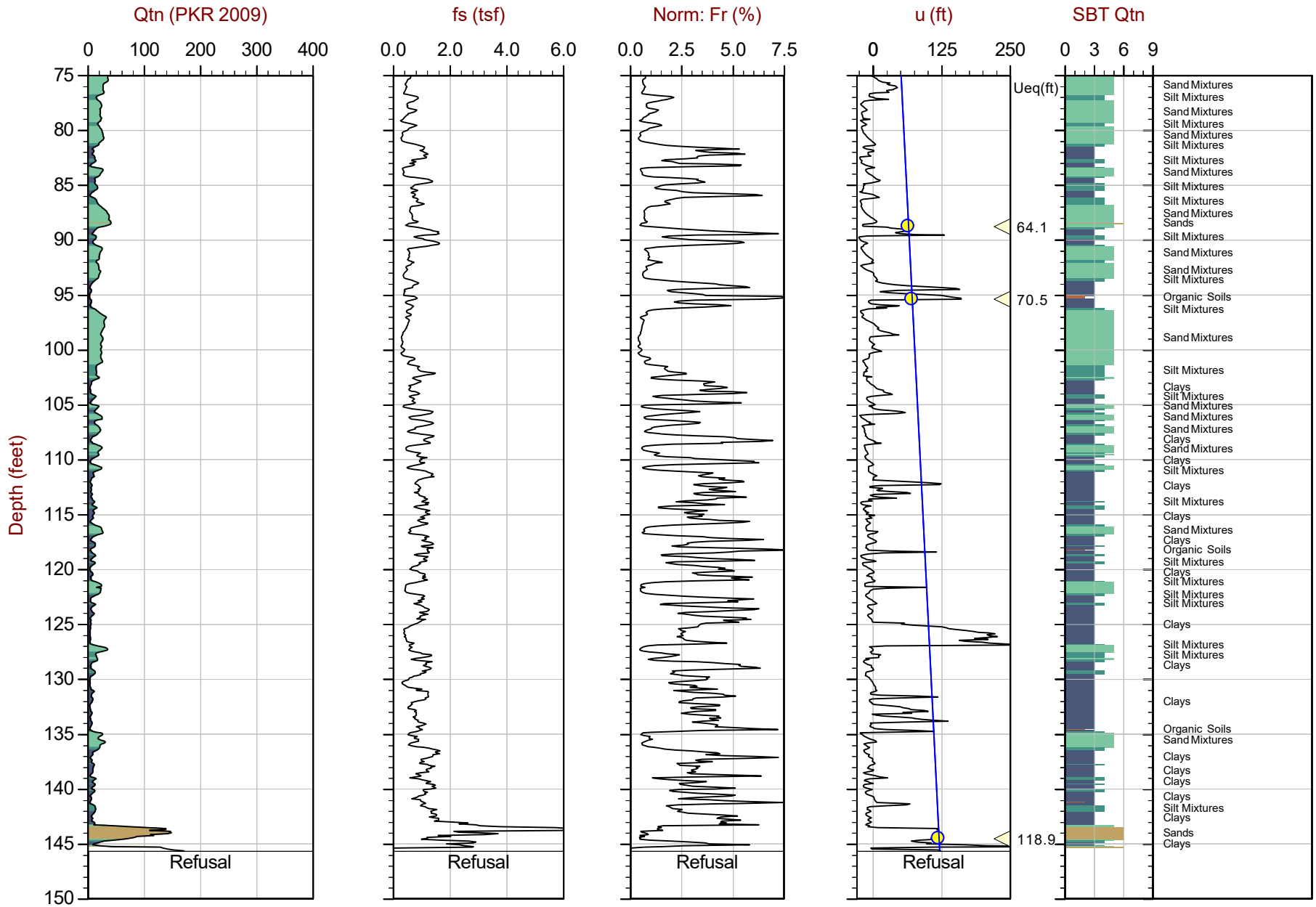
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 11:00
Site: Burnside Bridge Portland CPT

Sounding: CPT-03
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP03.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52314 Long: -122.66522

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

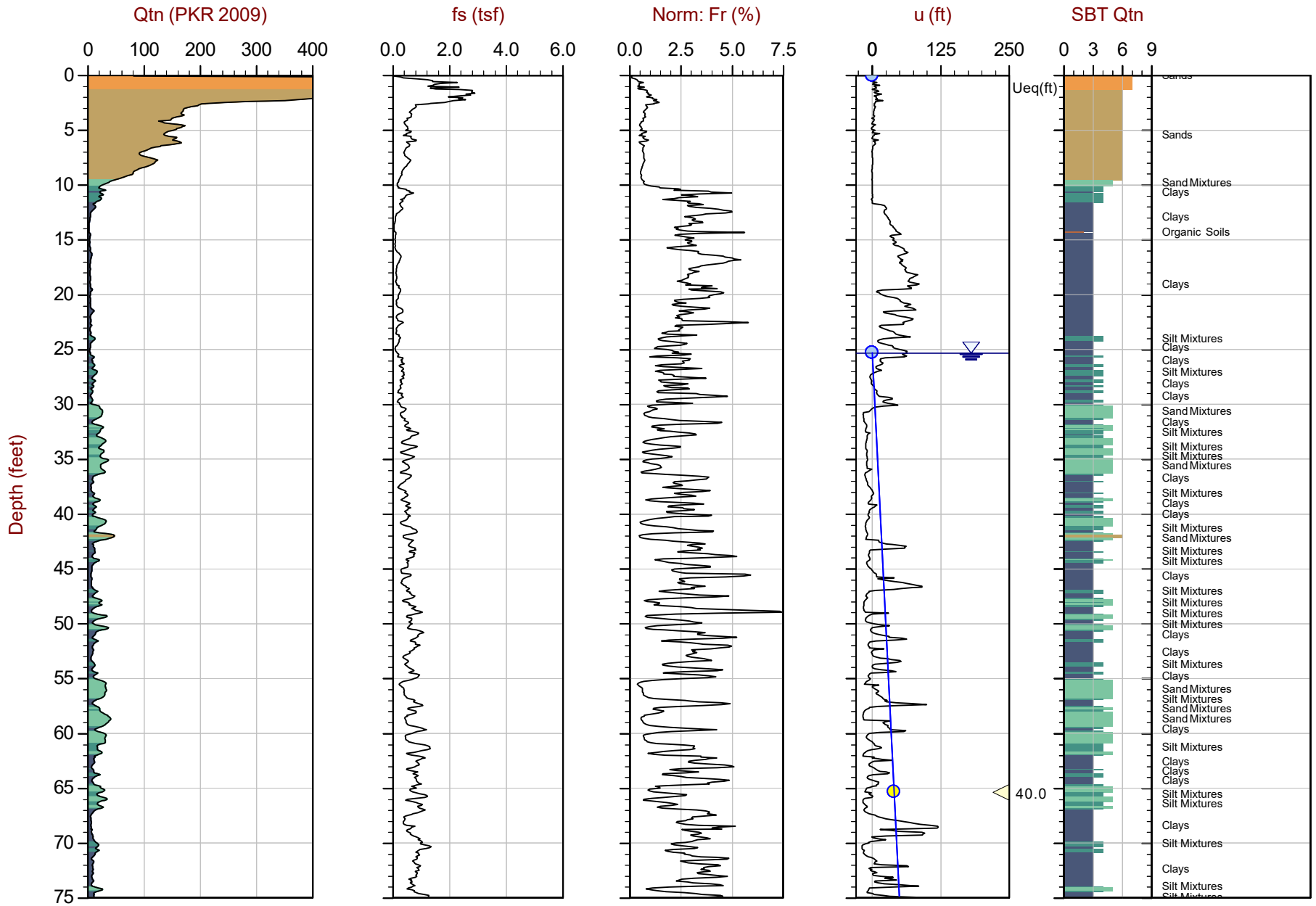
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 14:50
Site: Burnside Bridge Portland CPT

Sounding: CPT-04
Cone: 780:T1500F15U35



Max Depth: 43.225 m / 141.81 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP04.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52286 Long: -122.66496

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

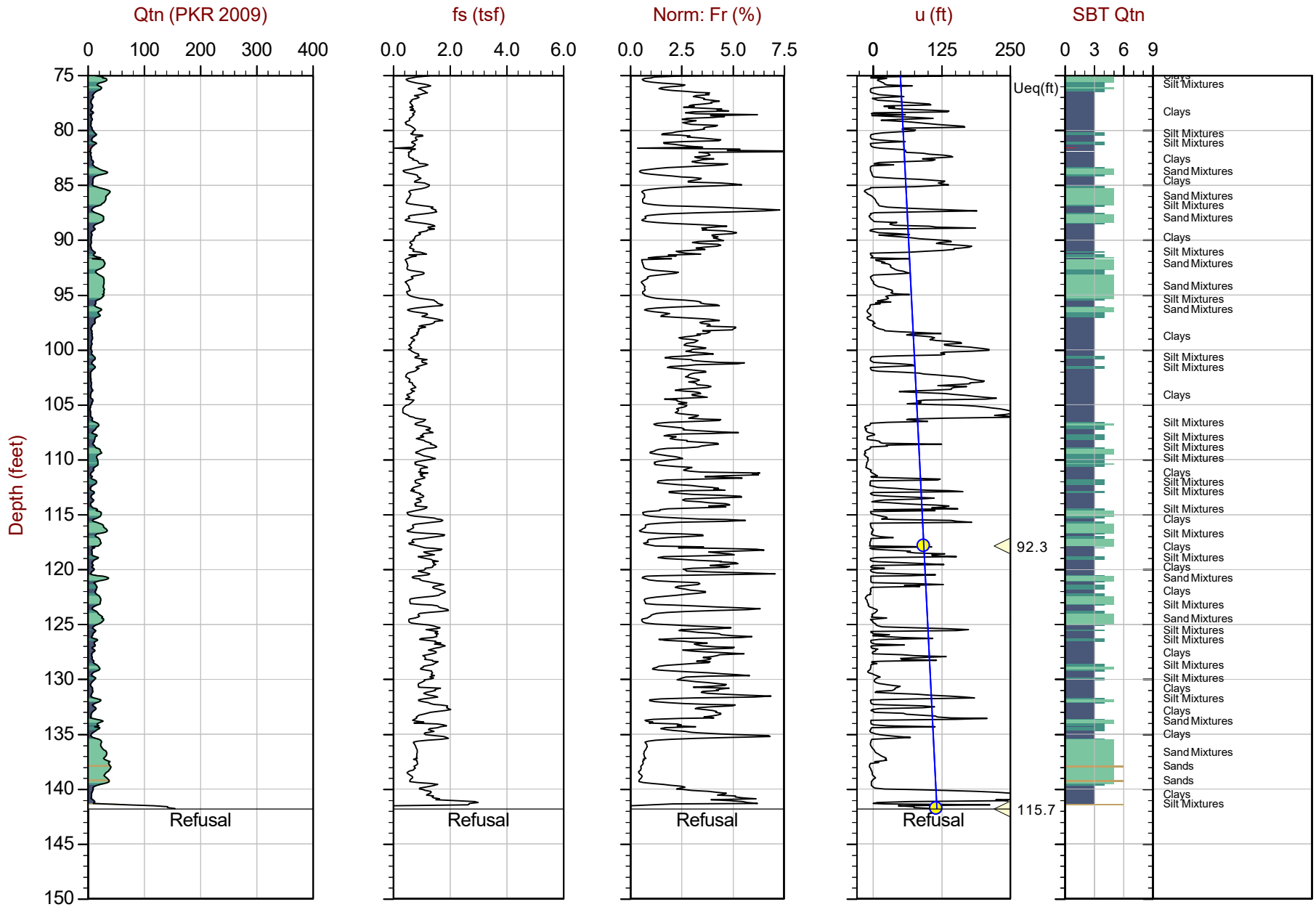
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 14:50
Site: Burnside Bridge Portland CPT

Sounding: CPT-04
Cone: 780:T1500F15U35



Max Depth: 43.225 m / 141.81 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP04.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52286 Long: -122.66496

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

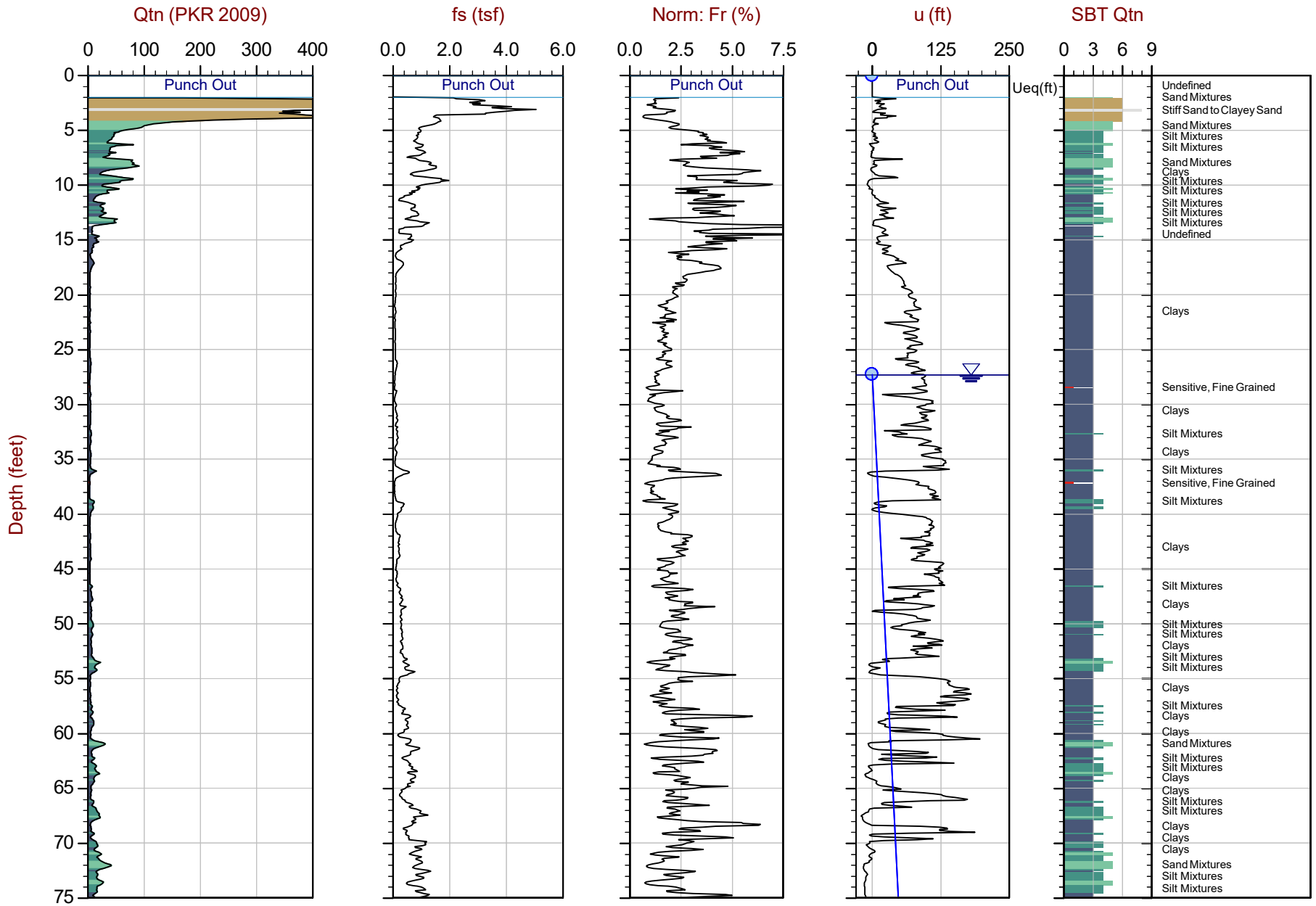
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 08:06
Site: Burnside Bridge Portland CPT

Sounding: CPT-05
Cone: 780:T1500F15U35



Max Depth: 45.425 m / 149.03 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP05.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52308 Long: -122.66425

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

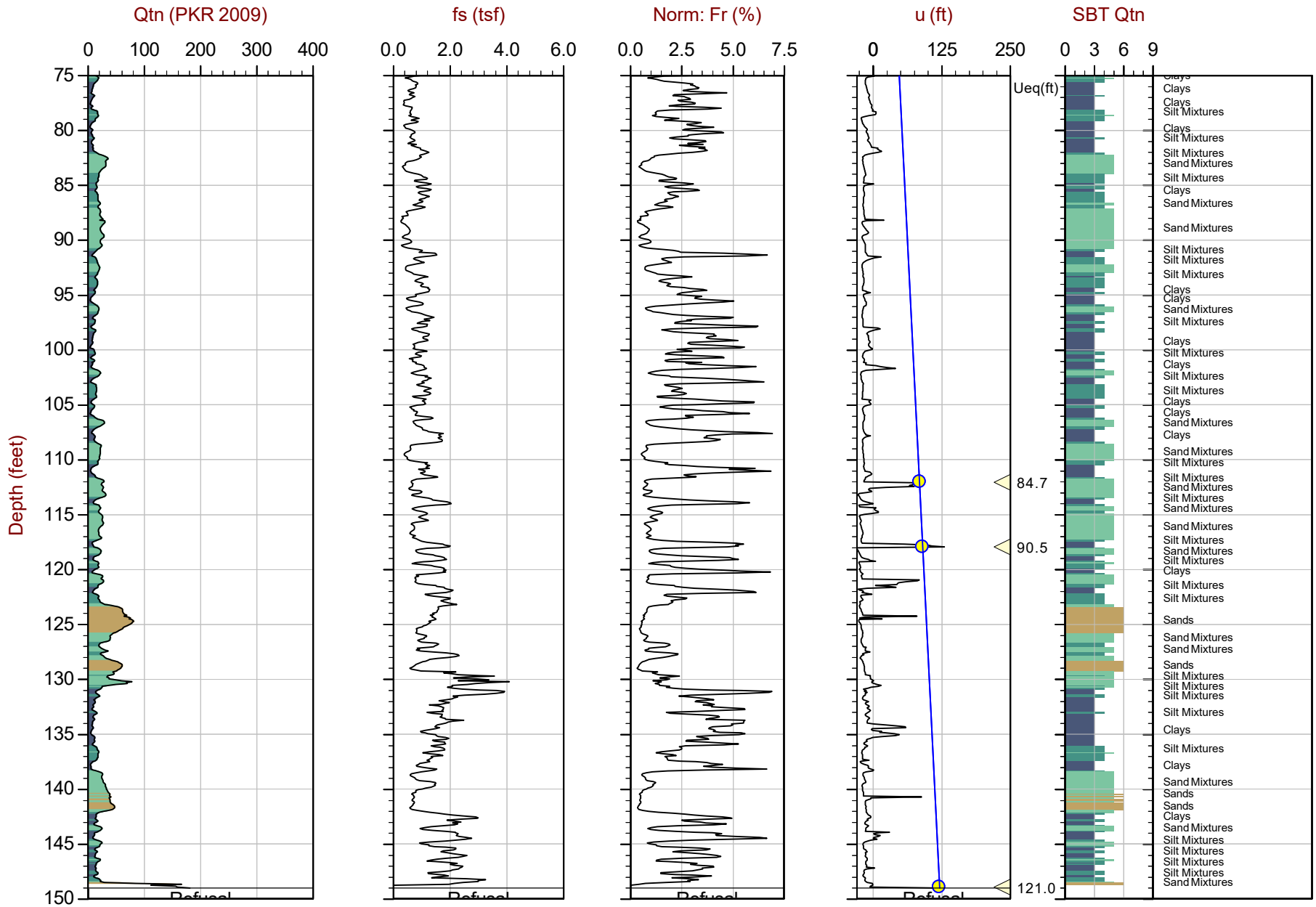
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 08:06
Site: Burnside Bridge Portland CPT

Sounding: CPT-05
Cone: 780:T1500F15U35



Max Depth: 45.425 m / 149.03 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP05.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52308 Long: -122.66425

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

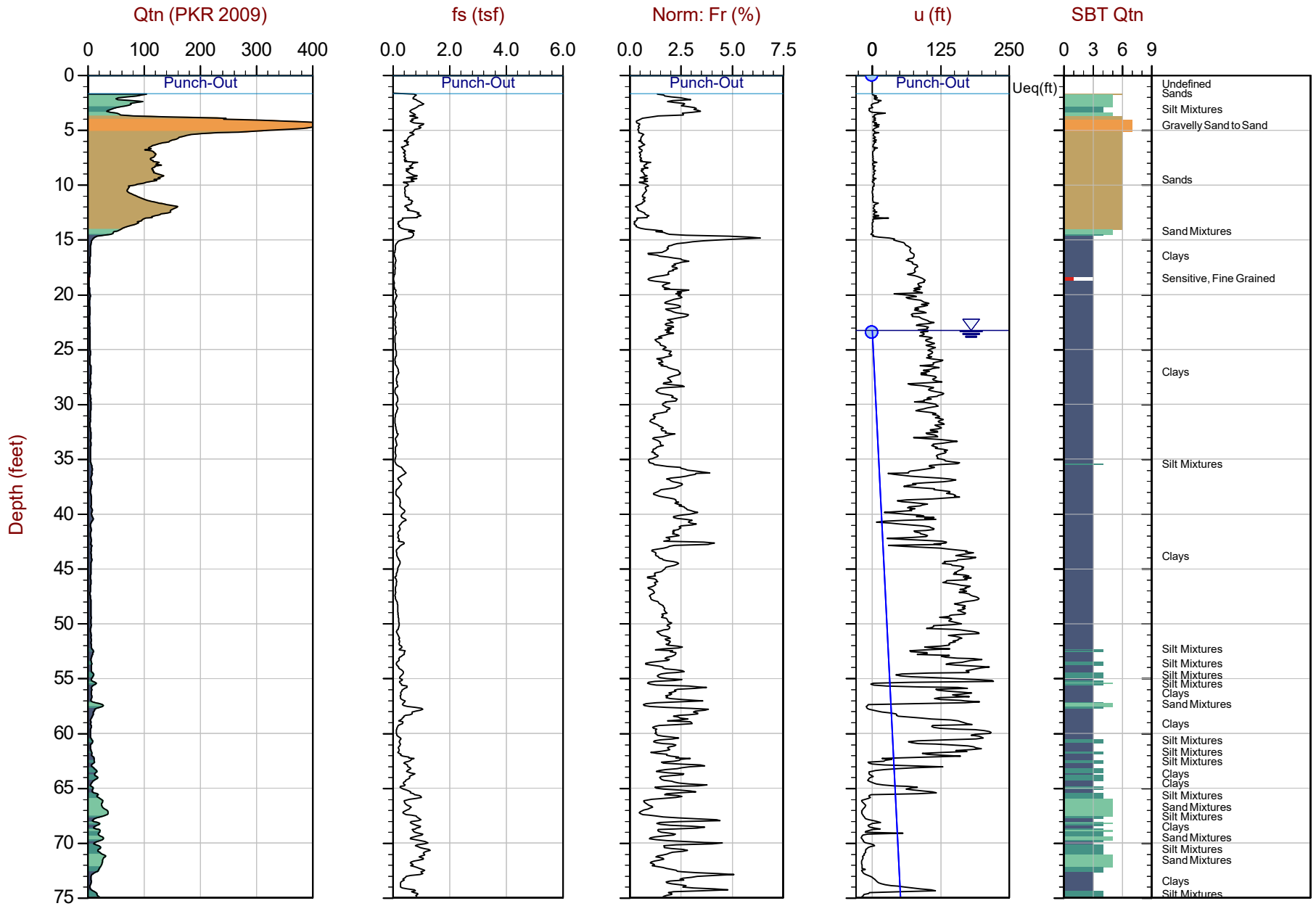
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 12:43
Site: Burnside Bridge Portland CPT

Sounding: CPT-06
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP06.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52277 Long: -122.66405

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

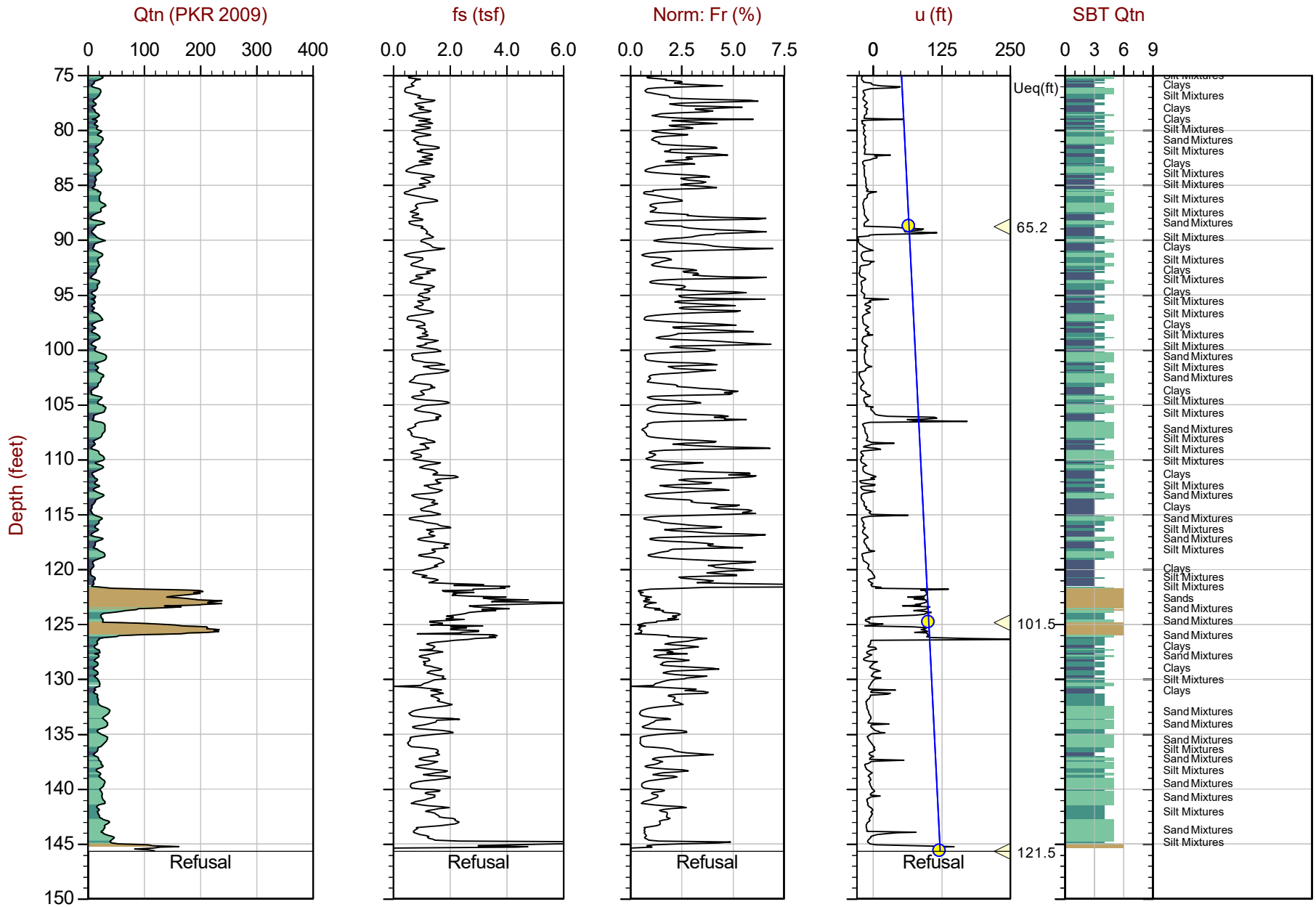
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 12:43
Site: Burnside Bridge Portland CPT

Sounding: CPT-06
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP06.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52277 Long: -122.66405

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

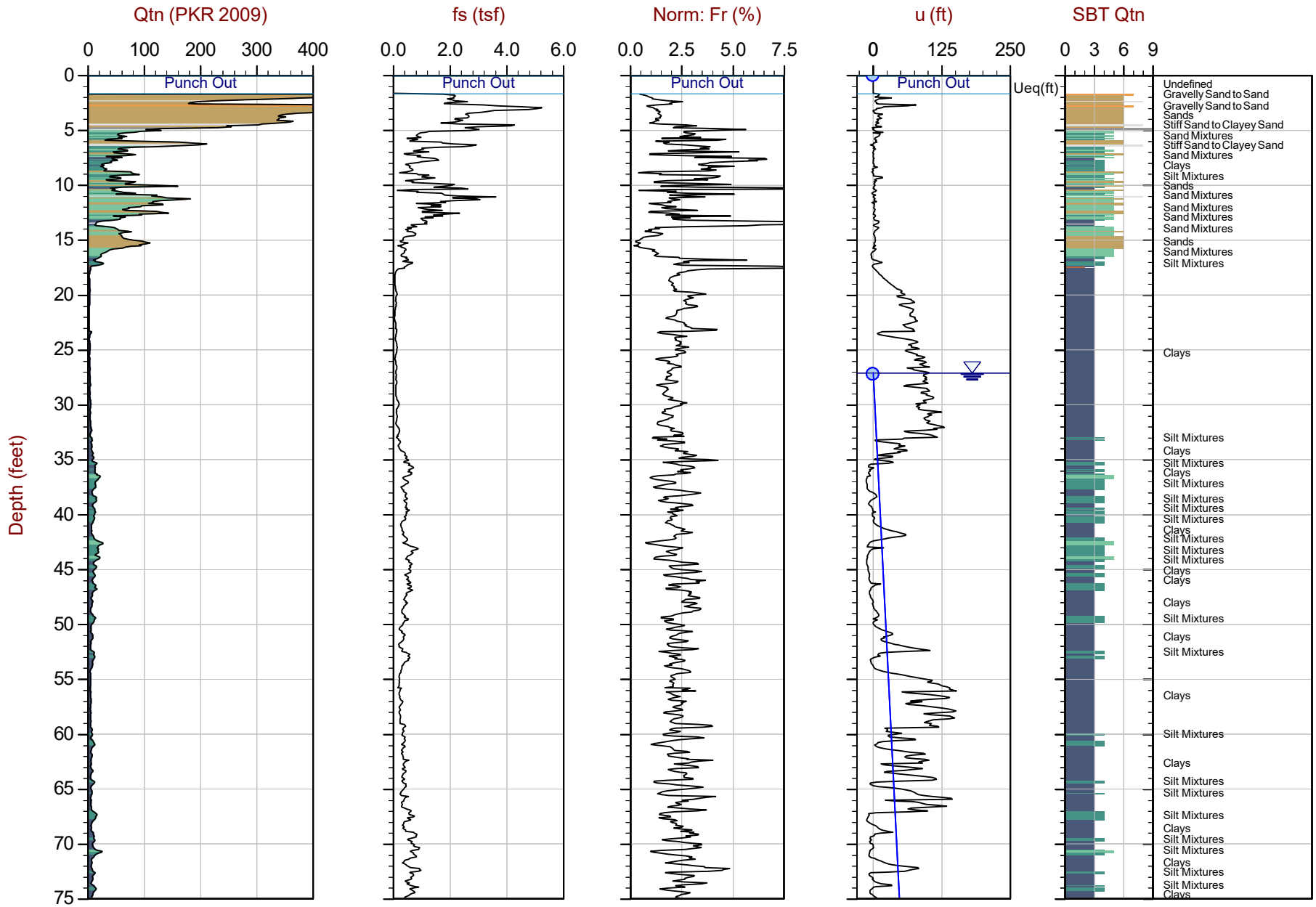
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-15 08:28
Site: Burnside Bridge Portland CPT

Sounding: CPT-07
Cone: 780:T1500F15U35



Max Depth: 42.750 m / 140.25 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP07.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52285 Long: -122.66459

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

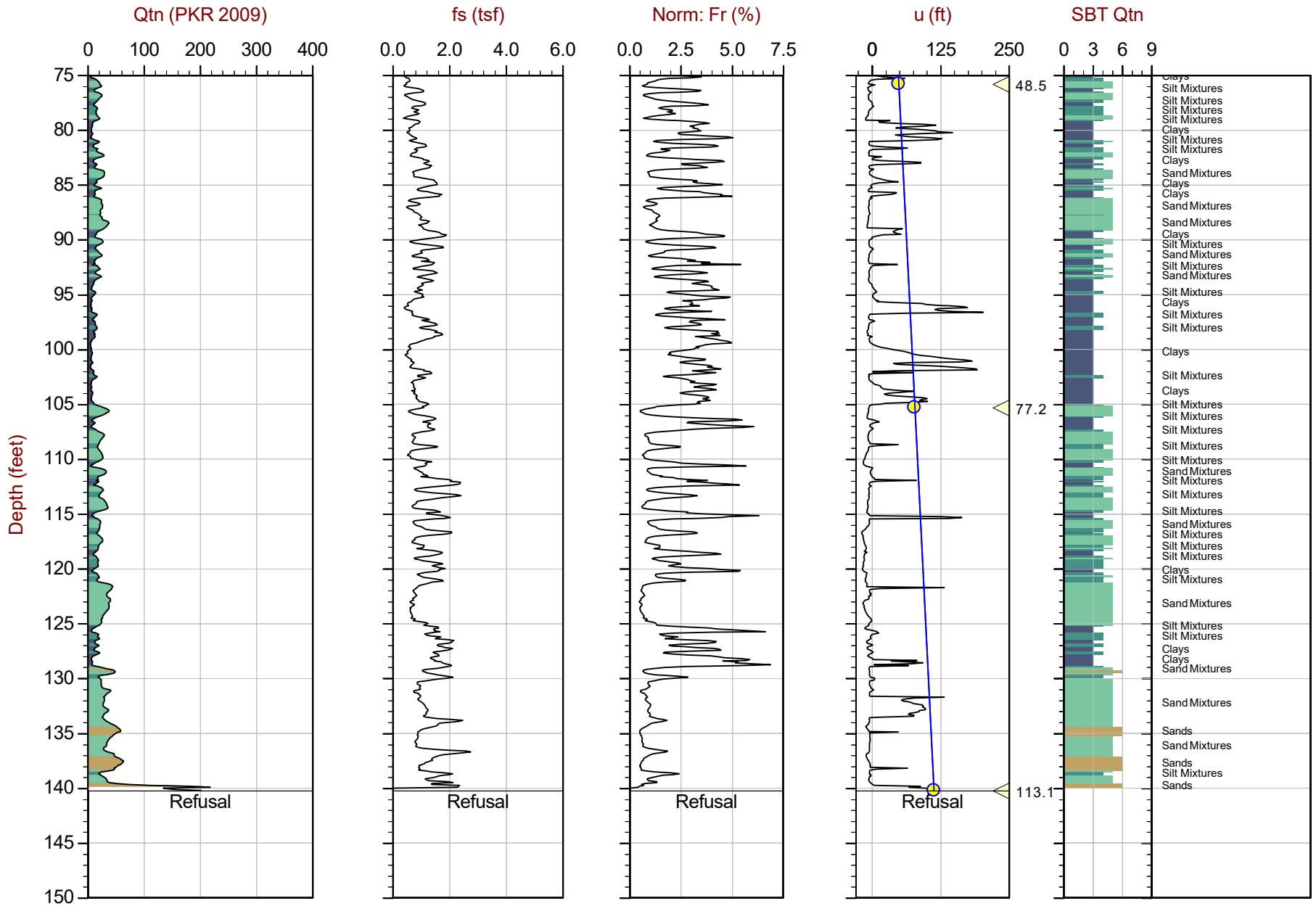
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-15 08:28
Site: Burnside Bridge Portland CPT

Sounding: CPT-07
Cone: 780:T1500F15U35



Max Depth: 42.750 m / 140.25 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP07.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52285 Long: -122.66459

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

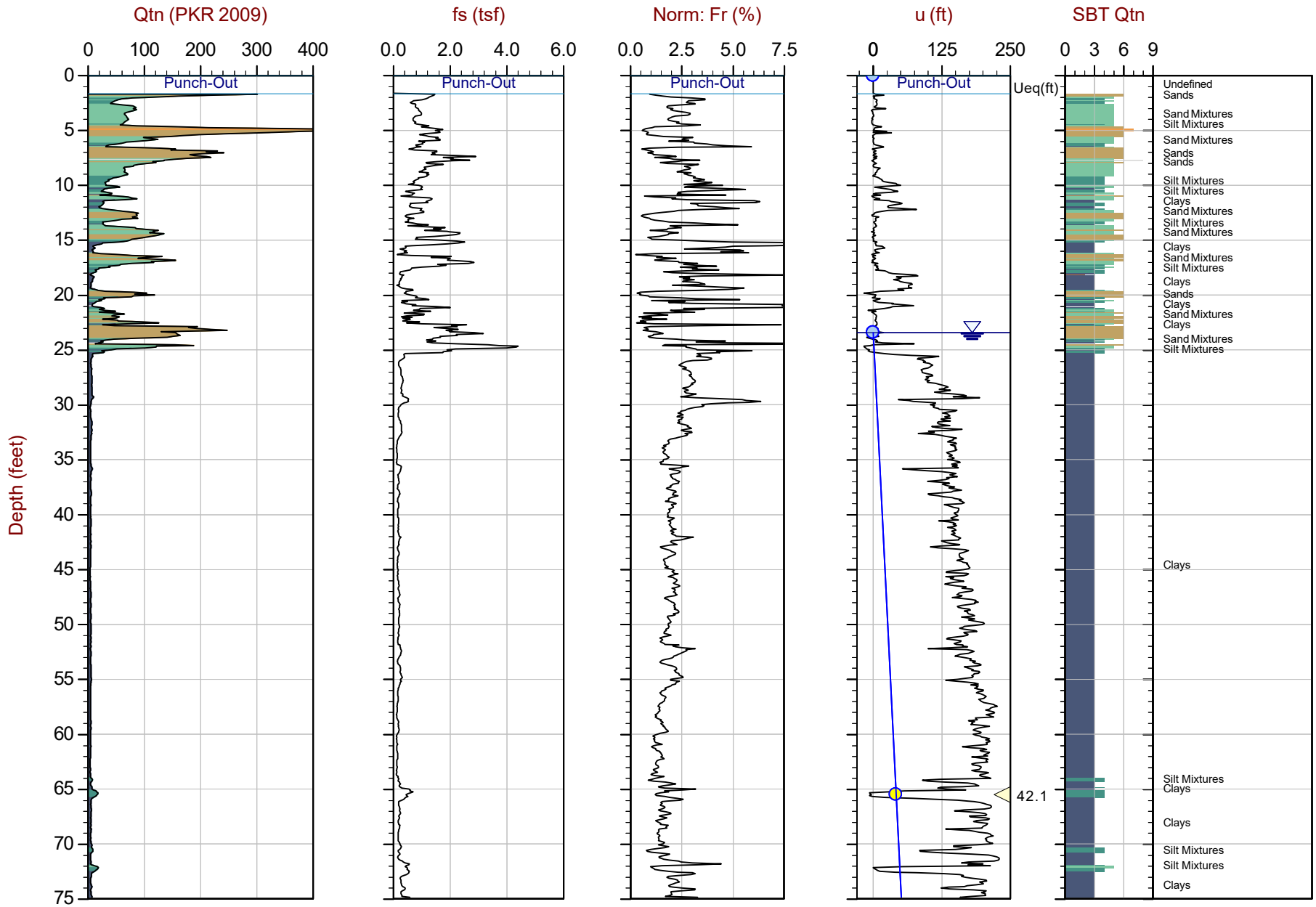
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 07:19
Site: Burnside Bridge Portland CPT

Sounding: CPT-08
Cone: 780:T1500F15U35



Max Depth: 39.075 m / 128.20 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP08.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52307 Long: -122.66370

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

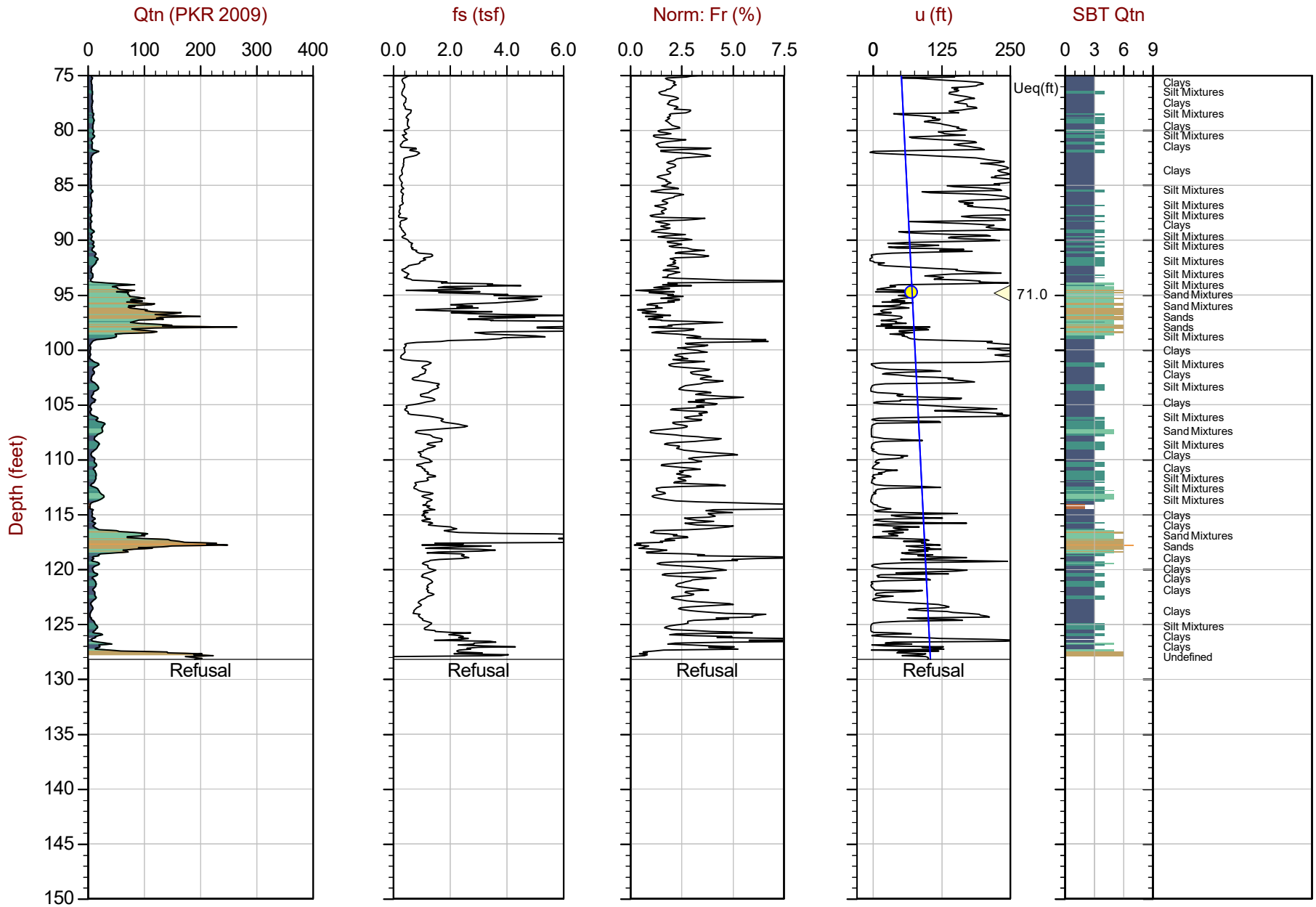
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 07:19
Site: Burnside Bridge Portland CPT

Sounding: CPT-08
Cone: 780:T1500F15U35



Max Depth: 39.075 m / 128.20 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP08.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52307 Long: -122.66370

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Advanced Cone Penetration Test Plots with Ic, Su, Phi and N(60)/N1(60)

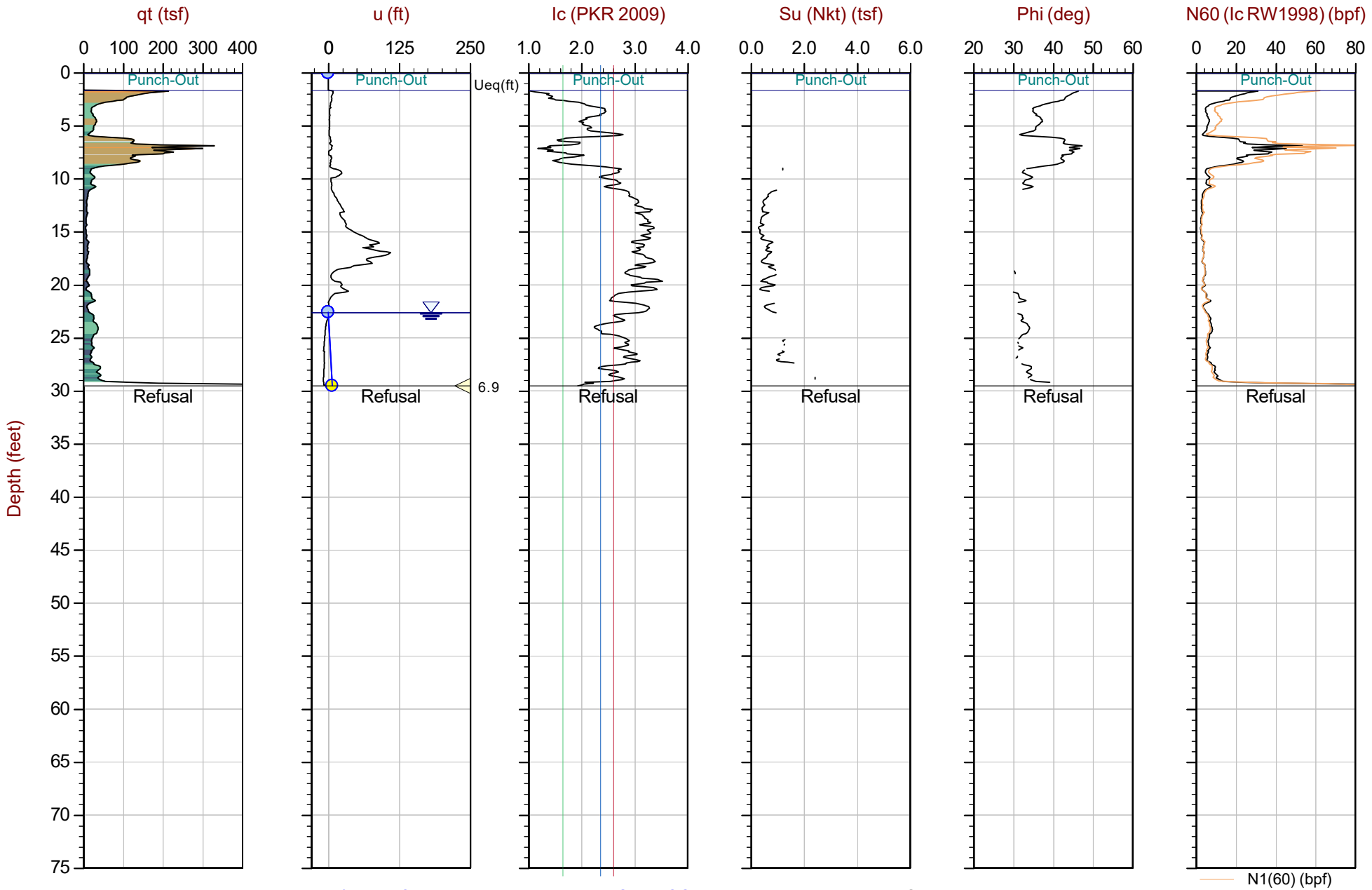
CONETEC

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 11:01
Site: Burnside Bridge Portland CPT

Sounding: CPT-01
Cone: 781:T1500F15U35



Max Depth: 9.000 m / 29.53 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP01.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52292 Long: -122.67103

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

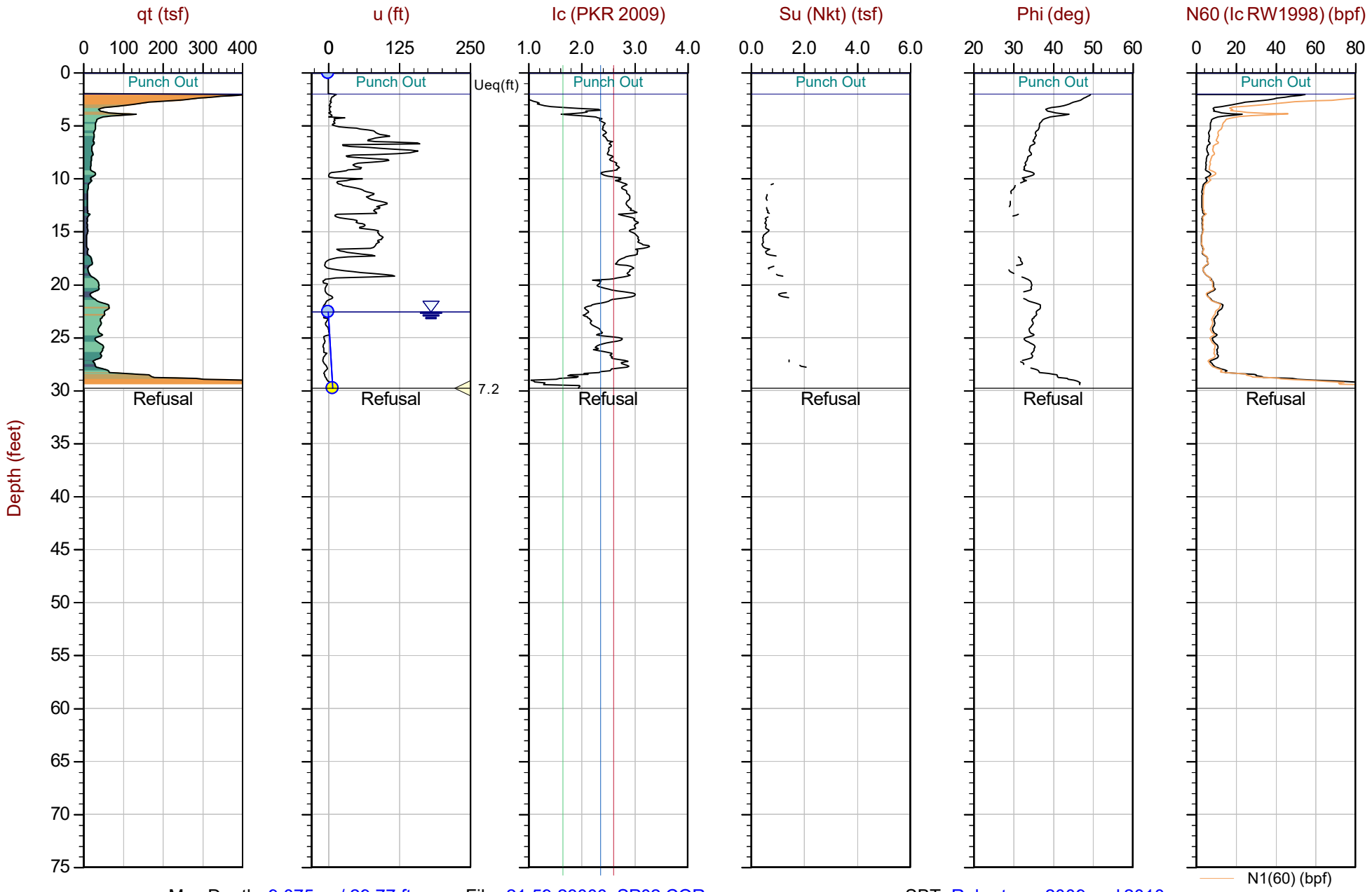
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 12:17
Site: Burnside Bridge Portland CPT

Sounding: CPT-02
Cone: 781:T1500F15U35



Max Depth: 9.075 m / 29.77 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP02.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52293 Long: -122.67062

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

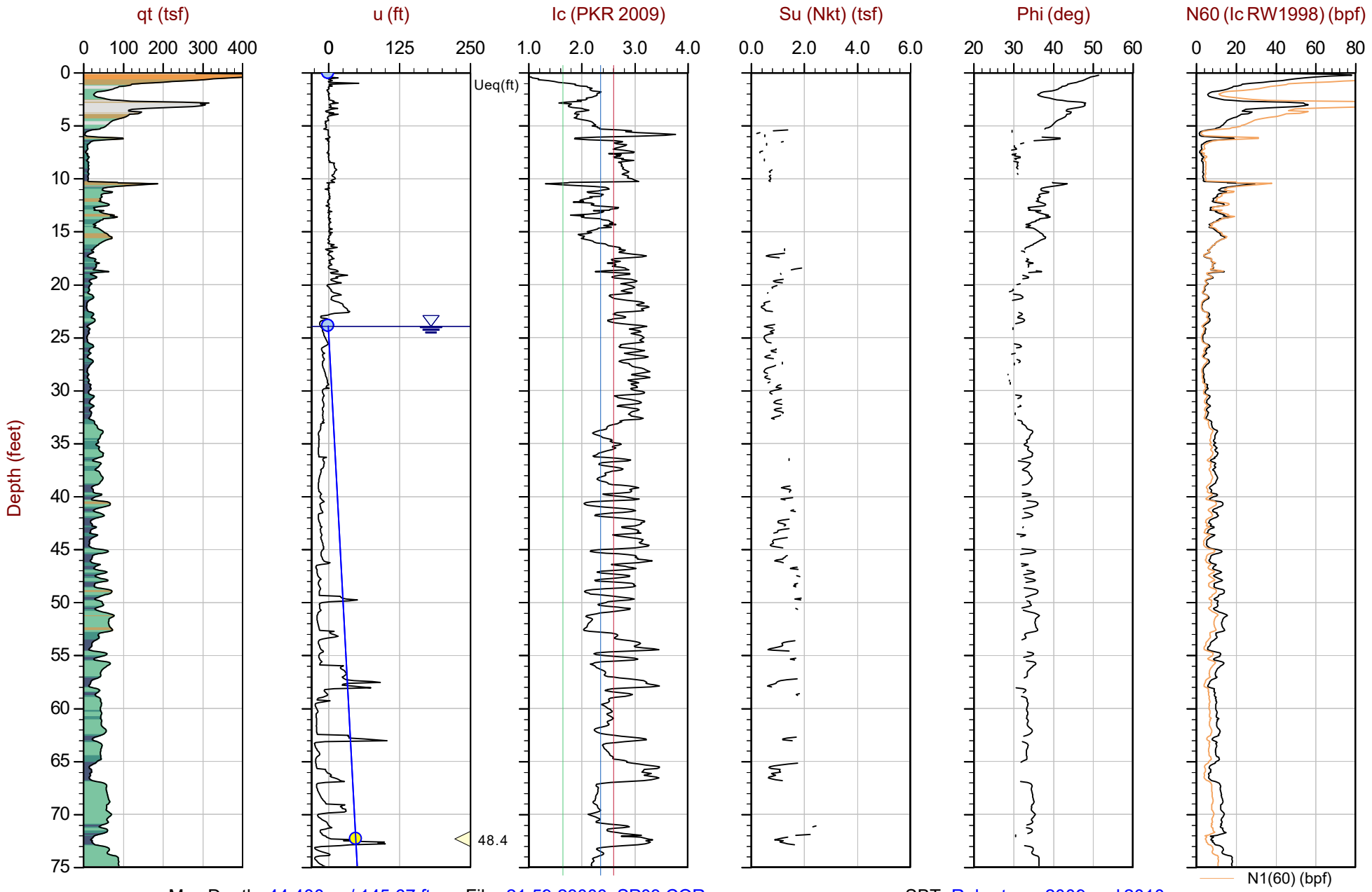
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 11:00
Site: Burnside Bridge Portland CPT

Sounding: CPT-03
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP03.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52314 Long: -122.66522

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

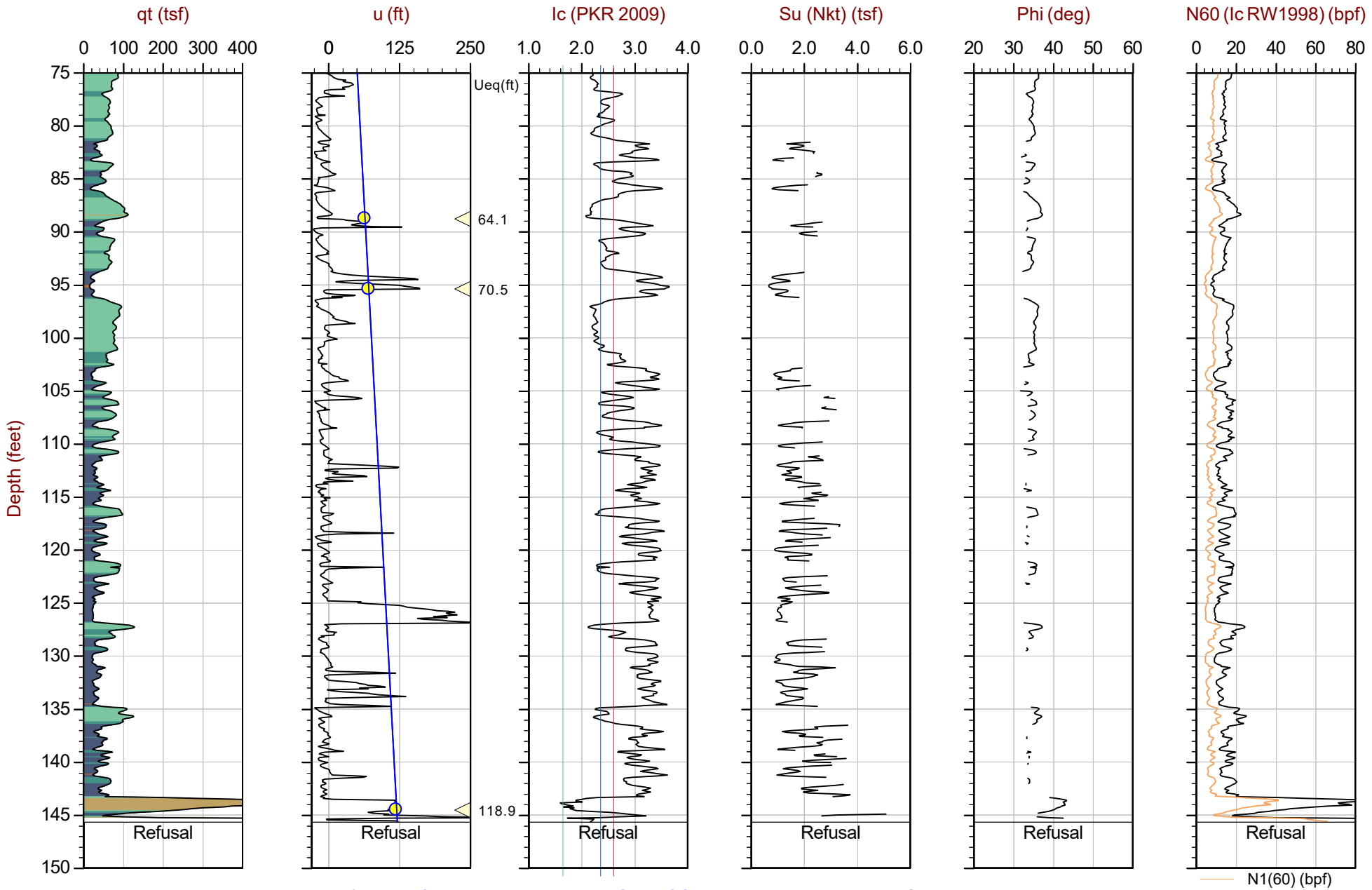
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 11:00
Site: Burnside Bridge Portland CPT

Sounding: CPT-03
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP03.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52314 Long: -122.66522

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

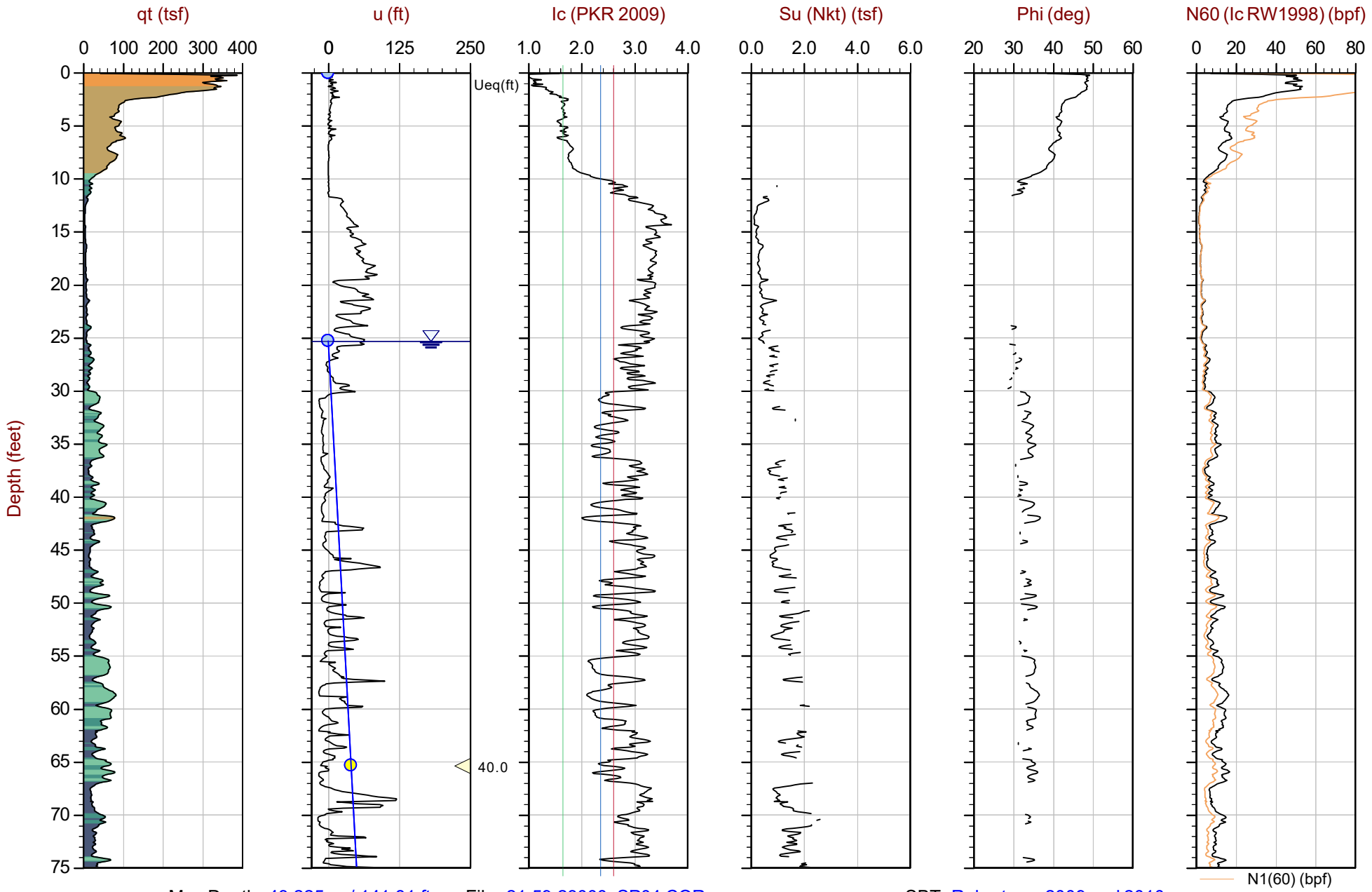
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 14:50
Site: Burnside Bridge Portland CPT

Sounding: CPT-04
Cone: 780:T1500F15U35



Max Depth: 43.225 m / 141.81 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP04.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52286 Long: -122.66496

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

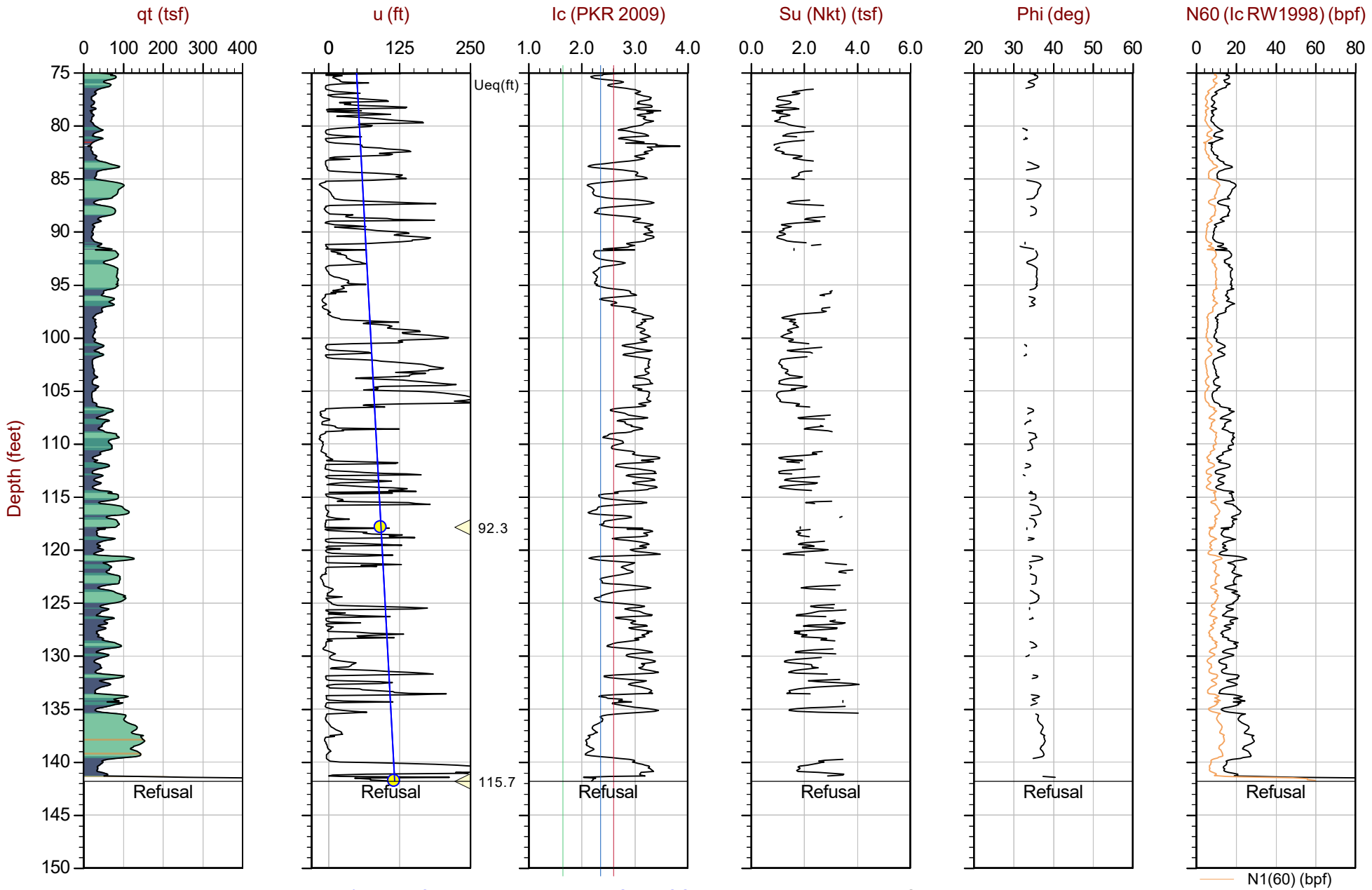
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 14:50
Site: Burnside Bridge Portland CPT

Sounding: CPT-04
Cone: 780:T1500F15U35



Max Depth: 43.225 m / 141.81 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP04.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52286 Long: -122.66496

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

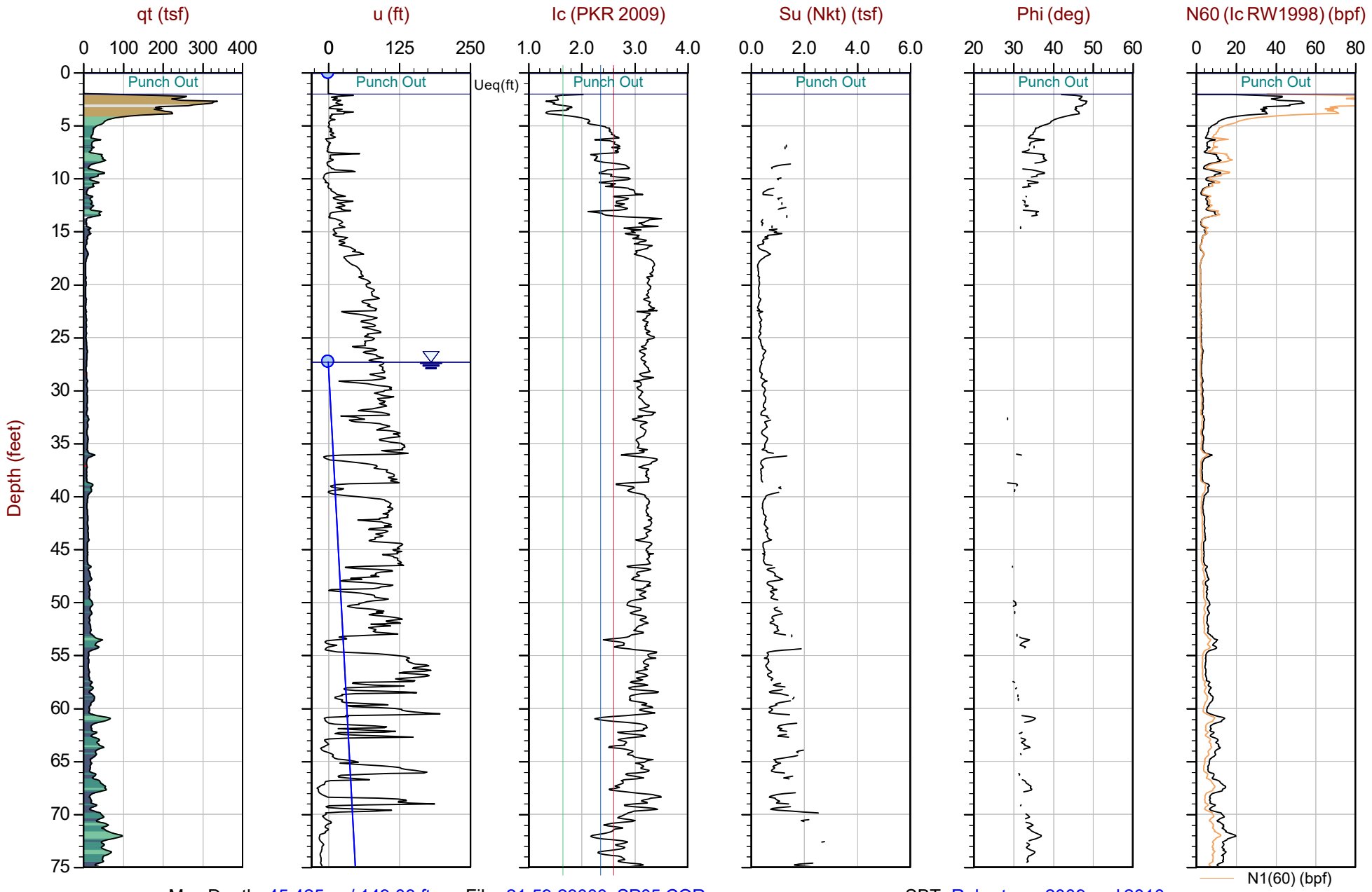
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 08:06
Site: Burnside Bridge Portland CPT

Sounding: CPT-05
Cone: 780:T1500F15U35



Max Depth: 45.425 m / 149.03 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP05.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52308 Long: -122.66425

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

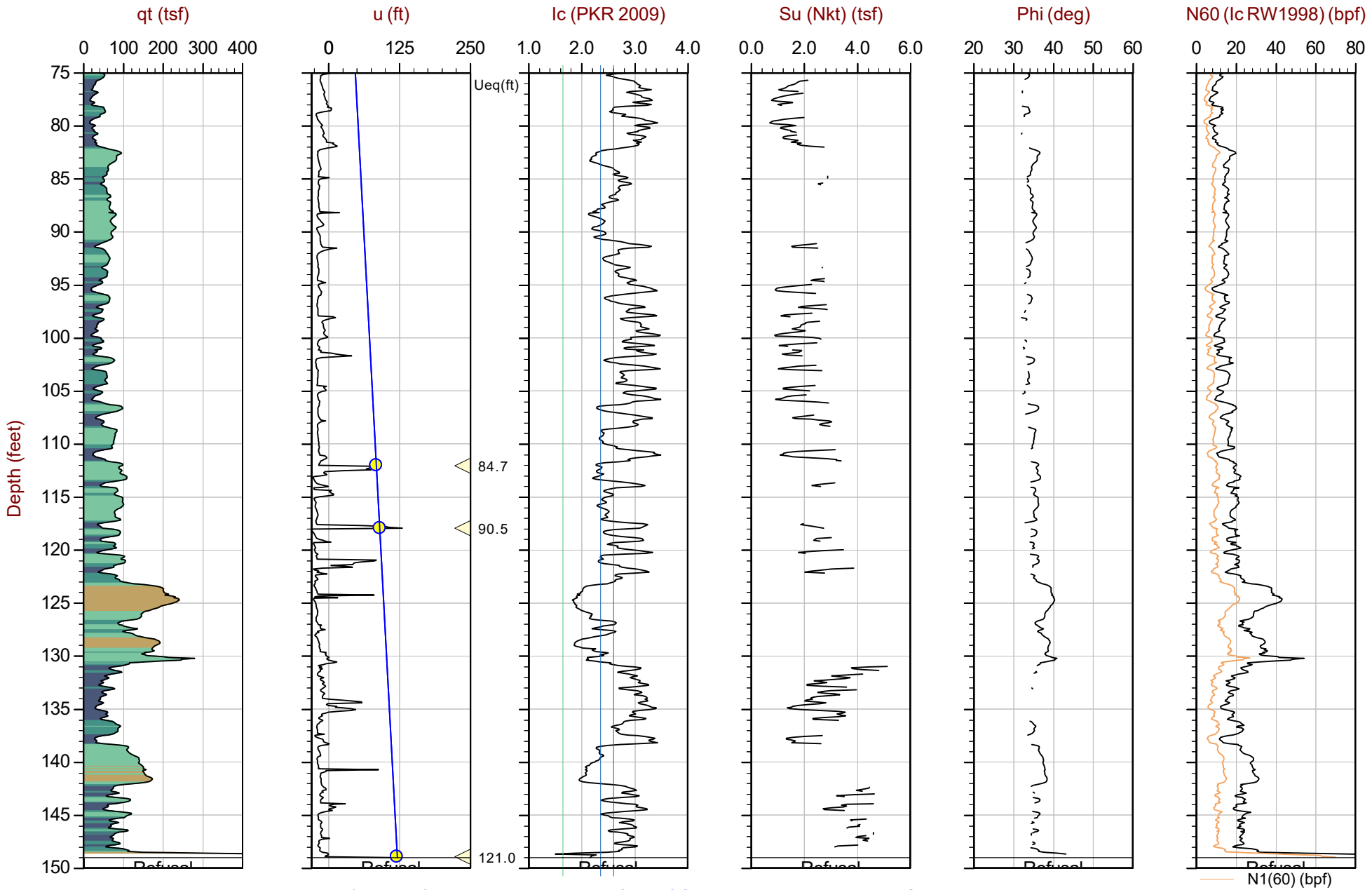
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 08:06
Site: Burnside Bridge Portland CPT

Sounding: CPT-05
Cone: 780:T1500F15U35



Max Depth: 45.425 m / 149.03 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP05.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52308 Long: -122.66425

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

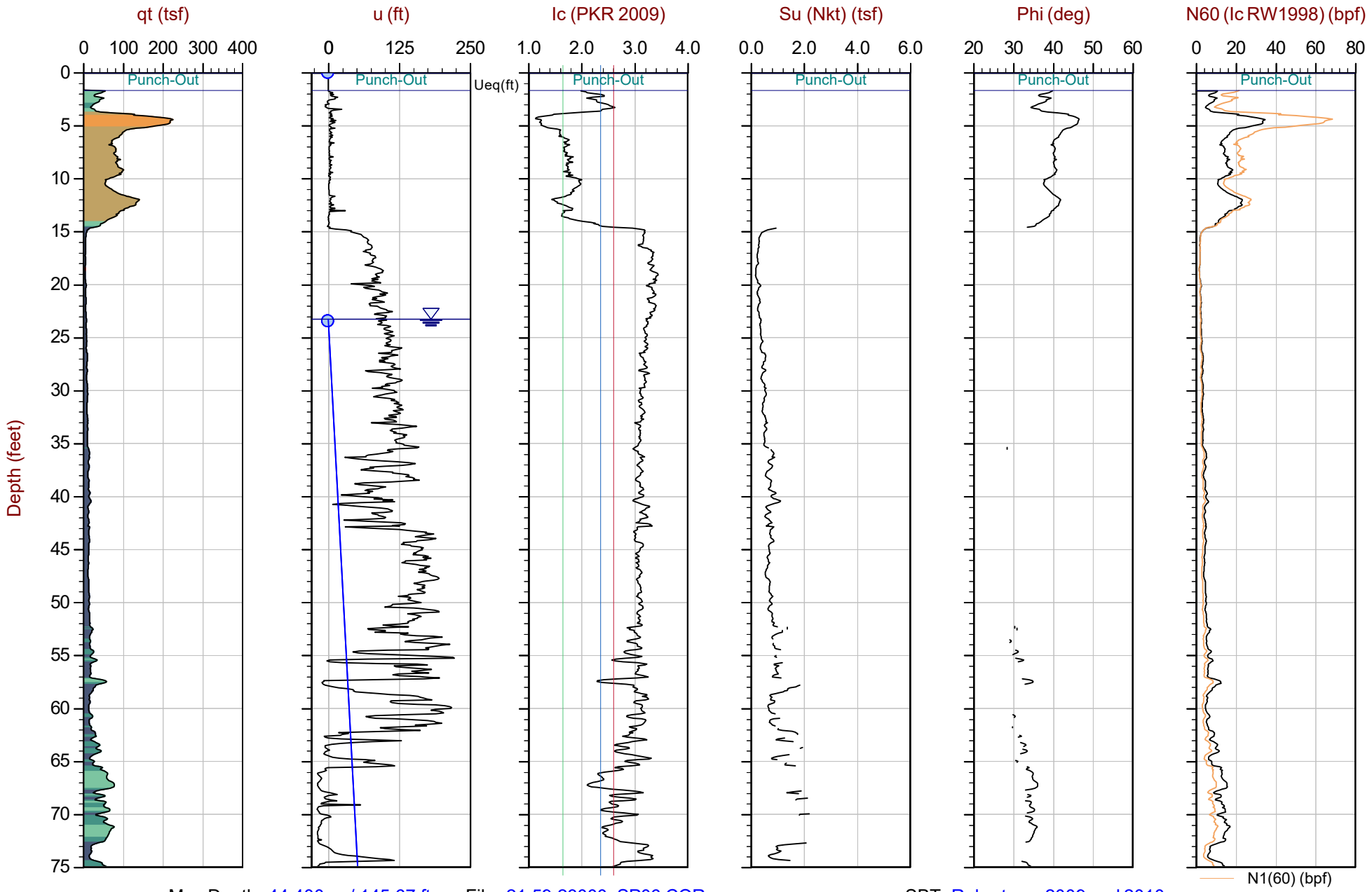
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 12:43
Site: Burnside Bridge Portland CPT

Sounding: CPT-06
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP06.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52277 Long: -122.66405

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

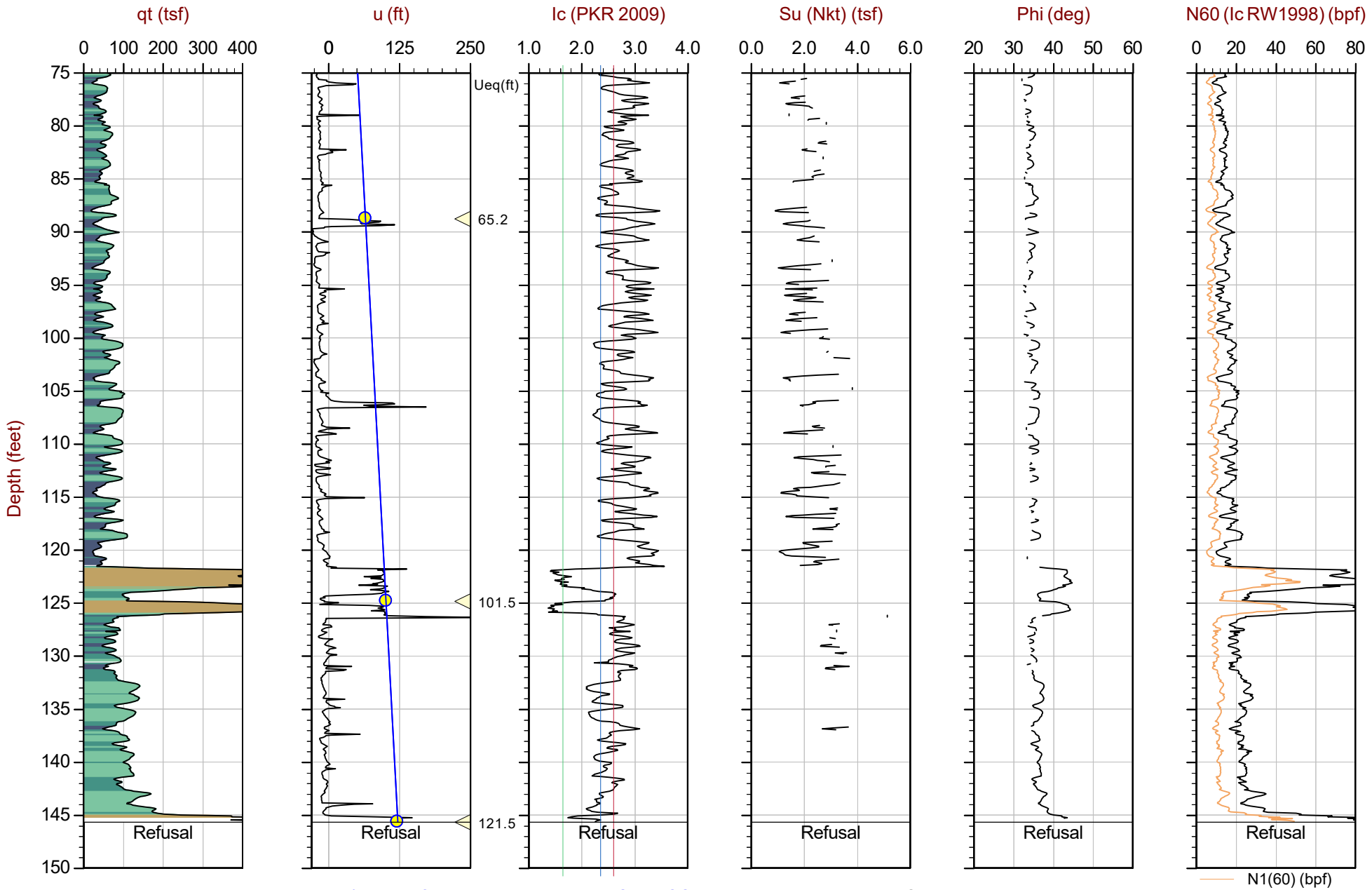
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 12:43
Site: Burnside Bridge Portland CPT

Sounding: CPT-06
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP06.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52277 Long: -122.66405

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

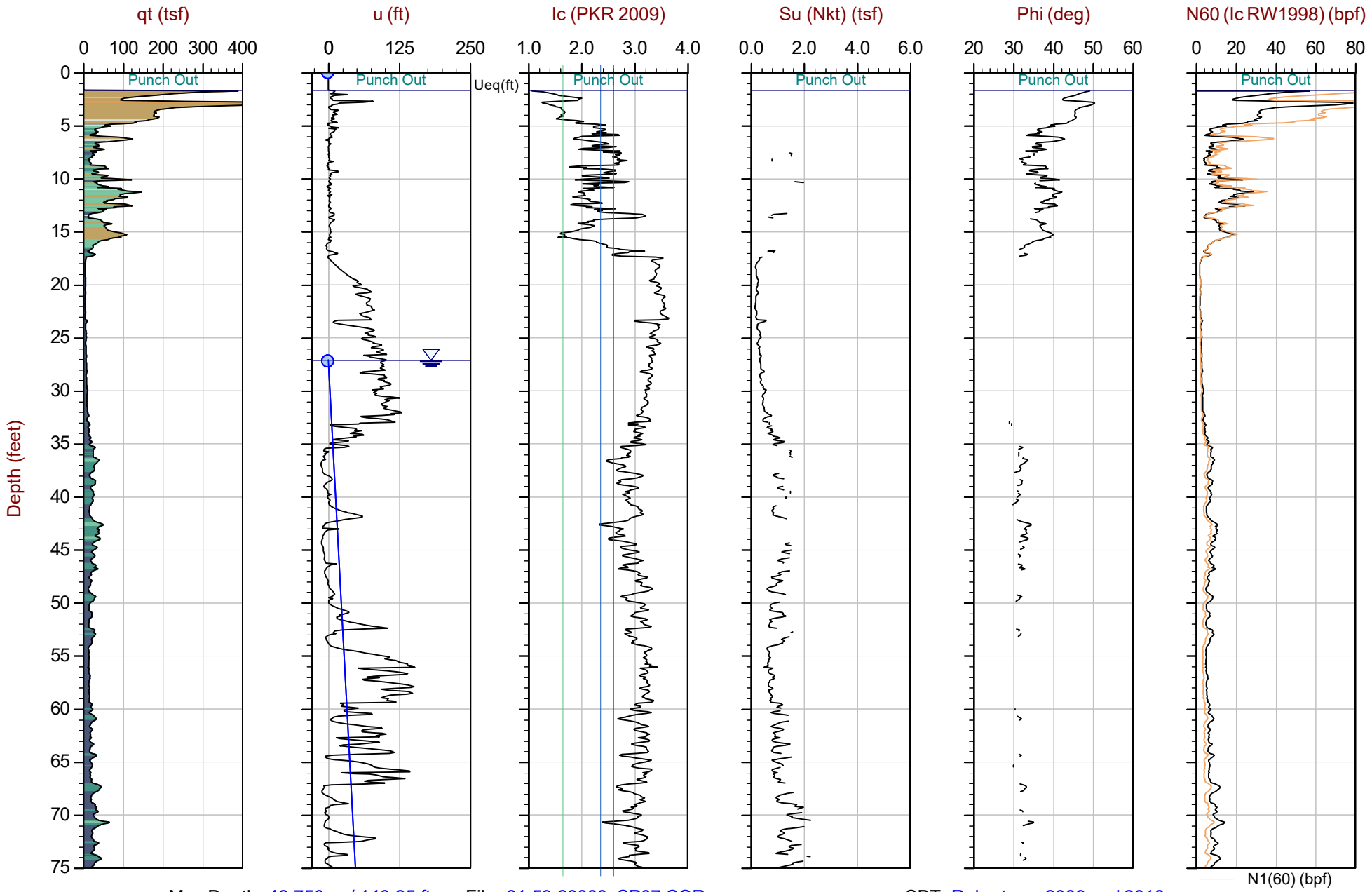
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-15 08:28
Site: Burnside Bridge Portland CPT

Sounding: CPT-07
Cone: 780:T1500F15U35



Max Depth: 42.750 m / 140.25 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP07.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52285 Long: -122.66459

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

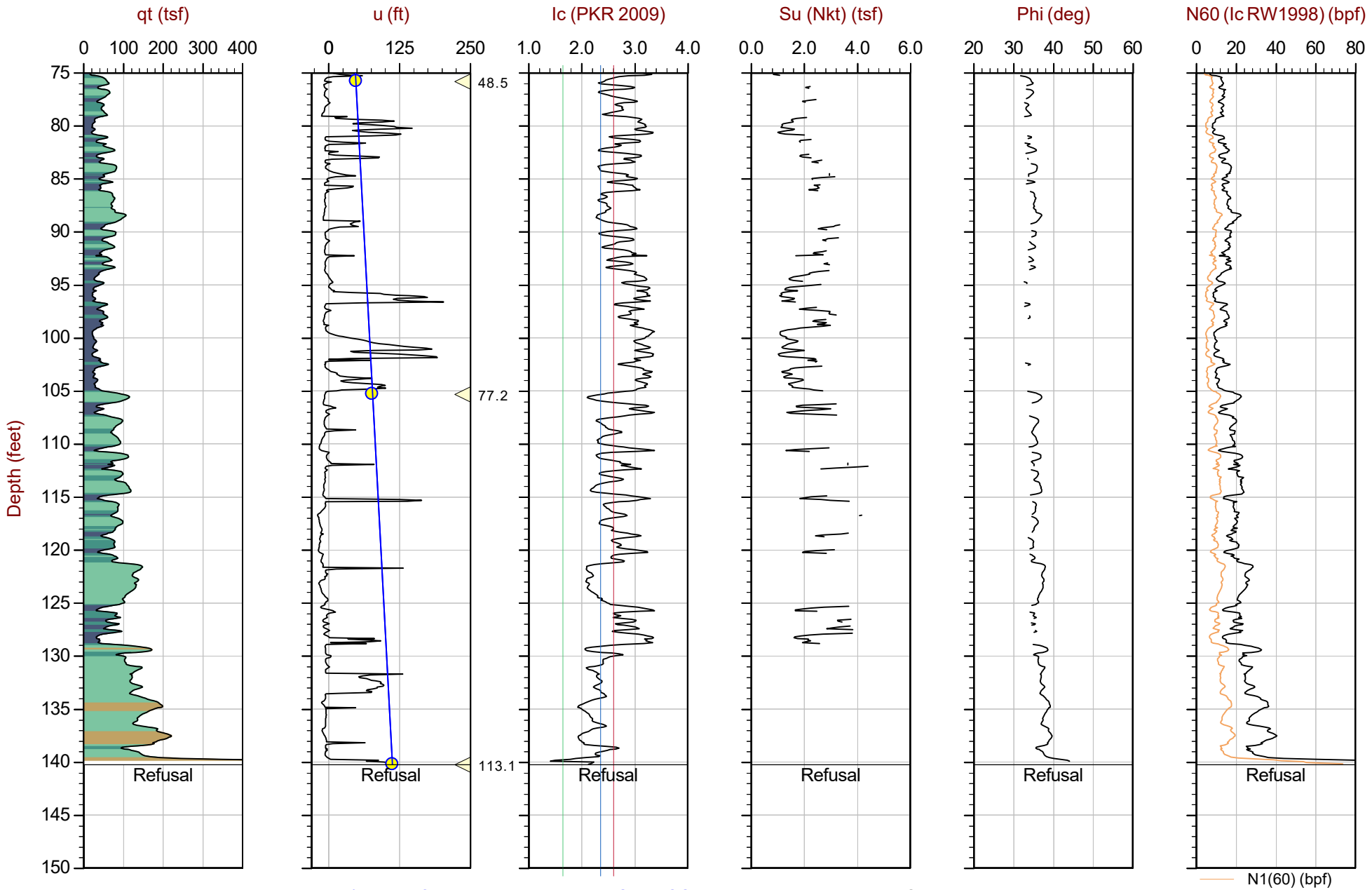
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-15 08:28
Site: Burnside Bridge Portland CPT

Sounding: CPT-07
Cone: 780:T1500F15U35



Max Depth: 42.750 m / 140.25 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP07.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52285 Long: -122.66459

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

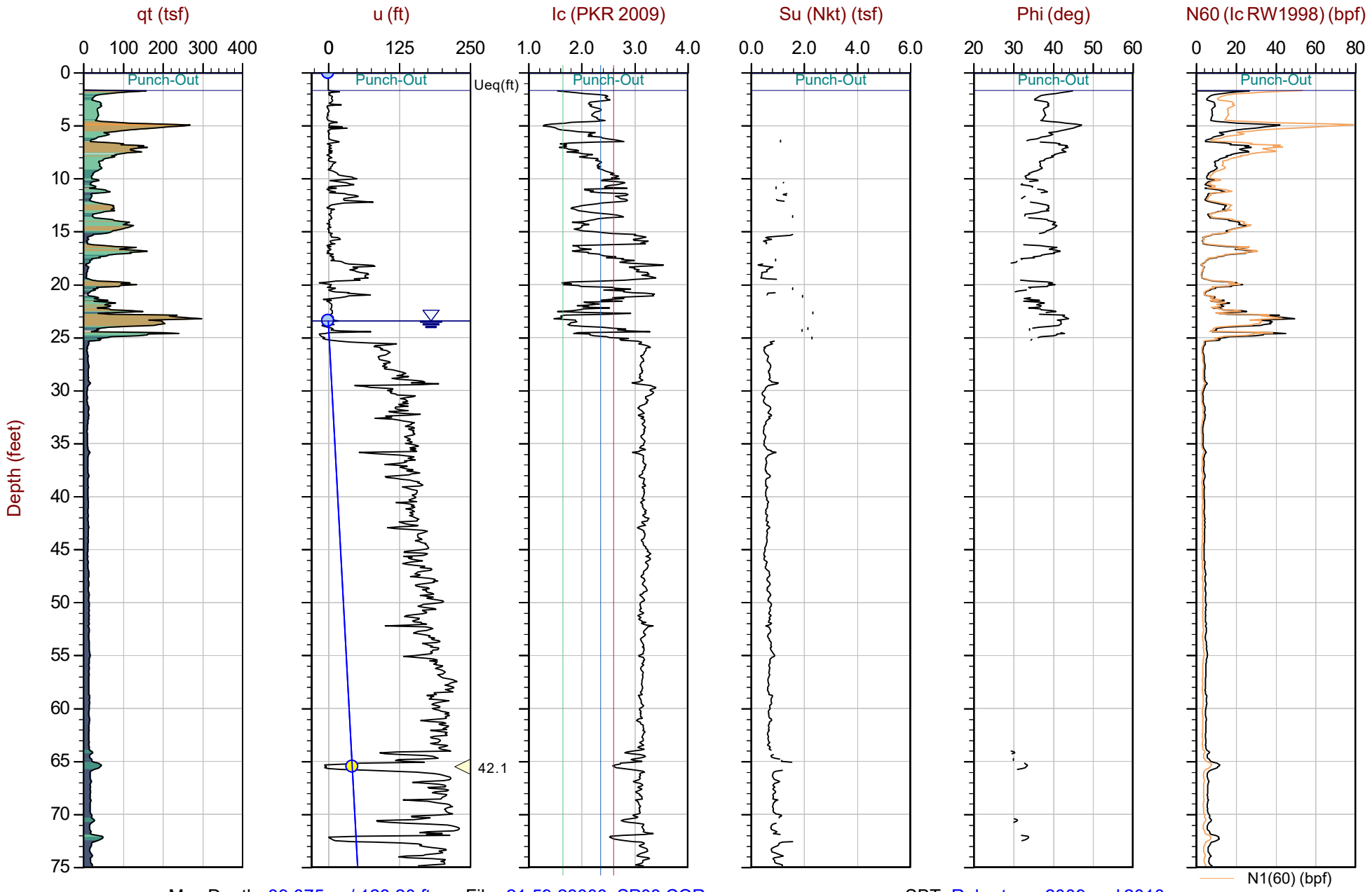
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 07:19
Site: Burnside Bridge Portland CPT

Sounding: CPT-08
Cone: 780:T1500F15U35



Max Depth: 39.075 m / 128.20 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP08.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52307 Long: -122.66370

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

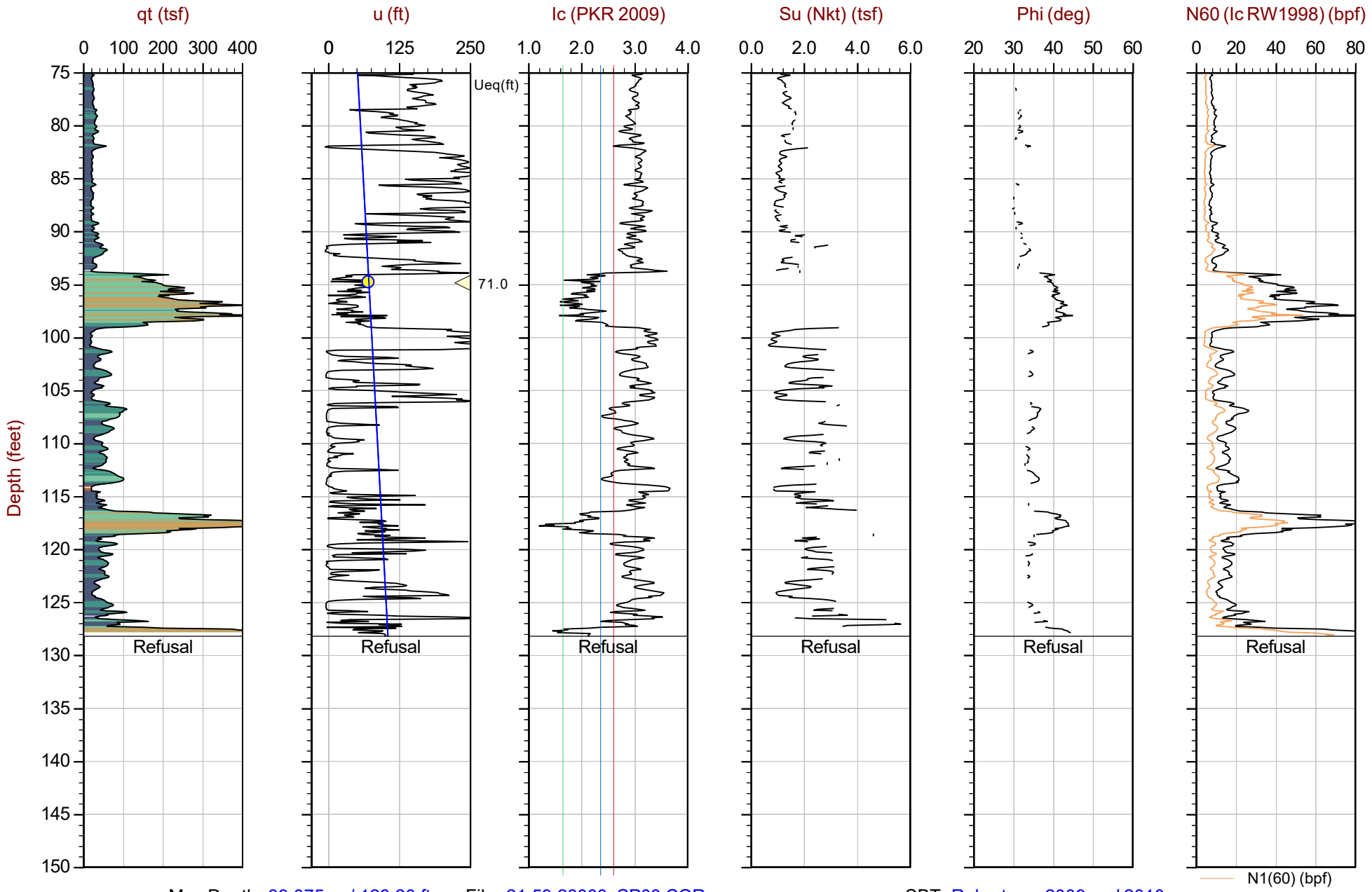
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 07:19
Site: Burnside Bridge Portland CPT

Sounding: CPT-08
Cone: 780:T1500F15U35



Max Depth: 39.075 m / 128.20 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP08.COR
Unit Wt: SBTQtn (PKR2009)
Su Nkt: 15.0

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52307 Long: -122.66370

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Seismic Cone Penetration Test Plots

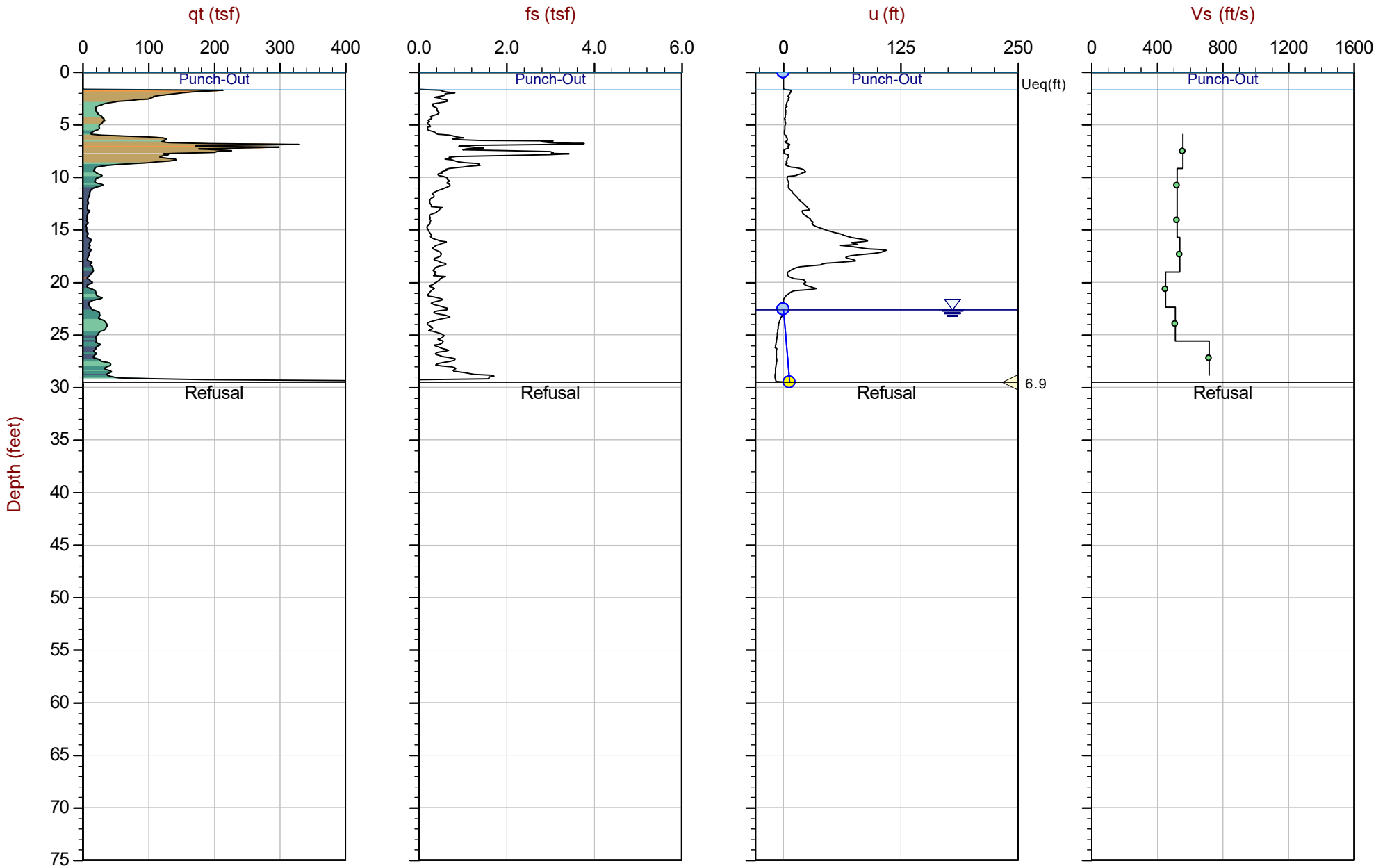
CONETEC

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 11:01
Site: Burnside Bridge Portland CPT

Sounding: CPT-01
Cone: 781:T1500F15U35



Max Depth: 9.000 m / 29.53 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP01.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52292 Long: -122.67103

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

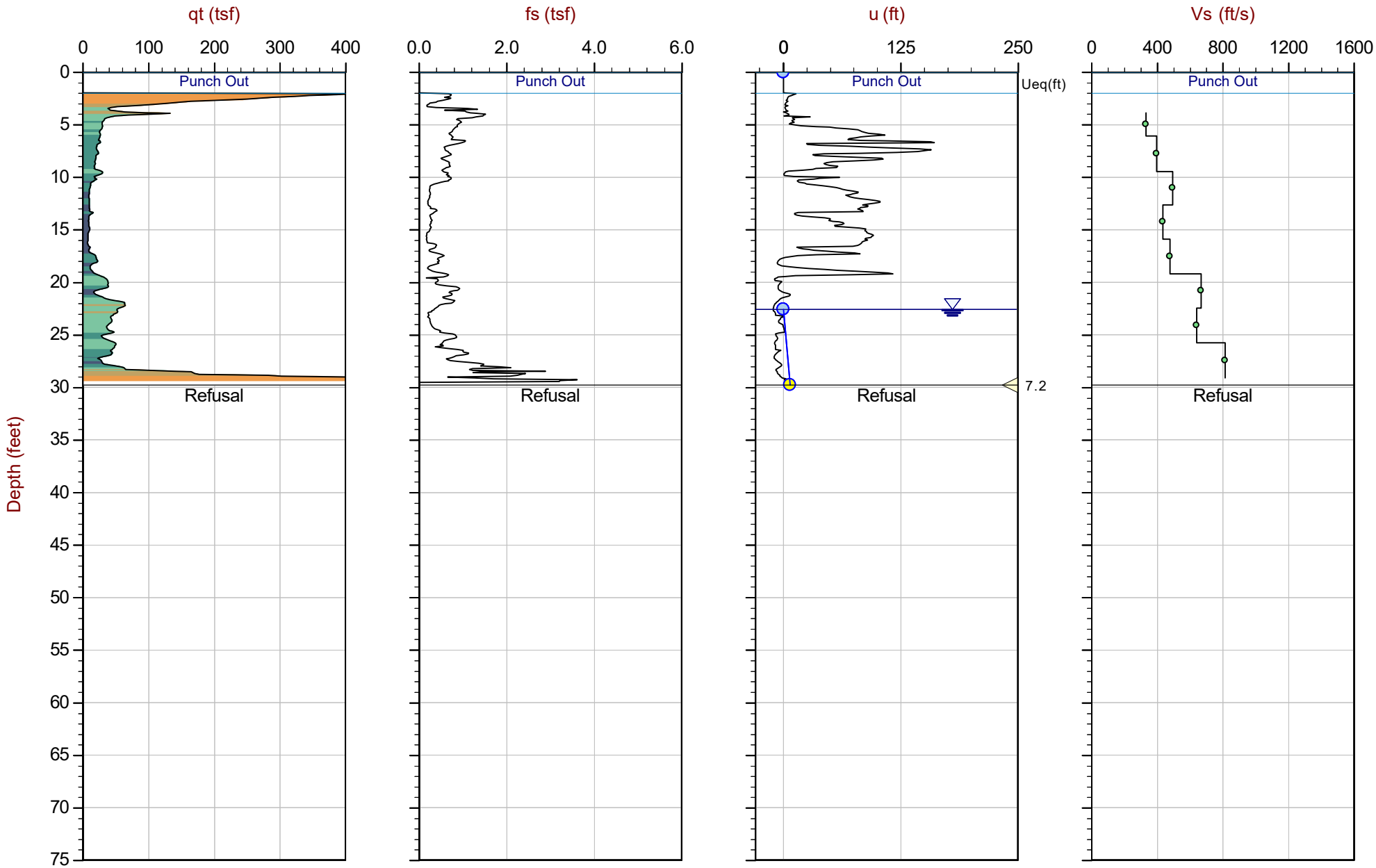
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 12:17
Site: Burnside Bridge Portland CPT

Sounding: CPT-02
Cone: 781:T1500F15U35



Max Depth: 9.075 m / 29.77 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP02.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52293 Long: -122.67062

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

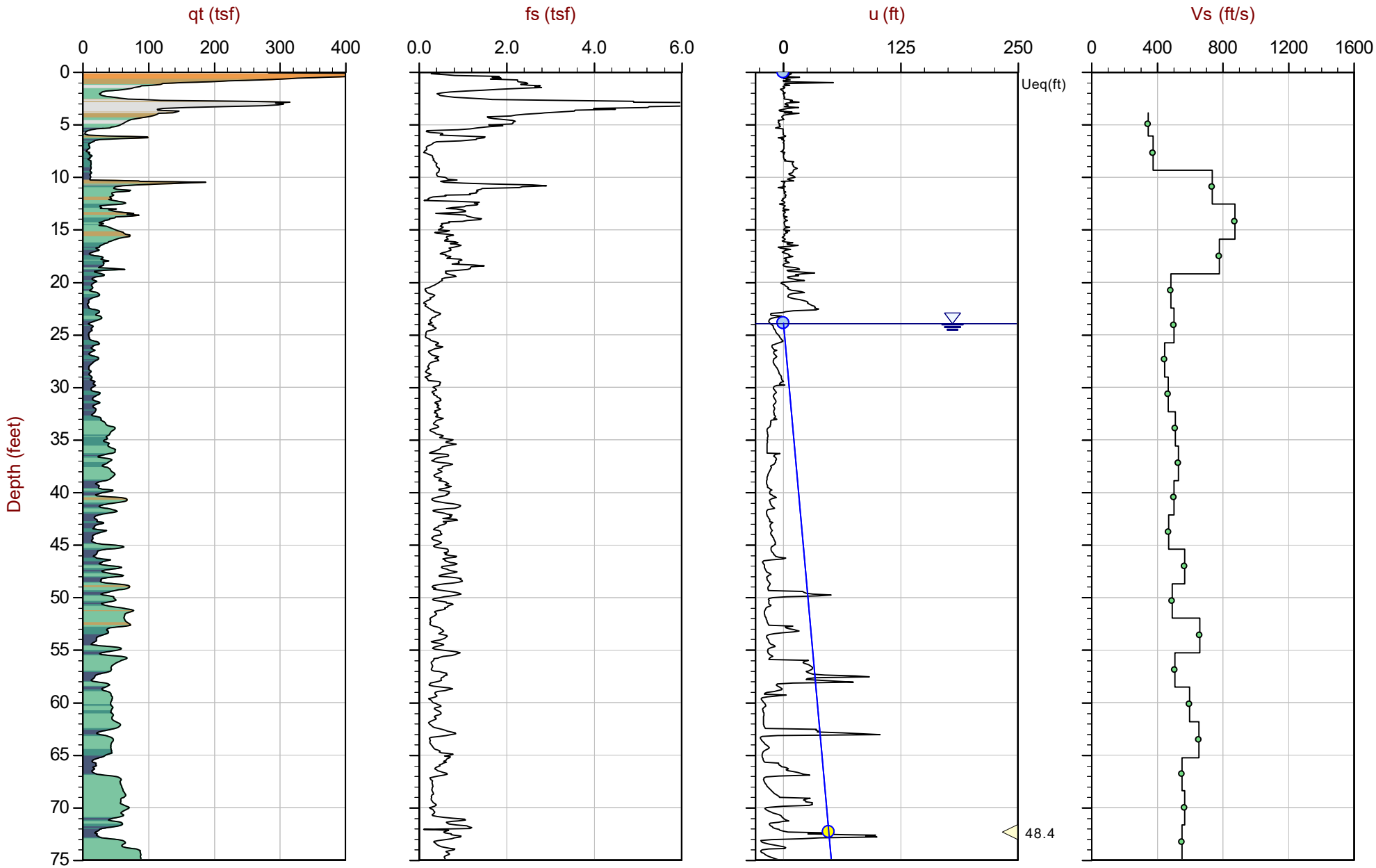
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 11:00
Site: Burnside Bridge Portland CPT

Sounding: CPT-03
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP03.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52314 Long: -122.66522

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

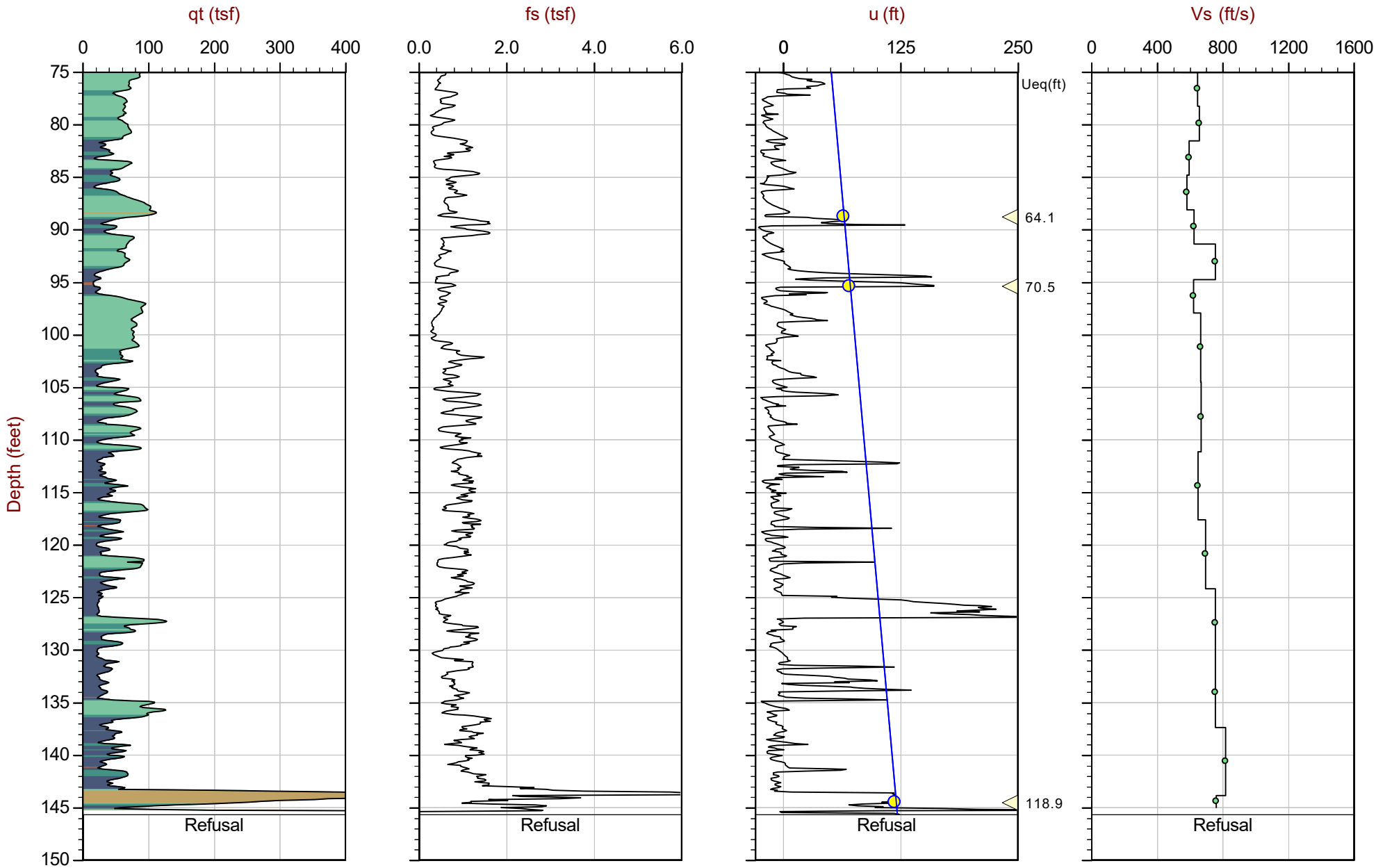
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 11:00
Site: Burnside Bridge Portland CPT

Sounding: CPT-03
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP03.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52314 Long: -122.66522

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

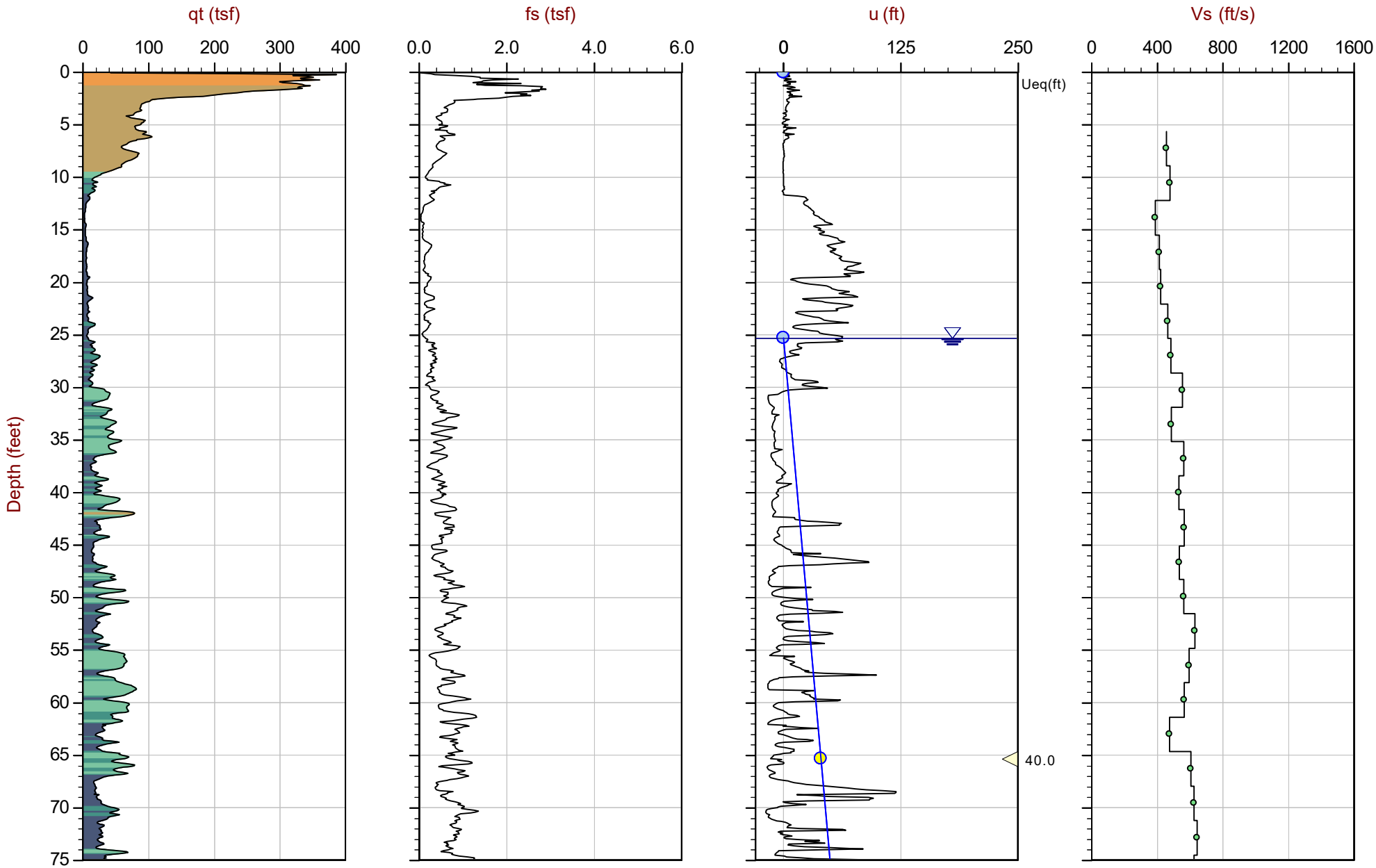
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 14:50
Site: Burnside Bridge Portland CPT

Sounding: CPT-04
Cone: 780:T1500F15U35



Max Depth: 43.225 m / 141.81 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP04.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52286 Long: -122.66496

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

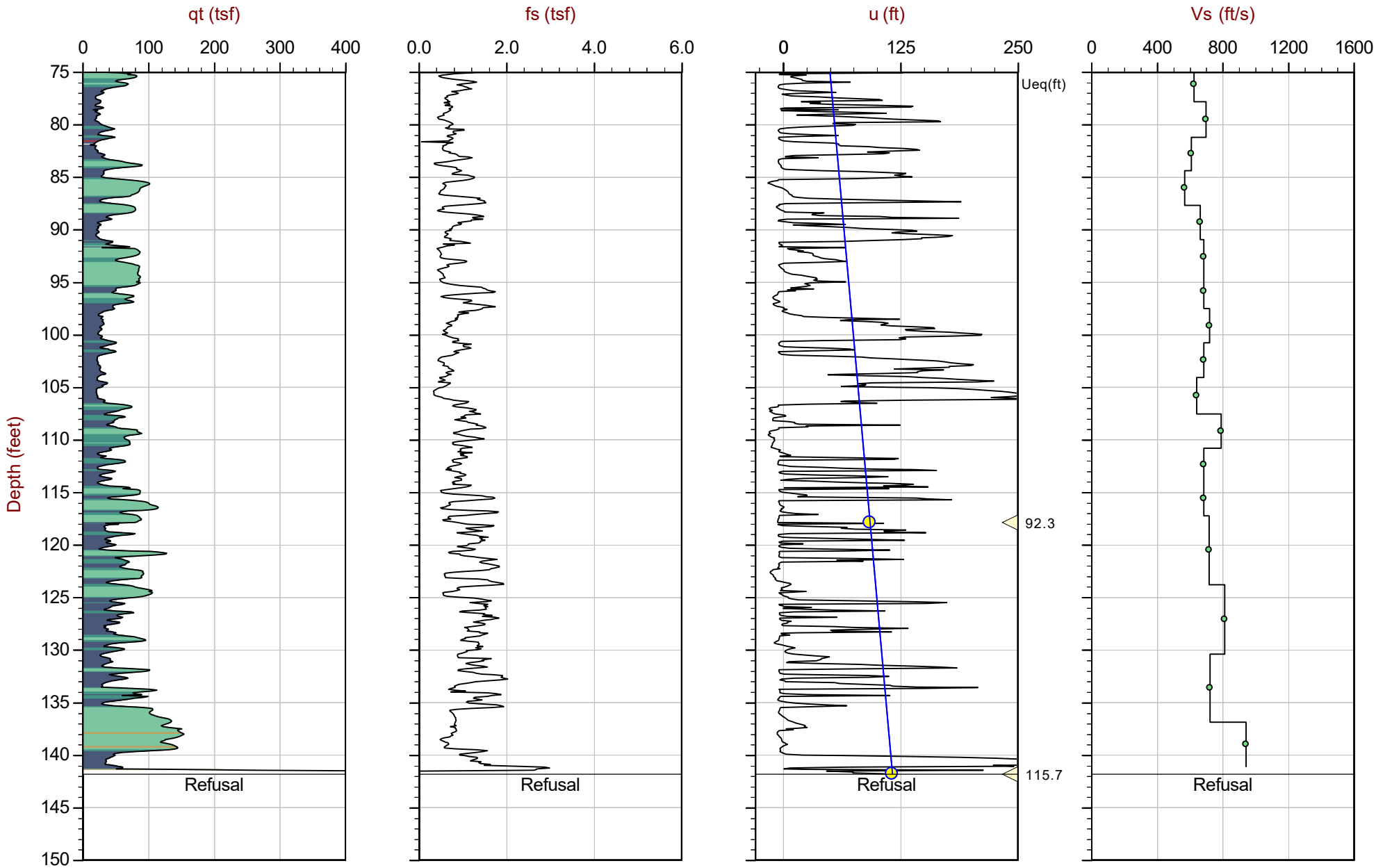
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-13 14:50
Site: Burnside Bridge Portland CPT

Sounding: CPT-04
Cone: 780:T1500F15U35



Max Depth: 43.225 m / 141.81 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP04.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52286 Long: -122.66496

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

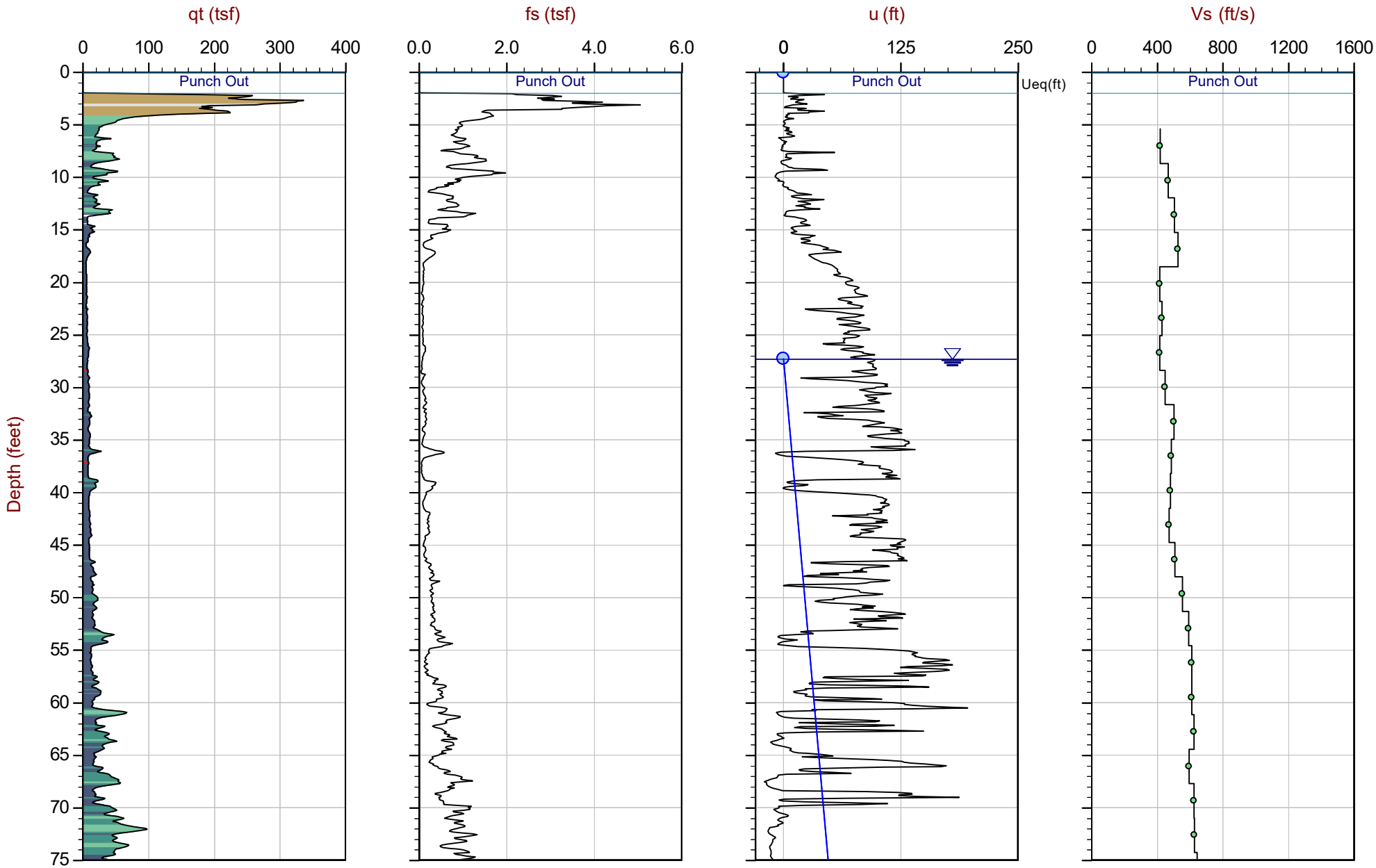
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 08:06
Site: Burnside Bridge Portland CPT

Sounding: CPT-05
Cone: 780:T1500F15U35



Max Depth: 45.425 m / 149.03 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP05.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52308 Long: -122.66425

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

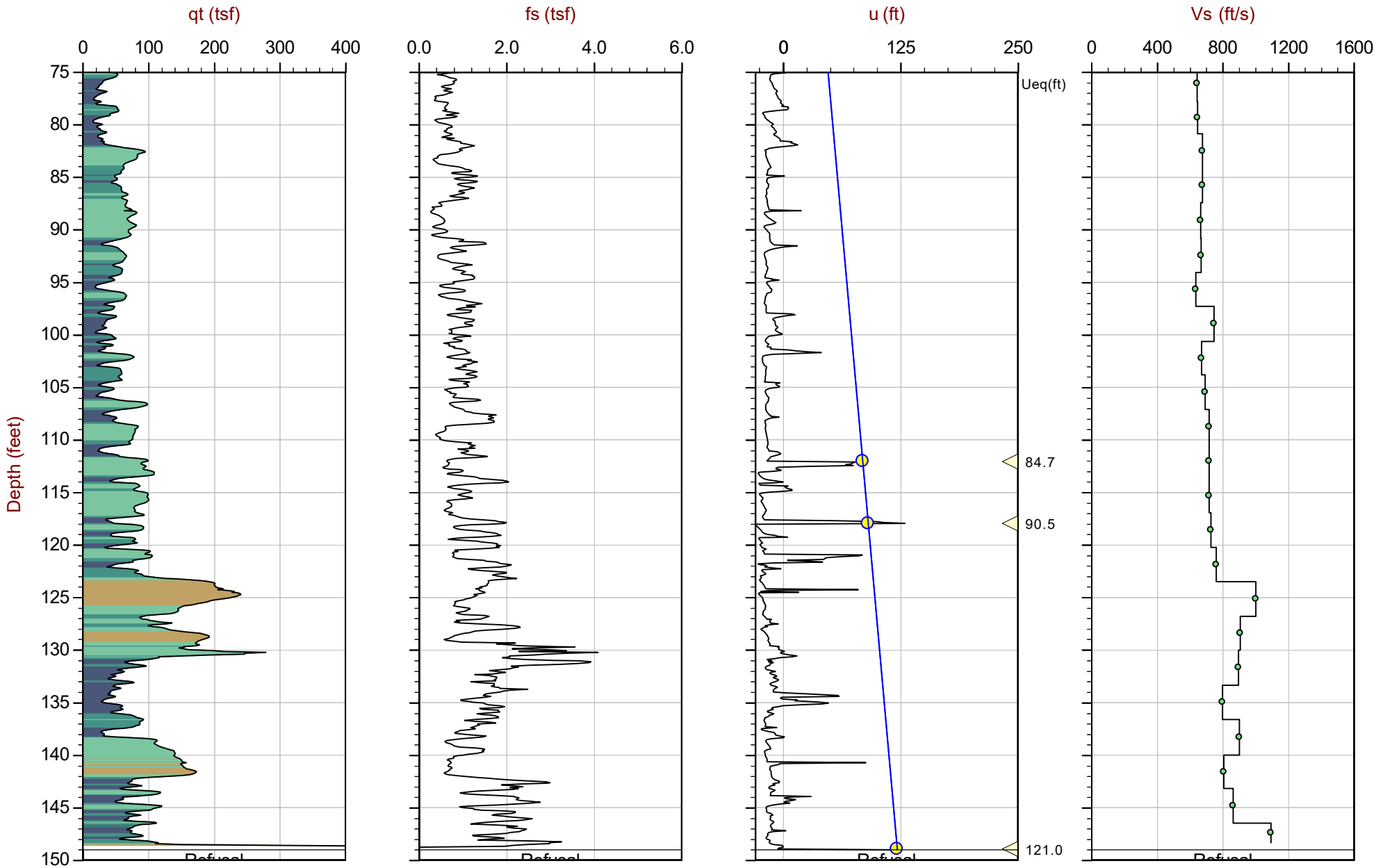
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 08:06
Site: Burnside Bridge Portland CPT

Sounding: CPT-05
Cone: 780:T1500F15U35



Max Depth: 45.425 m / 149.03 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP05.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52308 Long: -122.66425

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

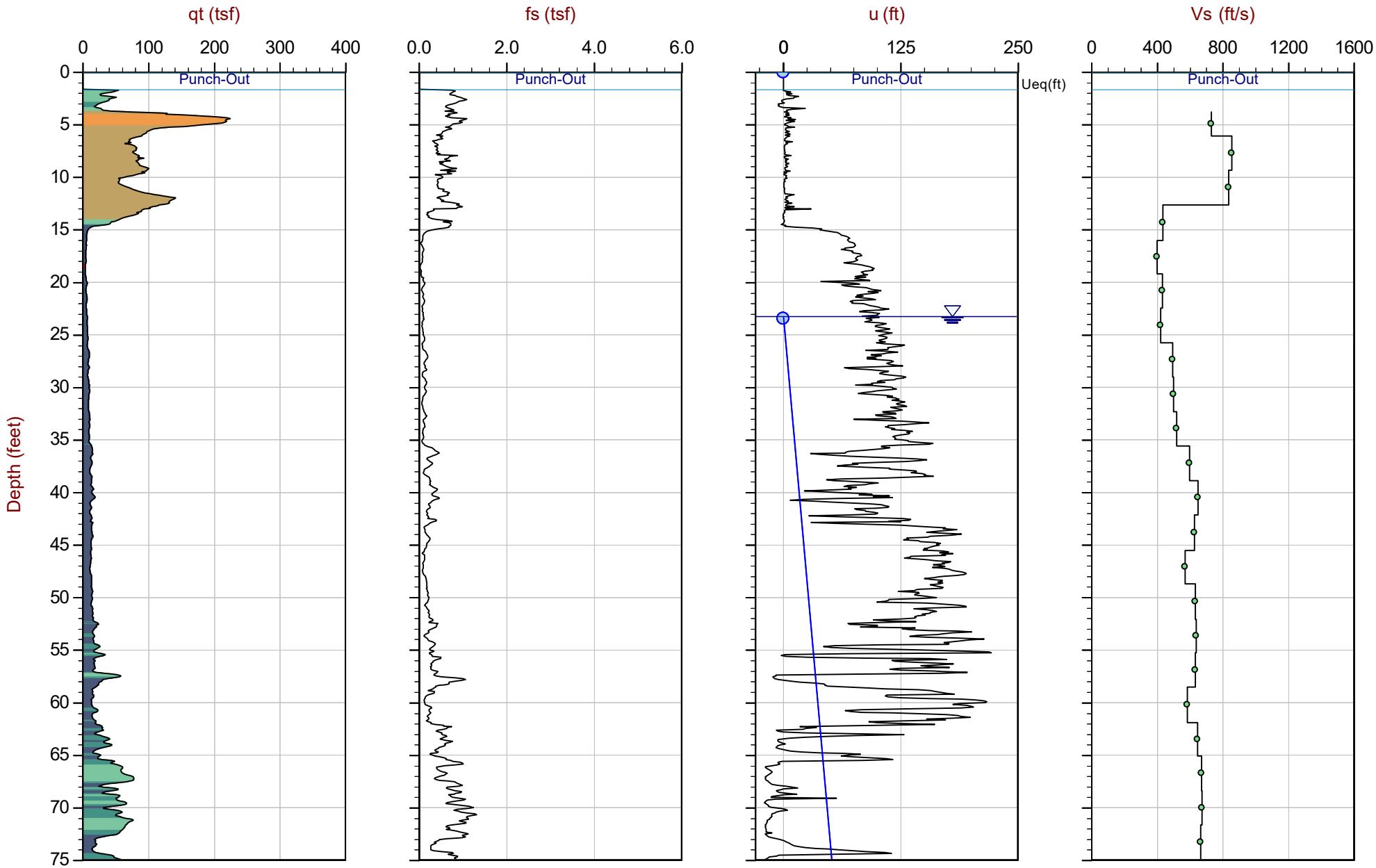
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 12:43
Site: Burnside Bridge Portland CPT

Sounding: CPT-06
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP06.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52277 Long: -122.66405

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

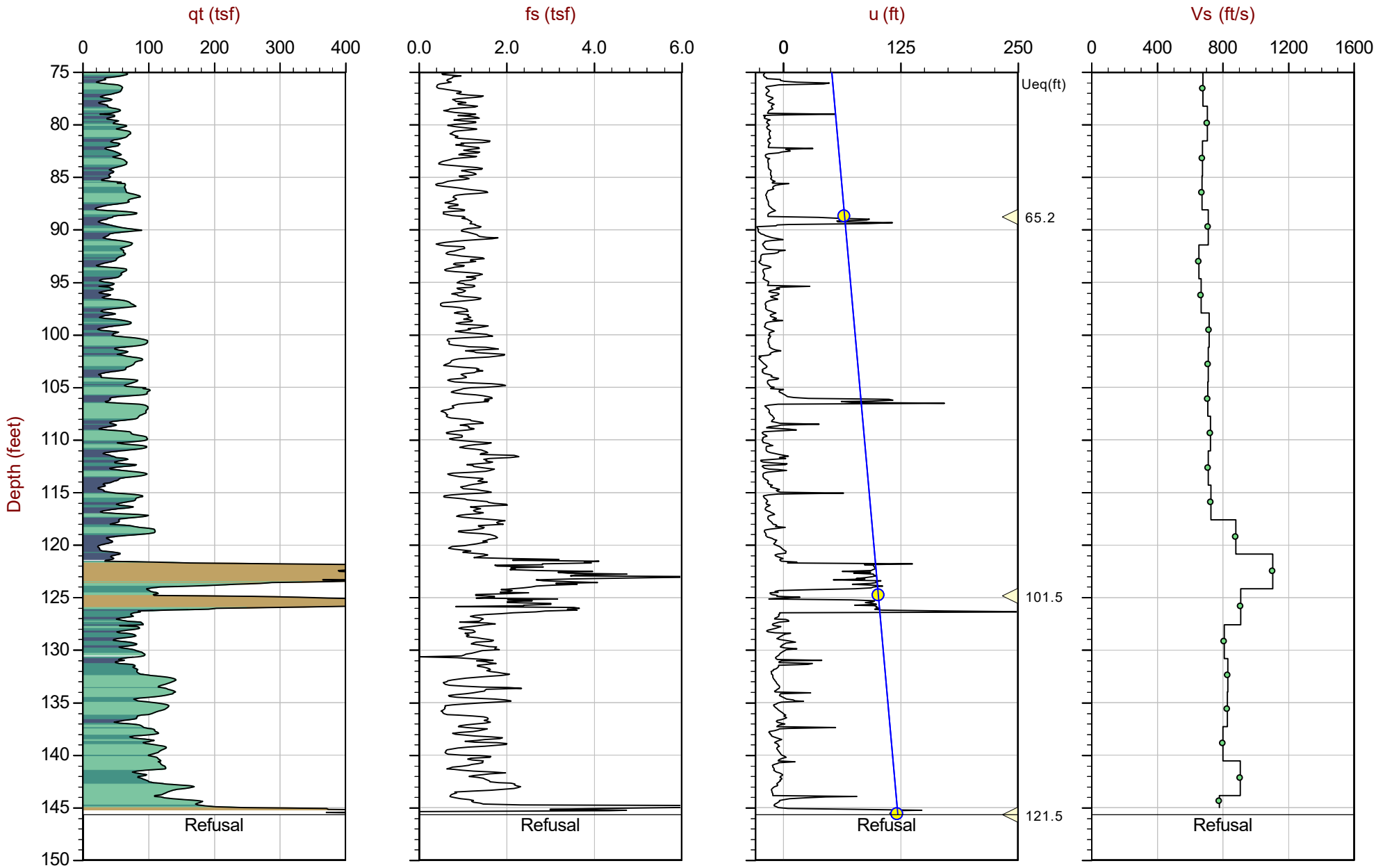
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-14 12:43
Site: Burnside Bridge Portland CPT

Sounding: CPT-06
Cone: 780:T1500F15U35



Max Depth: 44.400 m / 145.67 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP06.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52277 Long: -122.66405

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

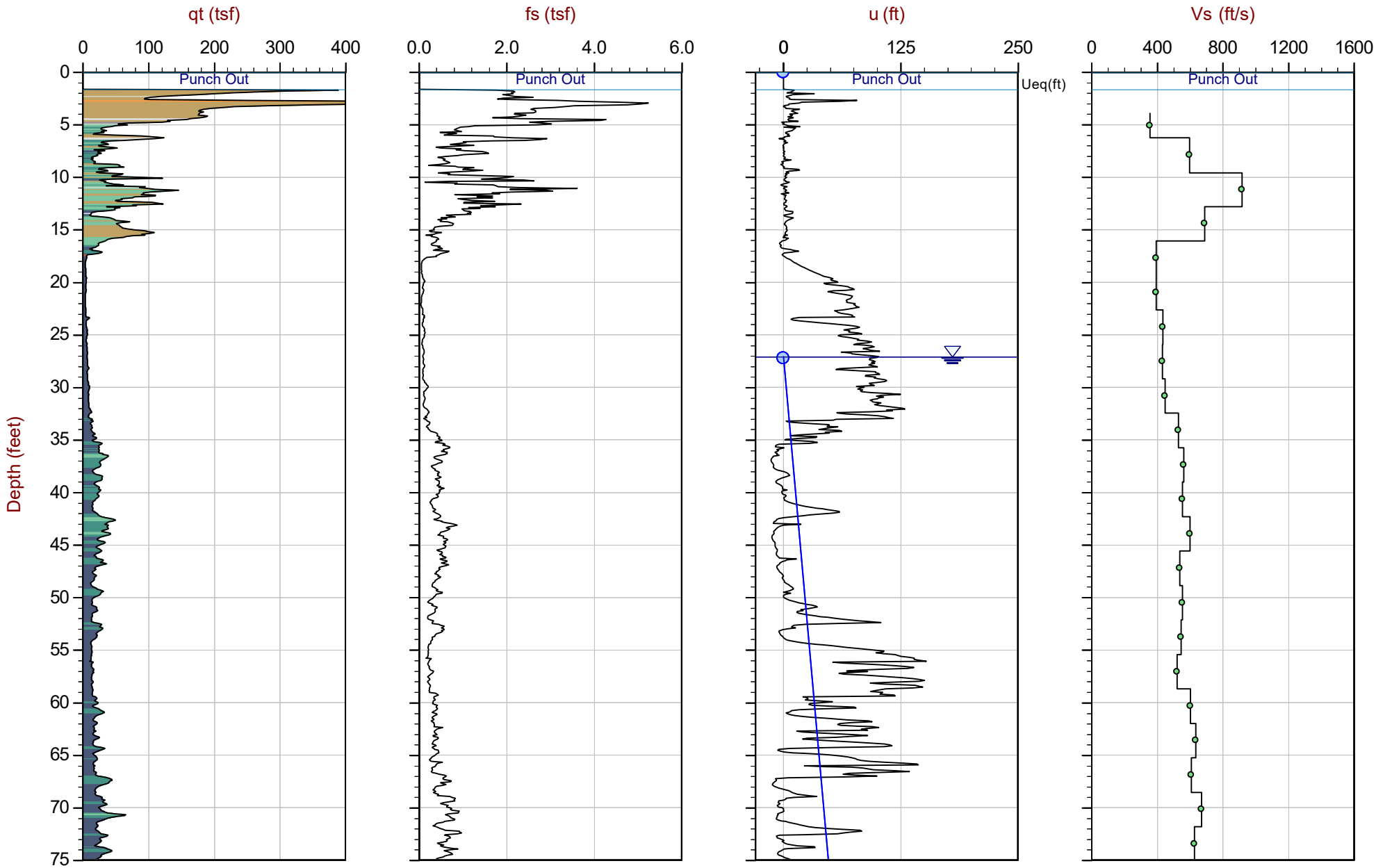
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-15 08:28
Site: Burnside Bridge Portland CPT

Sounding: CPT-07
Cone: 780:T1500F15U35



Max Depth: 42.750 m / 140.25 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP07.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52285 Long: -122.66459

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

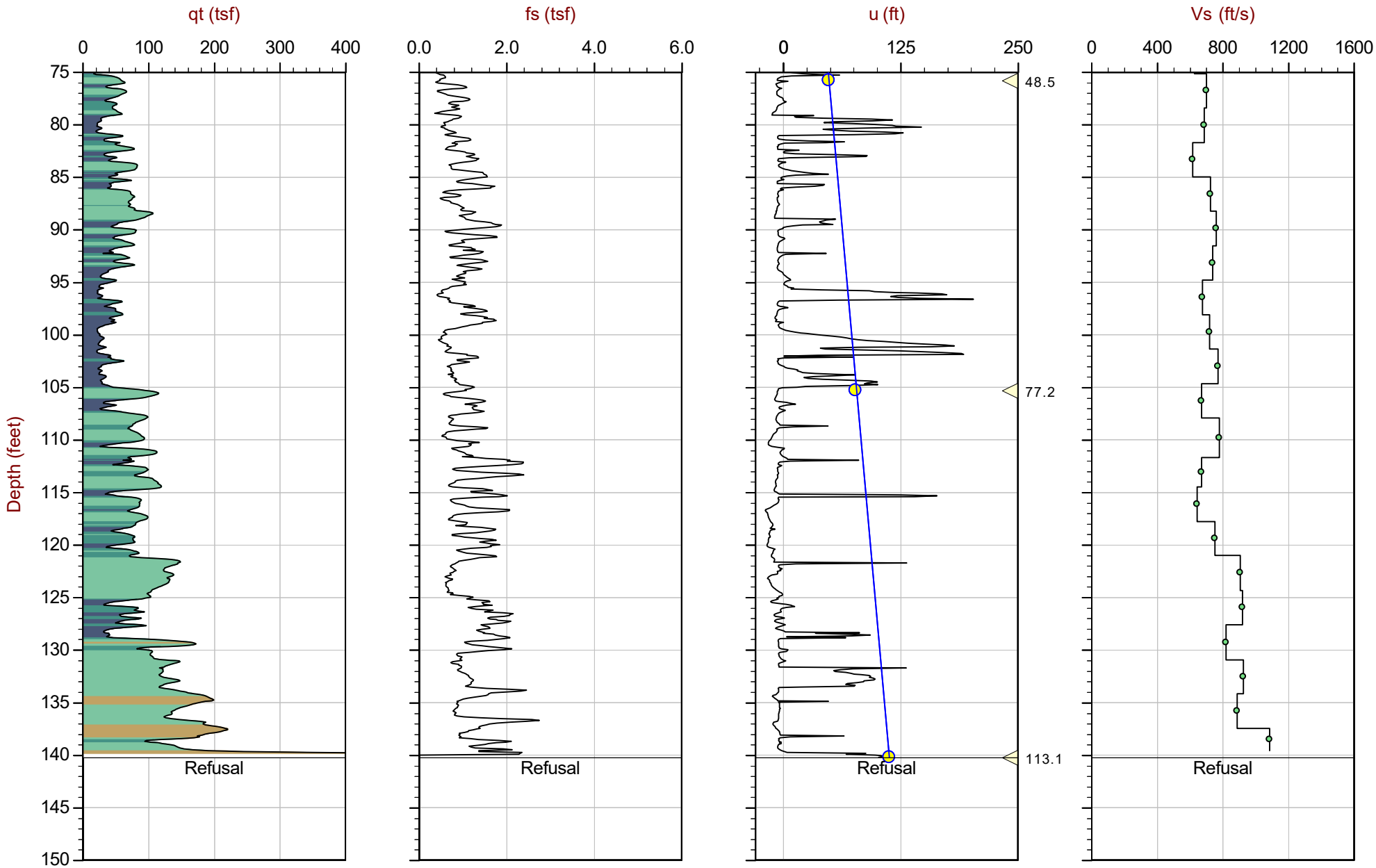
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-15 08:28
Site: Burnside Bridge Portland CPT

Sounding: CPT-07
Cone: 780:T1500F15U35



Max Depth: 42.750 m / 140.25 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP07.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52285 Long: -122.66459

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

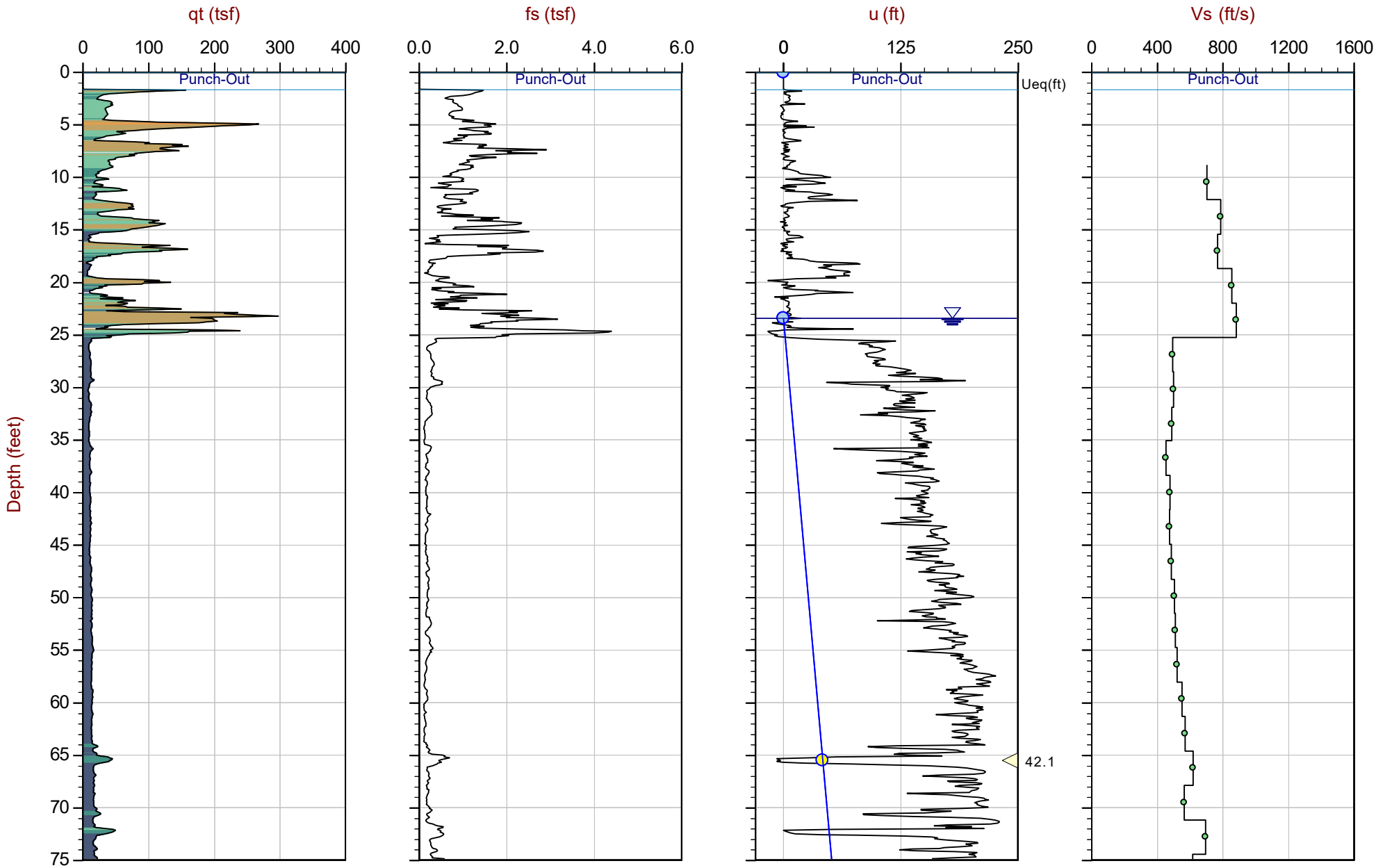
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 07:19
Site: Burnside Bridge Portland CPT

Sounding: CPT-08
Cone: 780:T1500F15U35



Max Depth: 39.075 m / 128.20 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP08.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52307 Long: -122.66370

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

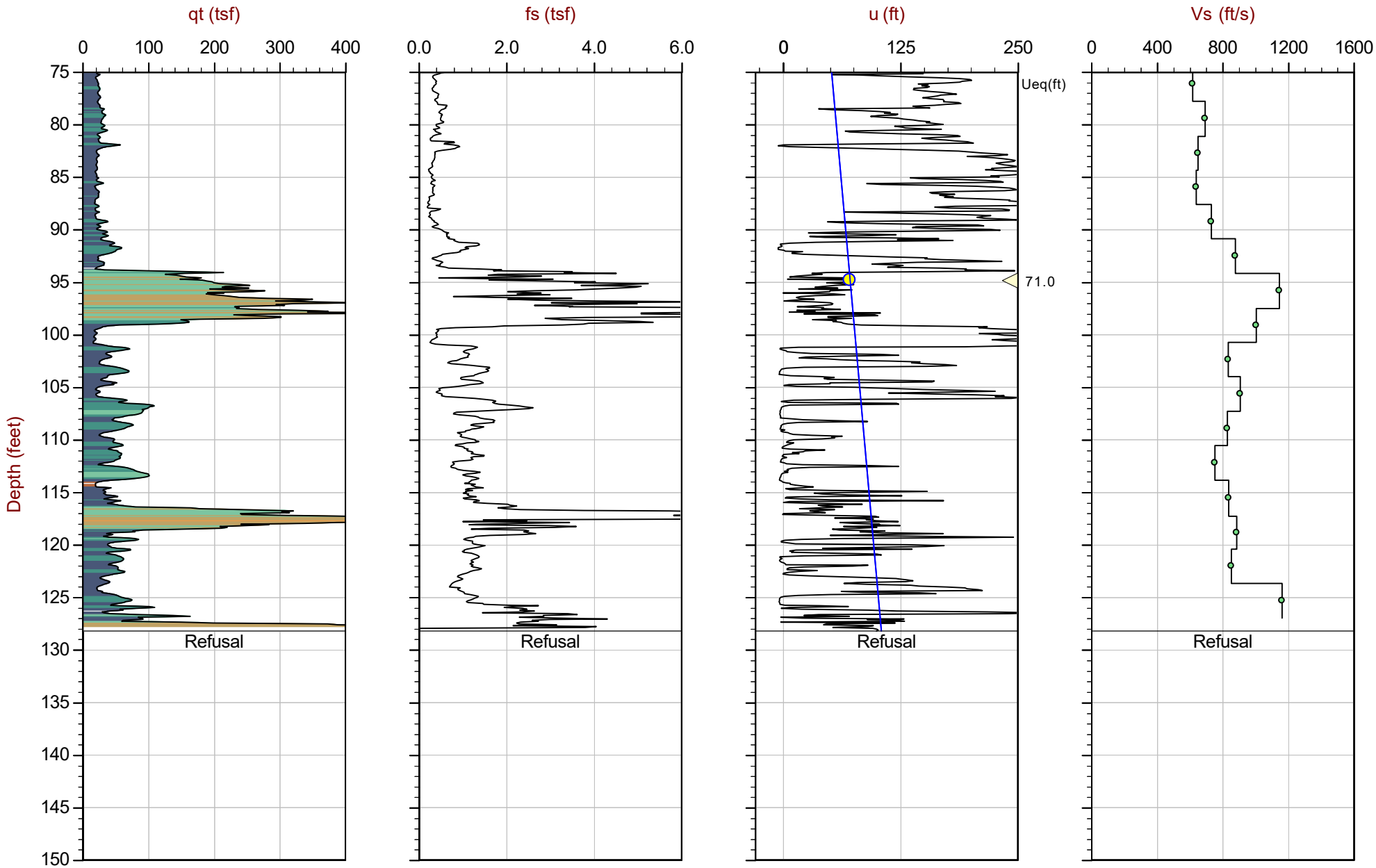
The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 2021-09-16 07:19
Site: Burnside Bridge Portland CPT

Sounding: CPT-08
Cone: 780:T1500F15U35



Max Depth: 39.075 m / 128.20 ft
Depth Inc: 0.025 m / 0.082 ft
Avg Int: Every Point

File: 21-59-23000_SP08.COR
Unit Wt: SBTQtn (PKR2009)

SBT: Robertson, 2009 and 2010
Coords: Lat: 45.52307 Long: -122.66370

Equilibrium Pore Pressure (Ueq) | Assumed Ueq | Dissipation, Ueq achieved | Dissipation, Ueq not achieved | Hydrostatic Line

The reported coordinates were acquired from hand-held GPS equipment and are only approximate locations. The coordinates should not be used for design purposes.

Seismic Cone Penetration Test Shear Wave (Vs) Tabular Results

CONETEC

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-01
Date:	16-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
6.56	5.91	10.51			
9.84	9.19	12.65	2.14	3.83	559
13.12	12.47	15.20	2.55	4.88	523
16.40	15.75	17.99	2.79	5.34	522
19.69	19.03	20.92	2.93	5.44	539
23.03	22.38	24.00	3.08	6.84	451
26.25	25.59	27.03	3.02	5.91	511
29.53	28.87	30.15	3.12	4.35	718

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-02
Date:	16-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
4.53	3.87	9.51			
6.73	6.07	10.60	1.09	3.26	333
10.10	9.45	12.84	2.24	5.62	399
13.29	12.63	15.33	2.50	5.04	495
16.57	15.91	18.13	2.80	6.41	436
19.85	19.19	21.07	2.94	6.13	479
23.13	22.47	24.10	3.03	4.53	669
26.41	25.76	27.18	3.09	4.81	641
29.79	29.13	30.40	3.22	3.95	815

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-03
Date:	13-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
4.53	3.87	9.51			
6.73	6.07	10.60	1.09	3.15	345
10.01	9.35	12.77	2.17	5.77	375
13.22	12.57	15.28	2.51	3.41	737
16.57	15.91	18.13	2.85	3.26	874
19.85	19.19	21.07	2.94	3.77	779
23.13	22.47	24.10	3.03	6.26	484
26.41	25.76	27.18	3.09	6.12	504
29.69	29.04	30.31	3.13	7.00	447
32.97	32.32	33.46	3.16	6.73	469
36.25	35.60	36.64	3.18	6.21	512
39.53	38.88	39.84	3.20	6.04	529
42.82	42.16	43.05	3.21	6.39	502
46.10	45.44	46.26	3.22	6.82	472
49.38	48.72	49.49	3.23	5.69	568
52.66	52.00	52.72	3.23	6.56	493
55.94	55.28	55.96	3.24	4.90	661
59.22	58.56	59.20	3.24	6.38	508
62.50	61.84	62.45	3.25	5.42	599
65.95	65.29	65.87	3.41	5.22	654
69.06	68.41	68.96	3.09	5.60	552
72.34	71.69	72.21	3.26	5.73	568
75.62	74.97	75.47	3.26	5.91	551
78.90	78.25	78.73	3.26	5.05	646
82.19	81.53	81.99	3.26	4.96	658
85.47	84.81	85.25	3.26	5.47	596
88.75	88.09	88.52	3.27	5.60	583
92.03	91.37	91.78	3.27	5.22	626
95.41	94.75	95.15	3.37	4.46	755
98.59	97.93	98.32	3.17	5.09	622
105.15	104.49	104.86	6.54	9.80	667

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-03
Date:	13-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
111.81	111.16	111.49	6.64	9.93	669
118.27	117.62	117.94	6.45	9.93	649
124.84	124.18	124.48	6.54	9.42	695
131.40	130.74	131.03	6.55	8.66	756
138.06	137.40	137.68	6.65	8.79	757
144.52	143.86	144.13	6.45	7.89	817
145.67	145.01	145.27	1.15	1.51	762

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-04
Date:	13-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
6.30	5.64	10.36			
9.58	8.92	12.46	2.10	4.59	457
12.86	12.21	14.98	2.53	5.29	478
16.17	15.52	17.79	2.80	7.23	388
19.46	18.80	20.71	2.92	7.07	414
22.74	22.08	23.73	3.02	7.15	422
26.02	25.36	26.81	3.08	6.61	466
29.30	28.64	29.93	3.12	6.45	484
32.58	31.92	33.09	3.15	5.68	556
35.83	35.17	36.23	3.14	6.45	487
39.11	38.45	39.42	3.19	5.67	563
42.32	41.67	42.56	3.14	5.91	532
45.77	45.11	45.94	3.38	5.98	564
48.95	48.29	49.07	3.13	5.83	537
52.23	51.58	52.30	3.23	5.75	562
55.51	54.86	55.54	3.24	5.13	631
58.79	58.14	58.78	3.24	5.44	596
62.07	61.42	62.03	3.25	5.75	565
65.35	64.70	65.28	3.25	6.84	475
68.64	67.98	68.53	3.25	5.36	607
71.92	71.26	71.79	3.26	5.21	625
75.20	74.54	75.05	3.26	5.05	645
78.48	77.82	78.31	3.26	5.21	626
81.86	81.20	81.67	3.36	4.82	697
85.04	84.38	84.83	3.16	5.21	608
88.32	87.66	88.09	3.27	5.75	568
91.60	90.95	91.36	3.27	4.92	664
94.88	94.23	94.63	3.27	4.77	685
98.16	97.51	97.89	3.27	4.77	685
101.44	100.79	101.16	3.27	4.53	721
104.72	104.07	104.43	3.27	4.77	686

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-04
Date:	13-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
108.20	107.55	107.90	3.47	5.40	643
111.48	110.83	111.17	3.27	4.14	789
114.60	113.94	114.28	3.11	4.54	685
117.88	117.22	117.55	3.27	4.77	686
124.44	123.79	124.09	6.55	9.13	717
131.07	130.41	130.70	6.61	8.13	813
137.53	136.88	137.15	6.45	8.94	722
141.80	141.14	141.41	4.26	4.51	944

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-05
Date:	14-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
6.07	5.41	10.24			
9.35	8.69	12.29	2.05	4.90	420
12.63	11.98	14.80	2.50	5.36	468
15.91	15.26	17.56	2.76	5.46	506
19.19	18.54	20.47	2.92	5.53	527
22.47	21.82	23.48	3.01	7.22	417
25.75	25.10	26.56	3.08	7.18	429
29.04	28.38	29.68	3.12	7.50	416
32.32	31.66	32.83	3.15	7.04	448
35.60	34.94	36.01	3.17	6.31	503
38.88	38.22	39.20	3.19	6.55	487
42.16	41.50	42.40	3.21	6.67	481
45.44	44.78	45.62	3.22	6.81	472
48.72	48.06	48.84	3.23	6.35	508
52.00	51.35	52.08	3.23	5.82	555
55.28	54.63	55.31	3.24	5.47	592
58.56	57.91	58.56	3.24	5.31	611
61.84	61.19	61.80	3.25	5.32	611
65.12	64.47	65.05	3.25	5.19	626
68.41	67.75	68.30	3.25	5.47	595
71.69	71.03	71.56	3.26	5.21	625
74.97	74.31	74.82	3.26	5.20	627
78.48	77.82	78.31	3.49	5.43	643
81.53	80.87	81.34	3.03	4.69	647
84.81	84.15	84.60	3.26	4.83	676
88.09	87.43	87.87	3.26	4.82	678
91.47	90.81	91.23	3.36	5.04	667
94.75	94.09	94.49	3.27	4.88	670
97.93	97.28	97.66	3.17	4.98	636
101.31	100.66	101.03	3.37	4.51	746
104.50	103.84	104.20	3.17	4.72	672

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-05
Date:	14-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
107.78	107.12	107.47	3.27	4.72	693
111.06	110.40	110.74	3.27	4.56	716
114.34	113.68	114.01	3.27	4.57	717
117.62	116.96	117.28	3.27	4.56	718
120.90	120.24	120.56	3.27	4.50	727
124.18	123.52	123.83	3.27	4.31	760
127.46	126.80	127.10	3.27	3.27	1001
130.68	130.02	130.31	3.21	3.53	908
134.02	133.37	133.65	3.34	3.73	896
137.30	136.65	136.92	3.27	4.10	799
140.68	140.03	140.30	3.37	3.73	903
143.86	143.21	143.47	3.18	3.94	806
147.15	146.49	146.75	3.28	3.79	865
149.02	148.36	148.61	1.87	1.71	1094

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-06
Date:	14-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
4.43	3.77	9.47			
6.73	6.07	10.60	1.13	1.54	730
10.01	9.35	12.77	2.17	2.53	856
13.29	12.63	15.33	2.57	3.07	836
16.67	16.01	18.22	2.88	6.65	434
19.85	19.19	21.07	2.85	7.15	399
23.13	22.47	24.10	3.03	7.00	433
26.41	25.76	27.18	3.09	7.30	423
29.69	29.04	30.31	3.13	6.33	494
32.97	32.32	33.46	3.16	6.29	502
36.25	35.60	36.64	3.18	6.11	520
39.53	38.88	39.84	3.20	5.35	597
42.82	42.16	43.05	3.21	4.94	650
46.19	45.54	46.36	3.32	5.29	627
49.38	48.72	49.49	3.13	5.47	572
52.76	52.10	52.82	3.33	5.25	634
55.94	55.28	55.96	3.14	4.92	639
59.22	58.56	59.20	3.24	5.12	633
62.60	61.94	62.55	3.35	5.72	585
65.78	65.12	65.70	3.15	4.87	648
69.06	68.41	68.96	3.25	4.85	671
72.34	71.69	72.21	3.26	4.82	675
75.62	74.97	75.47	3.26	4.90	665
78.90	78.25	78.73	3.26	4.80	679
82.19	81.53	81.99	3.26	4.62	706
85.56	84.91	85.35	3.36	4.97	676
88.75	88.09	88.52	3.17	4.70	673
92.13	91.47	91.88	3.36	4.72	713
95.31	94.65	95.05	3.17	4.84	655
98.59	97.93	98.32	3.27	4.89	669
101.87	101.21	101.59	3.27	4.55	718

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-06
Date:	14-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
105.15	104.49	104.86	3.27	4.59	712
108.43	107.78	108.13	3.27	4.60	711
111.71	111.06	111.40	3.27	4.50	726
114.99	114.34	114.67	3.27	4.60	711
118.27	117.62	117.94	3.27	4.50	727
121.56	120.90	121.21	3.27	3.72	879
124.84	124.18	124.48	3.27	2.96	1105
128.28	127.62	127.92	3.44	3.78	909
131.50	130.84	131.13	3.21	3.97	809
134.68	134.02	134.30	3.18	3.82	832
137.96	137.30	137.58	3.28	3.95	829
141.24	140.58	140.85	3.27	4.08	802
144.52	143.86	144.13	3.27	3.61	906
145.67	145.01	145.27	1.15	1.47	779

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-07
Date:	15-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
4.59	3.94	9.54			
6.89	6.23	10.69	1.15	3.23	357
10.24	9.58	12.93	2.24	3.75	598
13.45	12.80	15.47	2.53	2.76	918
16.73	16.08	18.27	2.81	4.08	689
20.01	19.36	21.22	2.94	7.48	394
23.29	22.64	24.25	3.03	7.66	396
26.58	25.92	27.34	3.09	7.08	436
29.86	29.20	30.47	3.13	7.22	433
33.14	32.48	33.62	3.16	7.05	448
36.42	35.76	36.80	3.18	5.99	531
39.70	39.04	40.00	3.20	5.67	564
42.98	42.32	43.21	3.21	5.79	554
46.26	45.60	46.43	3.22	5.37	600
49.54	48.88	49.65	3.23	5.99	538
52.82	52.17	52.88	3.23	5.84	554
56.10	55.45	56.12	3.24	5.92	547
59.38	58.73	59.37	3.24	6.22	522
62.66	62.01	62.61	3.25	5.38	604
65.95	65.29	65.87	3.25	5.12	635
69.23	68.57	69.12	3.25	5.35	609
72.51	71.85	72.37	3.26	4.85	672
75.79	75.13	75.63	3.26	5.20	627
79.07	78.41	78.89	3.26	4.65	702
82.35	81.69	82.15	3.26	4.75	687
85.63	84.97	85.42	3.26	5.30	616
88.91	88.26	88.68	3.27	4.50	726
92.19	91.54	91.95	3.27	4.29	761
95.47	94.82	95.21	3.27	4.42	739
98.75	98.10	98.48	3.27	4.82	677
102.03	101.38	101.75	3.27	4.54	720

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-07
Date:	15-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
105.31	104.66	105.02	3.27	4.24	771
108.60	107.94	108.29	3.27	4.87	671
112.37	111.71	112.05	3.76	4.82	780
115.16	114.50	114.83	2.78	4.14	671
118.44	117.78	118.10	3.27	5.07	645
121.65	121.00	121.31	3.21	4.27	752
125.00	124.34	124.65	3.34	3.68	907
128.28	127.62	127.92	3.27	3.55	921
131.63	130.97	131.26	3.34	4.07	821
134.84	134.19	134.47	3.21	3.46	926
138.12	137.47	137.74	3.27	3.69	888
140.26	139.60	139.87	2.13	1.96	1086

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-05
Date:	14-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
6.07	5.41	10.24			
9.35	8.69	12.29	2.05	4.90	420
12.63	11.98	14.80	2.50	5.36	468
15.91	15.26	17.56	2.76	5.46	506
19.19	18.54	20.47	2.92	5.53	527
22.47	21.82	23.48	3.01	7.22	417
25.75	25.10	26.56	3.08	7.18	429
29.04	28.38	29.68	3.12	7.50	416
32.32	31.66	32.83	3.15	7.04	448
35.60	34.94	36.01	3.17	6.31	503
38.88	38.22	39.20	3.19	6.55	487
42.16	41.50	42.40	3.21	6.67	481
45.44	44.78	45.62	3.22	6.81	472
48.72	48.06	48.84	3.23	6.35	508
52.00	51.35	52.08	3.23	5.82	555
55.28	54.63	55.31	3.24	5.47	592
58.56	57.91	58.56	3.24	5.31	611
61.84	61.19	61.80	3.25	5.32	611
65.12	64.47	65.05	3.25	5.19	626
68.41	67.75	68.30	3.25	5.47	595
71.69	71.03	71.56	3.26	5.21	625
74.97	74.31	74.82	3.26	5.20	627
78.48	77.82	78.31	3.49	5.43	643
81.53	80.87	81.34	3.03	4.69	647
84.81	84.15	84.60	3.26	4.83	676
88.09	87.43	87.87	3.26	4.82	678
91.47	90.81	91.23	3.36	5.04	667
94.75	94.09	94.49	3.27	4.88	670
97.93	97.28	97.66	3.17	4.98	636
101.31	100.66	101.03	3.37	4.51	746
104.50	103.84	104.20	3.17	4.72	672

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Sounding ID:	CPT-05
Date:	14-Sep-2021
Seismic Source:	Beam
Seismic Offset (ft):	8.69
Source Depth (ft):	0.00
Geophone Offset (ft):	0.66

SCPTu SHEAR WAVE VELOCITY TEST RESULTS - Vs

Tip Depth (ft)	Geophone Depth (ft)	Ray Path (ft)	Ray Path Difference (ft)	Travel Time Interval (ms)	Interval Velocity (ft/s)
107.78	107.12	107.47	3.27	4.72	693
111.06	110.40	110.74	3.27	4.56	716
114.34	113.68	114.01	3.27	4.57	717
117.62	116.96	117.28	3.27	4.56	718
120.90	120.24	120.56	3.27	4.50	727
124.18	123.52	123.83	3.27	4.31	760
127.46	126.80	127.10	3.27	3.27	1001
130.68	130.02	130.31	3.21	3.53	908
134.02	133.37	133.65	3.34	3.73	896
137.30	136.65	136.92	3.27	4.10	799
140.68	140.03	140.30	3.37	3.73	903
143.86	143.21	143.47	3.18	3.94	806
147.15	146.49	146.75	3.28	3.79	865
149.02	148.36	148.61	1.87	1.71	1094

Seismic Cone Penetration Test Shear Wave (Vs) Traces

CONETEC

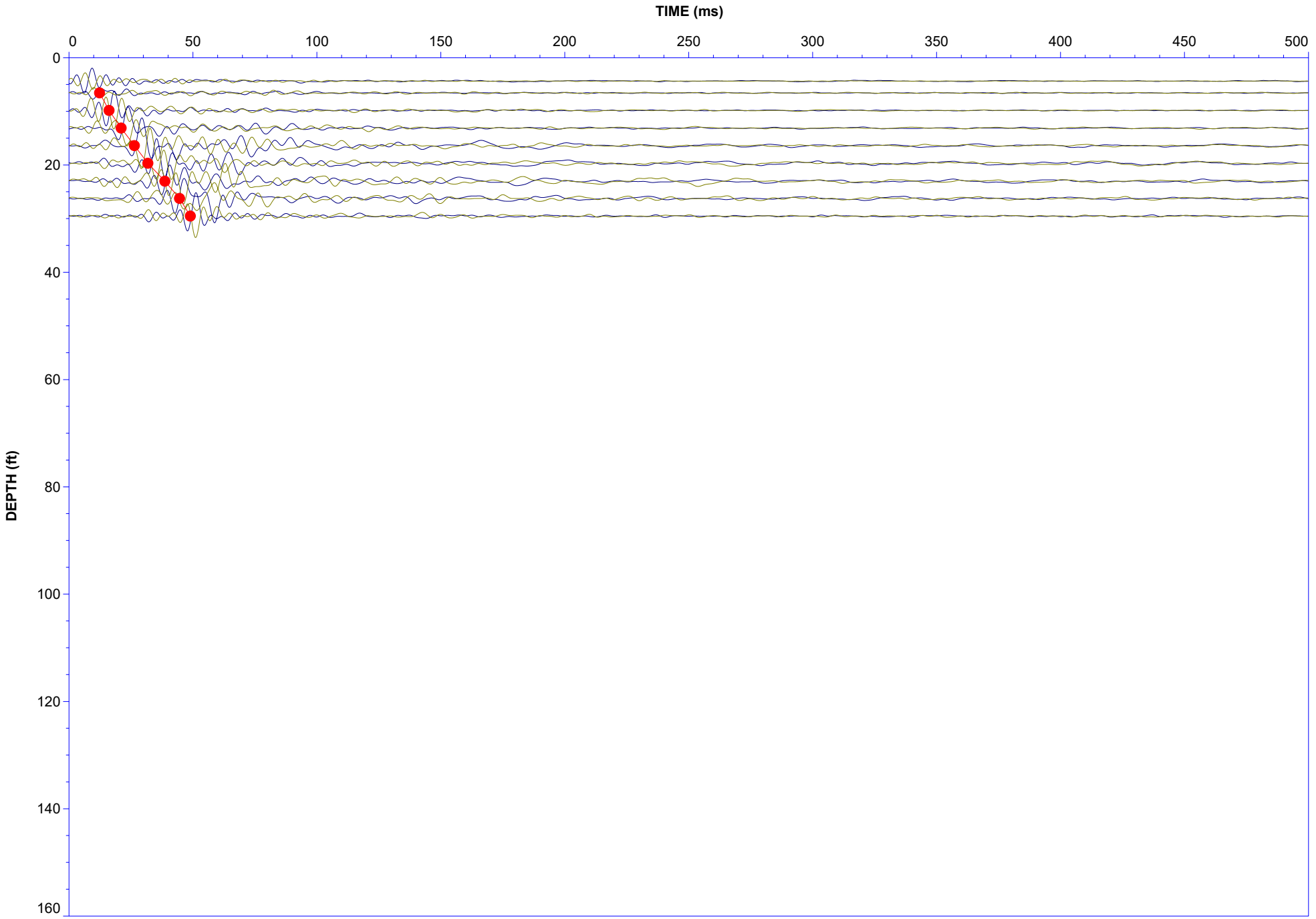
Job No: 21-59-23000
Date: 16-Sep-2021

Client: Shannon & Wilson, Inc.
Cone: 781:T1500F15U35

Project: Burnside Bridge Portland CPT

Sounding: CPT-01

Filter: 10-150Hz



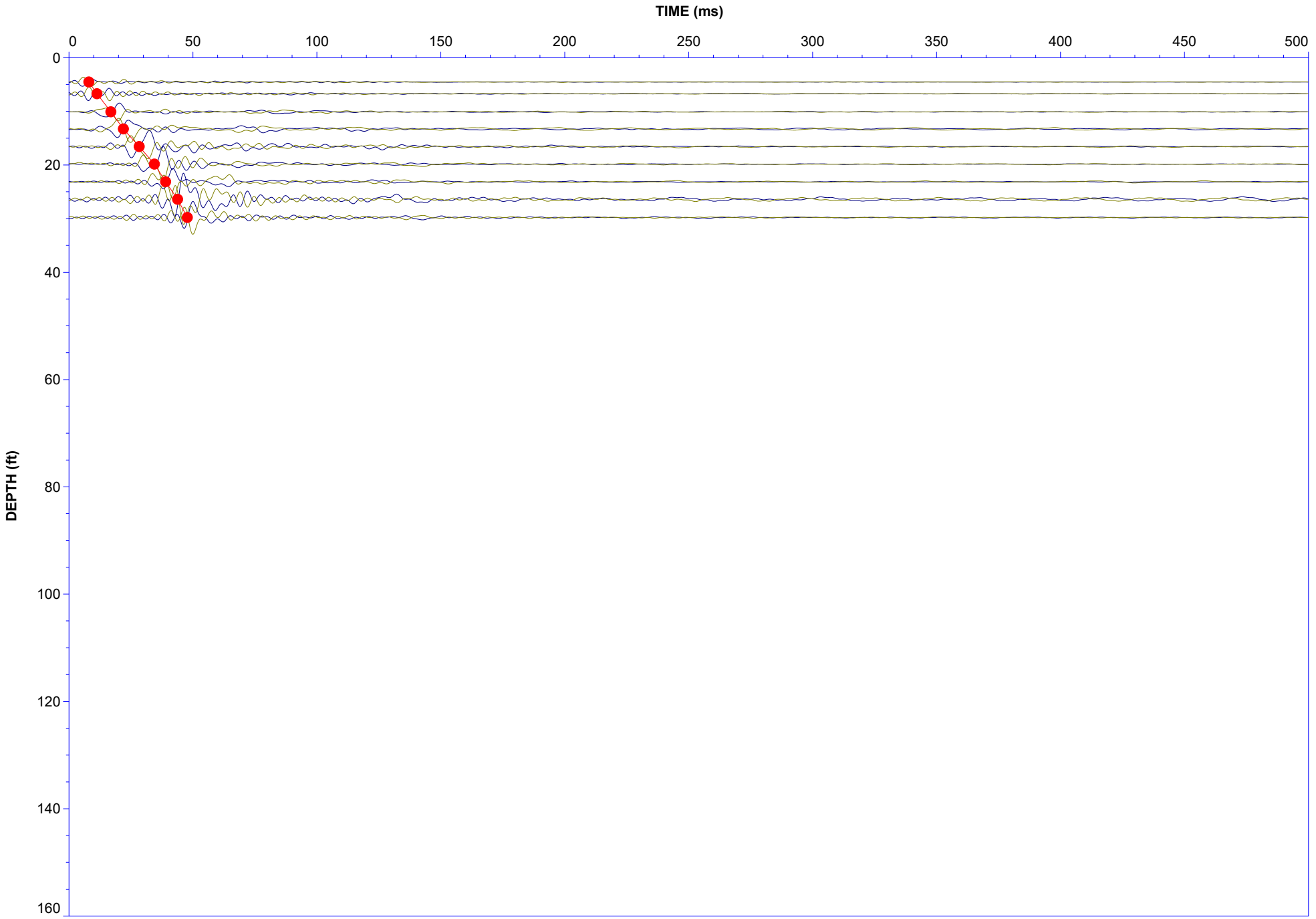
Job No: 21-59-23000
Date: 16-Sep-2021

Client: Shannon & Wilson, Inc.
Cone: 781:T1500F15U35

Project: Burnside Bridge Portland CPT

Sounding: CPT-02

Filter: 10-150Hz



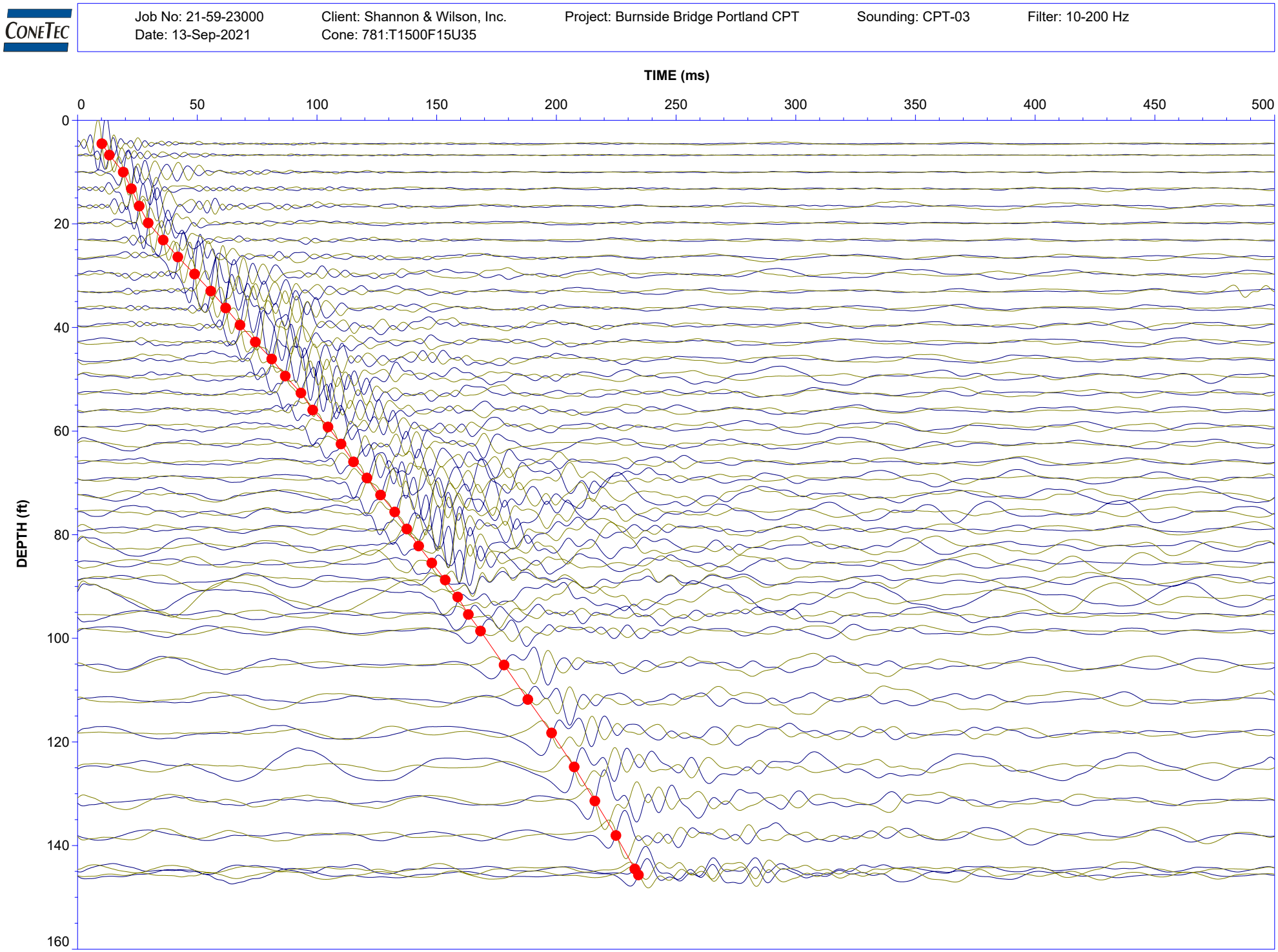
Job No: 21-59-23000
Date: 13-Sep-2021

Client: Shannon & Wilson, Inc.
Cone: 781:T1500F15U35

Project: Burnside Bridge Portland CPT

Sounding: CPT-03

Filter: 10-200 Hz



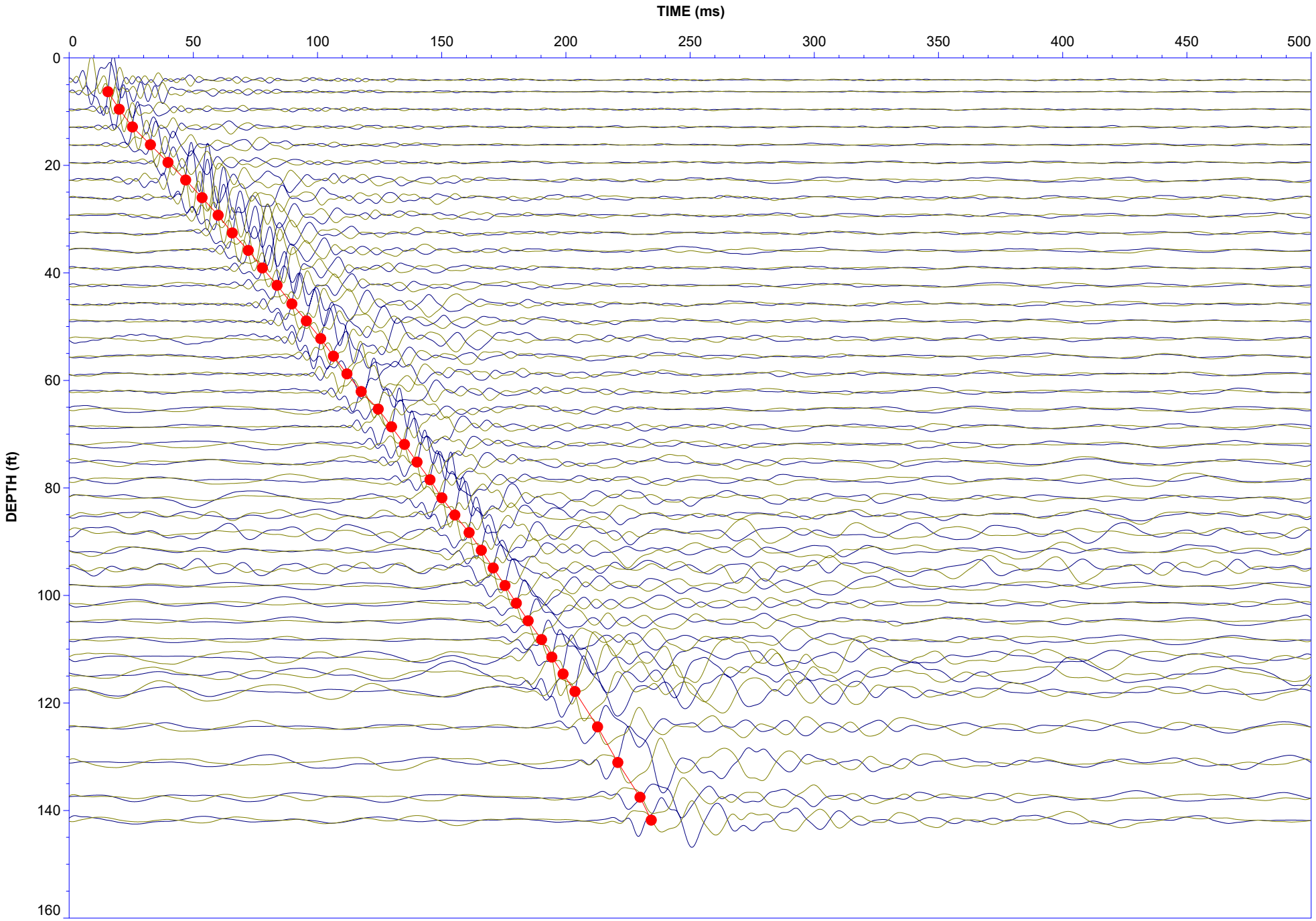
Job No: 21-59-23000
Date: 13-Sep-2021

Client: Shannon & Wilson, Inc.
Cone: 781:T1500F15U35

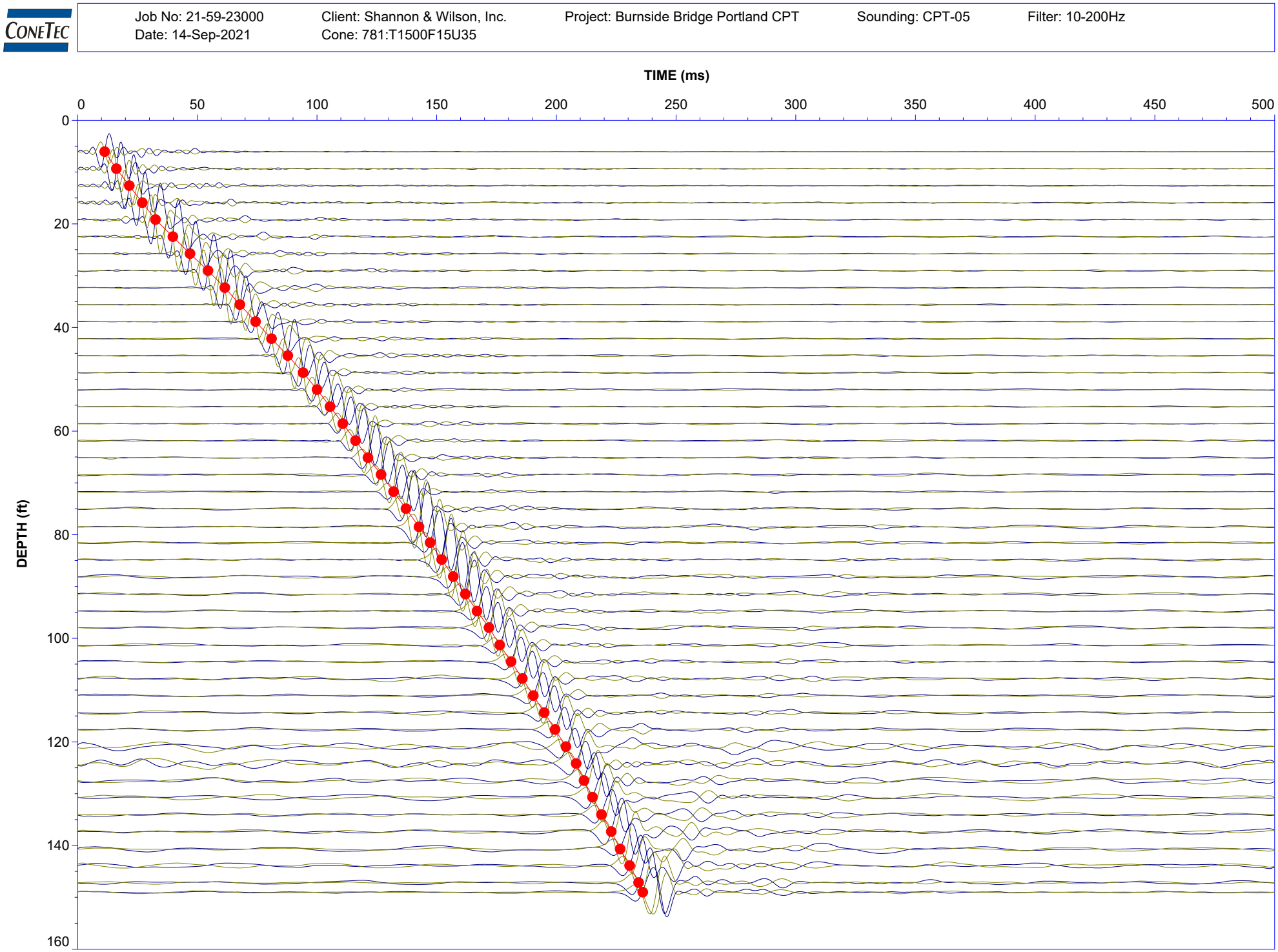
Project: Burnside Bridge Portland CPT

Sounding: CPT-04

Filter: 10-200 Hz



Job No: 21-59-23000
Date: 14-Sep-2021
Client: Shannon & Wilson, Inc.
Cone: 781:T1500F15U35
Project: Burnside Bridge Portland CPT
Sounding: CPT-05
Filter: 10-200Hz



CONETEC

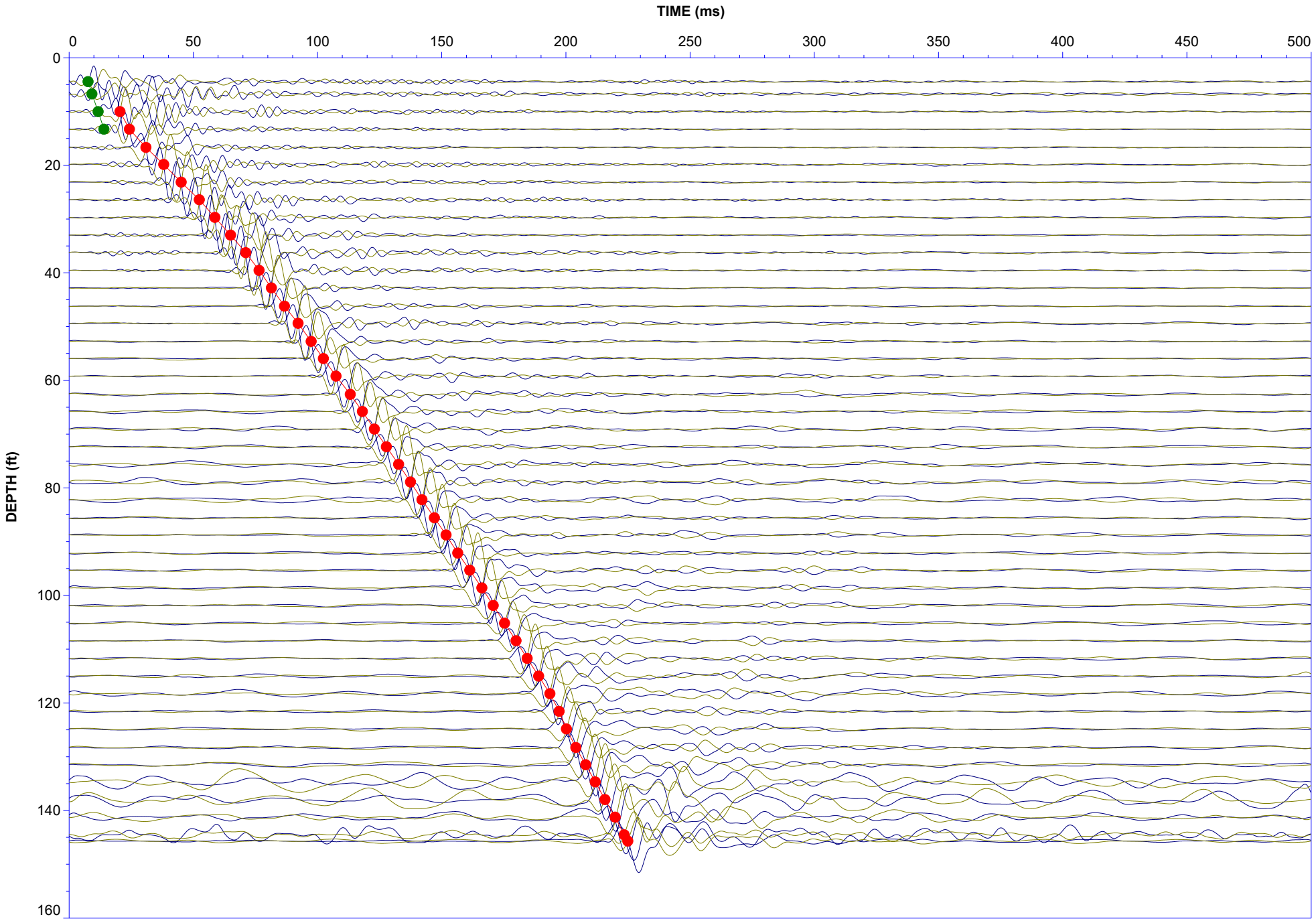
Job No: 21-59-23000
Date: 14-Sep-2021

Client: Shannon & Wilson, Inc.
Cone: 781:T1500F15U35

Project: Burnside Bridge Portland CPT

Sounding: CPT-06

Filter: 10-200 Hz



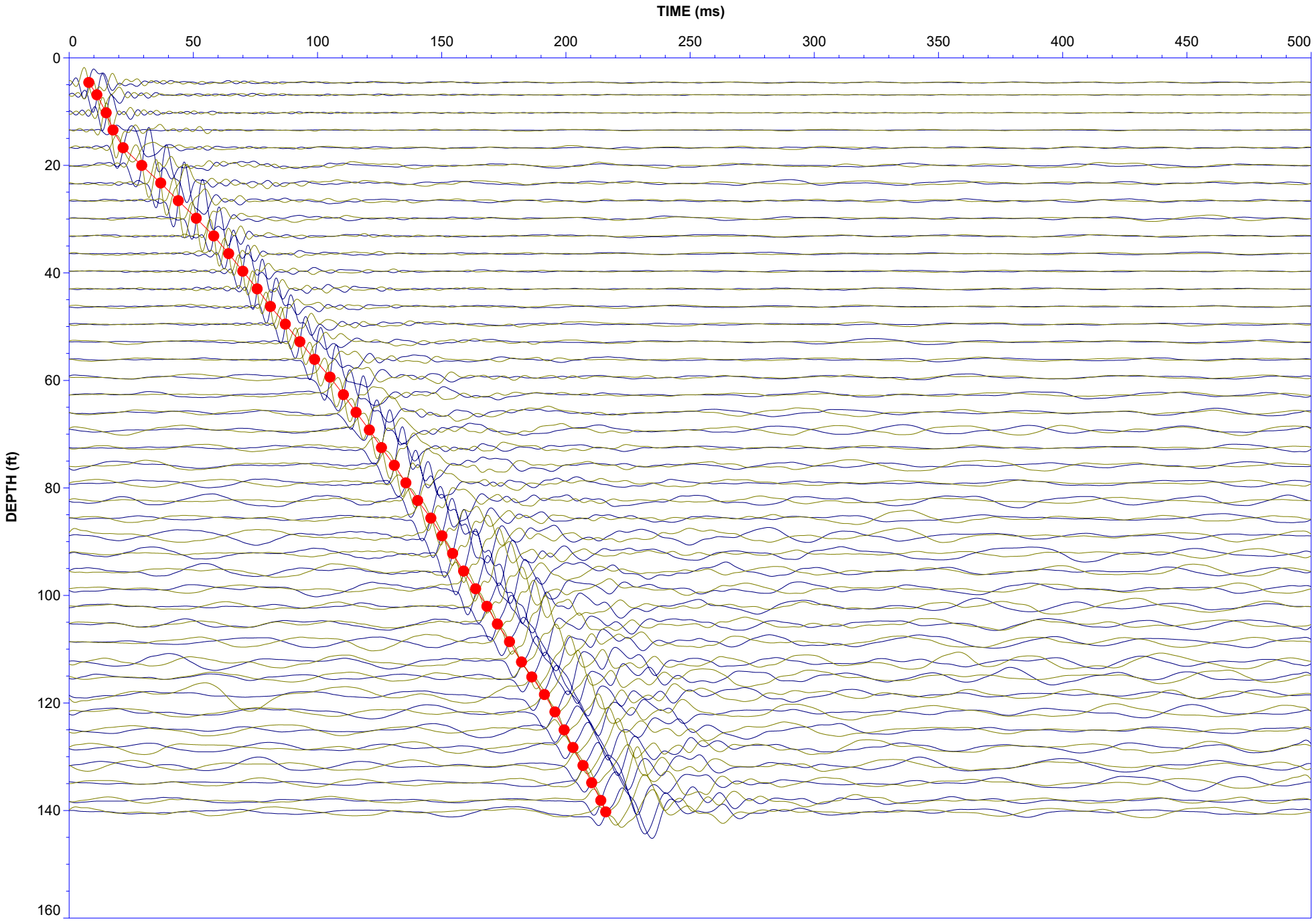
Job No: 21-59-23000
Date: 15-Sep-2021

Client: Shannon & Wilson, Inc.
Cone: 781:T1500F15U35

Project: Burnside Bridge Portland CPT

Sounding: CPT-07

Filter: 10-200Hz



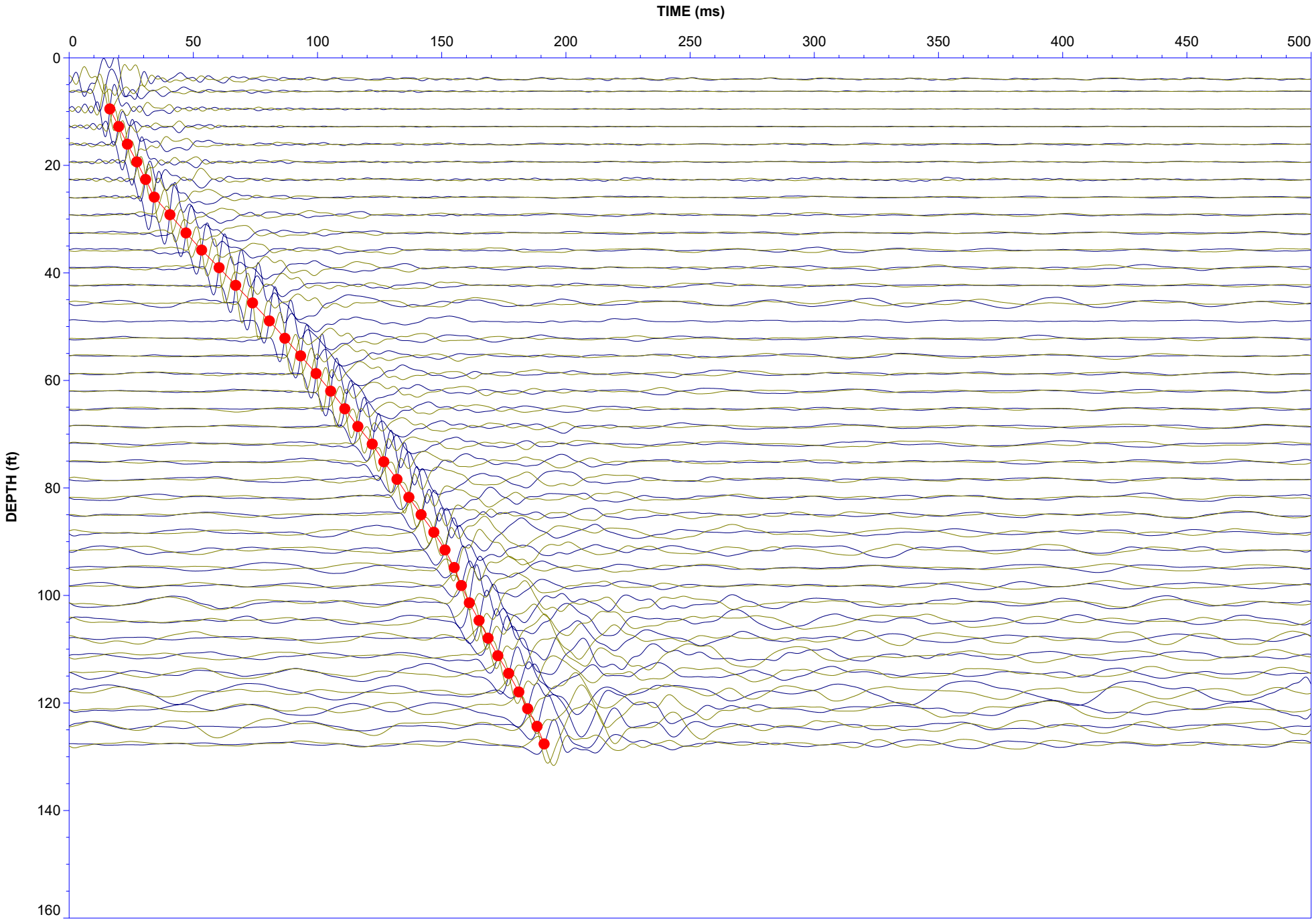
Job No: 21-59-23000
Date: 16-Sep-2021

Client: Shannon & Wilson, Inc.
Cone: 781:T1500F15U35

Project: Burnside Bridge Portland CPT

Sounding: CPT-08

Filter: 10-200Hz



Soil Behavior Type (SBT) Scatter Plots

CONETEC

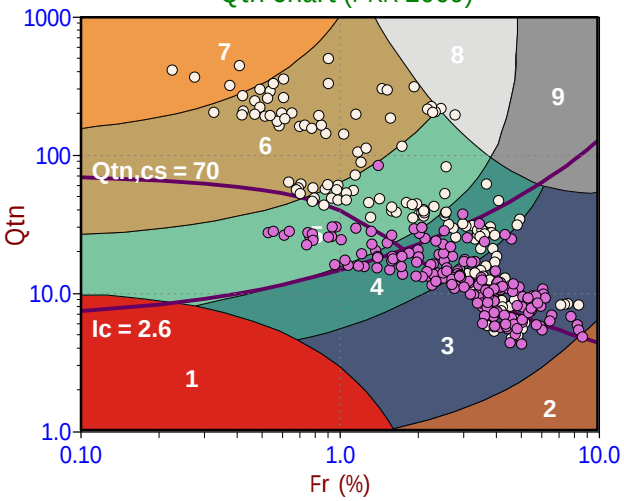
CONETEC

Shannon & Wilson

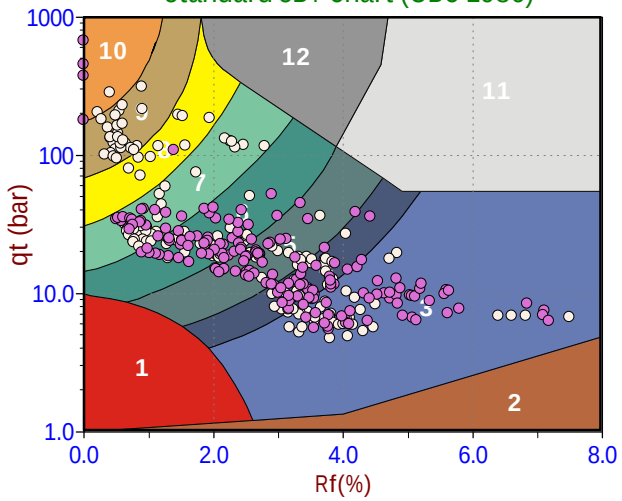
Job No: 21-59-23000
Date: 2021-09-16 11:01
Site: Burnside Bridge Portland CPT

Sounding: CPT-01
Cone: 781:T1500F15U35

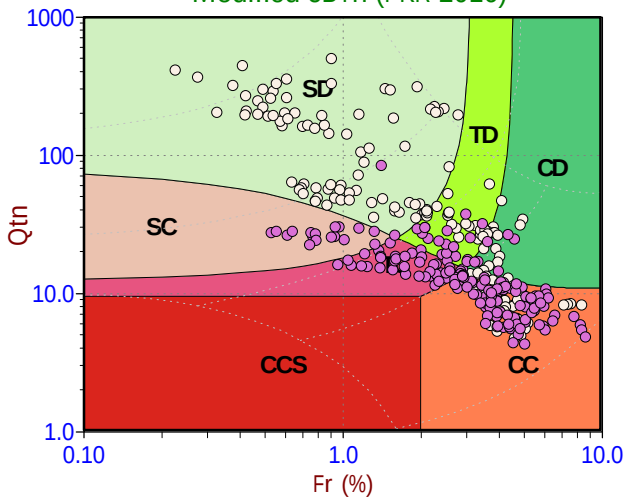
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 15.0 ft
- >15.0 to 30.0 ft
- >30.0 to 45.0 ft
- >45.0 to 60.0 ft
- >60.0 to 75.0 ft
- >75.0 to 90.0 ft
- >90.0 to 105.0 ft
- >105.0 to 120.0 ft
- >120.0 to 135.0 ft
- >135.0 to 150.0 ft
- >150.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

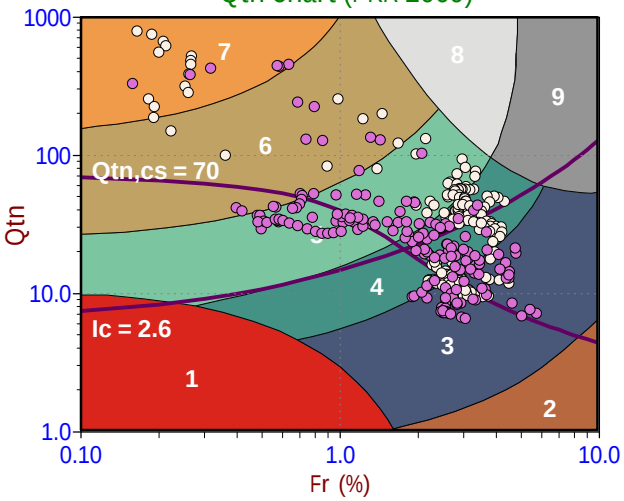
CONETEC

Shannon & Wilson

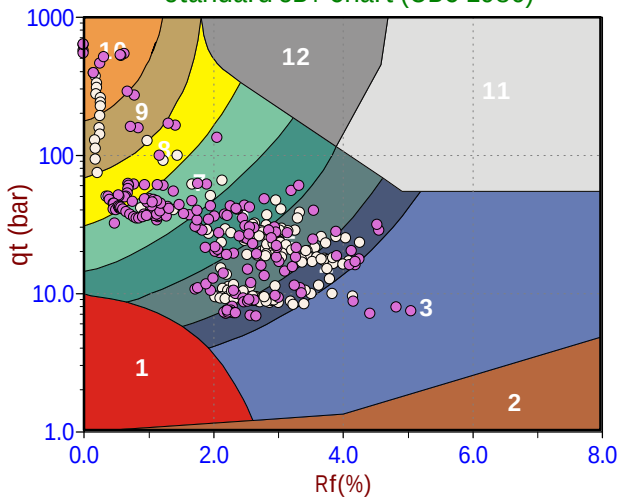
Job No: 21-59-23000
Date: 2021-09-16 12:17
Site: Burnside Bridge Portland CPT

Sounding: CPT-02
Cone: 781:T1500F15U35

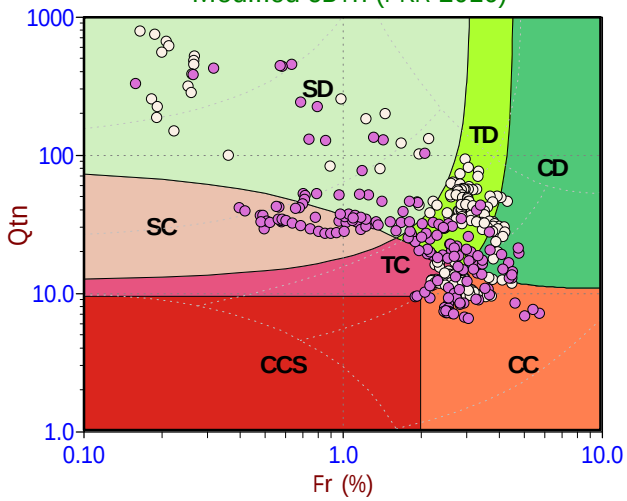
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 15.0 ft
- >15.0 to 30.0 ft
- >30.0 to 45.0 ft
- >45.0 to 60.0 ft
- >60.0 to 75.0 ft
- >75.0 to 90.0 ft
- >90.0 to 105.0 ft
- >105.0 to 120.0 ft
- >120.0 to 135.0 ft
- >135.0 to 150.0 ft
- >150.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

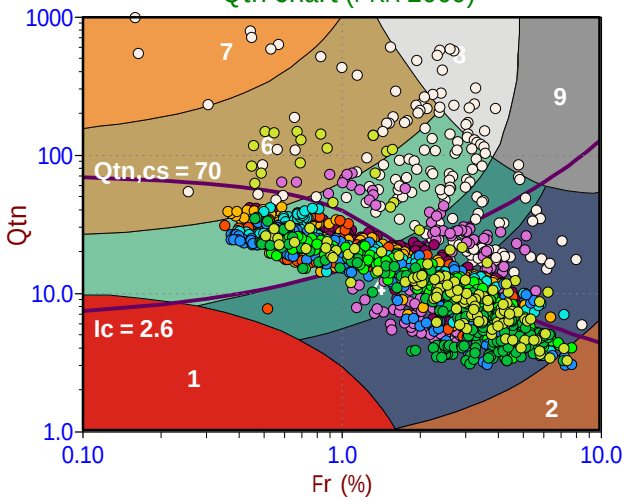
CONETEC

Shannon & Wilson

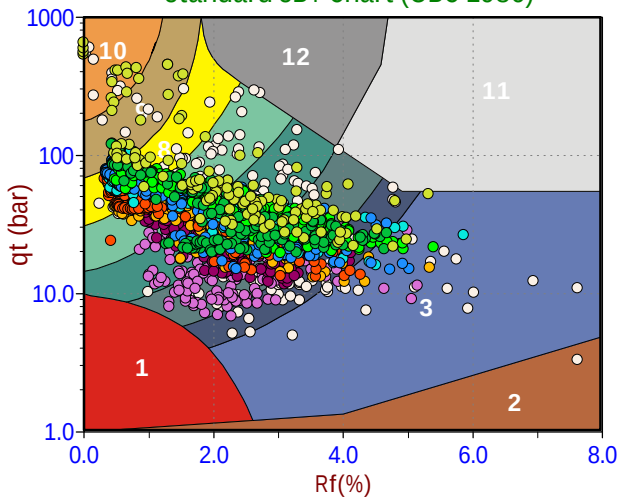
Job No: 21-59-23000
Date: 2021-09-13 11:00
Site: Burnside Bridge Portland CPT

Sounding: CPT-03
Cone: 780:T1500F15U35

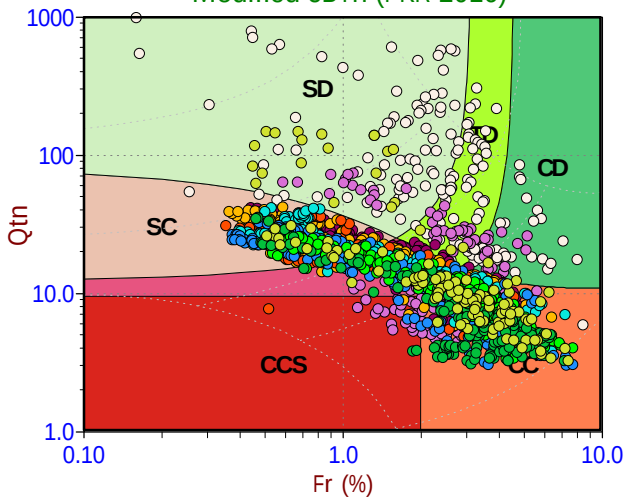
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 15.0 ft
- >15.0 to 30.0 ft
- >30.0 to 45.0 ft
- >45.0 to 60.0 ft
- >60.0 to 75.0 ft
- >75.0 to 90.0 ft
- >90.0 to 105.0 ft
- >105.0 to 120.0 ft
- >120.0 to 135.0 ft
- >135.0 to 150.0 ft
- >150.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

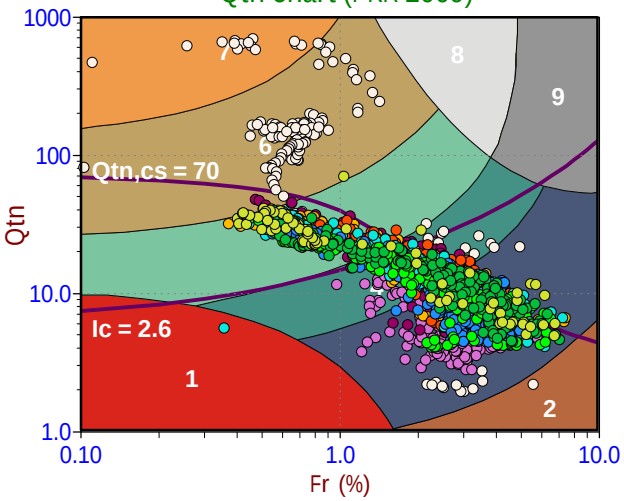
CONETEC

Shannon & Wilson

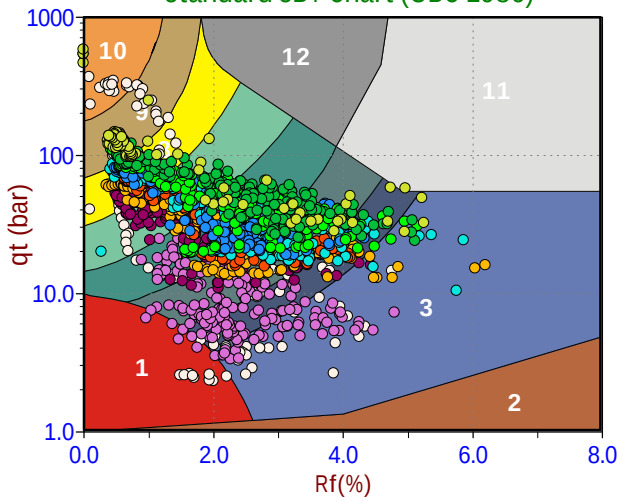
Job No: 21-59-23000
Date: 2021-09-13 14:50
Site: Burnside Bridge Portland CPT

Sounding: CPT-04
Cone: 780:T1500F15U35

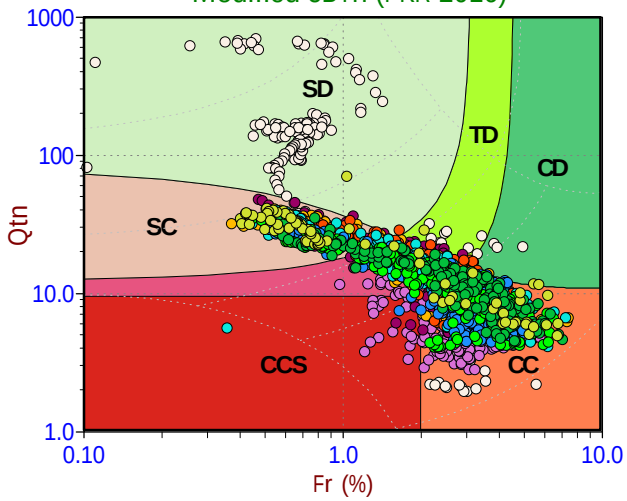
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 15.0 ft
- >15.0 to 30.0 ft
- >30.0 to 45.0 ft
- >45.0 to 60.0 ft
- >60.0 to 75.0 ft
- >75.0 to 90.0 ft
- >90.0 to 105.0 ft
- >105.0 to 120.0 ft
- >120.0 to 135.0 ft
- >135.0 to 150.0 ft
- >150.0 ft

Legend

- Sensitive, Fine Grained
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- Stiff Fine Grained
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- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

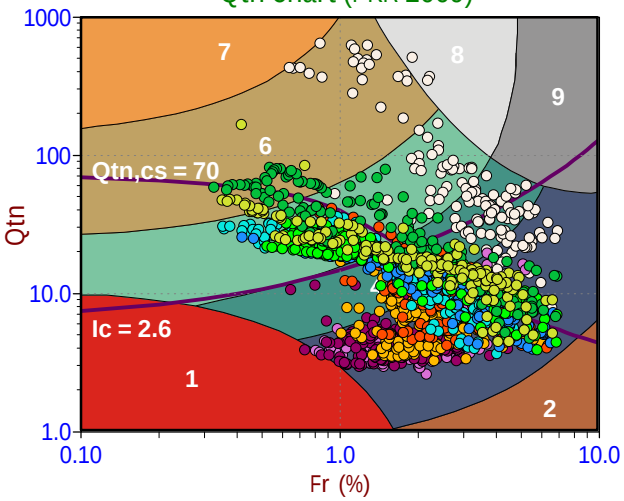
CONETEC

Shannon & Wilson

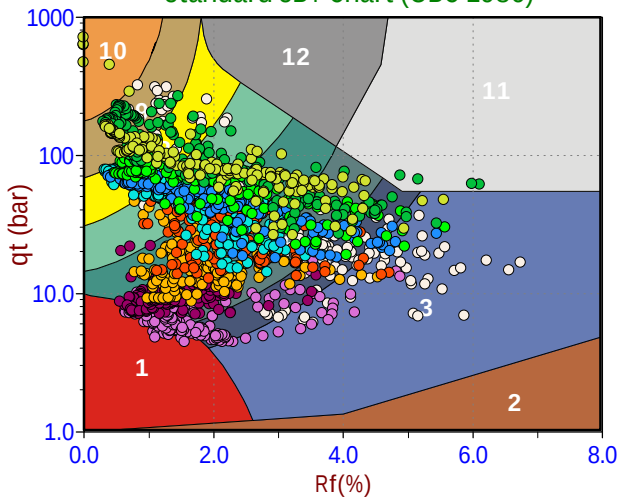
Job No: 21-59-23000
Date: 2021-09-14 08:06
Site: Burnside Bridge Portland CPT

Sounding: CPT-05
Cone: 780:T1500F15U35

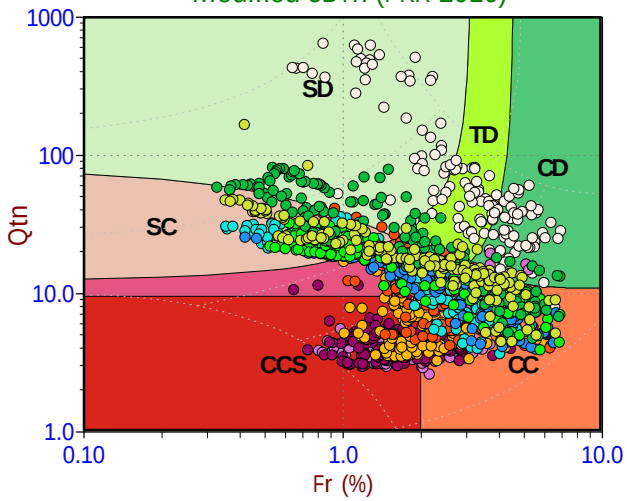
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 15.0 ft
- >15.0 to 30.0 ft
- >30.0 to 45.0 ft
- >45.0 to 60.0 ft
- >60.0 to 75.0 ft
- >75.0 to 90.0 ft
- >90.0 to 105.0 ft
- >105.0 to 120.0 ft
- >120.0 to 135.0 ft
- >135.0 to 150.0 ft
- >150.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

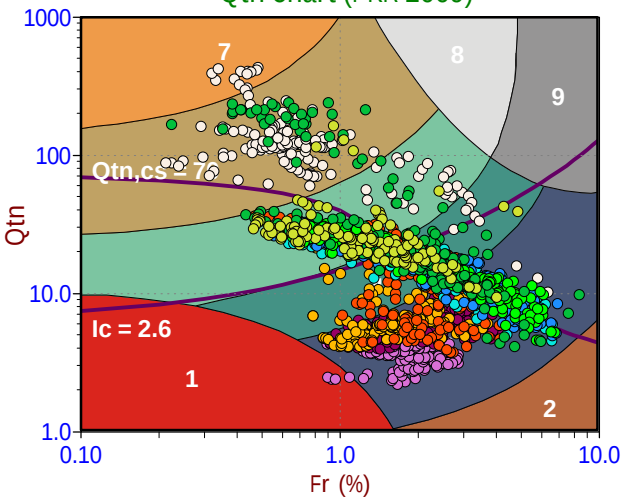
CONETEC

Shannon & Wilson

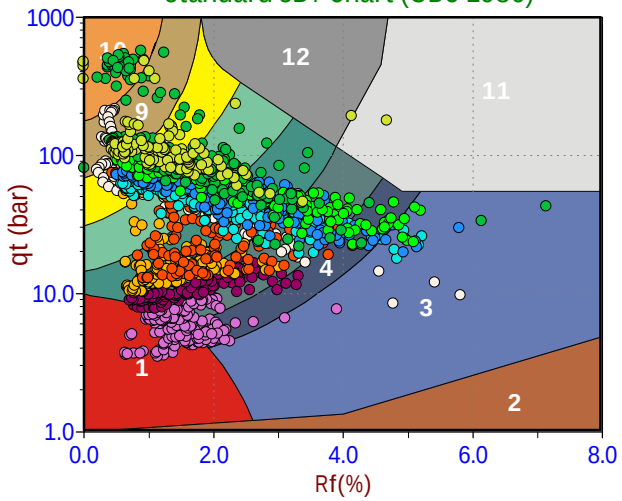
Job No: 21-59-23000
Date: 2021-09-14 12:43
Site: Burnside Bridge Portland CPT

Sounding: CPT-06
Cone: 780:T1500F15U35

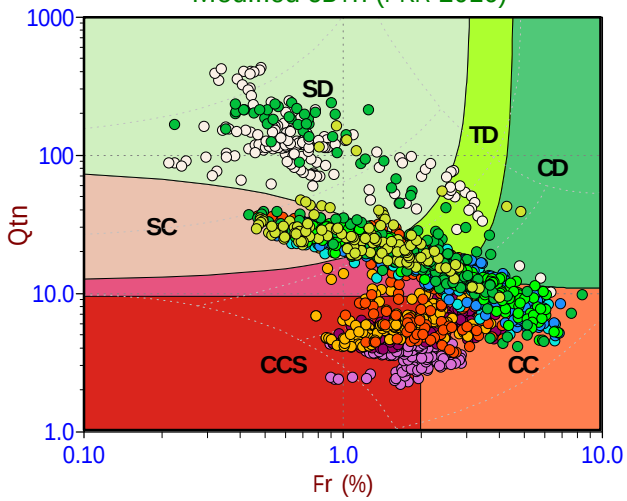
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 15.0 ft
- >15.0 to 30.0 ft
- >30.0 to 45.0 ft
- >45.0 to 60.0 ft
- >60.0 to 75.0 ft
- >75.0 to 90.0 ft
- >90.0 to 105.0 ft
- >105.0 to 120.0 ft
- >120.0 to 135.0 ft
- >135.0 to 150.0 ft
- >150.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

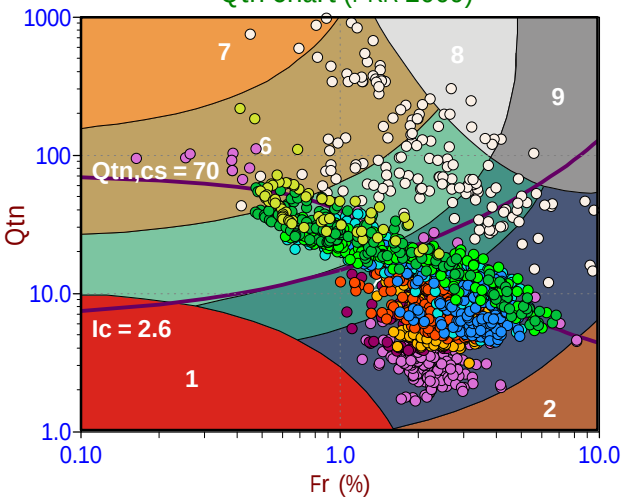
CONETEC

Shannon & Wilson

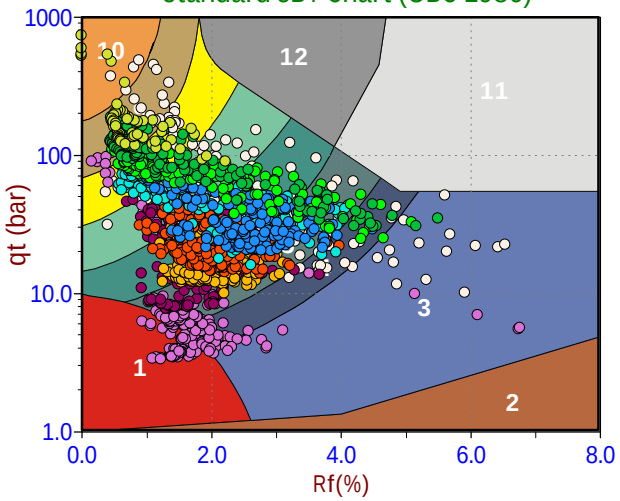
Job No: 21-59-23000
Date: 2021-09-15 08:28
Site: Burnside Bridge Portland CPT

Sounding: CPT-07
Cone: 780:T1500F15U35

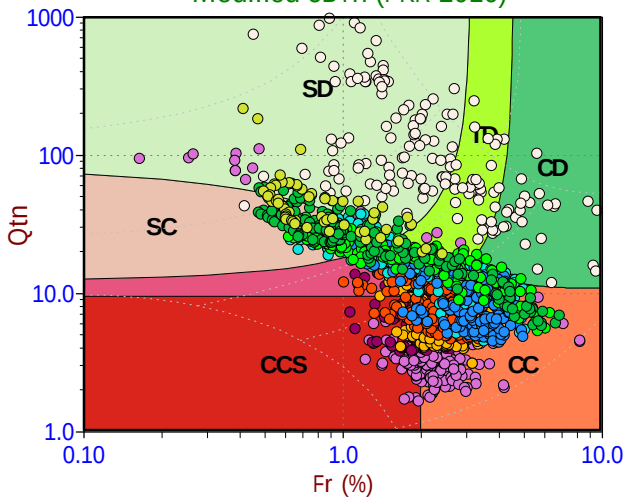
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 15.0 ft
- >15.0 to 30.0 ft
- >30.0 to 45.0 ft
- >45.0 to 60.0 ft
- >60.0 to 75.0 ft
- >75.0 to 90.0 ft
- >90.0 to 105.0 ft
- >105.0 to 120.0 ft
- >120.0 to 135.0 ft
- >135.0 to 150.0 ft
- >150.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

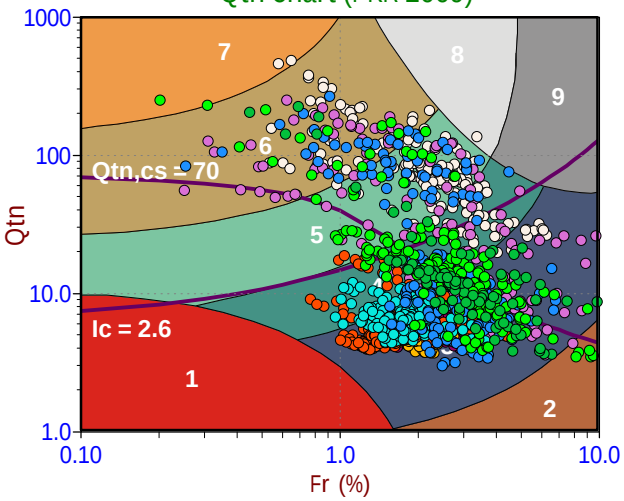
CONETEC

Shannon & Wilson

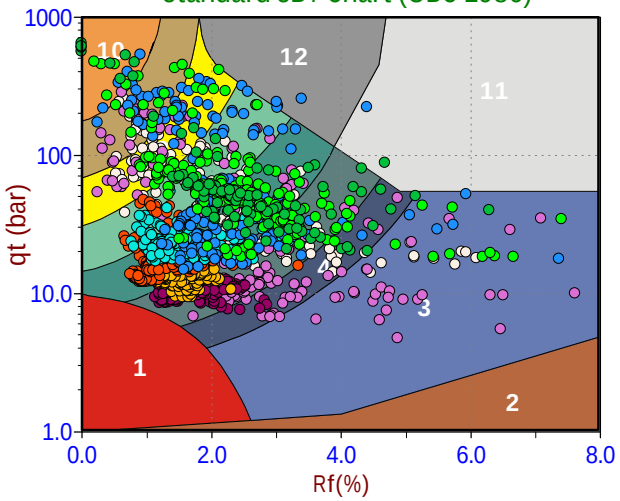
Job No: 21-59-23000
Date: 2021-09-16 07:19
Site: Burnside Bridge Portland CPT

Sounding: CPT-08
Cone: 780:T1500F15U35

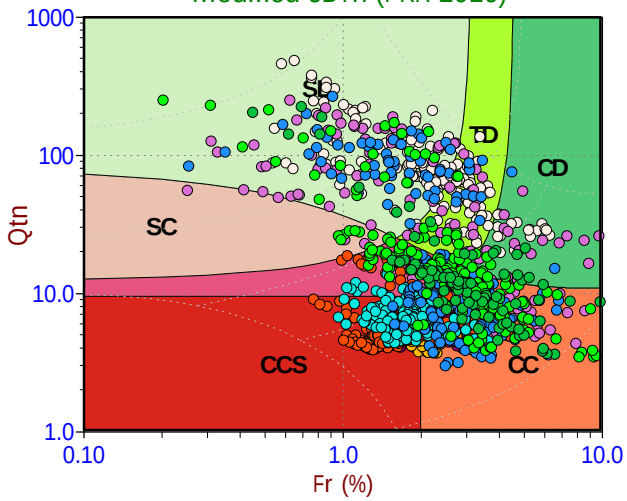
Qtn Chart (PKR 2009)



Standard SBT Chart (UBC 1986)



Modified SBTn (PKR 2016)



Depth Ranges

- >0.0 to 15.0 ft
- >15.0 to 30.0 ft
- >30.0 to 45.0 ft
- >45.0 to 60.0 ft
- >60.0 to 75.0 ft
- >75.0 to 90.0 ft
- >90.0 to 105.0 ft
- >105.0 to 120.0 ft
- >120.0 to 135.0 ft
- >135.0 to 150.0 ft
- >150.0 ft

Legend

- Sensitive, Fine Grained
- Organic Soils
- Clays
- Silt Mixtures
- Sand Mixtures
- Sands
- Gravelly Sand to Sand
- Stiff Sand to Clayey Sand
- Very Stiff Fine Grained

Legend

- Sensitive Fines
- Organic Soil
- Clay
- Silty Clay
- Clayey Silt
- Silt
- Sandy Silt
- Silty Sand/Sand
- Sand
- Gravelly Sand
- Stiff Fine Grained
- Cemented Sand

Legend

- CCS (Cont. sensitive clay like)
- CC (Cont. clay like)
- TC (Cont. transitional)
- SC (Cont. sand like)
- CD (Dil. clay like)
- TD (Dil. transitional)
- SD (Dil. sand like)

Pore Pressure Dissipation Summary and Pore Pressure Dissipation Plots

Job No:	21-59-23000
Client:	Shannon & Wilson, Inc.
Project:	Burnside Bridge Portland CPT
Start Date:	13-Sep-2021
End Date:	16-Sep-2021

CPTu PORE PRESSURE DISSIPATION SUMMARY

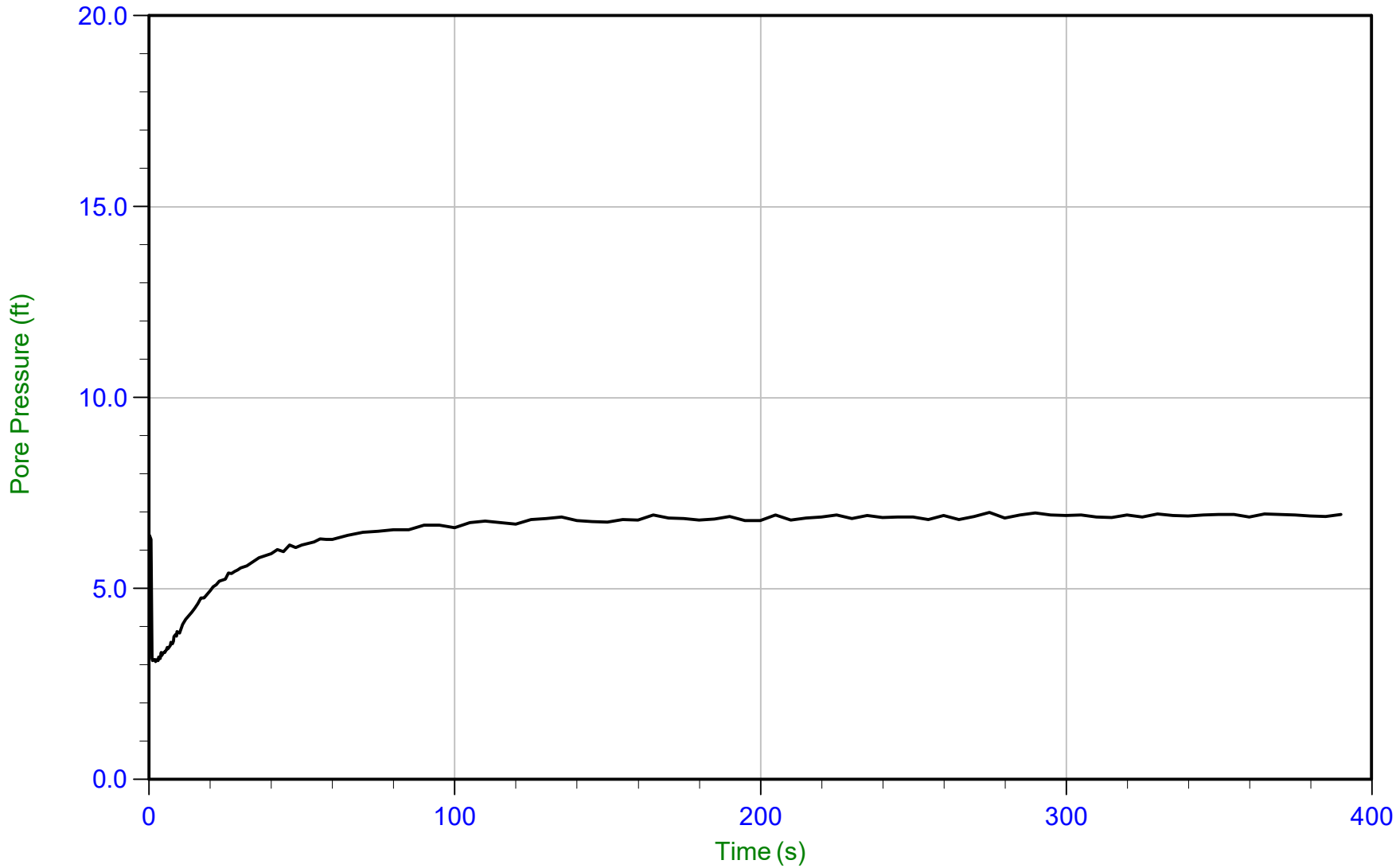
Sounding ID	File Name	Cone Area (cm^2)	Duration (s)	Test Depth (ft)	Estimated Equilibrium Pore Pressure U_{eq} (ft)	Calculated Phreatic Surface (ft)
CPT-01	21-59-23000_SP01.ppd2	15	390	29.5	6.9	22.6
CPT-02	21-59-23000_SP02.ppd2	15	370	29.8	7.2	22.6
CPT-03	21-59-23000_SP03.ppd2	15	1080	72.3	48.4	23.9
CPT-03	21-59-23000_SP03.ppd2	15	600	88.7	64.1	24.6
CPT-03	21-59-23000_SP03.ppd2	15	360	95.4	70.5	24.9
CPT-03	21-59-23000_SP03.ppd2	15	265	144.5	118.9	25.6
CPT-04	21-59-23000_SP04.ppd2	15	395	65.4	40.1	25.3
CPT-04	21-59-23000_SP04.ppd2	15	680	117.9	92.4	25.5
CPT-04	21-59-23000_SP04.ppd2	15	480	141.8	115.8	26.0
CPT-05	21-59-23000_SP05.ppd2	15	790	112.0	84.7	27.3
CPT-05	21-59-23000_SP05.ppd2	15	1000	117.9	90.5	27.4
CPT-05	21-59-23000_SP05.ppd2	15	205	148.9	121.1	27.9
CPT-06	21-59-23000_SP06.ppd2	15	790	88.7	65.3	23.5
CPT-06	21-59-23000_SP06.ppd2	15	790	124.8	101.6	23.3
CPT-06	21-59-23000_SP06.ppd2	15	200	145.7	121.6	24.1
CPT-07	21-59-23000_SP07.ppd2	15	650	75.8	48.5	27.3
CPT-07	21-59-23000_SP07.ppd2	15	390	105.3	77.3	28.1
CPT-07	21-59-23000_SP07.ppd2	15	385	140.3	113.2	27.1
CPT-08	21-59-23000_SP08.ppd2	15	390	65.5	42.1	23.4
CPT-08	21-59-23000_SP08.ppd2	15	390	94.8	71.0	23.8
Total Duration			176.7 mins			

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/16/2021 11:01
Site: Burnside Bridge Portland CPT

Sounding: CPT-01
Cone: 781:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP01.ppd2
Depth: 9.000 m / 29.527 ft
Duration: 390.0 s

u Min: 3.1 ft
u Max: 7.0 ft
u Final: 6.9 ft

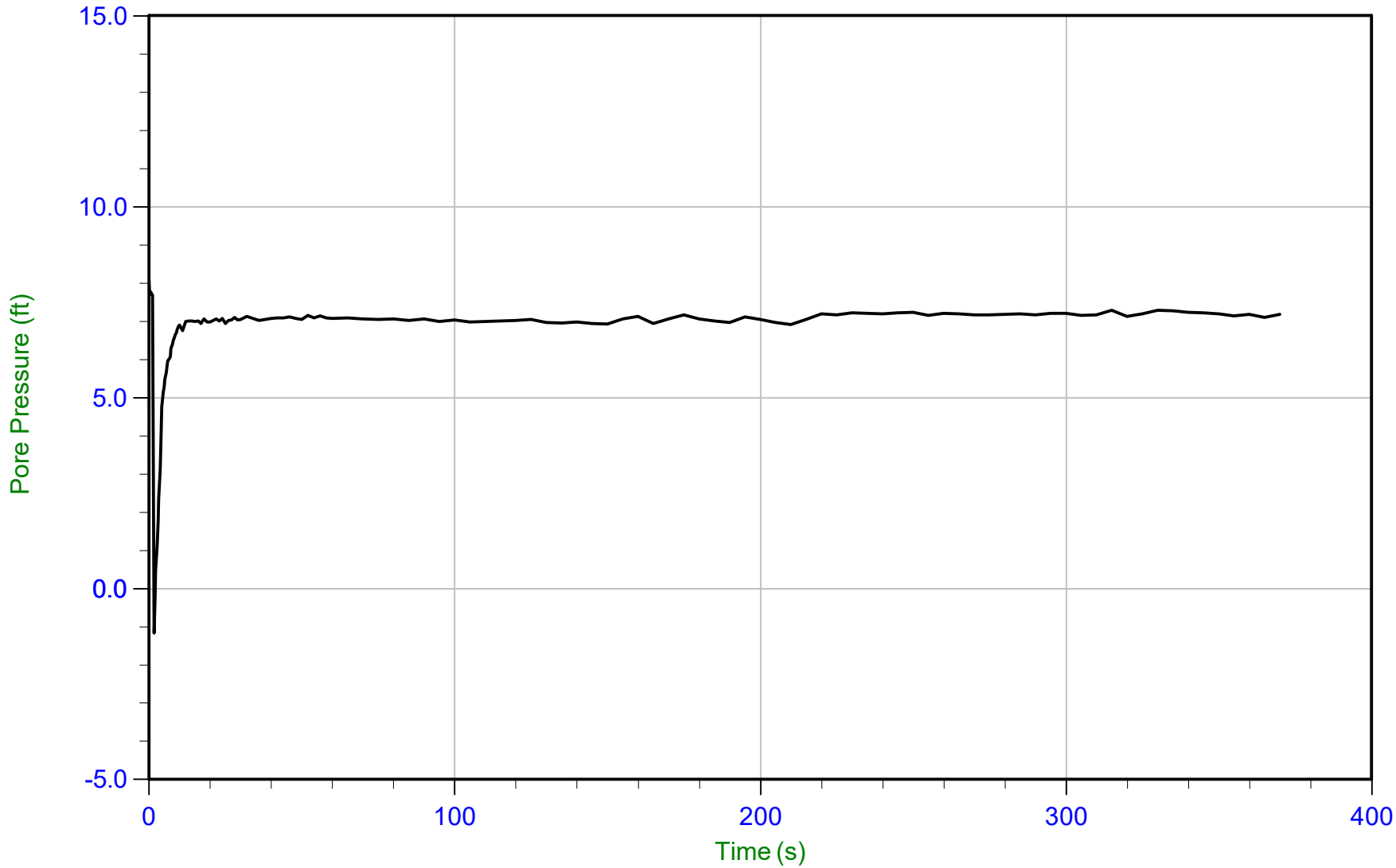
WT: 6.890 m / 22.605 ft
Ueq: 6.9 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/16/2021 12:17
Site: Burnside Bridge Portland CPT

Sounding: CPT-02
Cone: 781:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP02.ppd2
Depth: 9.075 m / 29.773 ft
Duration: 370.0 s

u Min: -1.2 ft
u Max: 8.1 ft
u Final: 7.2 ft

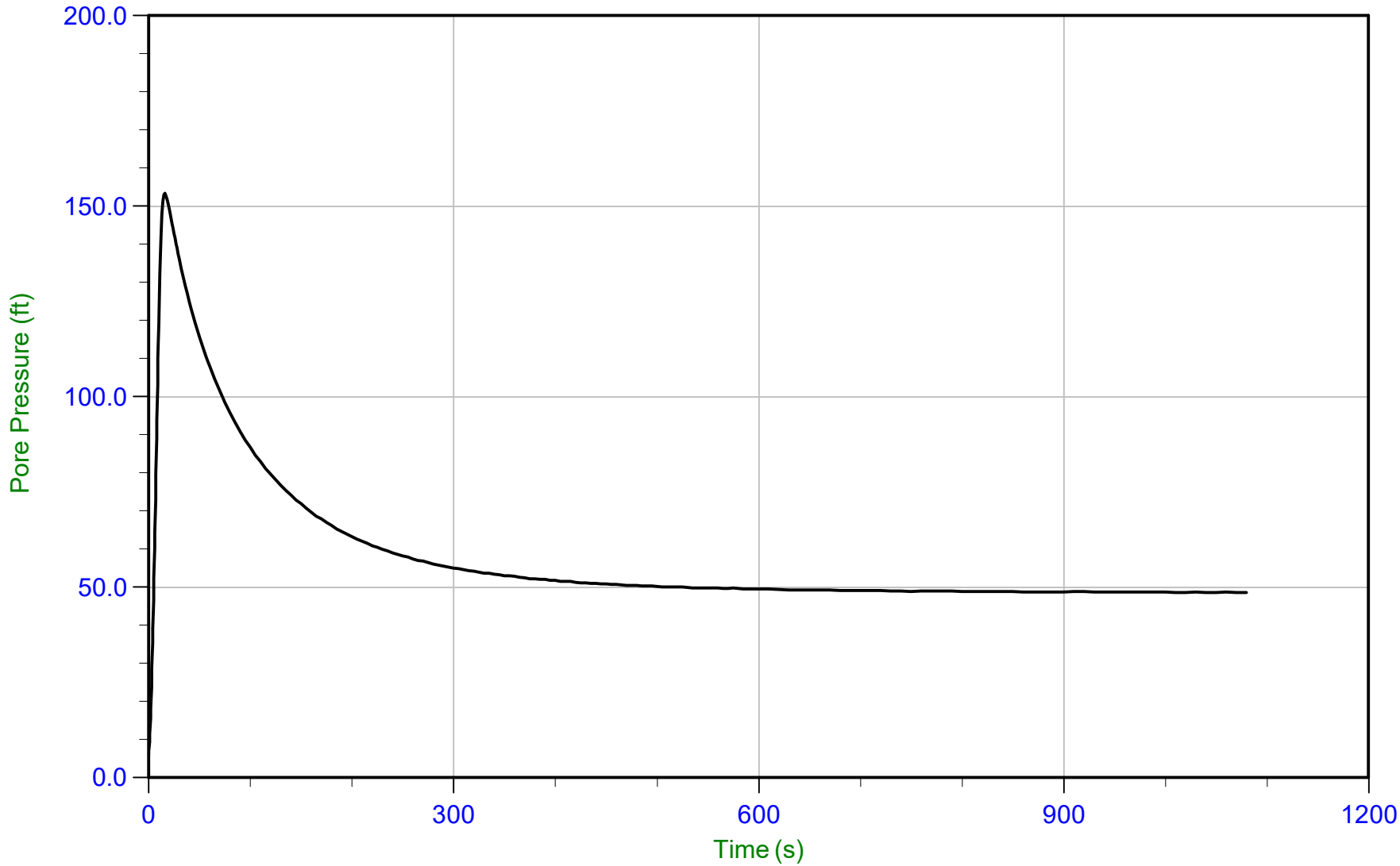
WT: 6.884 m / 22.585 ft
Ueq: 7.2 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/13/2021 11:00
Site: Burnside Bridge Portland CPT

Sounding: CPT-03
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP03.ppd2
Depth: 22.050 m / 72.342 ft
Duration: 1080.0 s

u Min: 6.0 ft
u Max: 153.4 ft
u Final: 48.7 ft

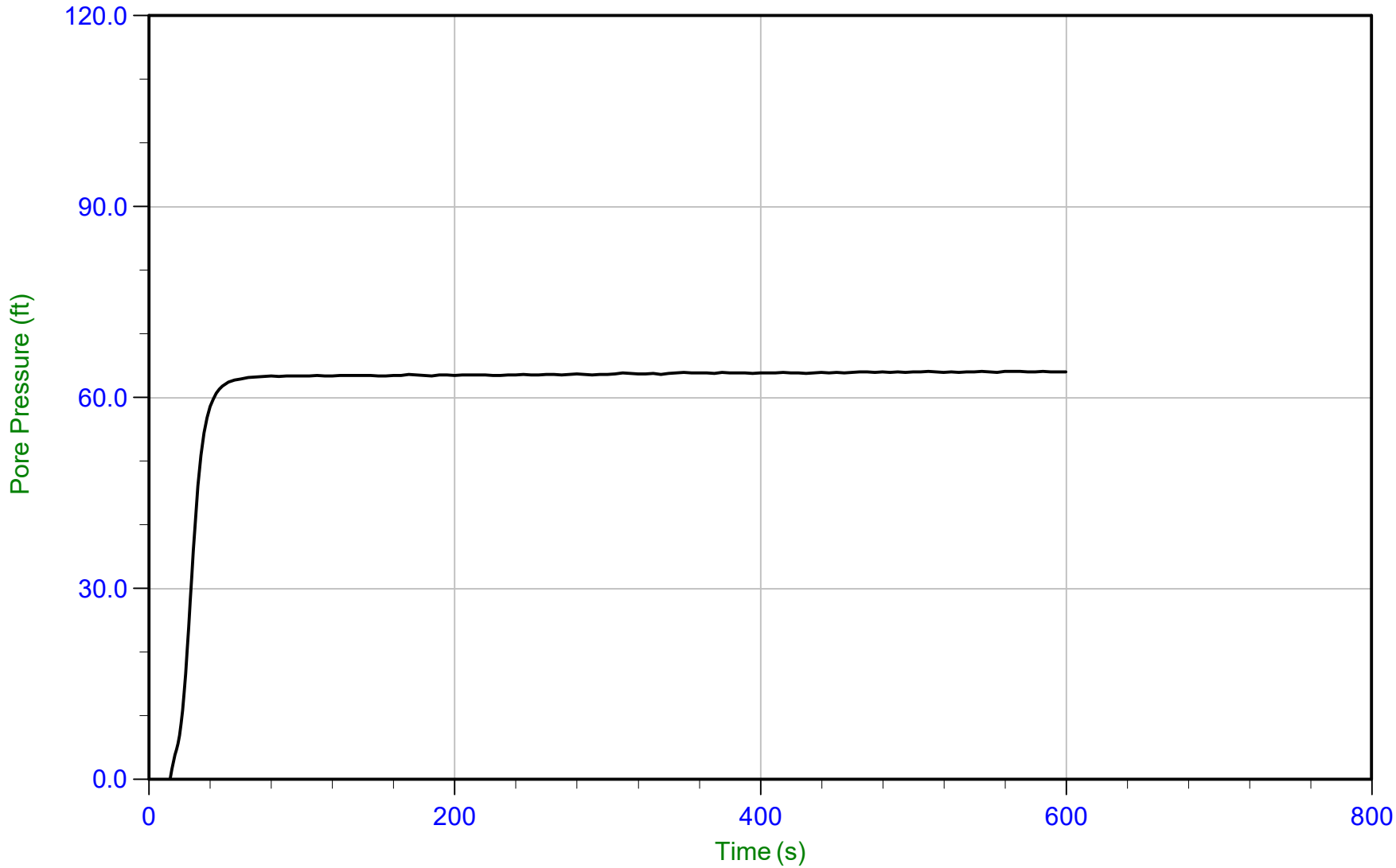
WT: 7.291 m / 23.920 ft
Ueq: 48.4 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/13/2021 11:00
Site: Burnside Bridge Portland CPT

Sounding: CPT-03
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP03.ppd2
Depth: 27.050 m / 88.746 ft
Duration: 600.0 s

u Min: -18.4 ft
u Max: 64.1 ft
u Final: 64.1 ft

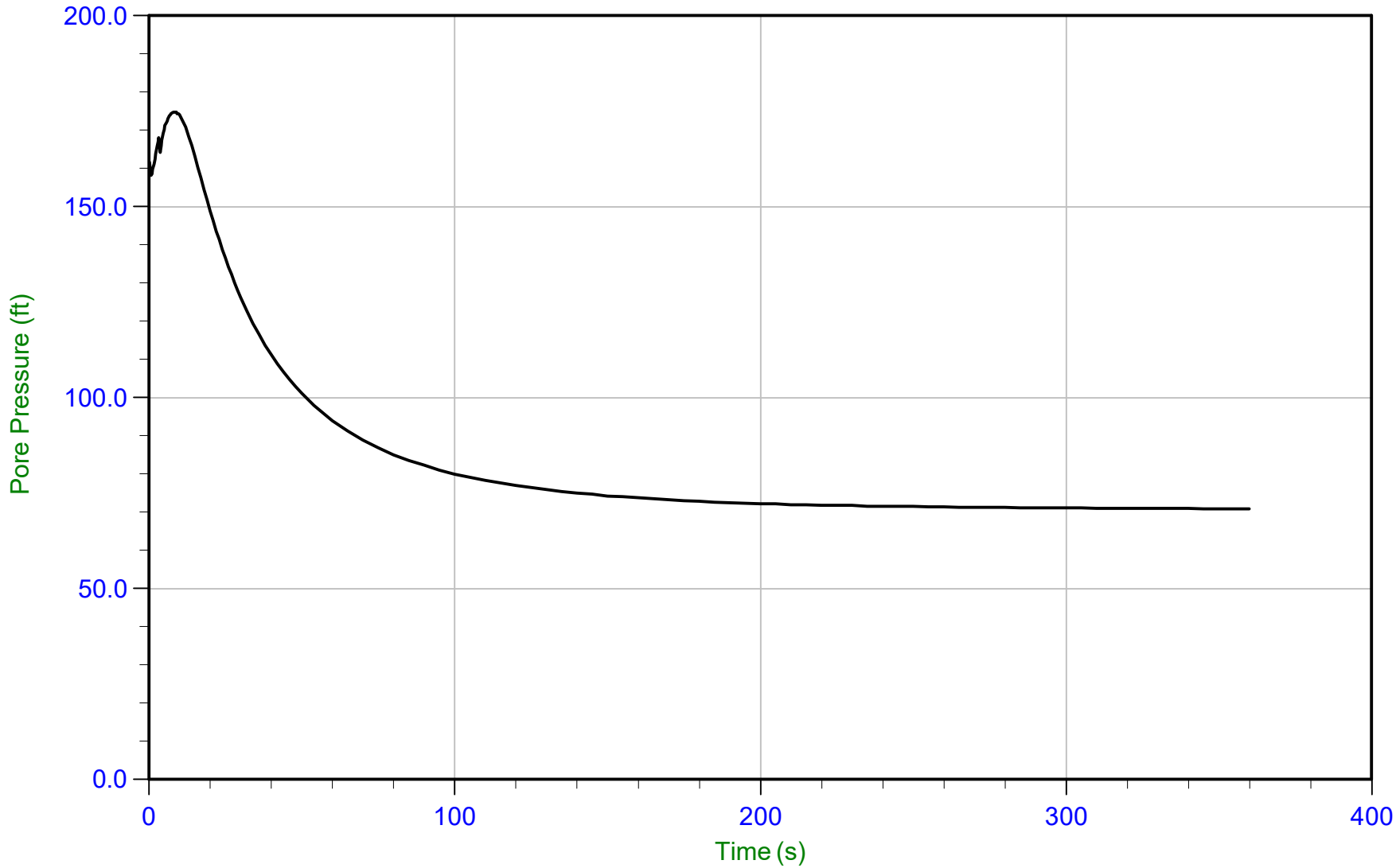
WT: 7.511 m / 24.642 ft
Ueq: 64.1 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/13/2021 11:00
Site: Burnside Bridge Portland CPT

Sounding: CPT-03
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP03.ppd2
Depth: 29.075 m / 95.389 ft
Duration: 360.0 s

u Min: 70.8 ft
u Max: 174.8 ft
u Final: 70.9 ft

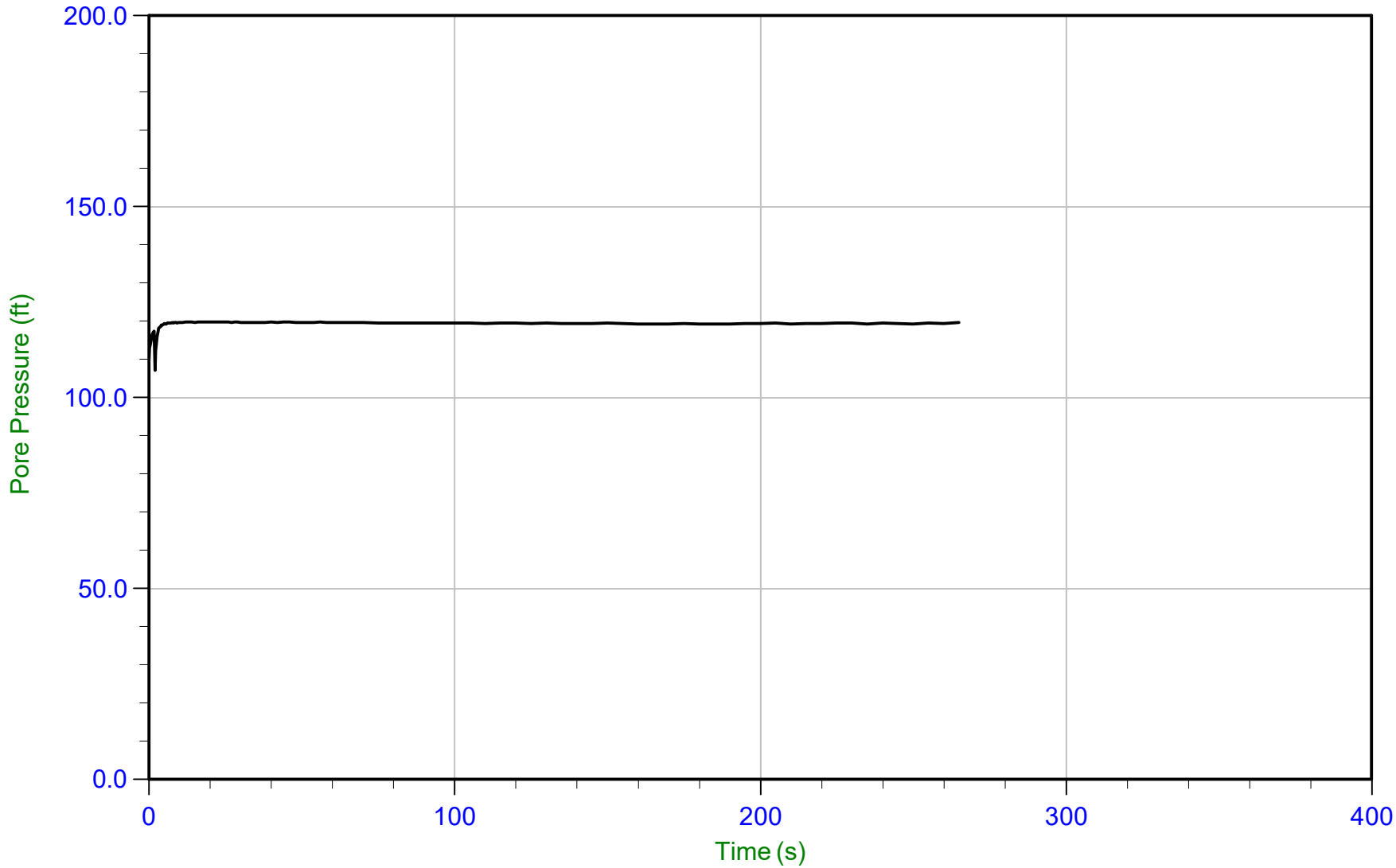
WT: 7.579 m / 24.865 ft
Ueq: 70.5 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/13/2021 11:00
Site: Burnside Bridge Portland CPT

Sounding: CPT-03
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP03.ppd2
Depth: 44.050 m / 144.519 ft
Duration: 265.0 s

u Min: 107.1 ft
u Max: 119.8 ft
u Final: 119.6 ft

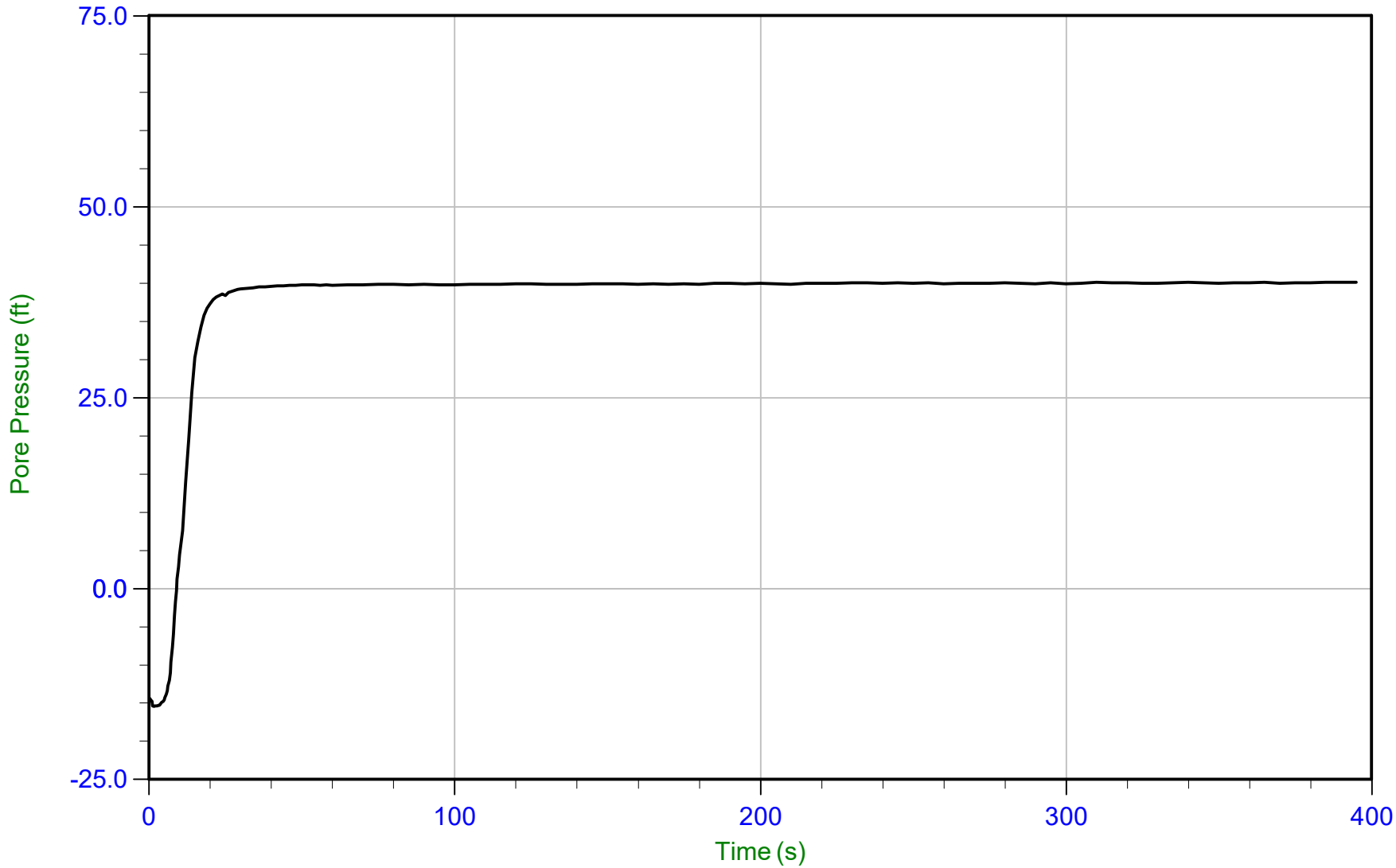
WT: 7.795 m / 25.574 ft
Ueq: 118.9 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/13/2021 14:50
Site: Burnside Bridge Portland CPT

Sounding: CPT-04
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP04.ppd2
Depth: 19.925 m / 65.370 ft
Duration: 395.0 s

u Min: -15.4 ft
u Max: 40.1 ft
u Final: 40.1 ft

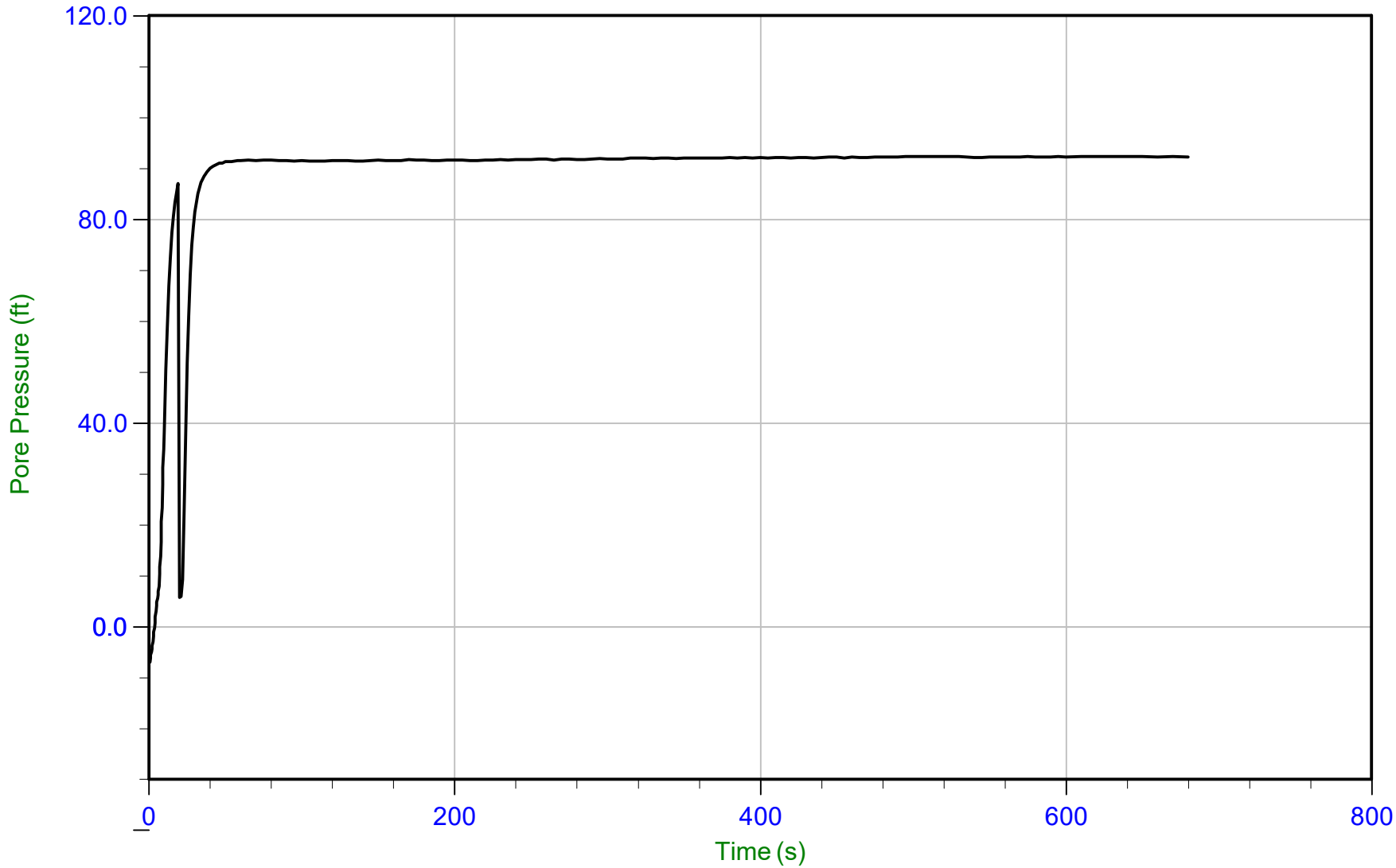
WT: 7.717 m / 25.318 ft
Ueq: 40.1 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/13/2021 14:50
Site: Burnside Bridge Portland CPT

Sounding: CPT-04
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP04.ppd2
Depth: 35.925 m / 117.863 ft
Duration: 680.0 s

u Min: -6.9 ft
u Max: 92.4 ft
u Final: 92.3 ft

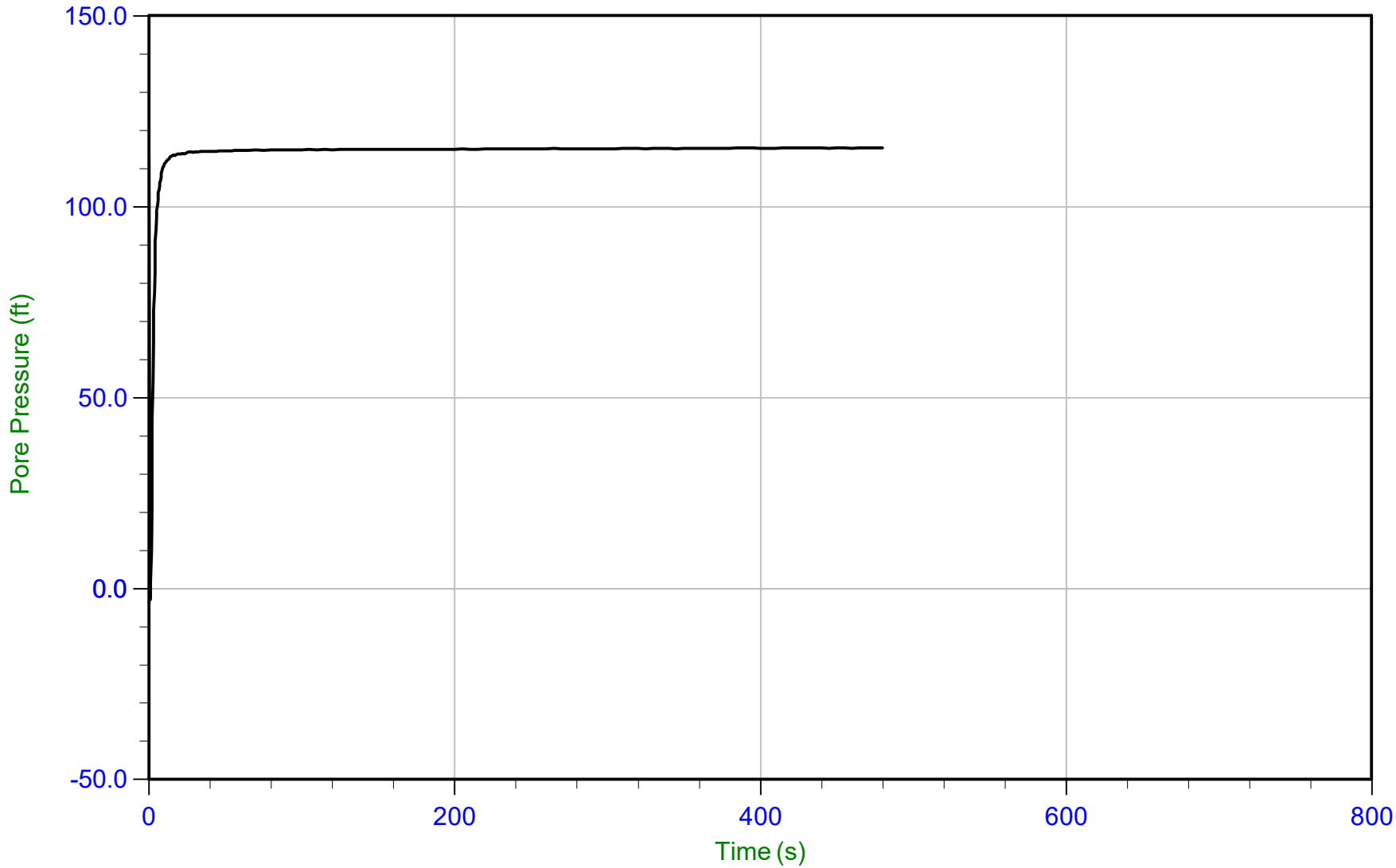
WT: 7.771 m / 25.495 ft
Ueq: 92.4 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/13/2021 14:50
Site: Burnside Bridge Portland CPT

Sounding: CPT-04
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP04.ppd2
Depth: 43.225 m / 141.813 ft
Duration: 480.0 s

u Min: -3.0 ft
u Max: 115.4 ft
u Final: 115.4 ft

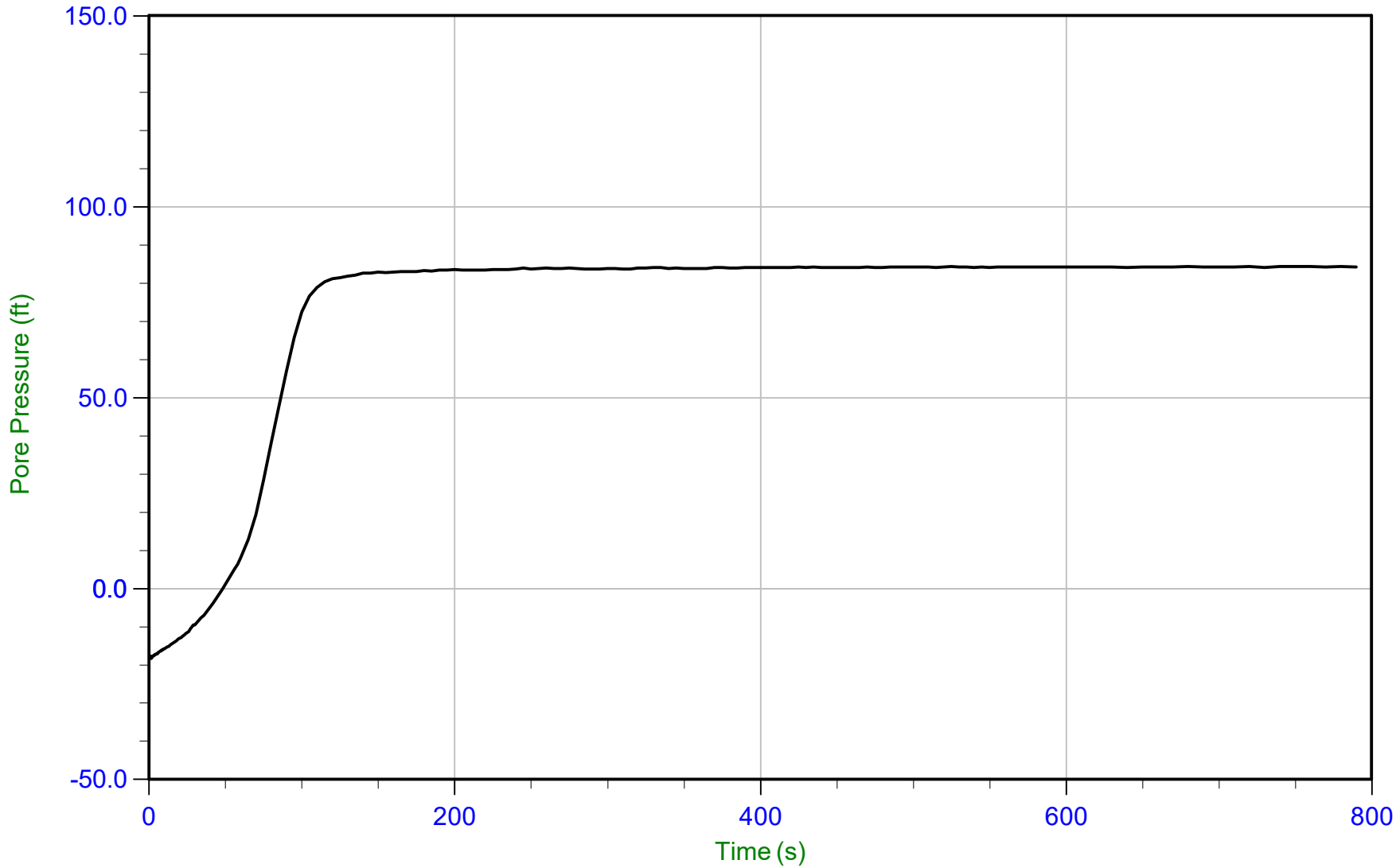
WT: 7.932 m / 26.023 ft
Ueq: 115.8 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/14/2021 08:06
Site: Burnside Bridge Portland CPT

Sounding: CPT-05
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP05.ppd2
Depth: 34.150 m / 112.039 ft
Duration: 790.0 s

u Min: -18.3 ft
u Max: 84.3 ft
u Final: 84.3 ft

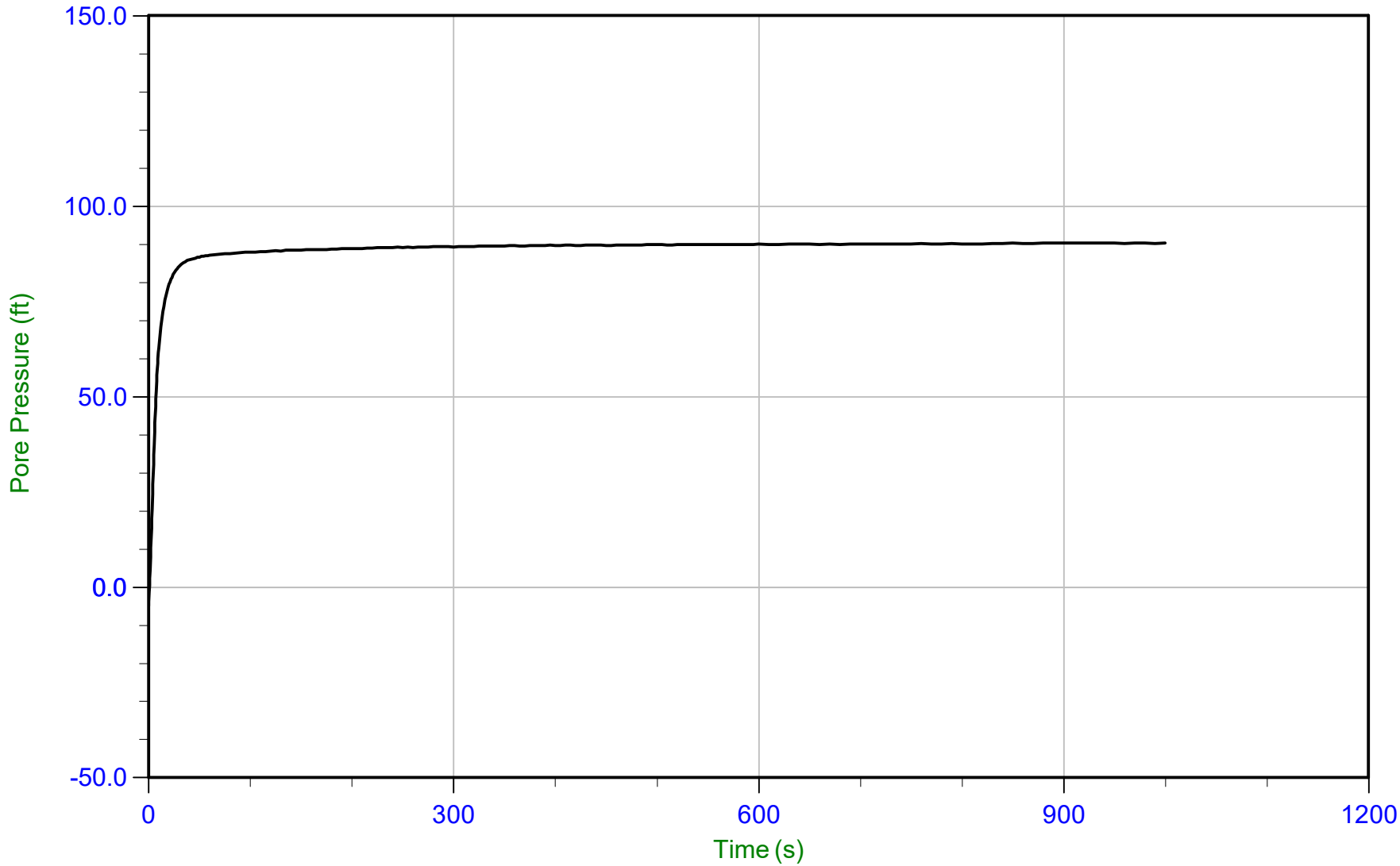
WT: 8.322 m / 27.303 ft
Ueq: 84.7 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/14/2021 08:06
Site: Burnside Bridge Portland CPT

Sounding: CPT-05
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP05.ppd2
Depth: 35.950 m / 117.945 ft
Duration: 1000.0 s

u Min: -4.8 ft
u Max: 90.4 ft
u Final: 90.3 ft

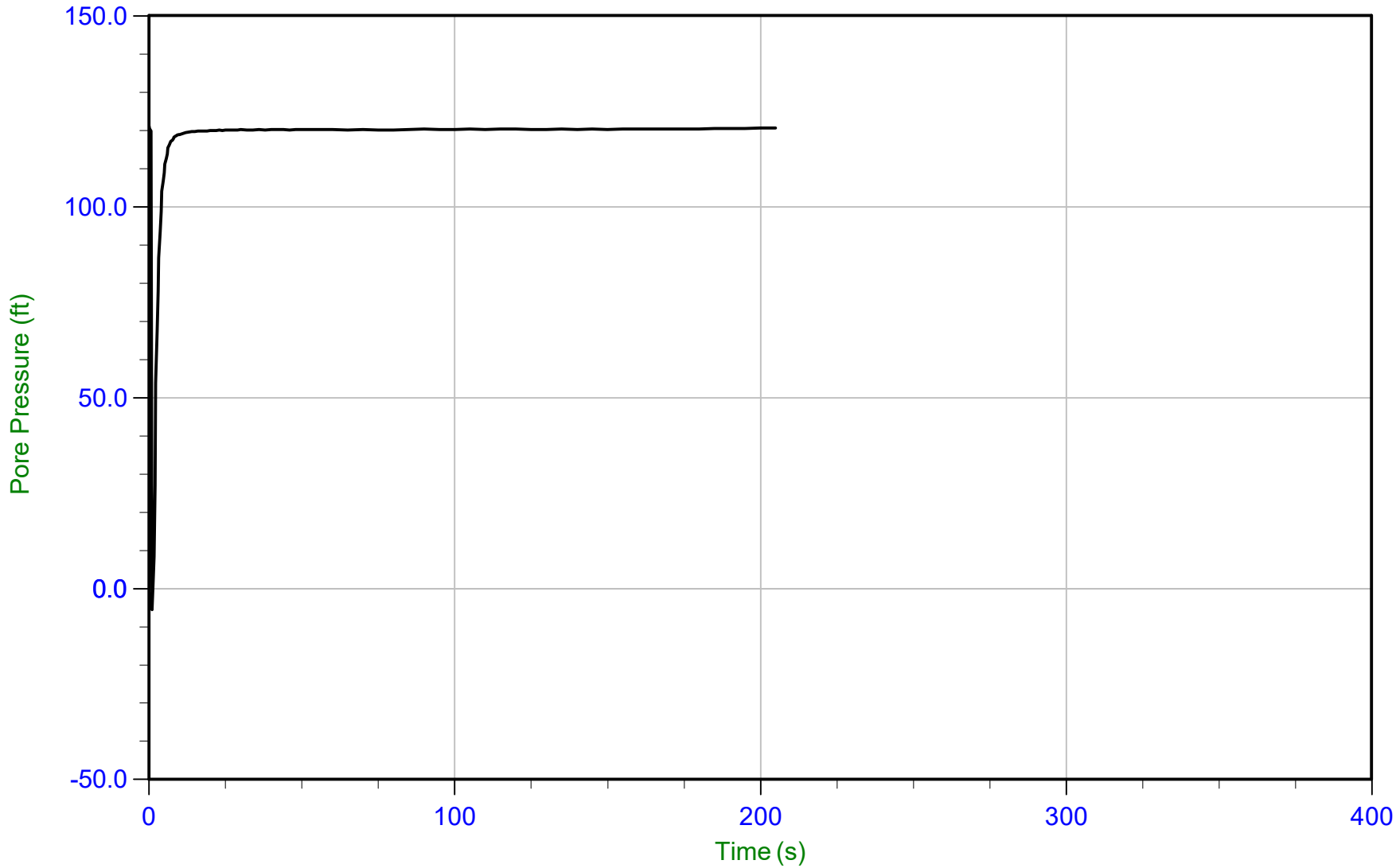
WT: 8.358 m / 27.421 ft
Ueq: 90.5 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/14/2021 08:06
Site: Burnside Bridge Portland CPT

Sounding: CPT-05
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP05.ppd2
Depth: 45.400 m / 148.948 ft
Duration: 205.0 s

u Min: -5.5 ft
u Max: 121.2 ft
u Final: 120.6 ft

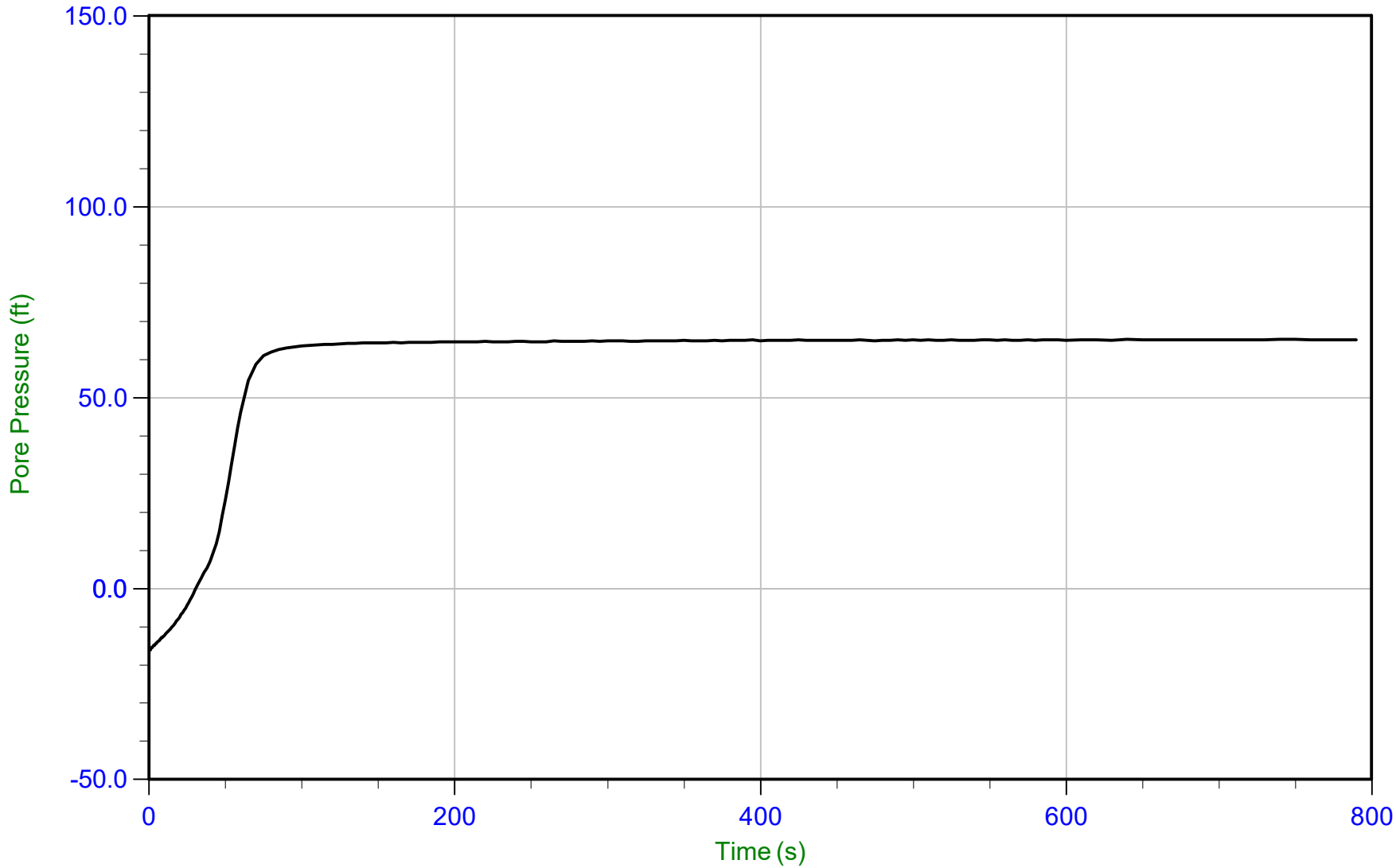
WT: 8.503 m / 27.897 ft
Ueq: 121.1 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/14/2021 12:43
Site: Burnside Bridge Portland CPT

Sounding: CPT-06
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP06.ppd2
Depth: 27.050 m / 88.746 ft
Duration: 790.0 s

u Min: -16.2 ft
u Max: 65.2 ft
u Final: 65.2 ft

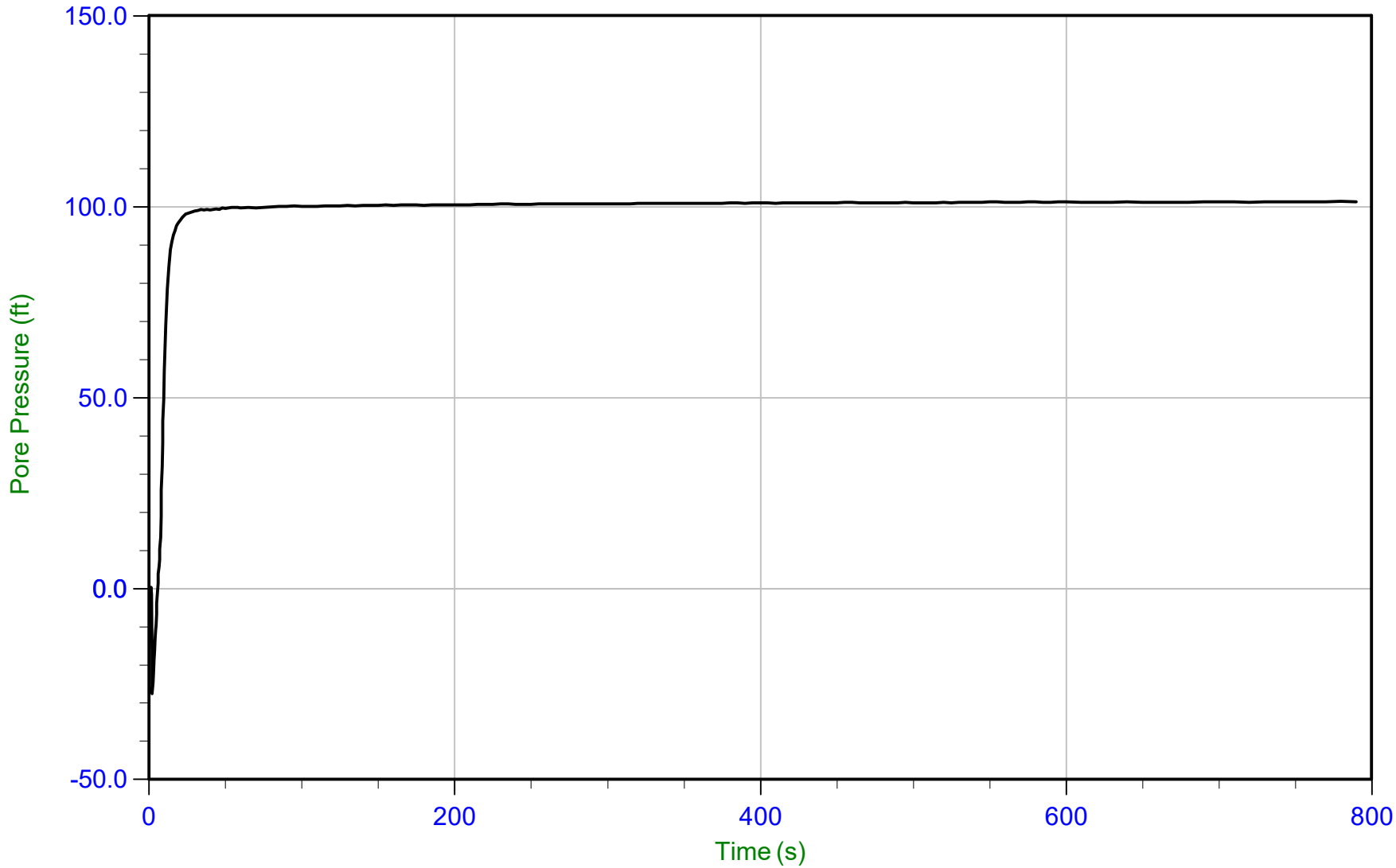
WT: 7.158 m / 23.484 ft
Ueq: 65.3 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/14/2021 12:43
Site: Burnside Bridge Portland CPT

Sounding: CPT-06
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP06.ppd2
Depth: 38.050 m / 124.834 ft
Duration: 790.0 s

u Min: -27.5 ft
u Max: 101.3 ft
u Final: 101.3 ft

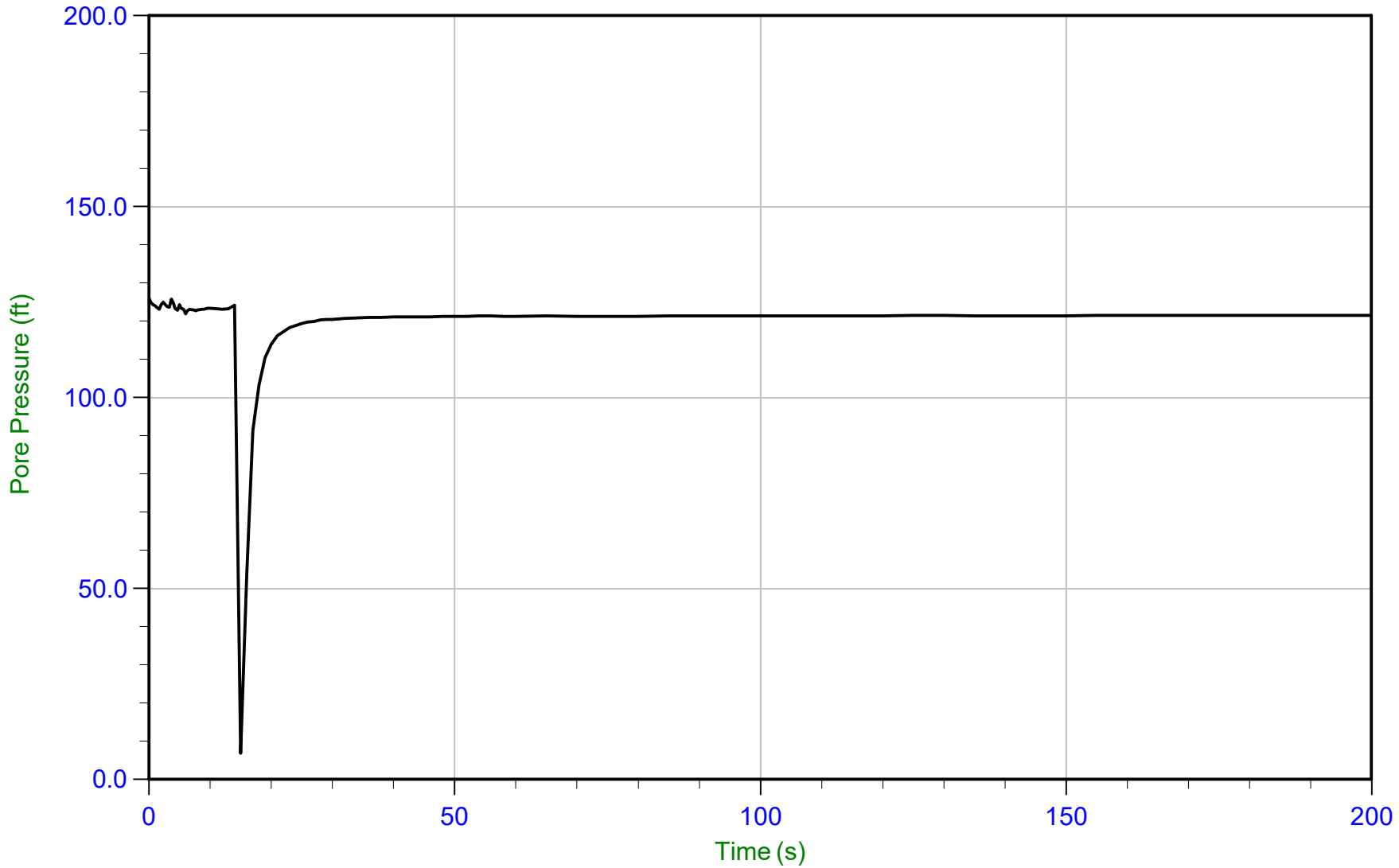
WT: 7.089 m / 23.258 ft
Ueq: 101.6 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/14/2021 12:43
Site: Burnside Bridge Portland CPT

Sounding: CPT-06
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP06.ppd2
Depth: 44.400 m / 145.668 ft
Duration: 200.0 s

u Min: 6.9 ft
u Max: 126.1 ft
u Final: 121.6 ft

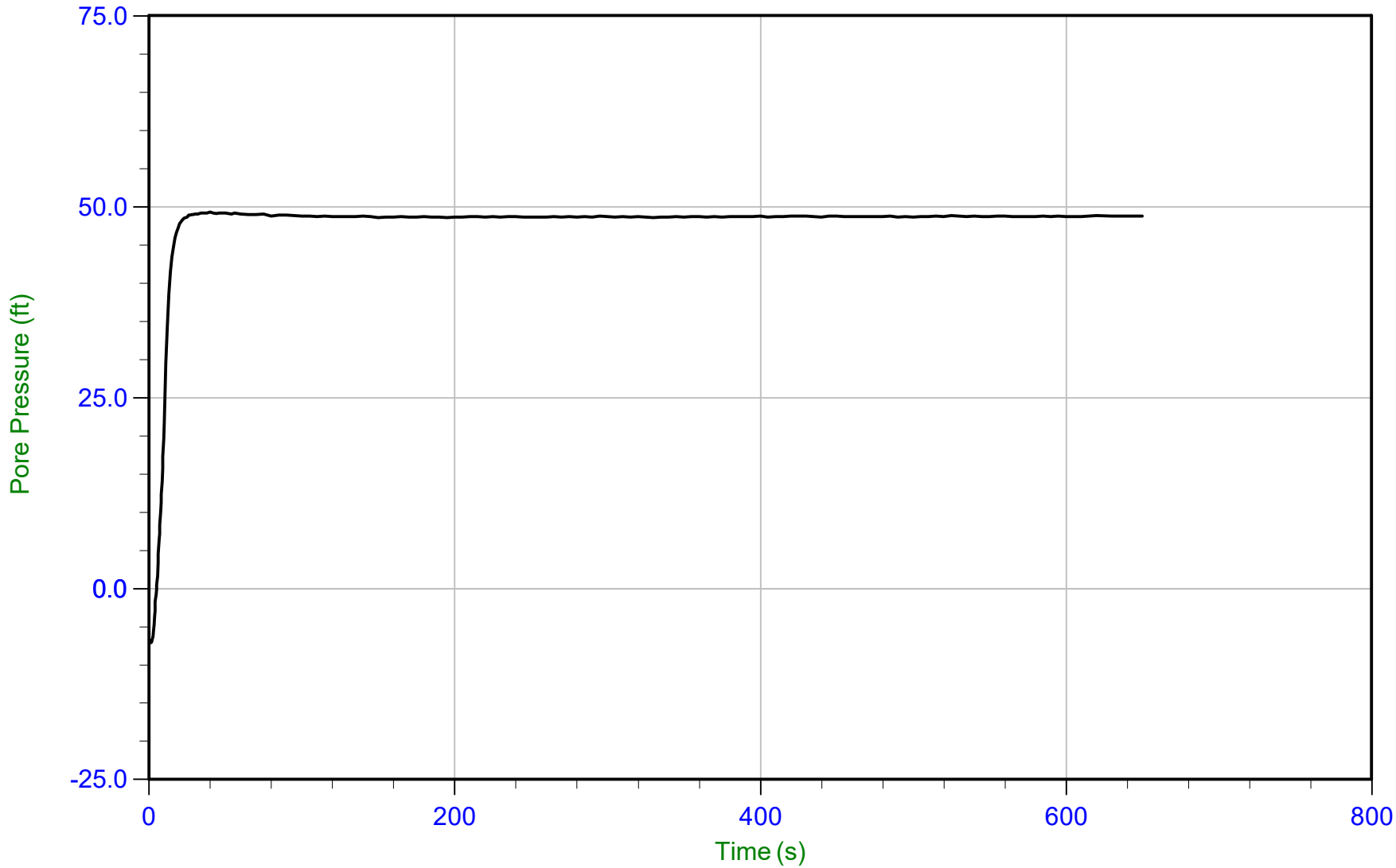
WT: 7.343 m / 24.090 ft
Ueq: 121.6 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/15/2021 08:28
Site: Burnside Bridge Portland CPT

Sounding: CPT-07
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP07.ppd2
Depth: 23.100 m / 75.786 ft
Duration: 650.0 s

u Min: -7.1 ft
u Max: 49.3 ft
u Final: 48.8 ft

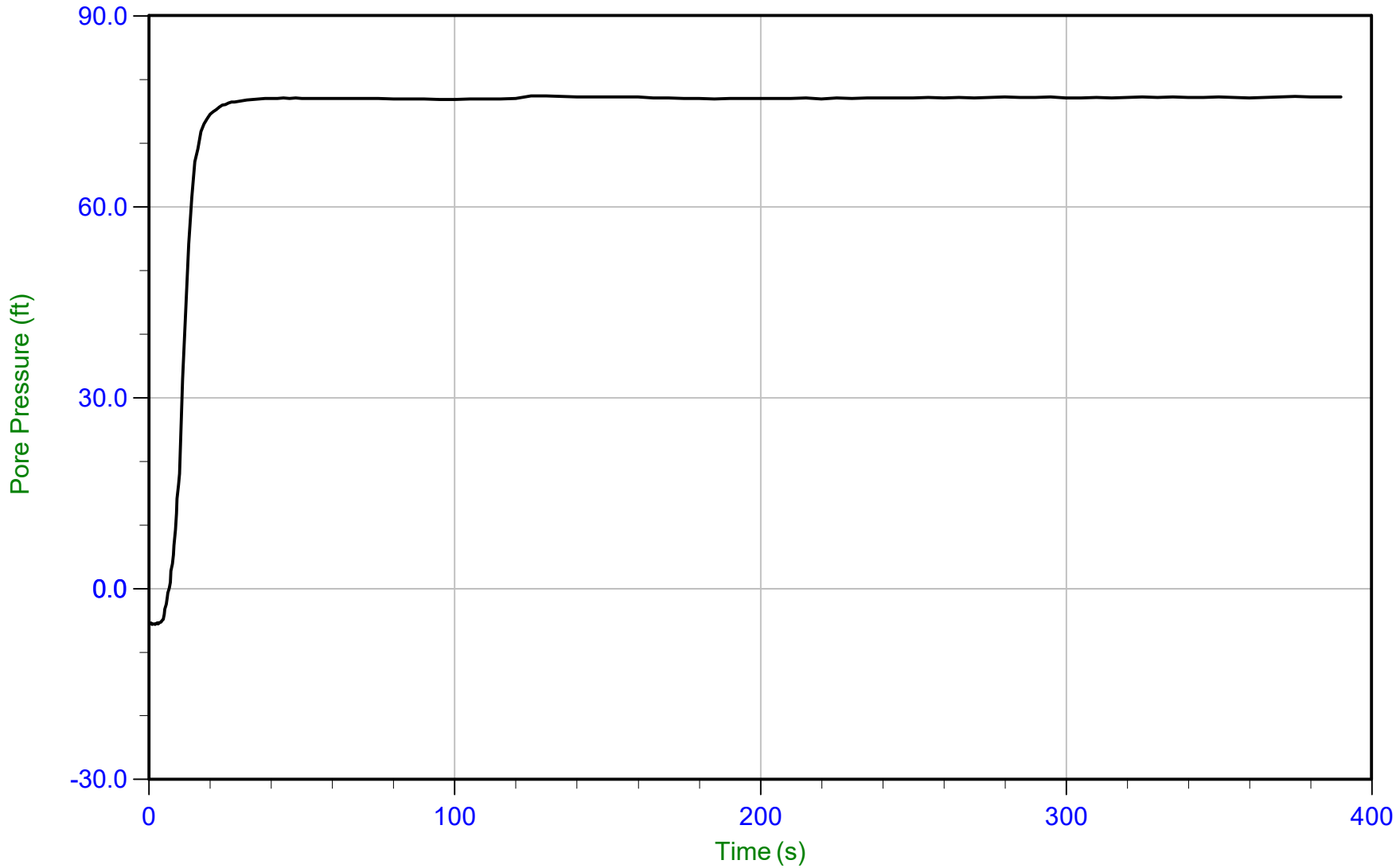
WT: 8.309 m / 27.260 ft
Ueq: 48.5 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/15/2021 08:28
Site: Burnside Bridge Portland CPT

Sounding: CPT-07
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP07.ppd2
Depth: 32.100 m / 105.314 ft
Duration: 390.0 s

u Min: -5.7 ft
u Max: 77.4 ft
u Final: 77.2 ft

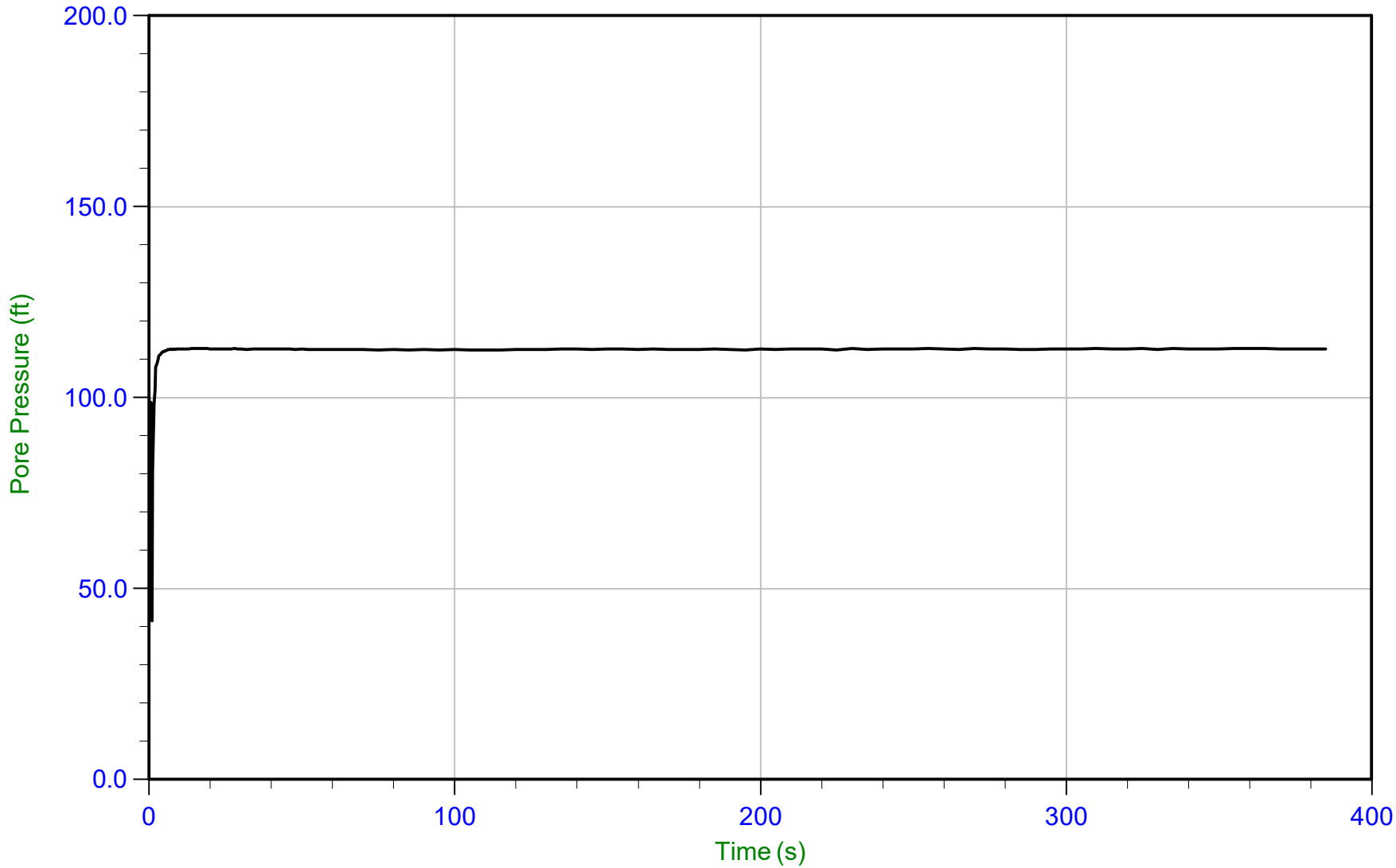
WT: 8.550 m / 28.051 ft
Ueq: 77.3 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/15/2021 08:28
Site: Burnside Bridge Portland CPT

Sounding: CPT-07
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP07.ppd2
Depth: 42.750 m / 140.254 ft
Duration: 385.0 s

u Min: 41.5 ft
u Max: 112.9 ft
u Final: 112.7 ft

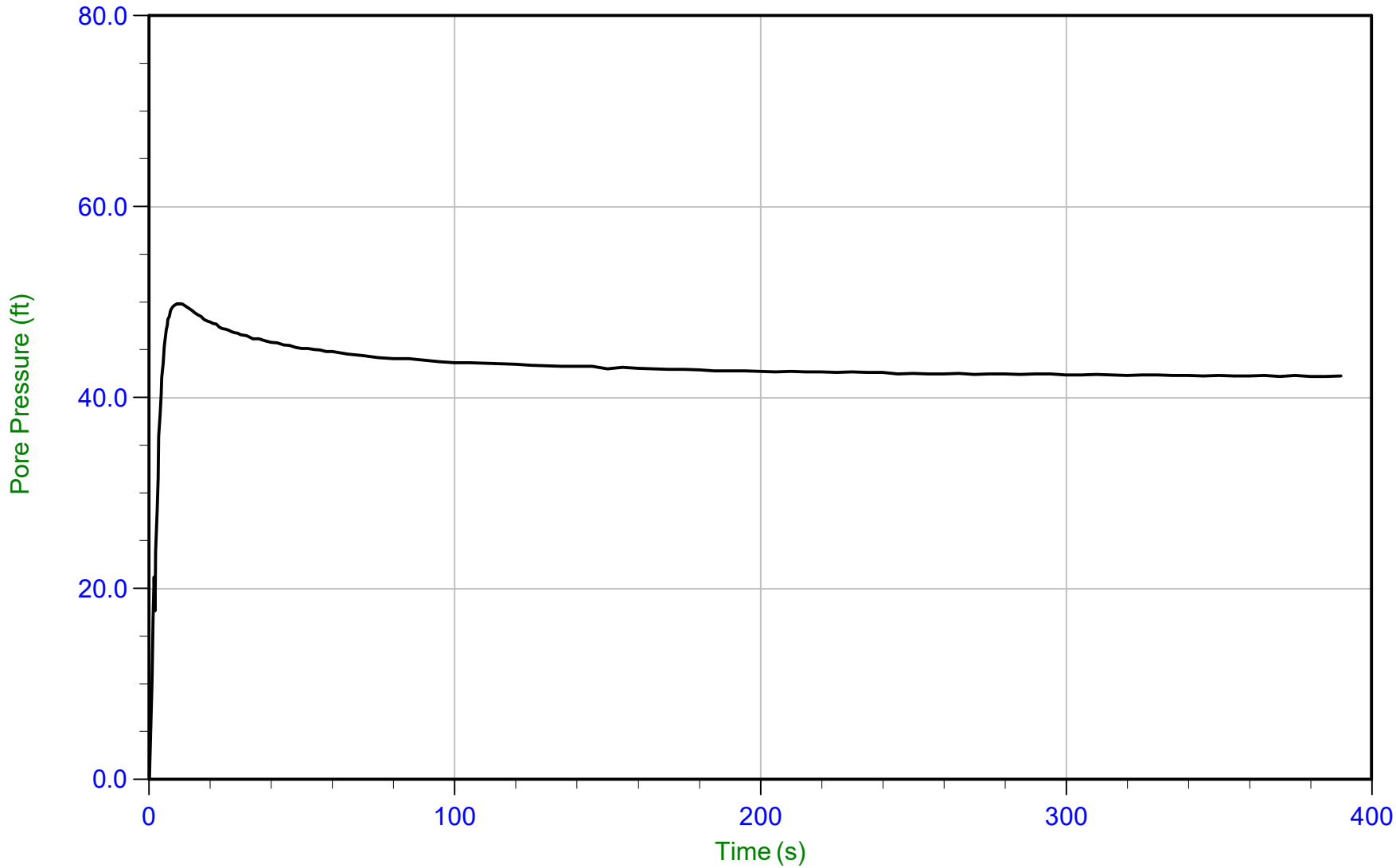
WT: 8.259 m / 27.096 ft
Ueq: 113.2 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/16/2021 07:19
Site: Burnside Bridge Portland CPT

Sounding: CPT-08
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP08.ppd2
Depth: 19.975 m / 65.534 ft
Duration: 390.0 s

u Min: -3.3 ft
u Max: 49.8 ft
u Final: 42.3 ft

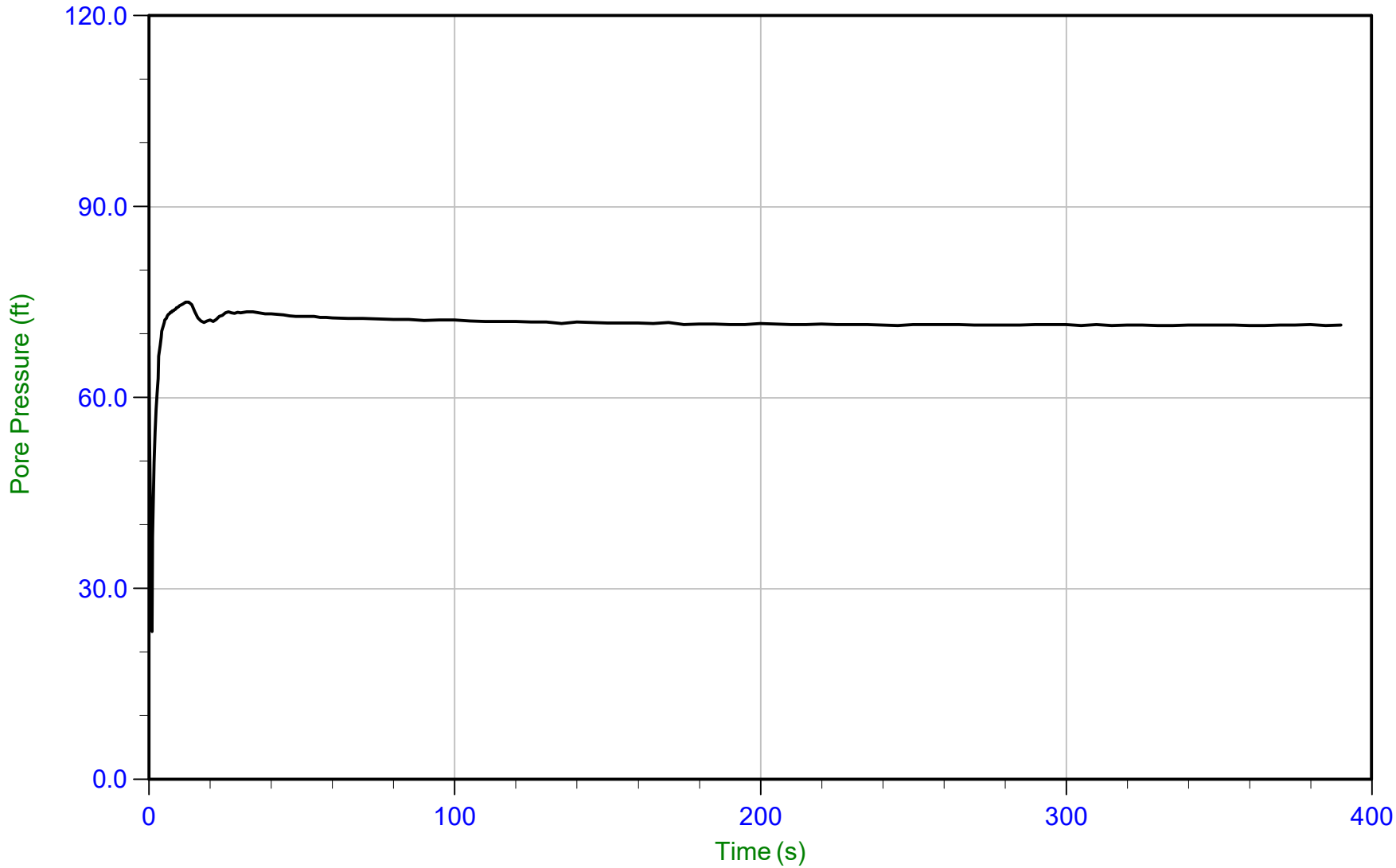
WT: 7.141 m / 23.428 ft
Ueq: 42.1 ft

CONETEC

Shannon & Wilson

Job No: 21-59-23000
Date: 09/16/2021 07:19
Site: Burnside Bridge Portland CPT

Sounding: CPT-08
Cone: 780:T1500F15U35 Area=15 cm²



Trace Summary:

Filename: 21-59-23000_SP08.ppd2
Depth: 28.900 m / 94.815 ft
Duration: 390.0 s

u Min: 23.2 ft
u Max: 75.0 ft
u Final: 71.4 ft

WT: 7.259 m / 23.815 ft
Ueq: 71.0 ft

APPENDIX E: LABORATORY TESTING

Appendix E

Laboratory Testing

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Attachments

1: Northwest Testing, Inc., Technical Report, dated November 28, 2016

2: Northwest Testing, Inc., Technical Report, dated August 31, 2021

3: Northwest Testing, Inc., Technical Report, dated November 22, 2021

4: Oregon State University, Cyclic Testing Data Report, dated January 10, 2022

5: GeoTesting Express results, dated November 24, 2021

APPENDIX E: LABORATORY TESTING

E.1 SOIL TESTING

The samples obtained during the field explorations were described and identified in the field in accordance with the ODOT Soil and Rock Classification Manual (1987). The samples were then reviewed in the laboratory. Physical characteristics of the samples were noted, and field descriptions and identifications were modified as necessary. During the course of the examination, representative samples were selected for further testing. We refined our descriptions and identifications based on the results of the laboratory tests, in accordance with the ODOT Soil and Rock Classification Manual (1987).

The soil testing program included moisture content tests, unit weight analyses, Atterberg limits tests, particle size analyses, consolidation tests, compressibility tests, bender element tests, monotonic direct simple shear tests, cyclic direct simple shear tests, post-cyclic monotonic direct simple shear tests, post-cyclic reconsolidation tests, and corrosivity testing. Testing was completed by Shannon & Wilson and outside labs, including Northwest Testing, Inc. (NTI), of Wilsonville, Oregon, Oregon State University (OSU) in Corvallis, Oregon, and GeoTesting Express, Inc. (GTX), of Acton, Massachusetts. All test procedures were performed in accordance with applicable ASTM International standards, except as noted. Test procedures are summarized in the following paragraphs and in the attached reports. Test results are included in Table E1, Summary of Laboratory Test Results. Table E1 also provides a reference to data contained in the attached testing reports. Additional laboratory tests are in progress; results will be included in subsequent geotechnical reports.

E.1.1 Moisture (Natural Water) Content

Natural moisture content tests were performed in accordance with ASTM D2216 on selected soil samples. The natural moisture content is a measure of the amount of moisture in the soil and is defined as the ratio of water weight to dry soil weight, expressed as a percentage. Natural moisture content tests were performed by Shannon & Wilson, NTI, and OSU. Results of all natural moisture content tests are presented in Table E1 and on the Drill Logs in Appendix B. Results of natural moisture content tests performed by outside labs are also presented in their respective reports, which are attached to the end of this appendix.

E.1.2 Unit Weight

Unit weights were determined on selected undisturbed Shelby tube samples in accordance with ASTM D7263. The wet and dry unit weights were calculated by measuring the dimensions of selected cylindrical samples, the sample weights, and moisture contents. Unit weight is defined as the ratio of soil weight in pounds (wet and dry) to the in-place

volume of the sample in cubic feet and is presented in pounds per cubic foot (pcf). Unit weight analyses were performed by NTI. Results of all unit weight analyses are presented in Table E1 and on the Drill Logs in Appendix B. Results of unit weight analyses performed by outside labs are also presented in their respective reports, which are attached to the end of this appendix.

E.1.3 Atterberg Limits

Atterberg limits were determined for selected samples in accordance with ASTM D4318. This analysis yields index parameters of the soil that are useful in soil identification, as well as in a number of engineering analyses, including liquefaction analysis. An Atterberg limits test determines a soil's liquid limit (LL) and plastic limit (PL). These are the maximum and minimum moisture contents at which the soil exhibits plastic behavior. A soil's plasticity index (PI) can be determined by subtracting PL from LL. Atterberg limits analyses were performed by Shannon & Wilson, NTI, and OSU. The LL, PL, and PI of the tested samples are presented on the Atterberg Limits Results, Figure E1. The results are shown in tabular format in Table E1. Results of analyses performed by outside labs are also presented in their respective reports, which are attached to the end of this appendix. For the purposes of soil description, we use the term nonplastic to refer to soils with a PI less than 3, low plasticity for soils with a PI range of 3 to 15, medium plasticity for soils with a PI range of 15 to 30, and high plasticity for soils with a PI greater than 30.

E.1.4 Particle-Size Analysis

Particle-size analyses were conducted on select samples in accordance with ASTM C117, C136, D422, D1140, D7928, and D6913. A wet sieve analysis was performed to determine a percentage (by weight) of the sample passing the No. 200 (0.075 mm) sieve (ASTM C117, D1140). For some samples, the material retained on the No. 200 sieve was shaken through a series of sieves to determine the distribution of the plus No. 200 fraction (ASTM C136, D6913). Some grain-size distributions also included a hydrometer analysis (ASTM D422, D7928). The hydrometer analysis yields the grain-size distribution of the sample fraction finer than the No. 200 sieve. Particle size analyses were performed by Shannon & Wilson, NTI, and OSU. Results of all particle-size analyses are plotted on Figure E2, Grain Size Distribution. The results are shown in tabular format in Table E1. Results of analyses performed by outside labs are also presented in their respective reports, which are attached to the end of this appendix.

E.1.5 Consolidation

One-dimensional consolidation tests were performed on selected samples in general accordance with the One-Dimensional Consolidation Properties of Saturated Cohesive Soils

Using Controlled-Strain Loading (ASTM D4186, except as noted in the attached reports). This test measures the volume change and rate of volume change of soil samples under a constant rate of strain. Each specimen is trimmed and fit into the testing apparatus. A constant rate of strain applied, the specimen is permitted to consolidate, and the amount of consolidation, axial force, and base excess pressure are measured at specified time intervals.

All consolidation tests were performed by outside labs. Test results are presented on outside lab plots, which are attached to the end of this appendix. Refer to Table E1 to locate the relevant attachment numbers.

E.1.6 Cyclic and Post-Cyclic Testing

Cyclic Direct Simple Shear (CDSS), post-cyclic monotonic Direct Simple Shear (DSS), post-cyclic reconsolidation, and bender element-based shear wave velocity tests were performed on selected undisturbed samples. CDSS tests were performed in general accordance with Consolidated Undrained Cyclic Direct Simple Shear Test under Constant Volume with Load Control or Displacement Control (ASTM D8296) and DSS tests with Consolidated Undrained Direct Simple Shear Testing of Fine Grained Soils (ASTM D6528), except as noted in the attached report. All cyclic and post-cyclic tests were performed by outside labs. Test results are presented on plots provided in the reports compiled by the outside lab, and attached to the end of this appendix. Refer to Table E1 to locate the relevant attachment numbers.

E.1.7 Corrosivity Potential

Analytical testing was performed on selected specimens to evaluate the corrosivity potential of the soil at the Burnside Bridge site. The corrosivity test suite included resistivity, chloride concentration, soil pH, and sulfate concentration. An analytical testing report, prepared by GeoTesting Express of Acton, Massachusetts, is attached to the end of this appendix.

The corrosion potential of a soil is primarily evaluated by comparing measured pH, resistivity, and sulfate and chloride concentrations to the values specified in Section 10.7.5 of the AASHTO LFRD Bridge Design Specifications (9th Edition, 2020).

Soil pH is a measurement of the hydrogen ion activity of the soil. Soil pH is reported in Standard Units (S.U.) on a scale ranging from 0 to 14, with 7 being neutral. Soils with a pH less than 7 are considered acidic, and soils with a pH greater than 7 are considered alkaline. According to the AASHTO specifications, soils with a pH less than 5.5 and soils with a pH between 5.5 and 8.5 that also have high organic content are considered potentially corrosive.

Resistivity (expressed as ohms-centimeter or ohms-cm) is the numerical expression of the ability of a soil to impede the transmission of an electrical current. Resistivity is the inverse of conductivity and is dependent on the presence of ions, their concentrations, mobility, and valence, as well as soil moisture and temperature. The AASHTO specifications state that effects of corrosion and deterioration shall be considered if resistivity values are less than 2,000 ohms-cm.

Sulfate and chloride concentrations were measured in each soil sample. Sulfates can be converted to sulfides by naturally occurring bacteria. Sulfides, when allowed to oxidize, will produce sulfuric acid, which is highly corrosive. Chlorides will also chemically react and facilitate dissolution reactions with metals and concrete. According to the AASHTO specifications, the soil is considered corrosive if the concentration of sulfate is greater than 1,000 parts per million (ppm) or the concentration of chloride is greater than 500 ppm.

Table E1 - Summary of Laboratory Test Results by Boring Number

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 μm (%)		
B-01	N-7	35	N	6	Sand/Silt Alluvium	ML	Sandy SILT			37	29	8	0.0	32.6	67.4			1
B-01	N-10	50	N	95	Gravel Alluvium	GP-GM	Sandy GRAVEL with some silt						46.0	44.3	9.7			1
B-01	N-18	90	N	40	Upper Troutdale Formation	MH	Clayey SILT			56	32	24						1
B-02	N-2	16	N	9	Sand Alluvium	SP	Gravelly SAND with trace silt						32.0	66.5	1.5			1
B-02	N-6	36.5	N	16	Sand Alluvium	SP-SM	SAND with some silt						0.0	94.0	6.0			1
B-02	N-12	67.1	N	17	Sand/Silt Alluvium	ML	Sandy SILT						1.0	33.1	65.9			1
B-02	N-14	77	N	53	Upper Troutdale Formation	CH	CLAY with some sand			56	26	30	0.0	23.7	76.3			1
B-03	N-2	10	N	6	Fill	SP-SM	SAND with some silt and some gravel						16.0	76.6	7.4			1
B-03	N-5	25	N	1	Sand/Silt Alluvium	SM	Silty SAND			33	27	6	0.0	57.1	42.9			1
B-03	N-6	32	N	9	Sand/Silt Alluvium	SM	Silty SAND						0.0	57.3	42.7			1
B-03	N-14	70	N	13	Sand/Silt Alluvium	ML	Sandy SILT			37	28	9	0.0	42.9	57.1			1
B-03	N-17	85	N	9	Sand/Silt Alluvium	ML	SILT with some sand			42	34	8	0.0	22.7	77.3			1
B-03	N-20	100	N	2	Fine-grained Alluvium	ML	SILT with some sand			40	31	9	0.0	27.3	72.7			1
B-03	N-23	115	N	21	Sand/Silt Alluvium	SM	Silty SAND						0.0	83.0	17.0			1
B-03	N-24	120	N	14	Sand/Silt Alluvium	ML	Sandy SILT			36	32	4	0.0	32.0	68.0			1
B-04	N-2	12.5	N	6	Fill			29.0										
B-04	N-3	15	N	12	Fill			33.8										
B-04	N-5	20	N	3	Fine-grained Alluvium			36.8										
B-04	N-6	25	N	4	Fine-grained Alluvium	ML	SILT with trace sand	43.2		39	27	12						3
B-04	N-7	32	N	7	Sand/Silt Alluvium	SM	Silty SAND	32.6							48.2			3
B-04	N-8	35	N	4	Sand/Silt Alluvium	ML	Sandy SILT	38.8							60.7			3
B-04	N-9a	40	N	8	Sand/Silt Alluvium			43.4										
B-04	N-9b	40.7			Sand/Silt Alluvium			37.3										
B-04	N-13	60	N	50/5"	Upper Troutdale Formation	SP-SM	SAND with some silt and trace gravel	23.1							10.8			3
B-04	N-16	75	N	42	Lower Troutdale Formation	CL	Silty CLAY with trace sand	30.1		36	21	15						3
B-05	N-1	10	N	2	Fine-grained Alluvium			35.9										
B-05	N-2	12.5	N	1	Fine-grained Alluvium			38.6										
B-05	N-3	15	N	3	Fine-grained Alluvium	ML	SILT with trace sand	37.9		38	26	12					Corrosivity	3,5
B-05	N-4	20	N	2	Sand/Silt Alluvium	ML	SILT with some sand	47.5							74.6			3
B-05	N-5	25	N	2	Sand/Silt Alluvium	ML	SILT with some sand	36.7							81.8			3
B-05	N-10	50	N	79/11"	Upper Troutdale Formation	SP-SM	Gravelly SAND with some silt	25.0					31.0	60.0	9.0			3
B-05	N-11	55	N	50/3"	Upper Troutdale Formation			19.9										
B-05	N-12	60	N	81	Upper Troutdale Formation	SM	Silty SAND	23.4							12.5			3
B-05	N-13	65	N	95/10"	Upper Troutdale Formation			22.9										

Table E1 - Summary of Laboratory Test Results by Boring Number

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-06	N-1	11	N	2	Fine-grained Alluvium												Corrosivity	5
B-06	N-2	15	N	1	Fine-grained Alluvium	ML	SILT with trace sand	42.4		38	29	9						
B-06	N-3	20	N	6	Sand/Silt Alluvium	SM	Silty SAND	37.5							43.9			
B-06	N-4	25	N	5	Sand/Silt Alluvium	ML	Sandy SILT	39.5							62.0			
B-06	N-5	30	N	73	Gravel Alluvium			11.0										
B-06	N-6	35	N	69	Gravel Alluvium			9.8										
B-06	N-7	40	N	47	Gravel Alluvium			16.1										
B-06	N-9	60	N	95/11.5"	Upper Troutdale Formation	SP-SM	SAND with some silt	25.8							8.6			
B-06	N-10	65	N	50/5.5"	Upper Troutdale Formation			21.8										
B-06	N-11	70	N	89	Upper Troutdale Formation			23.4										
B-06	N-12	75	N	50/2"	Lower Troutdale Formation			21.2										
B-07	N-1	11	N	1	Fill												Corrosivity	5
B-07	N-2	15	N	3	Fill	ML	SILT with trace sand	36.7		39	32	7						
B-07	N-3	20	N	2	Fill	ML	SILT with trace sand	39.0		42	29	13						
B-07	N-4	25	N	14	Sand/Silt Alluvium	ML	Sandy SILT	35.7							55.9			
B-07	N-5	30	N	46	Gravel Alluvium			11.7										
B-07	N-9	50	N	17	Fine-grained Alluvium	ML	SILT	46.7		49	31	19						
B-07	N-10	55	N	73	Sand Alluvium	SP-SM	Gravelly SAND with some silt	14.6					35.5	54.4	10.1			
B-07	N-11	60	N	82/11"	Gravel Alluvium			19.7										
B-07	N-12	65	N	83	Gravel Alluvium			16.1										
B-08	N-1	15	N	8	Fill												Corrosivity	5
B-08	N-2	17.5	N	7	Fill	SP-SM	SAND with some silt and trace gravel	9.8							5.3			
B-08	N-4	25	N	9	Fill	GC	Clayey GRAVEL with some sand	20.8							37.4			
B-08	N-5	30	N	15	Sand/Silt Alluvium	SM	Silty SAND with trace gravel	29.3							23.5			
B-08	N-7	40	N	91	Gravel Alluvium	GP-GM	GRAVEL with some silt and sand	10.3					69.8	22.4	7.8			
B-08	N-9	50	N	14	Fine-grained Alluvium	MH	Clayey SILT	42.2		54	32	22			98.3			
B-08	N-10	53.8	N	35	Sand Alluvium	SM	Silty SAND with trace gravel	20.5							13.3			
B-08	N-11	60	N	91	Gravel Alluvium			14.1										
B-08	N-14	75	N	73	Upper Troutdale Formation			23.7										
B-08	N-15	80	N	57	Upper Troutdale Formation	SM	Silty SAND	28.2							20.1			
B-08	N-24	150	N	79	Lower Troutdale Formation	SM	Silty SAND	36.2		43	33	11						

Table E1 - Summary of Laboratory Test Results by Boring Number

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-09	N-2	10	N	1	Sand Alluvium			47.5										
B-09	N-3	12.5	N	1	Sand/Silt Alluvium	ML	SILT with some sand	55.6					0.0	28.7	71.3			
B-09	N-7	25.4	N	4	Sand Alluvium	SM	Silty SAND	42.8							45.7			
B-09	N-20	94.7	N	90/7"	Lower Troutdale Formation			22.2										
B-09	N-23	116.3	N	56	Sandy River Mudstone	CL	Silty CLAY with trace sand	30.0		47	25	22						
B-09	N-24	121.5	N	42	Sandy River Mudstone			27.4										
B-09	N-25	127.2	N	29	Sandy River Mudstone	CH	CLAY with trace sand	33.2		52	24	29						
B-09	N-26	131.2	N	49	Sandy River Mudstone	CL	Silty CLAY with trace sand	31.2		47	26	21						
B-09	N-27	139.6	N	78	Sandy River Mudstone	SM	Silty SAND	29.3					2.5	73.1	24.4			
B-09	N-28	149.8	N	76	Sandy River Mudstone			39.5										
B-10	N-11	42.5	N	11	Sand/Silt Alluvium	ML	Sandy SILT	38.1					0.0	46.6	53.4	3.0		2
B-10	N-12	47.5	N	0	Sand/Silt Alluvium	ML	Sandy SILT	36.7		35	27	8			63.7			2
B-10	N-15	61.3	N	54	Upper Troutdale Formation	SM	Silty SAND with trace gravel	36.2					5.0	71.5	23.5			2
B-10	N-21	94.3	N	50/4"	Lower Troutdale Formation	SM	Silty SAND with some gravel	23.3							16.3			2
B-10	N-25	123	N	37	Sandy River Mudstone	MH	Sandy clayey SILT	41.8		60	32	28			70.4			2
B-10	N-26	133.5	N	91	Sandy River Mudstone	SM	Silty SAND	24.1					1.0	85.5	13.5	1.1		2
B-10	N-27b	144	N		Sandy River Mudstone	SM	Silty SAND	41.7		N/A	NP	NP			38.1			2
B-11	N-1	0	N	10	Fill	SP-SM	SAND with some silt and trace gravel	26.0							6.0			
B-11	N-2	2.5	N	1	Fill			32.7										
B-11	N-5	10	N	5	Fill			20.8										
B-11	N-6	12.5	N	6	Fill			21.4										
B-11	N-8	17.5	N	6	Fill			26.9										
B-11	N-9	20	N	7	Fill			27.5										
B-11	N-10	22.5	N	7	Fill	SP-SM	SAND with some silt and trace gravel	28.1							7.6			
B-11	N-11	27.5	N	0	Sand Alluvium	OH	Organic CLAY with some sand	89.4		72	48	24						
B-11	N-13	39	N	17	Sand Alluvium	SP-SM	SAND with some silt and trace gravel	31.4							7.7			
B-11	N-14	46	N	16	Sand Alluvium			34.5										
B-11	N-15	52.5	N	14	Sand Alluvium	SP-SM	SAND with some silt	33.9					0.0	92.9	7.2			
B-11	N-16	57.5	N	14	Sand Alluvium			32.8										
B-11	N-17	62.5	N	13	Sand Alluvium			36.1										
B-11	N-32a	165	N	50/5"	Lower Troutdale Formation			27.6										
B-11	N-32b	165.75			Sandy River Mudstone			32.6										
B-11	N-33	170	N	58/7"	Sandy River Mudstone	GP-GM	Sandy GRAVEL with some silt	25.3					45.6	44.3	10.1			
B-11	N-34	180	N	50/5"	Sandy River Mudstone			30.7										

Table E1 - Summary of Laboratory Test Results by Boring Number

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
									Dry Unit Weight (pcf)	LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)	
B-12	N-2	15	N	6	Sand Alluvium												Corrosivity	5
B-12	N-3	20.8	N	8	Sand Alluvium												Corrosivity	5
B-12A	N-3	10	N	4	Sand Alluvium	SP	SAND with trace silt and gravel	27.9							2.1			
B-12A	N-4	12.5	N	5	Sand Alluvium			27.6										
B-12A	N-5	15	N	7	Sand Alluvium			28.9										
B-12A	N-6	17.5	N	4	Sand Alluvium			27.0										
B-12A	N-7	20	N	6	Sand Alluvium			27.8										
B-12A	N-8	25	N	2	Sand Alluvium	SP	SAND with trace silt	38.2							1.6			
B-12A	N-9	30	N	6	Sand Alluvium			32.0										
B-12A	N-10	35	N	13	Sand Alluvium			38.1										
B-12A	N-11	40	N	10	Sand Alluvium			40.0										
B-12A	N-12	45	N	14	Sand Alluvium	SP	SAND with trace silt	37.5							4.7			
B-12A	N-13	50	N	16	Sand Alluvium			37.1										
B-12A	N-14	55	N	53	Sand Alluvium			20.8										
B-13	N-3	7.5	N	6	Sand/Silt Alluvium	ML	Sandy SILT	53.7							50.8			2
B-13	N-4	10	N	1	Sand Alluvium	SM	Silty SAND with some gravel	36.3					15.0	72.3	12.7			2
B-13	N-6	15	N	10	Sand Alluvium	SP	SAND with trace silt	30.0							3.5			2
B-13	N-11	35	N	7	Sand Alluvium	SM	Silty SAND	39.0							22.3			2
B-13	N-12	40	N	14	Sand Alluvium	SP-SM	SAND with some silt	28.0					1.0	91.8	7.2			2
B-13	N-14	50	N	11	Sand Alluvium	SP-SM	SAND with some silt	30.6							5.5			2
B-13	N-20	80	N	83	Gravel Alluvium	GP-GM	GRAVEL with some silt and sand	11.2							5.4			2

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Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
									Dry Unit Weight (pcf)	LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 μm (%)	
B-14	N-2	5	N	31	Fill	GM	Silty GRAVEL with some sand	31.1					60.3	26.8	12.9			
B-14	N-4	10	N	1	Sand/Silt Alluvium	SP-SM	SAND with some silt	37.6					0.6	88.5	10.9			
B-14	N-5	12.5	N	2	Sand/Silt Alluvium	SM	Silty SAND	45.4							42.2			
B-14	N-6	15	N	1	Sand/Silt Alluvium	SP-SM	SAND with some silt	39.5					2.4	88.2	9.4			
B-14	N-7	17.5	N	6	Sand/Silt Alluvium	SP-SM	SAND with some silt	35.7							8.9			
B-14	N-8	20	N	1	Sand/Silt Alluvium	SM	Silty SAND	44.5					0.0	53.3	46.7			
B-14	N-9	25	N	2	Sand/Silt Alluvium	ML	Sandy SILT	49.3		35	35	1			55.4			
B-14	N-10	30	N	1	Sand/Silt Alluvium	ML	Sandy SILT	50.9		41	35	6						
B-14	N-11	35	N	6	Sand/Silt Alluvium	SM	Silty SAND	45.1					0.0	57.3	42.7			
B-14	N-12a	40	N	4	Sand/Silt Alluvium	SP-SM	SAND with some silt	39.8							9.6			
B-14	N-13	45	N	3	Sand/Silt Alluvium	SM	Silty SAND	43.9					0.0	51.3	48.7			
B-14	N-14	50	N	5	Sand/Silt Alluvium	ML	Sandy SILT	45.1							58.2			
B-14	N-15	65	N		Sand Alluvium	SP-SM	SAND with some silt	40.9							8.8			
B-14	N-16	70	N		Sand Alluvium	SP-SM	SAND with some silt	41.2							6.4			
B-14	N-18	90	N		Sand Alluvium	SP	SAND with trace silt	44.5					0.0	95.5	4.5			
B-14	N-19	100	N	6	Fine-grained Alluvium	ML	SILT with trace sand	47.7							89.6			
B-14	N-20	110	N		Sand Alluvium	SP	SAND with trace silt	45.0							4.8			
B-14	N-21	120	N		Sand Alluvium	SP	SAND with trace silt	37.4							1.4			
B-14	N-22	128.6	N		Gravel Alluvium	*SP	*SAND with trace silt	35.4					0.0	95.3	4.7			

Table E1 - Summary of Laboratory Test Results by Boring Number

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 μm (%)		
B-15	N-9	25	N	14	Fill	SM	Silty SAND	10.8							12.6			
B-15	N-10	30	N	14	Fill	SM	Gravelly silty SAND	25.6							13.3			
B-15	N-11	35	N	3	Sand/Silt Alluvium	ML	Sandy SILT	41.4		36	32	4			59.6			
B-15	U-1a	38	U		Sand/Silt Alluvium	ML	Sandy SILT	43.3		N/A	NP	NP			51.0			
B-15	U-1b	39			Sand/Silt Alluvium	ML	Sandy SILT	42		36	30	6					BE, CDSS, Post Reconsol, CDSS, CRS, DSS	4
B-15	N-12	40	N	3	Sand/Silt Alluvium	ML	Sandy SILT	40.3							57.8			
B-15	N-13	45	N	4	Sand/Silt Alluvium	ML	Sandy SILT	46.2		N/A	NP	NP			62.3			
B-15	N-14	50	N	4	Sand/Silt Alluvium	ML/SM	Sandy SILT to Silty SAND	44.4							50.3			
B-15	N-15	55	N	7	Sand/Silt Alluvium	ML	Sandy SILT	40.2		33	32	1			55.6			
B-15	N-16	60	N	10	Sand/Silt Alluvium	ML	Sandy SILT	38.8		N/A	NP	NP			64.0			
B-15	N-17	65	N	11	Sand/Silt Alluvium	SM	Silty SAND	37.5							30.0			
B-15	N-18	70	N	11	Sand/Silt Alluvium	SM	Silty SAND	39.0					0.0	52.9	47.1			
B-15	N-19	75	N	9	Sand/Silt Alluvium	SM	Silty SAND	44.2							34.2			
B-15	N-20	80	N	8	Sand/Silt Alluvium	SM	Silty SAND	34.3		N/A	NP	NP			43.5			
B-15	U-3	83	U		Sand/Silt Alluvium	SM	Silty SAND	36		N/A	NP	NP					CDSS, Post Reconsol, CRS	4
B-15	N-21	85	N	0	Sand/Silt Alluvium	SM	Silty SAND	40.6							30.7			
B-15	N-22	90	N	14	Sand/Silt Alluvium	SM	Silty SAND	38.9							28.3			
B-15	N-23	95	N	*7	Sand/Silt Alluvium	ML	Sandy SILT	39.2		41	35	6			66.9			
B-15	N-24	100	N	15	Sand/Silt Alluvium	SM	Silty SAND	39.1							44.0			
B-15	N-25	105	N	14	Sand/Silt Alluvium	SM	Silty SAND	39.7							33.7			
B-15	N-26	110	N	8	Fine-grained Alluvium	ML	SILT with some sand	45.2		40	34	6			73.6			
B-15	N-27	115	N	8	Sand/Silt Alluvium	ML	Sandy SILT	41.0							66.6			
B-15	N-28	120	N	16	Sand/Silt Alluvium	ML	Sandy SILT	42.3		39	33	6			63.7			
B-15	N-29	125	N	9	Fine-grained Alluvium	ML	SILT with some sand	45.2							73.3			
B-15	N-30	130	N	10	Sand/Silt Alluvium	SM	Silty SAND	39.7							47.8			
B-15	N-31	135	N	8	Sand/Silt Alluvium	SM	Silty SAND	39.7							41.6			
B-15	N-32	140	N	14	Sand Alluvium	SM	Silty SAND	36.0							13.8			
B-15	N-33	145	N	25	Sand Alluvium	SM	Silty SAND	34.8							26.1			

Table E1 - Summary of Laboratory Test Results by Boring Number

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 μm (%)		
B-16	N-2	5	N	11	Fill			22.3										
B-16	N-3	7.5	N	12	Fill			23.7										
B-16	N-4	10	N	4	Fill			30.1									Corrosivity	5
B-16	N-5	12.5	N	19	Fill			23.7										
B-16	N-8	20	N	10	Sand/Silt Alluvium	ML	Sandy SILT	37.1							68.5			
B-16	N-9	27	N	3	Sand/Silt Alluvium	ML	Sandy SILT	45.7		N/A	NP	NP			61.5			
B-16	N-10	30	N	3	Sand/Silt Alluvium	ML	Sandy SILT	46.4		40	34	6			57.0			
B-16	U-2	35	U		Sand/Silt Alluvium	ML	Sandy SILT	40		N/A	NP	NP					BE, CDSS, Post DSS	4
B-16	N-11	37	N	6	Sand/Silt Alluvium	ML	Sandy SILT	45.7							51.0			
B-16	N-12a	40	N	12	Sand/Silt Alluvium	ML	Sandy SILT	43.3							68.7			
B-16	N-12b	40.75			Sand/Silt Alluvium	SM	Silty SAND	42.0							37.4			
B-16	N-13	45	N	6	Sand/Silt Alluvium	SM	Silty SAND	41.8		40	40	0			43.4			
B-16	N-14	50	N	5	Sand/Silt Alluvium	SM	Silty SAND	41.5							40.2			
B-16	N-15	55	N	4	Sand/Silt Alluvium	ML	Sandy SILT	47.6		45	42	3			56.5			
B-16	N-16	62	N	11	Sand/Silt Alluvium	SM	Silty SAND	38.6					0.0	70.6	29.4			
B-16	N-17	65	N	5	Sand/Silt Alluvium	ML	SILT with some sand	48.6		46	36	11			70.5			
B-16	N-18	70	N	10	Sand/Silt Alluvium	SM	Silty SAND	38.7							17.2			
B-16	N-19	75	N	11	Sand/Silt Alluvium	SM	Silty SAND	35.2							20.6			
B-16	N-20	80	N	8	Sand/Silt Alluvium	SM	Silty SAND	45.3							46.6			
B-16	N-21	85	N	8	Sand/Silt Alluvium	ML	Sandy SILT	45.6		45	37	8			51.5			
B-16	N-22	90	N	10	Sand/Silt Alluvium	SM	Silty SAND	38.6							43.9			
B-16	N-23	95	N	9	Sand/Silt Alluvium	SM	Silty SAND	37.2							28.4			
B-16	N-24	100	N	17	Sand/Silt Alluvium	SM	Silty SAND	37.8							16.3			
B-16	N-25	105	N	7	Sand/Silt Alluvium	ML	Sandy SILT	41.1		47	38	8			59.8			
B-16	N-26	112	N	9	Sand/Silt Alluvium	SM	Silty SAND	40.8							27.6			
B-16	N-27	115	N	19	Sand/Silt Alluvium	ML	Sandy SILT	37.2							62.8			
B-16	N-28	120	N	15	Sand/Silt Alluvium	ML	Sandy SILT	38.8							65.7			
B-16	N-29	125	N	14	Fine-grained Alluvium	ML	SILT with some sand	40.3		42	34	8			75.4			
B-16	N-30	130	N	25	Sand/Silt Alluvium	SM	Silty SAND	29.3		N/A	NP	NP			34.7			
B-16	N-31	135	N	20	Sand/Silt Alluvium	SM/ML	Silty SAND to Sandy SILT	34.5							50.0			
B-16	N-32	140	N	8	Sand/Silt Alluvium	ML	Sandy SILT	37.3							61.8			

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Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 μm (%)		
B-17	N-3	7.5	N	7	Fill			31.7										
B-17	N-5	12.5	N	4	Fill			31.8										
B-17	N-6	15	N	3	Fill			40.1										
B-17	N-7	17.5	N	2	Fine-grained Alluvium	MH	Clayey SILT	47.4		60	36	24			97.3			
B-17	N-8	20	N	0	Fine-grained Alluvium	MH	Clayey SILT	49.0							97.9			
B-17	U-1a	23	U		Fine-grained Alluvium	ML	SILT with some sand	48.2	72.8	49	32	17	0.0	22.3	77.7			3
B-17	U-1b	24			Fine-grained Alluvium	ML	SILT with some sand	50		34	25	9					DSS, CDSS, Post DSS, CRS	4
B-17	N-9	25	N	1	Fine-grained Alluvium	ML	SILT	50.2		46	35	12			95.9			
B-17	N-10	30	N	0	Fine-grained Alluvium	ML	SILT with trace sand	44.8							85.6			
B-17	N-11	35	N	1	Fine-grained Alluvium	ML	SILT with trace sand	45.4							93.7			
B-17	U-2a	40	U		Fine-grained Alluvium	SM	Silty SAND	41.3	79.4				2.0	76.7	21.3			3
B-17	U-2b	41			Fine-grained Alluvium	SM	Silty SAND	45		36	26	9					CRS, CDSS, Post DSS	4
B-17	N-12	42	N	4	Fine-grained Alluvium	ML	SILT with trace sand	47.4		48	37	11			92.1			
B-17	N-13	45	N	0	Fine-grained Alluvium	ML	SILT	52.5							97.1			
B-17	N-14	50	N	3	Fine-grained Alluvium	ML	SILT with some sand	44.1		N/A	NP	NP			77.2			
B-17	N-15	55	N	1	Fine-grained Alluvium	ML	SILT with trace sand	43.9							89.5			
B-17	N-16a	60	N	7	Fine-grained Alluvium	ML	SILT with trace sand	49.5							89.6			
B-17	N-16b	60.4			Sand/Silt Alluvium	SM	Silty SAND	41.4							47.6			
B-17	N-17	65	N	6	Fine-grained Alluvium	ML	SILT with trace sand	47.5							88.7			
B-17	N-18	70	N	6	Sand/Silt Alluvium	SM	Silty SAND	47.5							43.2			
B-17	N-19	75	N	0	Fine-grained Alluvium	ML	SILT with trace sand	49.9		39	38	1			89.3			
B-17	U-3a	80	U		Sand/Silt Alluvium	ML	SILT with some sand	38.8	79.9				0.0	27.3	72.7			3
B-17	U-3b	81			Sand/Silt Alluvium	ML	SILT with some sand	39		N/A	NP	NP					CRS, CDSS, Post DSS	4
B-17	N-20	82	N	17	Sand/Silt Alluvium	SM	Silty SAND	33.1							24.0			
B-17	N-21	85	N	6	Sand/Silt Alluvium	ML	Sandy SILT	48.4							63.2			
B-17	N-22	90	N	19	Sand/Silt Alluvium	SM	Silty SAND	32.1							18.2			
B-17	N-23	95	N	9	Sand/Silt Alluvium	SM	Silty SAND	45.4							39.5			
B-17	N-24	100	N	0	Sand/Silt Alluvium	ML	Sandy SILT	47.6					0.0	30.9	69.1			
B-17	U-4a	101.5	U		Sand/Silt Alluvium	SM	Silty SAND	36.5	78.2				0.0	60.3	39.7			3
B-17	U-4b	102.5			Sand/Silt Alluvium	SM	Silty SAND	46		N/A	NP	NP					CRS	4
B-17	N-25	103.5	N	40	Sand/Silt Alluvium	ML	Sandy SILT	39.4		35	33	2			53.6			
B-17	N-26	110	N	11	Sand/Silt Alluvium	ML	Sandy SILT	41.5							57.4			

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Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-17	N-27	115	N	19	Sand/Silt Alluvium	SM	Silty SAND	44.2							41.7			
B-17	N-28	120	N	22	Sand/Silt Alluvium	SM	Silty SAND	40.2							28.4			
B-17	N-29	125	N	40	Sand/Silt Alluvium	SM	Silty SAND	28.2							13.8			
B-17	N-30b	130.75	N	20	Sand/Silt Alluvium	ML	SILT with some sand	38.3							71.1			
B-17	N-31	135	N	15	Sand/Silt Alluvium	ML	SILT with some sand	46.5							76.4			
B-17	N-32	140	N	19	Sand/Silt Alluvium	ML	Sandy SILT	39.8		38	34	4			59.2			
B-17	N-33	145	N	20	Sand/Silt Alluvium	ML	Sandy SILT	42.7							61.8			
B-18	N-4	10	N	1	Fill			57.9										
B-18	N-5	12.5	N	2	Fill			69.7										
B-18	N-6	15	N	2	Fill	SM	Silty SAND with some organics	73.0							37.5			
B-18	N-7	17.5	N	3	Fill			55.3										
B-18	N-8	20	N	2	Fine-grained Alluvium			45.4										
B-18	N-9	25	N	4	Fine-grained Alluvium	OH	Organic CLAY with trace sand	93.0							93.8			
B-18	N-10	30	N	3	Fine-grained Alluvium	OH	Organic CLAY	87.1							96.0			
B-18	N-11	35	N	2	Fine-grained Alluvium	OH	Organic CLAY	105.3		120	77	43			96.4			
B-18	U-2a	38	U		Fine-grained Alluvium	OL	Organic SILT with some sand	102.7	40.2				2.0	26.5	71.5			3
B-18	U-2b	39			Fine-grained Alluvium	OL	Organic SILT with some sand	51		45	39	7					CRS, CDSS, Post DSS	4
B-18	N-12	40	N	5	Fine-grained Alluvium	OH	Organic CLAY with trace sand	93.5		130	75	55			88.9			
B-18	N-13a	45	N	4	Fine-grained Alluvium	CL	Sandy silty CLAY	26.2							54.7			
B-18	N-13b	46	N		Fine-grained Alluvium			109.5										
B-18	N-14	50	N	5	Sand/Silt Alluvium	ML	Sandy SILT	32.7							67.4			
B-18	N-15	55	N	9	Sand/Silt Alluvium	ML	Sandy SILT	34.6		38	27	11						
B-19	N-4	17.5	N	30	Fill												Corrosivity	5
B-19	N-5	20	N	43	Fill	SP-SM	SAND with some silt	6.7							9.9			
B-19	N-6	25	N	34	Sand Alluvium			16.1										
B-19	N-7	30	N	69	Gravel Alluvium			13.4										
B-19	N-17a	80	N	50/4"	Lower Troutdale Formation	SM	Silty SAND	30.6							24.7			
B-20	N-1	10	N	6	Catastrophic Flood Deposits - Fine Grained Facies	ML	SILT with trace sand	40.9		39	29	10						
B-20	N-2	15	N	4	Catastrophic Flood Deposits - Fine Grained Facies	ML	SILT with some sand	39.1		N/A	NP	NP						
B-20	N-3	19.5	N	69	Catastrophic Flood Deposits - Channel Facies	GM	Silty GRAVEL with some sand	11.0							14.3			
B-20	N-4	25	N	29	Catastrophic Flood Deposits - Channel Facies	SM	Silty SAND	22.5							26.8			
B-20	N-5	30	N	25	Catastrophic Flood Deposits - Channel Facies	SM	Silty SAND with trace gravel	18.8							14.0			

Table E1 - Summary of Laboratory Test Results by Boring Number

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 μm (%)		
B-21	N-1	5	N	7	Fill			33.8										
B-21	N-2	10	N	5	Fill	ML	SILT with trace sand	36.7		39	27	12						
B-21	N-3	15	N	3	Fine-grained Alluvium			39.4										
B-21	N-4	20	N	4	Fine-grained Alluvium	ML	SILT with some sand	32.5		27	27	0						
B-21	N-11	55	N	63	Upper Troutdale Formation	SP-SM	SAND with some silt	25.0					0.0	88.6	11.4			
B-21	N-12	60	N	64	Upper Troutdale Formation	SP-SM	SAND with some silt	22.4							9.4			
B-21	N-13	65	N	64	Upper Troutdale Formation	SP-SM	SAND with some silt and gravel	18.5							9.5			
B-21	N-14	70	N	59	Upper Troutdale Formation	SP-SM	SAND with some silt	23.2					0.0	89.8	10.3			
B-21	N-15	75	N	79	Upper Troutdale Formation	SP-SM	SAND with some silt	24.4							10.6			
B-21	N-16	80	N	84/11"	Upper Troutdale Formation	SP-SM	SAND with some silt	25.1							10.3			
B-21	N-17	85	N	90/7"	Upper Troutdale Formation	SP-SM	SAND with some silt and trace gravel	22.3					5.5	85.7	8.9			
B-21	N-18	90	N	50/4"	Upper Troutdale Formation	SP-SM	SAND with some silt and trace gravel	21.5							7.9			
B-21	N-19	95	N	50/4"	Upper Troutdale Formation	SP-SM	SAND with some silt and trace gravel	24.6							10.8			
B-22	S-1	10	S		Fill	CL	Silty CLAY			41	25	17			97.9			
B-22	S-3a	30	S		Gravel Alluvium	GM	Silty GRAVEL with some sand						57.3	29.4	13.3			
B-22	S-3b	44	S		Sand/Silt Alluvium	ML	SILT						0.0	0.6	99.4			
B-22	S-4a	50	S		Sand/Silt Alluvium	SP-SM	Gravelly SAND with some silt						42.5	51.9	5.6			
B-22	S-4d	63	S		Upper Troutdale Formation	SP-SM	SAND with some silt						0.0	94.7	5.4			
B-22	S-6a	90	S		Lower Troutdale Formation	GM	Silty GRAVEL with some sand						59.8	26.4	13.9			
B-22	S-6b	92	S		Lower Troutdale Formation	MH	Clayey SILT			66	39	28			95.7			
B-22	S-7	100	S		Lower Troutdale Formation	GC	Clayey GRAVEL with some sand						65.1	21.9	13.0			
B-22	S-9b	116	S		Lower Troutdale Formation	GM	Silty GRAVEL with some sand						60.9	26.9	12.1			
B-22	S-11a	130	S		Lower Troutdale Formation	GP-GM	Sandy GRAVEL with some silt						75.2	19.6	5.2			
B-23	S-1a	6	S		Fill	GM	Silty GRAVEL with some sand						37.2	21.8	41.0			
B-23	S-2c	28	S		Gravel Alluvium	GM	Sandy silty GRAVEL						52.2	29.8	18.0			
B-23	S-3c	32.5	S		Gravel Alluvium	GP-GM	GRAVEL with some silt and sand						75.3	19.8	4.9			
B-23	S-3d	45	S		Fine-grained Alluvium	CL	Silty CLAY			49	27	22						
B-23	S-4	50	S		Gravel Alluvium	GP-GM	GRAVEL with some silt and sand						68.1	23.8	8.1			
B-23	S-5b	63	S		Upper Troutdale Formation	SP-SM	SAND with some silt						0.0	89.1	10.9			
B-23	S-6b	82	S		Lower Troutdale Formation	SP-SM	Gravelly SAND with some silt						45.2	47.9	6.9			
B-23	S-7a	90.1	S		Lower Troutdale Formation	ML	SILT with trace sand						0.0	7.2	92.8			
B-23	S-7c	94	S		Lower Troutdale Formation	GM	Silty GRAVEL with some sand						57.3	24.1	18.5			
B-23	S-9a	117	S		Lower Troutdale Formation	GP-GM	Sandy GRAVEL with some silt						64.2	30.5	5.3			

Table E1 - Summary of Laboratory Test Results by Boring Number

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 μm (%)		
B-24	S-2	10	S		Sand Alluvium	GP-GM	Sandy GRAVEL with some silt						53.4	41.1	5.4			
B-24	S-5b	33	S		Sand/Silt Alluvium	SM	Silty SAND			34	26	8	0.0	59.1	40.9			3
B-24	S-6b	42	S		Sand/Silt Alluvium	SM	Silty SAND								30.0			
B-24	S-7a	50	S		Sand/Silt Alluvium	SC	Clayey SAND			32	22	10			23.7			3
B-24	S-8	60	S		Lower Troutdale Formation	GM	Sandy silty GRAVEL						48.5	36.8	14.7			
B-24	S-10	75	S		Lower Troutdale Formation	GM	Silty GRAVEL with some sand						58.5	28.4	13.1			
B-24	S-13	90	S		Lower Troutdale Formation	GM	Sandy silty GRAVEL						48.3	34.3	17.4			
B-24	S-17b	113	S		Lower Troutdale Formation	GP	GRAVEL with trace silt and sand						84.0	13.0	3.1			
B-24	S-19a	120	S		Sandy River Mudstone	CH	CLAY with trace sand			77	34	43						3
B-24	S-21	140	S		Sandy River Mudstone	SM	Silty SAND								15.2			
B-25	S-3	14	S		Sand Alluvium	SP-SM	Gravelly SAND with some silt						47.0	47.4	5.6			
B-25	S-5b	36	S		Sand/Silt Alluvium	SM	Silty SAND								15.9			
B-25	S-6a	44	S		Gravel Alluvium	GM	Sandy silty GRAVEL						52.0	30.0	18.0			3
B-25	S-6b	49			Upper Troutdale Formation	CL	Silty CLAY with some sand			29	19	10						3
B-25	S-11	84	S		Lower Troutdale Formation	GP-GM	Sandy GRAVEL with some silt						57.0	32.5	10.5			3
B-25	S-13	104	S		Sandy River Mudstone	CL	Sandy silty CLAY			47	27	20						3
B-25	S-16b	138.5	S		Sandy River Mudstone	SP-SM	SAND with some silt			N/A	NP	NP						3
B-25	S-17a	144	S		Sandy River Mudstone	SP-SM	SAND with some silt								7.8			
B-25	S-19	159	S		Sandy River Mudstone	SP	SAND with trace silt								4.7			
B-26	S-4c	33	S		Gravel Alluvium	GP-GM	Sandy GRAVEL with some silt						51.5	40.2	8.3			
B-26	S-6	48	S		Gravel Alluvium	GW	GRAVEL with some sand and trace silt						73.5	23.7	2.9			
B-26	S-8b	70.5	S		Lower Troutdale Formation	GC	Clayey GRAVEL with some sand						56.0	29.6	14.4			3
B-26	S-9a	78	S		Lower Troutdale Formation	GP-GM	Sandy GRAVEL with some silt								7.4			
B-26	S-15	128	S		Lower Troutdale Formation	GP-GC	GRAVEL with some clay and sand						71.5	18.8	9.7			
B-26	S-17b	140.5	S		Sandy River Mudstone	MH	Clayey SILT with trace sand			76	38	38						3

Table E1 - Summary of Laboratory Test Results by Boring Number

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 μm (%)		
B-27	N-2	7.9	N	14	Sand Alluvium			26.0									Corrosivity	5
B-27	N-3	10.5	N	10	Sand Alluvium	SP	Gravelly SAND with trace silt	18.6							1.8			
B-27	N-6	18.6	N	12	Sand Alluvium	SP-SM	SAND with some silt and gravel	26.4							6.5			
B-27	N-7	21.1	N	8	Sand Alluvium			24.0										
B-27	N-8	26.2	N	14	Sand Alluvium			24.2										
B-27	N-14	55.7	N	20	Sand Alluvium	SM	Silty SAND with trace gravel	35.5							20.0			
B-27	N-15	60.9	N	11	Sand Alluvium			40.5										
B-27	N-16	66.2	N	0	Sand/Silt Alluvium	ML	SILT with some sand	38.4		38	29	9						
B-27	N-19	79.4	N	46	Upper Troutdale Formation	MH	Clayey SILT with trace sand	35.8		60	44	17						
B-27	N-20	84.5	N	33	Upper Troutdale Formation	ML	SILT with some sand	39.7		44	32	12						
B-27	N-24	111.2	N	98	Sandy River Mudstone	SM	Silty SAND	27.7							11.8			
B-27	N-25	121.1	N	62	Sandy River Mudstone	SC	Clayey SAND	34.4					0.0	70.6	29.4			
B-27	N-26	138.1	N	56	Sandy River Mudstone	SM	Silty SAND	30.2							17.8			
B-27	N-27	148.6	N	21	Sandy River Mudstone	MH	Clayey SILT with trace sand	45.1		63	36	28						
B-27	N-28	160.3	N	71	Sandy River Mudstone	SM	Silty SAND	27.2					0.0	85.4	14.6			
B-27	N-29	171	N	50/5"	Sandy River Mudstone			30.6										
B-27	N-30	177.9	N	50/5"	Sandy River Mudstone			28.8										
B-28	S-1b	8.5	S		Sand Alluvium	SP	SAND with trace silt and gravel								3.7			
B-28	S-2d	29.7	S		Sand Alluvium	SM	Silty SAND								20.4			
B-28	S-3b	47.5	S		Gravel Alluvium	GP-GM	GRAVEL with some silt and sand						69.7	24.6	5.7			
B-28	S-5a	84	S		Lower Troutdale Formation	GP-GM	GRAVEL with some silt and sand						73.4	17.1	9.6			
B-28	S-7c	123	S		Lower Troutdale Formation	GW-GM	GRAVEL with some silt and sand						63.3	29.6	7.1			
B-29	S-2	25	S		Sand Alluvium	SP	SAND with trace silt and gravel								2.1			
B-29	S-3	40	S		Sand Alluvium	SP	SAND with trace silt and gravel								2.5			
B-29	S-4d	76	S		Lower Troutdale Formation	GW-GM	Sandy GRAVEL with some silt						60.6	30.2	9.2			
B-29	S-8c	129	S		Lower Troutdale Formation	GM	Silty GRAVEL with some sand						56.3	24.7	19.0			
B-29	S-9b	138	S		Lower Troutdale Formation	CH	CLAY with trace sand			61	29	33						
B-29	S-10b	152	S		Sandy River Mudstone	SP-SM	SAND with some silt								5.6			

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Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-30	S-2b	26	S		Sand Alluvium	SM	Silty SAND						4.2	73.1	22.6			
B-30	S-3a	44	S		Sand Alluvium	SP-SM	SAND with some silt						2.7	89.2	8.1			
B-30	S-4d	72	S		Upper Troutdale Formation	CH	CLAY			64	31	33						
B-30	S-5a	85	S		Upper Troutdale Formation	ML	SILT with trace sand			40	32	8						
B-30	S-5c	91	S		Lower Troutdale Formation	GC	Clayey GRAVEL with some sand						57.7	28.8	13.5			
B-30	S-7a	106	S		Lower Troutdale Formation	GP-GC	Sandy GRAVEL with some clay						52.1	37.0	11.0			
B-30	S-8c	127	S		Sandy River Mudstone	SC	Clayey SAND						1.0	67.9	31.1			
B-30	S-10	146	S		Sandy River Mudstone	SM	Silty SAND						1.3	86.3	12.4			
B-31	S-1b	1	S		Sand Alluvium	GP	Sandy GRAVEL with trace silt								1.4			
B-31	S-3a	30.7	S		Sand Alluvium	SM	Silty SAND								21.5			
B-31	S-4b	55	S		Gravel Alluvium	GP	GRAVEL with trace silt and sand						87.1	10.4	2.5			
B-31	S-5	70.1	S		Lower Troutdale Formation	GC	Sandy clayey GRAVEL						39.6	34.7	25.7			
B-31	S-7	101.8	S		Lower Troutdale Formation	GP-GM	Sandy GRAVEL with some silt						63.5	30.0	6.5			
B-31	S-9b	128	S		Lower Troutdale Formation	GW-GC	GRAVEL with some clay and sand						64.5	28.9	6.5			
B-32	N-2	12.5	N	5	Fill	SP-SM	SAND with some silt and trace gravel	24.2							7.3			
B-32	N-3	15	N	3	Fine-grained Alluvium	OH	Organic CLAY with trace sand	47.9							92.8			
B-32	N-4	20	N	0	Fine-grained Alluvium	OH	Organic CLAY with trace sand	50.4							87.4		Corrosivity	5
B-32	N-5	25	N	0	Fine-grained Alluvium	OH	Organic CLAY	45.0		52	29	23			96.0			
B-32	N-6	30	N	0	Fine-grained Alluvium	ML/CL	SILT to Silty CLAY	50.9							98.6			
B-32	N-7	35	N	0	Fine-grained Alluvium	ML/CL	SILT to Silty CLAY with trace sand	42.8		49	28	21			93.2			
B-32	N-8	40	N	0	Fine-grained Alluvium	ML/CL	SILT to Silty CLAY	43.2							97.3			
B-32	N-9	45	N	0	Fine-grained Alluvium	ML	SILT with trace sand	46.3							93.5			
B-32	N-10	50	N	2	Fine-grained Alluvium	ML	SILT with trace sand	41.4		47	28	19			87.6			
B-32	N-11	55	N	0	Sand/Silt Alluvium	ML	Sandy SILT	40.5		48	29	19			64.6			
B-32	N-12	60	N	0	Fine-grained Alluvium	ML	SILT with some sand	47.7							83.0			
B-32	U-2	63	U		Fine-grained Alluvium	ML	SILT with some sand	37		N/A	NP	NP					BE, CRS, CDSS, DSS	4
B-32	N-13	65	N	4	Sand/Silt Alluvium	ML	Sandy SILT	47.7		N/A	NP	NP			54.1			
B-32	N-14	70	N	7	Sand/Silt Alluvium	ML	Sandy SILT	43.5							62.0			
B-32	N-15	75	N	3	Sand/Silt Alluvium	SM	Silty SAND	44.3							41.5			

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Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
									Dry Unit Weight (pcf)	LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)	
B-32	N-16	80	N	5	Sand/Silt Alluvium	SM/ML	Silty SAND to Sandy SILT	44.5							50.0			
B-32	N-17	85	N	1	Sand/Silt Alluvium	ML	Sandy SILT	45.8							59.8			
B-32	N-18	90	N	9	Sand/Silt Alluvium	ML	Sandy SILT	42.7							60.4			
B-32	N-19	95	N	4	Sand/Silt Alluvium	ML	Sandy SILT	43.4							59.7			
B-32	N-20	100	N	4	Sand/Silt Alluvium	ML	Sandy SILT	41.8							51.8			
B-32	N-21	105	N	19	Sand/Silt Alluvium	SM	Silty SAND	38.4					0.0	64.6	35.5			
B-32	N-22	110	N	18	Sand/Silt Alluvium	SM	Silty SAND	39.1							27.1			
B-32	N-23	115	N	14	Sand/Silt Alluvium	ML	Sandy SILT	42.7							57.1			
B-32	N-26	130	N	23	Sand/Silt Alluvium	ML	Sandy SILT	34.5							54.7			
B-32	N-27	135	N	23	Sand/Silt Alluvium	SM	Silty SAND	31.7							33.2			
B-32	N-28	140	N	25	Sand/Silt Alluvium	SM	Silty SAND	31.8							27.5			
B-32	N-30	150	N	27	Sand Alluvium	SM	Silty SAND	35.7							36.1			
B-32	N-31	155	N	89/11"	Gravel Alluvium	GM	Silty GRAVEL with some sand	14.5							13.1			
B-33	N-7	22.5	N	0	Fine-grained Alluvium	CL	Silty CLAY with trace sand	52.2							87.1		Corrosivity	5
B-33	N-8	25	N	0	Fine-grained Alluvium	CL	Silty CLAY with trace sand	47.5							90.6			
B-33	N-9	30	N	0	Fine-grained Alluvium	ML	SILT with some sand	44.9		48	33	15			83.7			
B-33	U-1	33	U		Fine-grained Alluvium	ML	SILT with some sand	49		N/A	NP	NP					CDSS, Post DSS	4
B-33	N-10	35	N	0	Sand/Silt Alluvium	ML	Sandy SILT	45.7		N/A	NP	NP			70.1			
B-33	N-11	40	N	4	Sand/Silt Alluvium	ML	Sandy SILT	43.1							58.4			
B-33	N-12	45	N	0	Fine-grained Alluvium	ML	SILT with some sand	47.0		43	40	3			77.4			
B-33	U-2	48	U		Fine-grained Alluvium	ML	SILT with some sand	44		36	30	6					CDSS, Post DSS	4
B-33	N-13	50	N	0	Sand/Silt Alluvium	ML	Sandy SILT	45.0		39	35	4						
B-33	N-14	55	N	0	Sand/Silt Alluvium	ML	Sandy SILT	45.0							63.4			
B-33	N-15	60	N	5	Sand/Silt Alluvium	ML	SILT with some sand	45.6		42	40	2			70.6			
B-33	U-3	63	U		Fine-grained Alluvium	ML	SILT with some sand	43		N/A	NP	NP					CRS, CDSS, Post DSS, DSS	4
B-33	N-16	65	N	9	Sand/Silt Alluvium	ML	Sandy SILT	42.6		36	32	4			68.2			

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Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-33	N-17	70	N	11	Sand/Silt Alluvium	SM	Silty SAND	39.7							37.1			
B-33	N-18	75	N	1	Sand/Silt Alluvium	ML	Sandy SILT	44.1							60.8			
B-33	N-19	80	N	8	Sand/Silt Alluvium	ML	Sandy SILT	40.1							68.7			
B-33	N-20	85	N	10	Sand/Silt Alluvium	SM	Silty SAND	42.0							43.0			
B-33	N-21	90	N	5	Sand/Silt Alluvium	ML	Sandy SILT	42.9							64.5			
B-33	N-22	95	N	3	Fine-grained Alluvium	ML	SILT with some sand	43.2		38	33	5			75.3			
B-33	N-23	100	N	17	Sand/Silt Alluvium	ML	Sandy SILT	43.7							57.4			
B-33	N-24	105	N	15	Sand/Silt Alluvium	SM	Silty SAND	38.7							46.0			
B-33	N-25	110	N	22	Sand/Silt Alluvium	SM	Silty SAND	38.7							24.5			
B-33	N-26	115	N	14	Sand/Silt Alluvium	ML	Sandy SILT	40.9		N/A	NP	NP			61.4			
B-33	N-27	120	N	20	Sand/Silt Alluvium	ML	Sandy SILT	38.3							56.4			
B-33	N-28	125	N	6	Fine-grained Alluvium	ML	SILT with some sand	45.8		44	38	6			80.3			
B-33	U-5	127	U		Sand/Silt Alluvium	SM	Silty SAND	29.2	94.9				0.0	77.1	22.9			3
B-33	N-29	129	N	6	Sand/Silt Alluvium	SM	Silty SAND	33.8							36.2			
B-33	N-30	135	N	27	Sand/Silt Alluvium	SM	Silty SAND	30.8							13.0			
B-33	N-31	140	N	35	Sand Alluvium	SM	Gravelly silty SAND	32.5							21.7			
B-33	N-35	165	N	56	Sand Alluvium	SP-SM	SAND with some silt and gravel	23.7							10.3			
B-33	N-37	175	N	41	Sand Alluvium	SP-SM	SAND with some silt and gravel	12.8							9.9			

NOTES:
1 All depths are in feet below the hole collar.
2 N = Standard Penetration Test (SPT); U = Shelby Tube; D&M = Dames & Moore; S = Rotary Sonic Core
3 See report text for Geotechnical Unit descriptions.
4 Visual-manual procedures were used to assign USCS Symbols and Descriptions for samples without sufficient laboratory testing to determine classifications per ASTM D2487.
5 Soil descriptions based on the ODOT Soil and Rock Classification Manual (1987). See report for additional information.
6 BE = Bender Element-based Shear Wave Velocity; CDSS = Cyclic Direct Simple Shear; CRS = Constant Rate of Strain Consolidation; DSS = Monotonic Direct Simple Shear; Post DSS = Post-Cyclic Monotonic Direct Simple Shear; Post Reconsol = Post-Cyclic Reconsolidation
7 Refer to the numbered Appendix E attachments indicated for results of testing by others. Results of tests performed by Shannon & Wilson are shown on Figures E1 and E2 and on the drill logs in Appendix B.
* Result not representative of material. See drill log for notes.
See Appendix E text and appendix attachments for laboratory testing methods and descriptions of tests.
bgs = below ground surface; LL = Liquid Limit; N/A = Not Applicable; NP = Nonplastic; pcf = pounds per cubic foot; PI = Plasticity Index; PL = Plastic Limit; USCS = Unified Soil Classification System

Table E2 - Summary of Laboratory Test Results by Geotechnical Unit

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-03	N-2	10	N	6	Fill	SP-SM	SAND with some silt and some gravel						16	76.6	7.4			1
B-04	N-2	12.5	N	6	Fill			29										
B-04	N-3	15	N	12	Fill			33.8										
B-07	N-1	11	N	1	Fill												Corrosivity	5
B-07	N-2	15	N	3	Fill	ML	SILT with trace sand	36.7		38.8	31.5	7.3						
B-07	N-3	20	N	2	Fill	ML	SILT with trace sand	39		42.1	29	13.1						
B-08	N-1	15	N	8	Fill												Corrosivity	5
B-08	N-2	17.5	N	7	Fill	SP-SM	SAND with some silt and trace gravel	9.8							5.3			
B-08	N-4	25	N	9	Fill	GC	Clayey GRAVEL with some sand	20.8							37.4			
B-11	N-1	0	N	10	Fill	SP-SM	SAND with some silt and trace gravel	26							6			
B-11	N-2	2.5	N	1	Fill			32.7										
B-11	N-5	10	N	5	Fill			20.8										
B-11	N-6	12.5	N	6	Fill			21.4										
B-11	N-8	17.5	N	6	Fill			26.9										
B-11	N-9	20	N	7	Fill			27.5										
B-11	N-10	22.5	N	7	Fill	SP-SM	SAND with some silt and trace gravel	28.1							7.6			
B-14	N-2	5	N	31	Fill	GM	Silty GRAVEL with some sand	31.1					60.3	26.8	12.9			
B-15	N-9	25	N	14	Fill	SM	Silty SAND	10.8							12.6			
B-15	N-10	30	N	14	Fill	SM	Gravelly silty SAND	25.6							13.3			
B-16	N-2	5	N	11	Fill			22.3										
B-16	N-3	7.5	N	12	Fill			23.7										
B-16	N-4	10	N	4	Fill			30.1									Corrosivity	5
B-16	N-5	12.5	N	19	Fill			23.7										
B-17	N-3	7.5	N	7	Fill			31.7										
B-17	N-5	12.5	N	4	Fill			31.8										
B-17	N-6	15	N	3	Fill			40.1										
B-18	N-4	10	N	1	Fill			57.9										
B-18	N-5	12.5	N	2	Fill			69.7										
B-18	N-6	15	N	2	Fill	SM	Silty SAND with some organics	73							37.5			
B-18	N-7	17.5	N	3	Fill			55.3										
B-19	N-4	17.5	N	30	Fill												Corrosivity	5
B-19	N-5	20	N	43	Fill	SP-SM	SAND with some silt	6.7							9.9			
B-21	N-1	5	N	7	Fill			33.8										
B-21	N-2	10	N	5	Fill	ML	SILT with trace sand	36.7		39	27.4	11.6						
B-22	S-1	10	S		Fill	CL	Silty CLAY			41.1	24.5	16.6			97.9			
B-23	S-1a	6	S		Fill	GM	Silty GRAVEL with some sand						37.2	21.8	41			

Table E2 - Summary of Laboratory Test Results by Geotechnical Unit

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-32	N-2	12.5	N	5	Fill	SP-SM	SAND with some silt and trace gravel	24.2							7.3			
B-03	N-20	100	N	2	Fine-grained Alluvium	ML	SILT with some sand			40	31	9	0	27.3	72.7			1
B-04	N-5	20	N	3	Fine-grained Alluvium			36.8										
B-04	N-6	25	N	4	Fine-grained Alluvium	ML	SILT with trace sand	43.2		39	27	12						3
B-05	N-1	10	N	2	Fine-grained Alluvium			35.9										
B-05	N-2	12.5	N	1	Fine-grained Alluvium			38.6										
B-05	N-3	15	N	3	Fine-grained Alluvium	ML	SILT with trace sand	37.9		38	26	12					Corrosivity	3,5
B-06	N-1	11	N	2	Fine-grained Alluvium												Corrosivity	5
B-06	N-2	15	N	1	Fine-grained Alluvium	ML	SILT with trace sand	42.4		38.3	29.2	9.1						
B-07	N-9	50	N	17	Fine-grained Alluvium	ML	SILT	46.7		49.3	30.8	18.5						
B-08	N-9	50	N	14	Fine-grained Alluvium	MH	Clayey SILT	42.2		53.8	31.8	22			98.3			
B-11	N-11	27.5	N	0	Fine-grained Alluvium	OH	Organic CLAY with some sand	89.4		71.8	47.6	24.2						
B-14	N-19	100	N	6	Fine-grained Alluvium	ML	SILT with trace sand	47.7							89.6			
B-15	N-26	110	N	8	Fine-grained Alluvium	ML	SILT with some sand	45.2		40.4	34.2	6.2			73.6			
B-15	N-29	125	N	9	Fine-grained Alluvium	ML	SILT with some sand	45.2							73.3			
B-16	N-29	125	N	14	Fine-grained Alluvium	ML	SILT with some sand	40.3		42	33.8	8.2			75.4			
B-17	N-7	17.5	N	2	Fine-grained Alluvium	MH	Clayey SILT	47.4		60.3	35.9	24.4			97.3			
B-17	N-8	20	N	0	Fine-grained Alluvium	MH	Clayey SILT	49							97.9			
B-17	U-1a	23	U		Fine-grained Alluvium	ML	SILT with some sand	48.2	72.8	49	32	17	0	22.3	77.7			3
B-17	U-1b	24			Fine-grained Alluvium	ML	SILT with some sand	50		34.3	24.8	9					DSS, CDSS, Post DSS, CRS	4
B-17	N-9	25	N	1	Fine-grained Alluvium	ML	SILT	50.2		46.4	34.6	11.8			95.9			
B-17	N-10	30	N	0	Fine-grained Alluvium	ML	SILT with trace sand	44.8							85.6			
B-17	N-11	35	N	1	Fine-grained Alluvium	ML	SILT with trace sand	45.4							93.7			
B-17	U-2a	40	U		Fine-grained Alluvium	SM	Silty SAND	41.3	79.4				2	76.7	21.3			3
B-17	U-2b	41			Fine-grained Alluvium	SM	Silty SAND	45		35.7	26.3	9.4					CRS, CDSS, Post DSS	4
B-17	N-12	42	N	4	Fine-grained Alluvium	ML	SILT with trace sand	47.4		47.9	36.7	11.2			92.1			
B-17	N-13	45	N	0	Fine-grained Alluvium	ML	SILT	52.5							97.1			
B-17	N-14	50	N	3	Fine-grained Alluvium	ML	SILT with some sand	44.1		N/A	NP	NP			77.2			
B-17	N-15	55	N	1	Fine-grained Alluvium	ML	SILT with trace sand	43.9							89.5			
B-17	N-16a	60	N	7	Fine-grained Alluvium	ML	SILT with trace sand	49.5							89.6			
B-17	N-17	65	N	6	Fine-grained Alluvium	ML	SILT with trace sand	47.5							88.7			
B-17	N-19	75	N	0	Fine-grained Alluvium	ML	SILT with trace sand	49.9		39.2	38.3	0.9			89.3			
B-18	N-8	20	N	2	Fine-grained Alluvium			45.4										
B-18	N-9	25	N	4	Fine-grained Alluvium	OH	Organic CLAY with trace sand	93							93.8			
B-18	N-10	30	N	3	Fine-grained Alluvium	OH	Organic CLAY	87.1							96			
B-18	N-11	35	N	2	Fine-grained Alluvium	OH	Organic CLAY	105.3		119.7	76.7	43			96.4			

Table E2 - Summary of Laboratory Test Results by Geotechnical Unit

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-18	U-2a	38	U		Fine-grained Alluvium	OL	Organic SILT with some sand	102.7	40.2				2	26.5	71.5			3
B-18	U-2b	39			Fine-grained Alluvium	OL	Organic SILT with some sand	51		45.2	38.5	6.8					CRS, CDSS, Post DSS	4
B-18	N-12	40	N	5	Fine-grained Alluvium	OH	Organic CLAY with trace sand	93.5		129.9	75.4	54.5			88.9			
B-18	N-13a	45	N	4	Fine-grained Alluvium	CL	Sandy silty CLAY	26.2							54.7			
B-18	N-13b	46	N		Fine-grained Alluvium			109.5										
B-21	N-3	15	N	3	Fine-grained Alluvium			39.4										
B-21	N-4	20	N	4	Fine-grained Alluvium	ML	SILT with some sand	32.5		27.4	27	0.4						
B-23	S-3d	45	S		Fine-grained Alluvium	CL	Silty CLAY			49.1	26.9	22.2						
B-32	N-3	15	N	3	Fine-grained Alluvium	OH	Organic CLAY with trace sand	47.9							92.8			
B-32	N-4	20	N	0	Fine-grained Alluvium	OH	Organic CLAY with trace sand	50.4							87.4		Corrosivity	5
B-32	N-5	25	N	0	Fine-grained Alluvium	OH	Organic CLAY	45		52.1	29.1	23			96			
B-32	N-6	30	N	0	Fine-grained Alluvium	ML/CL	SILT to Silty CLAY	50.9							98.6			
B-32	N-7	35	N	0	Fine-grained Alluvium	ML/CL	SILT to Silty CLAY with trace sand	42.8		48.7	27.5	21.2			93.2			
B-32	N-8	40	N	0	Fine-grained Alluvium	ML/CL	SILT to Silty CLAY	43.2							97.3			
B-32	N-9	45	N	0	Fine-grained Alluvium	ML	SILT with trace sand	46.3							93.5			
B-32	N-10	50	N	2	Fine-grained Alluvium	ML	SILT with trace sand	41.4		47.2	28.3	18.9			87.6			
B-32	N-12	60	N	0	Fine-grained Alluvium	ML	SILT with some sand	47.7							83			
B-32	U-2	63	U		Fine-grained Alluvium	ML	SILT with some sand	37		N/A	NP	NP					BE, CRS, CDSS, DSS	4
B-33	N-7	22.5	N	0	Fine-grained Alluvium	CL	Silty CLAY with trace sand	52.2							87.1		Corrosivity	5
B-33	N-8	25	N	0	Fine-grained Alluvium	CL	Silty CLAY with trace sand	47.5							90.6			
B-33	N-9	30	N	0	Fine-grained Alluvium	ML	SILT with some sand	44.9		48.1	33.2	14.9			83.7			
B-33	U-1	33	U		Fine-grained Alluvium	ML	SILT with some sand	49		N/A	NP	NP					CDSS, Post DSS	4
B-33	N-12	45	N	0	Fine-grained Alluvium	ML	SILT with some sand	47		42.8	40	2.8			77.4			
B-33	U-2	48	U		Fine-grained Alluvium	ML	SILT with some sand	44.1		36.3	30.2	6.1					CDSS, Post DSS	4
B-33	U-3	63	U		Fine-grained Alluvium	ML	SILT with some sand	43.4		N/A	NP	NP					CRS, CDSS, Post DSS, DSS	4
B-33	N-22	95	N	3	Fine-grained Alluvium	ML	SILT with some sand	43.2		37.7	32.9	4.8			75.3			
B-33	N-28	125	N	6	Fine-grained Alluvium	ML	SILT with some sand	45.8		43.6	37.6	6			80.3			
B-01	N-7	35	N	6	Sand/Silt Alluvium	ML	Sandy SILT			37	29	8	0	32.6	67.4			1
B-02	N-12	67.1	N	17	Sand/Silt Alluvium	ML	Sandy SILT						1	33.1	65.9			1
B-03	N-5	25	N	1	Sand/Silt Alluvium	SM	Silty SAND			33	27	6	0	57.1	42.9			1
B-03	N-6	32	N	9	Sand/Silt Alluvium	SM	Silty SAND						0	57.3	42.7			1
B-03	N-14	70	N	13	Sand/Silt Alluvium	ML	Sandy SILT			37	28	9	0	42.9	57.1			1
B-03	N-17	85	N	9	Sand/Silt Alluvium	ML	SILT with some sand			42	34	8	0	22.7	77.3			1
B-03	N-23	115	N	21	Sand/Silt Alluvium	SM	Silty SAND						0	83	17			1
B-03	N-24	120	N	14	Sand/Silt Alluvium	ML	Sandy SILT			36	32	4	0	32	68			1
B-04	N-7	32	N	7	Sand/Silt Alluvium	SM	Silty SAND	32.6							48.2			3

Table E2 - Summary of Laboratory Test Results by Geotechnical Unit

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-04	N-8	35	N	4	Sand/Silt Alluvium	ML	Sandy SILT	38.8							60.7			3
B-04	N-9a	40	N	8	Sand/Silt Alluvium			43.4										
B-04	N-9b	40.7			Sand/Silt Alluvium			37.3										
B-05	N-4	20	N	2	Sand/Silt Alluvium	ML	SILT with some sand	47.5							74.6			3
B-05	N-5	25	N	2	Sand/Silt Alluvium	ML	SILT with some sand	36.7							81.8			3
B-06	N-3	20	N	6	Sand/Silt Alluvium	SM	Silty SAND	37.5							43.9			
B-06	N-4	25	N	5	Sand/Silt Alluvium	ML	Sandy SILT	39.5							62			
B-07	N-4	25	N	14	Sand/Silt Alluvium	ML	Sandy SILT	35.7							55.9			
B-08	N-5	30	N	15	Sand/Silt Alluvium	SM	Silty SAND with trace gravel	29.3							23.5			
B-09	N-3	12.5	N	1	Sand/Silt Alluvium	ML	SILT with some sand	55.6					0	28.7	71.3			
B-10	N-11	42.5	N	11	Sand/Silt Alluvium	ML	Sandy SILT	38.1					0	46.6	53.4	3		2
B-10	N-12	47.5	N	0	Sand/Silt Alluvium	ML	Sandy SILT	36.7		35	27	8			63.7			2
B-13	N-3	7.5	N	6	Sand/Silt Alluvium	ML	Sandy SILT	53.7							50.8			2
B-14	N-4	10	N	1	Sand/Silt Alluvium	SP-SM	SAND with some silt	37.6					0.6	88.5	10.9			
B-14	N-5	12.5	N	2	Sand/Silt Alluvium	SM	Silty SAND	45.4							42.2			
B-14	N-6	15	N	1	Sand/Silt Alluvium	SP-SM	SAND with some silt	39.5					2.4	88.2	9.4			
B-14	N-7	17.5	N	6	Sand/Silt Alluvium	SP-SM	SAND with some silt	35.7							8.9			
B-14	N-8	20	N	1	Sand/Silt Alluvium	SM	Silty SAND	44.5					0	53.3	46.7			
B-14	N-9	25	N	2	Sand/Silt Alluvium	ML	Sandy SILT	49.3		35.4	34.5	0.9			55.4			
B-14	N-10	30	N	1	Sand/Silt Alluvium	ML	Sandy SILT	50.9		41.1	34.8	6.3						
B-14	N-11	35	N	6	Sand/Silt Alluvium	SM	Silty SAND	45.1					0	57.3	42.7			
B-14	N-12a	40	N	4	Sand/Silt Alluvium	SP-SM	SAND with some silt	39.8							9.6			
B-14	N-13	45	N	3	Sand/Silt Alluvium	SM	Silty SAND	43.9					0	51.3	48.7			
B-14	N-14	50	N	5	Sand/Silt Alluvium	ML	Sandy SILT	45.1							58.2			
B-15	N-11	35	N	3	Sand/Silt Alluvium	ML	Sandy SILT	41.4		36.2	32.2	4			59.6			
B-15	U-1a	38	U		Sand/Silt Alluvium	ML	Sandy SILT	43.3		N/A	NP	NP			51			
B-15	U-1b	39			Sand/Silt Alluvium	ML	Sandy SILT	42		36.3	30.4	5.9					BE, CDSS, Post Reconsol. CDSS.	4
B-15	N-12	40	N	3	Sand/Silt Alluvium	ML	Sandy SILT	40.3							57.8			
B-15	N-13	45	N	4	Sand/Silt Alluvium	ML	Sandy SILT	46.2		N/A	NP	NP			62.3			
B-15	N-14	50	N	4	Sand/Silt Alluvium	ML/SM	Sandy SILT to Silty SAND	44.4							50.3			
B-15	N-15	55	N	7	Sand/Silt Alluvium	ML	Sandy SILT	40.2		33.4	32	1.4			55.6			
B-15	N-16	60	N	10	Sand/Silt Alluvium	ML	Sandy SILT	38.8		N/A	NP	NP			64			
B-15	N-17	65	N	11	Sand/Silt Alluvium	SM	Silty SAND	37.5							30			
B-15	N-18	70	N	11	Sand/Silt Alluvium	SM	Silty SAND	39					0	52.9	47.1			
B-15	N-19	75	N	9	Sand/Silt Alluvium	SM	Silty SAND	44.2							34.2			

Table E2 - Summary of Laboratory Test Results by Geotechnical Unit

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-15	N-20	80	N	8	Sand/Silt Alluvium	SM	Silty SAND	34.3		N/A	NP	NP			43.5			
B-15	U-3	83	U		Sand/Silt Alluvium	SM	Silty SAND	36		N/A	NP	NP					CDSS, Post Reconsol, CRS	4
B-15	N-21	85	N	0	Sand/Silt Alluvium	SM	Silty SAND	40.6							30.7			
B-15	N-22	90	N	14	Sand/Silt Alluvium	SM	Silty SAND	38.9							28.3			
B-15	N-23	95	N	*7	Sand/Silt Alluvium	ML	Sandy SILT	39.2		41.1	35.4	5.7			66.9			
B-15	N-24	100	N	15	Sand/Silt Alluvium	SM	Silty SAND	39.1							44			
B-15	N-25	105	N	14	Sand/Silt Alluvium	SM	Silty SAND	39.7							33.7			
B-15	N-27	115	N	8	Sand/Silt Alluvium	ML	Sandy SILT	41							66.6			
B-15	N-28	120	N	16	Sand/Silt Alluvium	ML	Sandy SILT	42.3		39	32.7	6.3			63.7			
B-15	N-30	130	N	10	Sand/Silt Alluvium	SM	Silty SAND	39.7							47.8			
B-15	N-31	135	N	8	Sand/Silt Alluvium	SM	Silty SAND	39.7							41.6			
B-16	N-8	20	N	10	Sand/Silt Alluvium	ML	Sandy SILT	37.1							68.5			
B-16	N-9	27	N	3	Sand/Silt Alluvium	ML	Sandy SILT	45.7		N/A	NP	NP			61.5			
B-16	N-10	30	N	3	Sand/Silt Alluvium	ML	Sandy SILT	46.4		39.7	33.9	5.8			57			
B-16	U-2	35	U		Sand/Silt Alluvium	ML	Sandy SILT	40.4		N/A	NP	NP					BE, CDSS, Post DSS	4
B-16	N-11	37	N	6	Sand/Silt Alluvium	ML	Sandy SILT	45.7							51			
B-16	N-12a	40	N	12	Sand/Silt Alluvium	ML	Sandy SILT	43.3							68.7			
B-16	N-12b	40.75			Sand/Silt Alluvium	SM	Silty SAND	42							37.4			
B-16	N-13	45	N	6	Sand/Silt Alluvium	SM	Silty SAND	41.8		40.4	40.1	0.3			43.4			
B-16	N-14	50	N	5	Sand/Silt Alluvium	SM	Silty SAND	41.5							40.2			
B-16	N-15	55	N	4	Sand/Silt Alluvium	ML	Sandy SILT	47.6		44.8	42.2	2.6			56.5			
B-16	N-16	62	N	11	Sand/Silt Alluvium	SM	Silty SAND	38.6					0	70.6	29.4			
B-16	N-17	65	N	5	Sand/Silt Alluvium	ML	SILT with some sand	48.6		46.4	35.9	10.5			70.5			
B-16	N-18	70	N	10	Sand/Silt Alluvium	SM	Silty SAND	38.7							17.2			
B-16	N-19	75	N	11	Sand/Silt Alluvium	SM	Silty SAND	35.2							20.6			
B-16	N-20	80	N	8	Sand/Silt Alluvium	SM	Silty SAND	45.3							46.6			
B-16	N-21	85	N	8	Sand/Silt Alluvium	ML	Sandy SILT	45.6		44.8	37.1	7.7			51.5			
B-16	N-22	90	N	10	Sand/Silt Alluvium	SM	Silty SAND	38.6							43.9			
B-16	N-23	95	N	9	Sand/Silt Alluvium	SM	Silty SAND	37.2							28.4			
B-16	N-24	100	N	17	Sand/Silt Alluvium	SM	Silty SAND	37.8							16.3			
B-16	N-25	105	N	7	Sand/Silt Alluvium	ML	Sandy SILT	41.1		46.5	38.1	8.4			59.8			
B-16	N-26	112	N	9	Sand/Silt Alluvium	SM	Silty SAND	40.8							27.6			
B-16	N-27	115	N	19	Sand/Silt Alluvium	ML	Sandy SILT	37.2							62.8			
B-16	N-28	120	N	15	Sand/Silt Alluvium	ML	Sandy SILT	38.8							65.7			
B-16	N-30	130	N	25	Sand/Silt Alluvium	SM	Silty SAND	29.3		N/A	NP	NP			34.7			

Table E2 - Summary of Laboratory Test Results by Geotechnical Unit

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-16	N-31	135	N	20	Sand/Silt Alluvium	SM/ML	Silty SAND to Sandy SILT	34.5							50			
B-16	N-32	140	N	8	Sand/Silt Alluvium	ML	Sandy SILT	37.3							61.8			
B-17	N-16b	60.4			Sand/Silt Alluvium	SM	Silty SAND	41.4							47.6			
B-17	N-18	70	N	6	Sand/Silt Alluvium	SM	Silty SAND	47.5							43.2			
B-17	U-3a	80	U		Sand/Silt Alluvium	ML	SILT with some sand	38.8	79.9				0	27.3	72.7			3
B-17	U-3b	81			Sand/Silt Alluvium	ML	SILT with some sand	39		N/A	NP	NP					CRS, CDSS, Post DSS	4
B-17	N-20	82	N	17	Sand/Silt Alluvium	SM	Silty SAND	33.1							24			
B-17	N-21	85	N	6	Sand/Silt Alluvium	ML	Sandy SILT	48.4							63.2			
B-17	N-22	90	N	19	Sand/Silt Alluvium	SM	Silty SAND	32.1							18.2			
B-17	N-23	95	N	9	Sand/Silt Alluvium	SM	Silty SAND	45.4							39.5			
B-17	N-24	100	N	0	Sand/Silt Alluvium	ML	Sandy SILT	47.6					0	30.9	69.1			
B-17	U-4a	101.5	U		Sand/Silt Alluvium	SM	Silty SAND	36.5	78.2				0	60.3	39.7			3
B-17	U-4b	102.5			Sand/Silt Alluvium	SM	Silty SAND	46		N/A	NP	NP					CRS	4
B-17	N-25	103.5	N	40	Sand/Silt Alluvium	ML	Sandy SILT	39.4		34.9	33.3	1.6			53.6			
B-17	N-26	110	N	11	Sand/Silt Alluvium	ML	Sandy SILT	41.5							57.4			
B-17	N-27	115	N	19	Sand/Silt Alluvium	SM	Silty SAND	44.2							41.7			
B-17	N-28	120	N	22	Sand/Silt Alluvium	SM	Silty SAND	40.2							28.4			
B-17	N-29	125	N	40	Sand/Silt Alluvium	SM	Silty SAND	28.2							13.8			
B-17	N-30b	130.75	N	20	Sand/Silt Alluvium	ML	SILT with some sand	38.3							71.1			
B-17	N-31	135	N	15	Sand/Silt Alluvium	ML	SILT with some sand	46.5							76.4			
B-17	N-32	140	N	19	Sand/Silt Alluvium	ML	Sandy SILT	39.8		38.4	34.2	4.2			59.2			
B-17	N-33	145	N	20	Sand/Silt Alluvium	ML	Sandy SILT	42.7							61.8			
B-18	N-14	50	N	5	Sand/Silt Alluvium	ML	Sandy SILT	32.7							67.4			
B-18	N-15	55	N	9	Sand/Silt Alluvium	ML	Sandy SILT	34.6		37.8	26.5	11.3						
B-22	S-3b	44	S		Sand/Silt Alluvium	ML	SILT						0	0.6	99.4			
B-22	S-4a	50	S		Sand/Silt Alluvium	SP-SM	Gravelly SAND with some silt						42.5	51.9	5.6			
B-24	S-5b	33	S		Sand/Silt Alluvium	SM	Silty SAND			34	26	8	0	59.1	40.9			3
B-24	S-6b	42	S		Sand/Silt Alluvium	SM	Silty SAND								30			
B-24	S-7a	50	S		Sand/Silt Alluvium	SC	Clayey SAND			32	22	10			23.7			3
B-25	S-5b	36	S		Sand/Silt Alluvium	SM	Silty SAND								15.9			
B-27	N-16	66.2	N	0	Sand/Silt Alluvium	ML	SILT with some sand	38.4		37.9	28.7	9.2						
B-32	N-11	55	N	0	Sand/Silt Alluvium	ML	Sandy SILT	40.5		47.8	28.7	19.1			64.6			
B-32	N-13	65	N	4	Sand/Silt Alluvium	ML	Sandy SILT	47.7		N/A	NP	NP			54.1			
B-32	N-14	70	N	7	Sand/Silt Alluvium	ML	Sandy SILT	43.5							62			
B-32	N-15	75	N	3	Sand/Silt Alluvium	SM	Silty SAND	44.3							41.5			
B-32	N-16	80	N	5	Sand/Silt Alluvium	SM/ML	Silty SAND to Sandy SILT	44.5							50			

Table E2 - Summary of Laboratory Test Results by Geotechnical Unit

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-32	N-17	85	N	1	Sand/Silt Alluvium	ML	Sandy SILT	45.8							59.8			
B-32	N-18	90	N	9	Sand/Silt Alluvium	ML	Sandy SILT	42.7							60.4			
B-32	N-19	95	N	4	Sand/Silt Alluvium	ML	Sandy SILT	43.4							59.7			
B-32	N-20	100	N	4	Sand/Silt Alluvium	ML	Sandy SILT	41.8							51.8			
B-32	N-21	105	N	19	Sand/Silt Alluvium	SM	Silty SAND	38.4					0	64.6	35.5			
B-32	N-22	110	N	18	Sand/Silt Alluvium	SM	Silty SAND	39.1							27.1			
B-32	N-23	115	N	14	Sand/Silt Alluvium	ML	Sandy SILT	42.7							57.1			
B-32	N-26	130	N	23	Sand/Silt Alluvium	ML	Sandy SILT	34.5							54.7			
B-32	N-27	135	N	23	Sand/Silt Alluvium	SM	Silty SAND	31.7							33.2			
B-32	N-28	140	N	25	Sand/Silt Alluvium	SM	Silty SAND	31.8							27.5			
B-33	N-10	35	N	0	Sand/Silt Alluvium	ML	Sandy SILT	45.7		N/A	NP	NP			70.1			
B-33	N-11	40	N	4	Sand/Silt Alluvium	ML	Sandy SILT	43.1							58.4			
B-33	N-13	50	N	0	Sand/Silt Alluvium	ML	Sandy SILT	45		38.5	35	3.5						
B-33	N-14	55	N	0	Sand/Silt Alluvium	ML	Sandy SILT	45							63.4			
B-33	N-15	60	N	5	Sand/Silt Alluvium	ML	SILT with some sand	45.6		41.6	39.8	1.8			70.6			
B-33	N-16	65	N	9	Sand/Silt Alluvium	ML	Sandy SILT	42.6		36.1	32.4	3.7			68.2			
B-33	N-17	70	N	11	Sand/Silt Alluvium	SM	Silty SAND	39.7							37.1			
B-33	N-18	75	N	1	Sand/Silt Alluvium	ML	Sandy SILT	44.1							60.8			
B-33	N-19	80	N	8	Sand/Silt Alluvium	ML	Sandy SILT	40.1							68.7			
B-33	N-20	85	N	10	Sand/Silt Alluvium	SM	Silty SAND	42							43			
B-33	N-21	90	N	5	Sand/Silt Alluvium	ML	Sandy SILT	42.9							64.5			
B-33	N-23	100	N	17	Sand/Silt Alluvium	ML	Sandy SILT	43.7							57.4			
B-33	N-24	105	N	15	Sand/Silt Alluvium	SM	Silty SAND	38.7							46			
B-33	N-25	110	N	22	Sand/Silt Alluvium	SM	Silty SAND	38.7							24.5			
B-33	N-26	115	N	14	Sand/Silt Alluvium	ML	Sandy SILT	40.9		N/A	NP	NP			61.4			
B-33	N-27	120	N	20	Sand/Silt Alluvium	ML	Sandy SILT	38.3							56.4			
B-33	U-5	127	U		Sand/Silt Alluvium	SM	Silty SAND	29.2	94.9				0	77.1	22.9			3
B-33	N-29	129	N	6	Sand/Silt Alluvium	SM	Silty SAND	33.8							36.2			
B-33	N-30	135	N	27	Sand/Silt Alluvium	SM	Silty SAND	30.8							13			
B-02	N-2	16	N	9	Sand Alluvium	SP	Gravelly SAND with trace silt						32	66.5	1.5			1
B-02	N-6	36.5	N	16	Sand Alluvium	SP-SM	SAND with some silt						0	94	6			1
B-07	N-10	55	N	73	Sand Alluvium	SP-SM	Gravelly SAND with some silt	14.6					35.5	54.4	10.1			
B-08	N-10	53.8	N	35	Sand Alluvium	SM	Silty SAND with trace gravel	20.5							13.3			
B-09	N-2	10	N	1	Sand Alluvium			47.5										
B-09	N-7	25.4	N	4	Sand Alluvium	SM	Silty SAND	42.8							45.7			
B-11	N-13	39	N	17	Sand Alluvium	SP-SM	SAND with some silt and trace gravel	31.4							7.7			

Table E2 - Summary of Laboratory Test Results by Geotechnical Unit

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-11	N-14	46	N	16	Sand Alluvium			34.5										
B-11	N-15	52.5	N	14	Sand Alluvium	SP-SM	SAND with some silt	33.9					0	92.9	7.2			
B-11	N-16	57.5	N	14	Sand Alluvium			32.8										
B-11	N-17	62.5	N	13	Sand Alluvium			36.1										
B-12	N-2	15	N	6	Sand Alluvium												Corrosivity	5
B-12	N-3	20.8	N	8	Sand Alluvium												Corrosivity	5
B-12A	N-3	10	N	4	Sand Alluvium	SP	SAND with trace silt and gravel	27.9							2.1			
B-12A	N-4	12.5	N	5	Sand Alluvium			27.6										
B-12A	N-5	15	N	7	Sand Alluvium			28.9										
B-12A	N-6	17.5	N	4	Sand Alluvium			27										
B-12A	N-7	20	N	6	Sand Alluvium			27.8										
B-12A	N-8	25	N	2	Sand Alluvium	SP	SAND with trace silt	38.2							1.6			
B-12A	N-9	30	N	6	Sand Alluvium			32										
B-12A	N-10	35	N	13	Sand Alluvium			38.1										
B-12A	N-11	40	N	10	Sand Alluvium			40										
B-12A	N-12	45	N	14	Sand Alluvium	SP	SAND with trace silt	37.5							4.7			
B-12A	N-13	50	N	16	Sand Alluvium			37.1										
B-12A	N-14	55	N	53	Sand Alluvium			20.8										
B-13	N-4	10	N	1	Sand Alluvium	SM	Silty SAND with some gravel	36.3					15	72.3	12.7			2
B-13	N-6	15	N	10	Sand Alluvium	SP	SAND with trace silt	30							3.5			2
B-13	N-11	35	N	7	Sand Alluvium	SM	Silty SAND	39							22.3			2
B-13	N-12	40	N	14	Sand Alluvium	SP-SM	SAND with some silt	28					1	91.8	7.2			2
B-13	N-14	50	N	11	Sand Alluvium	SP-SM	SAND with some silt	30.6							5.5			2
B-14	N-15	65	N		Sand Alluvium	SP-SM	SAND with some silt	40.9							8.8			
B-14	N-16	70	N		Sand Alluvium	SP-SM	SAND with some silt	41.2							6.4			
B-14	N-18	90	N		Sand Alluvium	SP	SAND with trace silt	44.5					0	95.5	4.5			
B-14	N-20	110	N		Sand Alluvium	SP	SAND with trace silt	45							4.8			
B-14	N-21	120	N		Sand Alluvium	SP	SAND with trace silt	37.4							1.4			
B-15	N-32	140	N	14	Sand Alluvium	SM	Silty SAND	36							13.8			
B-15	N-33	145	N	25	Sand Alluvium	SM	Silty SAND	34.8							26.1			
B-19	N-6	25	N	34	Sand Alluvium			16.1										
B-24	S-2	10	S		Sand Alluvium	GP-GM	Sandy GRAVEL with some silt						53.4	41.1	5.4			
B-25	S-3	14	S		Sand Alluvium	SP-SM	Gravelly SAND with some silt						47	47.4	5.6			
B-27	N-2	7.9	N	14	Sand Alluvium			26									Corrosivity	5
B-27	N-3	10.5	N	10	Sand Alluvium	SP	Gravelly SAND with trace silt	18.6							1.8			
B-27	N-6	18.6	N	12	Sand Alluvium	SP-SM	SAND with some silt and gravel	26.4							6.5			

Table E2 - Summary of Laboratory Test Results by Geotechnical Unit

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-27	N-7	21.1	N	8	Sand Alluvium			24										
B-27	N-8	26.2	N	14	Sand Alluvium			24.2										
B-27	N-14	55.7	N	20	Sand Alluvium	SM	Silty SAND with trace gravel	35.5							20			
B-27	N-15	60.9	N	11	Sand Alluvium			40.5										
B-28	S-1b	8.5	S		Sand Alluvium	SP	SAND with trace silt and gravel								3.7			
B-28	S-2d	29.7	S		Sand Alluvium	SM	Silty SAND								20.4			
B-29	S-2	25	S		Sand Alluvium	SP	SAND with trace silt and gravel								2.1			
B-29	S-3	40	S		Sand Alluvium	SP	SAND with trace silt and gravel								2.5			
B-30	S-2b	26	S		Sand Alluvium	SM	Silty SAND						4.2	73.1	22.6			
B-30	S-3a	44	S		Sand Alluvium	SP-SM	SAND with some silt						2.7	89.2	8.1			
B-31	S-1b	1	S		Sand Alluvium	GP	Sandy GRAVEL with trace silt								1.4			
B-31	S-3a	30.7	S		Sand Alluvium	SM	Silty SAND								21.5			
B-32	N-30	150	N	27	Sand Alluvium	SM	Silty SAND	35.7							36.1			
B-33	N-31	140	N	35	Sand Alluvium	SM	Gravelly silty SAND	32.5							21.7			
B-33	N-35	165	N	56	Sand Alluvium	SP-SM	SAND with some silt and gravel	23.7							10.3			
B-33	N-37	175	N	41	Sand Alluvium	SP-SM	SAND with some silt and gravel	12.8							9.9			
B-01	N-10	50	N	95	Gravel Alluvium	GP-GM	Sandy GRAVEL with some silt						46	44.3	9.7			1
B-06	N-5	30	N	73	Gravel Alluvium			11										
B-06	N-6	35	N	69	Gravel Alluvium			9.8										
B-06	N-7	40	N	47	Gravel Alluvium			16.1										
B-07	N-5	30	N	46	Gravel Alluvium			11.7										
B-07	N-11	60	N	82/11"	Gravel Alluvium			19.7										
B-07	N-12	65	N	83	Gravel Alluvium			16.1										
B-08	N-7	40	N	91	Gravel Alluvium	GP-GM	GRAVEL with some silt and sand	10.3					69.8	22.4	7.8			
B-08	N-11	60	N	91	Gravel Alluvium			14.1										
B-13	N-20	80	N	83	Gravel Alluvium	GP-GM	GRAVEL with some silt and sand	11.2							5.4			2
B-14	N-22	128.6	N		Gravel Alluvium	*SP	*SAND with trace silt	35.4					0	95.3	4.7			
B-19	N-7	30	N	69	Gravel Alluvium			13.4										
B-22	S-3a	30	S		Gravel Alluvium	GM	Silty GRAVEL with some sand						57.3	29.4	13.3			
B-23	S-2c	28	S		Gravel Alluvium	GM	Sandy silty GRAVEL						52.2	29.8	18			
B-23	S-3c	32.5	S		Gravel Alluvium	GP-GM	GRAVEL with some silt and sand						75.3	19.8	4.9			
B-23	S-4	50	S		Gravel Alluvium	GP-GM	GRAVEL with some silt and sand						68.1	23.8	8.1			
B-25	S-6a	44	S		Gravel Alluvium	GM	Sandy silty GRAVEL						52	30	18			3
B-26	S-4c	33	S		Gravel Alluvium	GP-GM	Sandy GRAVEL with some silt						51.5	40.2	8.3			
B-26	S-6	48	S		Gravel Alluvium	GW	GRAVEL with some sand and trace silt						73.5	23.7	2.9			
B-28	S-3b	47.5	S		Gravel Alluvium	GP-GM	GRAVEL with some silt and sand						69.7	24.6	5.7			

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Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-31	S-4b	55	S		Gravel Alluvium	GP	GRAVEL with trace silt and sand						87.1	10.4	2.5			
B-32	N-31	155	N	89/11"	Gravel Alluvium	GM	Silty GRAVEL with some sand	14.5							13.1			
B-20	N-3	19.5	N	69	Catastrophic Flood Deposits - Channel Facies	GM	Silty GRAVEL with some sand	11							14.3			
B-20	N-4	25	N	29	Catastrophic Flood Deposits - Channel Facies	SM	Silty SAND	22.5							26.8			
B-20	N-5	30	N	25	Catastrophic Flood Deposits - Channel Facies	SM	Silty SAND with trace gravel	18.8							14			
B-20	N-1	10	N	6	Catastrophic Flood Deposits - Fine Grained Facies	ML	SILT with trace sand	40.9		38.8	29.3	9.5						
B-20	N-2	15	N	4	Catastrophic Flood Deposits - Fine Grained Facies	ML	SILT with some sand	39.1		N/A	NP	NP						
B-01	N-18	90	N	40	Upper Troutdale Formation	MH	Clayey SILT			56	32	24						1
B-02	N-14	77	N	53	Upper Troutdale Formation	CH	CLAY with some sand			56	26	30	0	23.7	76.3			1
B-04	N-13	60	N	50/5"	Upper Troutdale Formation	SP-SM	SAND with some silt and trace gravel	23.1							10.8			3
B-05	N-10	50	N	79/11"	Upper Troutdale Formation	SP-SM	Gravelly SAND with some silt	25					31	60	9			3
B-05	N-11	55	N	50/3"	Upper Troutdale Formation			19.9										
B-05	N-12	60	N	81	Upper Troutdale Formation	SM	Silty SAND	23.4							12.5			3
B-05	N-13	65	N	95/10"	Upper Troutdale Formation			22.9										
B-06	N-9	60	N	95/11.5"	Upper Troutdale Formation	SP-SM	SAND with some silt	25.8							8.6			
B-06	N-10	65	N	50/5.5"	Upper Troutdale Formation			21.8										
B-06	N-11	70	N	89	Upper Troutdale Formation			23.4										
B-08	N-14	75	N	73	Upper Troutdale Formation			23.7										
B-08	N-15	80	N	57	Upper Troutdale Formation	SM	Silty SAND	28.2							20.1			
B-10	N-15	61.3	N	54	Upper Troutdale Formation	SM	Silty SAND with trace gravel	36.2					5	71.5	23.5			2
B-21	N-11	55	N	63	Upper Troutdale Formation	SP-SM	SAND with some silt	25					0	88.6	11.4			
B-21	N-12	60	N	64	Upper Troutdale Formation	SP-SM	SAND with some silt	22.4							9.4			
B-21	N-13	65	N	64	Upper Troutdale Formation	SP-SM	SAND with some silt and gravel	18.5							9.5			
B-21	N-14	70	N	59	Upper Troutdale Formation	SP-SM	SAND with some silt	23.2					0	89.8	10.3			
B-21	N-15	75	N	79	Upper Troutdale Formation	SP-SM	SAND with some silt	24.4							10.6			
B-21	N-16	80	N	84/11"	Upper Troutdale Formation	SP-SM	SAND with some silt	25.1							10.3			
B-21	N-17	85	N	90/7"	Upper Troutdale Formation	SP-SM	SAND with some silt and trace gravel	22.3					5.5	85.7	8.9			
B-21	N-18	90	N	50/4"	Upper Troutdale Formation	SP-SM	SAND with some silt and trace gravel	21.5							7.9			
B-21	N-19	95	N	50/4"	Upper Troutdale Formation	SP-SM	SAND with some silt and trace gravel	24.6							10.8			
B-22	S-4d	63	S		Upper Troutdale Formation	SP-SM	SAND with some silt						0	94.7	5.4			
B-23	S-5b	63	S		Upper Troutdale Formation	SP-SM	SAND with some silt						0	89.1	10.9			
B-25	S-6b	49			Upper Troutdale Formation	CL	Silty CLAY with some sand			29	19	10						3
B-27	N-19	79.4	N	46	Upper Troutdale Formation	MH	Clayey SILT with trace sand	35.8		60.1	43.6	16.5						
B-27	N-20	84.5	N	33	Upper Troutdale Formation	ML	SILT with some sand	39.7		43.7	32	11.7						
B-30	S-4d	72	S		Upper Troutdale Formation	CH	CLAY			64	30.7	33.3						

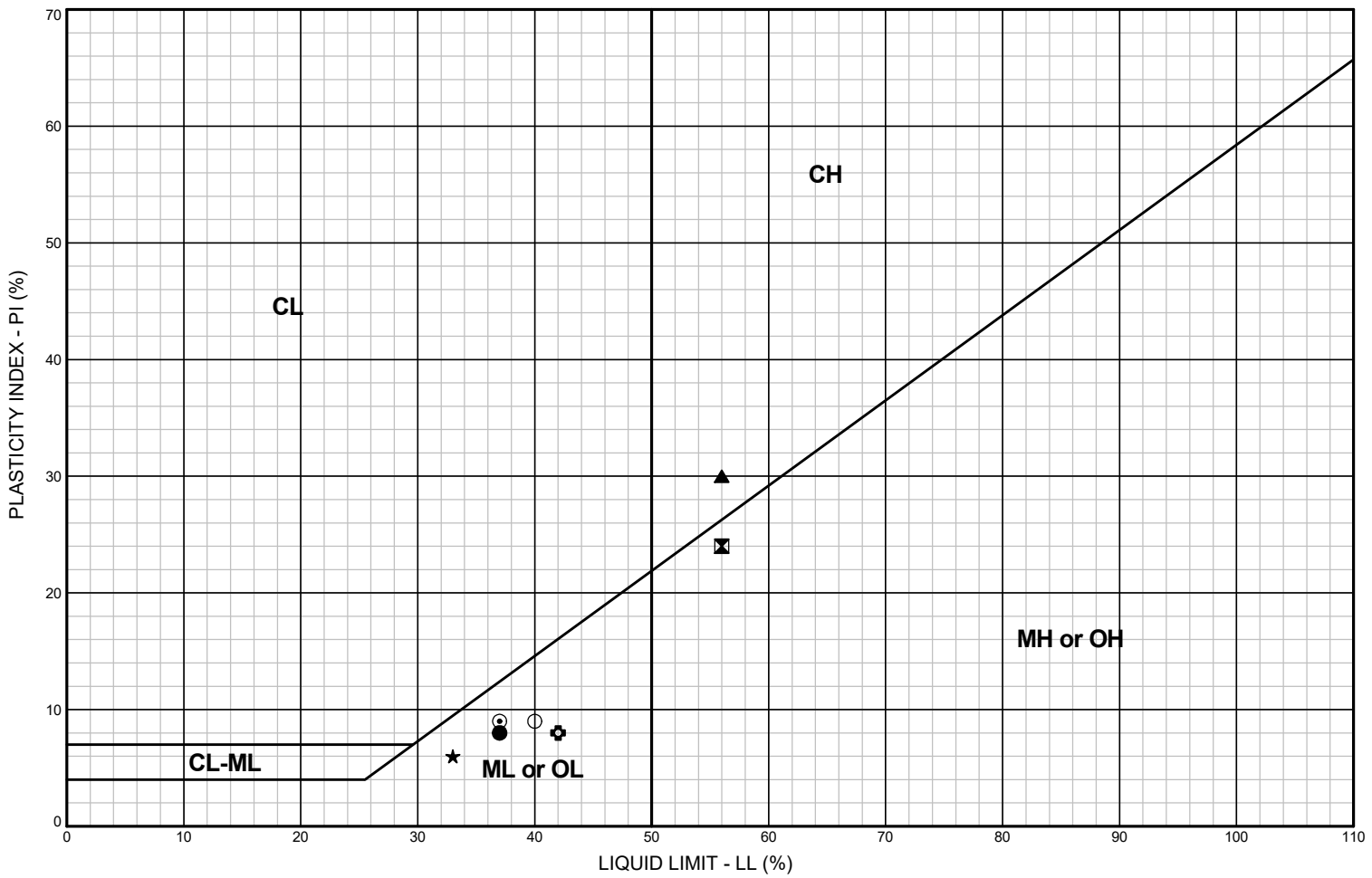
Table E2 - Summary of Laboratory Test Results by Geotechnical Unit

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-30	S-5a	85	S		Upper Troutdale Formation	ML	SILT with trace sand			40.3	31.9	8.4						
B-04	N-16	75	N	42	Lower Troutdale Formation	CL	Silty CLAY with trace sand	30.1		36	21	15						3
B-06	N-12	75	N	50/2"	Lower Troutdale Formation			21.2										
B-08	N-24	150	N	79	Lower Troutdale Formation	SM	Silty SAND	36.2		43.4	32.5	10.9						
B-09	N-20	94.7	N	90/7"	Lower Troutdale Formation			22.2										
B-10	N-21	94.3	N	50/4"	Lower Troutdale Formation	SM	Silty SAND with some gravel	23.3							16.3			2
B-11	N-32a	165	N	50/5"	Lower Troutdale Formation			27.6										
B-19	N-17a	80	N	50/4"	Lower Troutdale Formation	SM	Silty SAND	30.6							24.7			
B-22	S-6a	90	S		Lower Troutdale Formation	GM	Silty GRAVEL with some sand						59.8	26.4	13.9			
B-22	S-6b	92	S		Lower Troutdale Formation	MH	Clayey SILT			66.2	38.6	27.6			95.7			
B-22	S-7	100	S		Lower Troutdale Formation	GC	Clayey GRAVEL with some sand						65.1	21.9	13			
B-22	S-9b	116	S		Lower Troutdale Formation	GM	Silty GRAVEL with some sand						60.9	26.9	12.1			
B-22	S-11a	130	S		Lower Troutdale Formation	GP-GM	Sandy GRAVEL with some silt						75.2	19.6	5.2			
B-23	S-6b	82	S		Lower Troutdale Formation	SP-SM	Gravelly SAND with some silt						45.2	47.9	6.9			
B-23	S-7a	90.1	S		Lower Troutdale Formation	ML	SILT with trace sand						0	7.2	92.8			
B-23	S-7c	94	S		Lower Troutdale Formation	GM	Silty GRAVEL with some sand						57.3	24.1	18.5			
B-23	S-9a	117	S		Lower Troutdale Formation	GP-GM	Sandy GRAVEL with some silt						64.2	30.5	5.3			
B-24	S-8	60	S		Lower Troutdale Formation	GM	Sandy silty GRAVEL						48.5	36.8	14.7			
B-24	S-10	75	S		Lower Troutdale Formation	GM	Silty GRAVEL with some sand						58.5	28.4	13.1			
B-24	S-13	90	S		Lower Troutdale Formation	GM	Sandy silty GRAVEL						48.3	34.3	17.4			
B-24	S-17b	113	S		Lower Troutdale Formation	GP	GRAVEL with trace silt and sand						84	13	3.1			
B-25	S-11	84	S		Lower Troutdale Formation	GP-GM	Sandy GRAVEL with some silt						57	32.5	10.5			3
B-26	S-8b	70.5	S		Lower Troutdale Formation	GC	Clayey GRAVEL with some sand						56	29.6	14.4			3
B-26	S-9a	78	S		Lower Troutdale Formation	GP-GM	Sandy GRAVEL with some silt								7.4			
B-26	S-15	128	S		Lower Troutdale Formation	GP-GC	GRAVEL with some clay and sand						71.5	18.8	9.7			
B-28	S-5a	84	S		Lower Troutdale Formation	GP-GM	GRAVEL with some silt and sand						73.4	17.1	9.6			
B-28	S-7c	123	S		Lower Troutdale Formation	GW-GM	GRAVEL with some silt and sand						63.3	29.6	7.1			
B-29	S-4d	76	S		Lower Troutdale Formation	GW-GM	Sandy GRAVEL with some silt						60.6	30.2	9.2			
B-29	S-8c	129	S		Lower Troutdale Formation	GM	Silty GRAVEL with some sand						56.3	24.7	19			
B-29	S-9b	138	S		Lower Troutdale Formation	CH	CLAY with trace sand			61.3	28.8	32.5						
B-30	S-5c	91	S		Lower Troutdale Formation	GC	Clayey GRAVEL with some sand						57.7	28.8	13.5			
B-30	S-7a	106	S		Lower Troutdale Formation	GP-GC	Sandy GRAVEL with some clay						52.1	37	11			
B-31	S-5	70.1	S		Lower Troutdale Formation	GC	Sandy clayey GRAVEL						39.6	34.7	25.7			
B-31	S-7	101.8	S		Lower Troutdale Formation	GP-GM	Sandy GRAVEL with some silt						63.5	30	6.5			
B-31	S-9b	128	S		Lower Troutdale Formation	GW-GC	GRAVEL with some clay and sand						64.5	28.9	6.5			
B-09	N-23	116.3	N	56	Sandy River Mudstone	CL	Silty CLAY with trace sand	30		47.2	25.3	21.9						

Table E2 - Summary of Laboratory Test Results by Geotechnical Unit

Boring	Sample Number	Top Depth (ft)[1]	Sample Type[2]	Blow Count (field)	Geotechnical Unit[3]	USCS Symbol[4]	Description[4,5]	Moisture Content (%)	Dry Unit Weight (pcf)	Atterberg Limits			Grain Size Analyses				Other Testing[6]	Attachment Reference(s)[7]
										LL (%)	PL (%)	PI (%)	Gravel (%)	Sand (%)	Fines (%)	<2 µm (%)		
B-09	N-24	121.5	N	42	Sandy River Mudstone			27.4										
B-09	N-25	127.2	N	29	Sandy River Mudstone	CH	CLAY with trace sand	33.2		52.4	23.6	28.8						
B-09	N-26	131.2	N	49	Sandy River Mudstone	CL	Silty CLAY with trace sand	31.2		46.8	26.1	20.7						
B-09	N-27	139.6	N	78	Sandy River Mudstone	SM	Silty SAND	29.3					2.5	73.1	24.4			
B-09	N-28	149.8	N	76	Sandy River Mudstone			39.5										
B-10	N-25	123	N	37	Sandy River Mudstone	MH	Sandy clayey SILT	41.8		60	32	28			70.4			2
B-10	N-26	133.5	N	91	Sandy River Mudstone	SM	Silty SAND	24.1					1	85.5	13.5	1.1		2
B-10	N-27b	144	N		Sandy River Mudstone	SM	Silty SAND	41.7		N/A	NP	NP			38.1			2
B-11	N-32b	165.75			Sandy River Mudstone			32.6										
B-11	N-33	170	N	58/7"	Sandy River Mudstone	GP-GM	Sandy GRAVEL with some silt	25.3					45.6	44.3	10.1			
B-11	N-34	180	N	50/5"	Sandy River Mudstone			30.7										
B-24	S-19a	120	S		Sandy River Mudstone	CH	CLAY with trace sand			77	34	43						3
B-24	S-21	140	S		Sandy River Mudstone	SM	Silty SAND								15.2			
B-25	S-13	104	S		Sandy River Mudstone	CL	Sandy silty CLAY			47	27	20						3
B-25	S-16b	138.5	S		Sandy River Mudstone	SP-SM	SAND with some silt			N/A	NP	NP						3
B-25	S-17a	144	S		Sandy River Mudstone	SP-SM	SAND with some silt								7.8			
B-25	S-19	159	S		Sandy River Mudstone	SP	SAND with trace silt								4.7			
B-26	S-17b	140.5	S		Sandy River Mudstone	MH	Clayey SILT with trace sand			76	38	38						3
B-27	N-24	111.2	N	98	Sandy River Mudstone	SM	Silty SAND	27.7							11.8			
B-27	N-25	121.1	N	62	Sandy River Mudstone	SC	Clayey SAND	34.4					0	70.6	29.4			
B-27	N-26	138.1	N	56	Sandy River Mudstone	SM	Silty SAND	30.2							17.8			
B-27	N-27	148.6	N	21	Sandy River Mudstone	MH	Clayey SILT with trace sand	45.1		63.2	35.6	27.6						
B-27	N-28	160.3	N	71	Sandy River Mudstone	SM	Silty SAND	27.2					0	85.4	14.6			
B-27	N-29	171	N	50/5"	Sandy River Mudstone			30.6										
B-27	N-30	177.9	N	50/5"	Sandy River Mudstone			28.8										
B-29	S-10b	152	S		Sandy River Mudstone	SP-SM	SAND with some silt								5.6			
B-30	S-8c	127	S		Sandy River Mudstone	SC	Clayey SAND						1	67.9	31.1			
B-30	S-10	146	S		Sandy River Mudstone	SM	Silty SAND						1.3	86.3	12.4			

NOTES:
1 All depths are in feet below the hole collar.
2 N = Standard Penetration Test (SPT); U = Shelby Tube; D&M = Dames & Moore; S = Rotary Sonic Core
3 See report text for Geotechnical Unit descriptions.
4 Visual-manual procedures were used to assign USCS Symbols and Descriptions for samples without sufficient laboratory testing to determine classifications per ASTM D2487.
5 Soil descriptions based on the ODOT Soil and Rock Classification Manual (1987). See report for additional information.
6 BE = Bender Element-based Shear Wave Velocity; CDSS = Cyclic Direct Simple Shear; CRS = Constant Rate of Strain Consolidation; DSS = Monotonic Direct Simple Shear; Post DSS = Post-Cyclic Monotonic Direct Simple Shear; Post Reconsol = Post-Cyclic Reconsolidation
7 Refer to the numbered Appendix E attachments indicated for results of testing by others. Results of tests performed by Shannon & Wilson are shown on Figures E1 and E2 and on the drill logs in Appendix B.
* Result not representative of material. See drill log for notes.
See Appendix E text and appendix attachments for laboratory testing methods and descriptions of tests.
bgs = below ground surface; LL = Liquid Limit; N/A = Not Applicable; NP = Nonplastic; pcf = pounds per cubic foot; PI = Plasticity Index; PL = Plastic Limit; USCS = Unified Soil Classification System



NOTES

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

3) Plasticity adjectives used in sample descriptions correspond to plasticity index as follows:
- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-01, N7	35.0	*ML*	*Sandy SILT*	37	29	8		67
⊠ B-01, N18	90.0	*MH*	*Clayey SILT*	56	32	24		
▲ B-02, N14	77.0	*CH*	*CLAY with some sand*	56	26	30		76
★ B-03, N5	25.0	*SM*	*Silty SAND*	33	27	6		43
⊙ B-03, N14	70.0	*ML*	*Sandy SILT*	37	28	9		57
✿ B-03, N17	85.0	*ML*	*SILT with some sand*	42	34	8		77
○ B-03, N20	100.0	*ML*	*SILT with some sand*	40	31	9		73

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ATTERBERG LIMITS RESULTS BY BORING NUMBER

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FIG. E1
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FIG. E1

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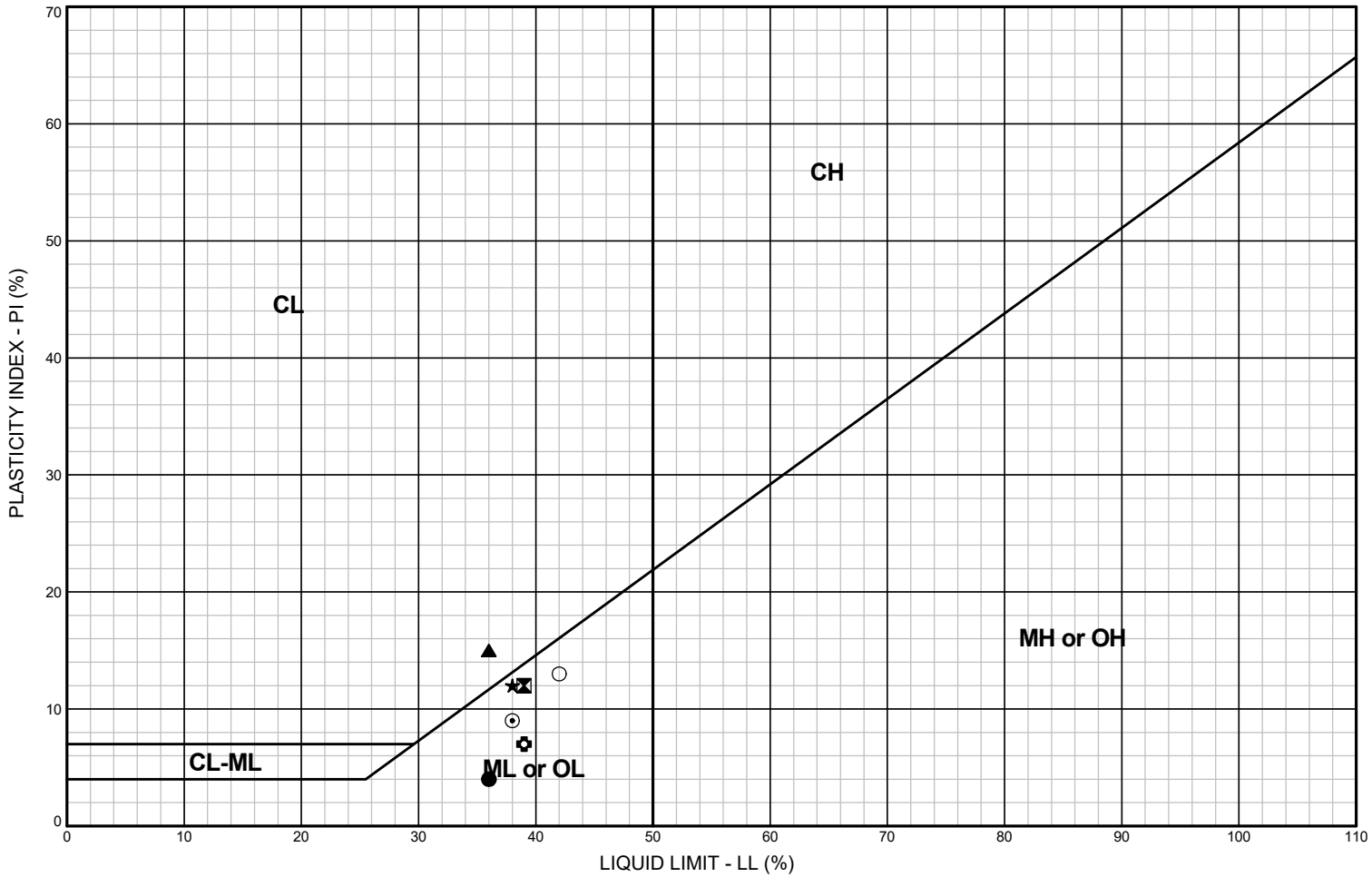

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- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-03, N24	120.0	*ML*	*Sandy SILT*	36	32	4		68
⊠ B-04, N6	25.0	*ML*	*SILT with trace sand*	39	27	12	43	
▲ B-04, N16	75.0	*CL*	*Silty CLAY with trace sand*	36	21	15	30	
★ B-05, N3	15.0	*ML*	*SILT with trace sand*	38	26	12	38	
⊙ B-06, N2	15.0	*ML*	*SILT with trace sand*	38	29	9	42	
✿ B-07, N2	15.0	*ML*	*SILT with trace sand*	39	32	7	37	
○ B-07, N3	20.0	*ML*	*SILT with trace sand*	42	29	13	39	

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ATTERBERG LIMITS RESULTS BY BORING NUMBER

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FIG. E1
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FIG. E1

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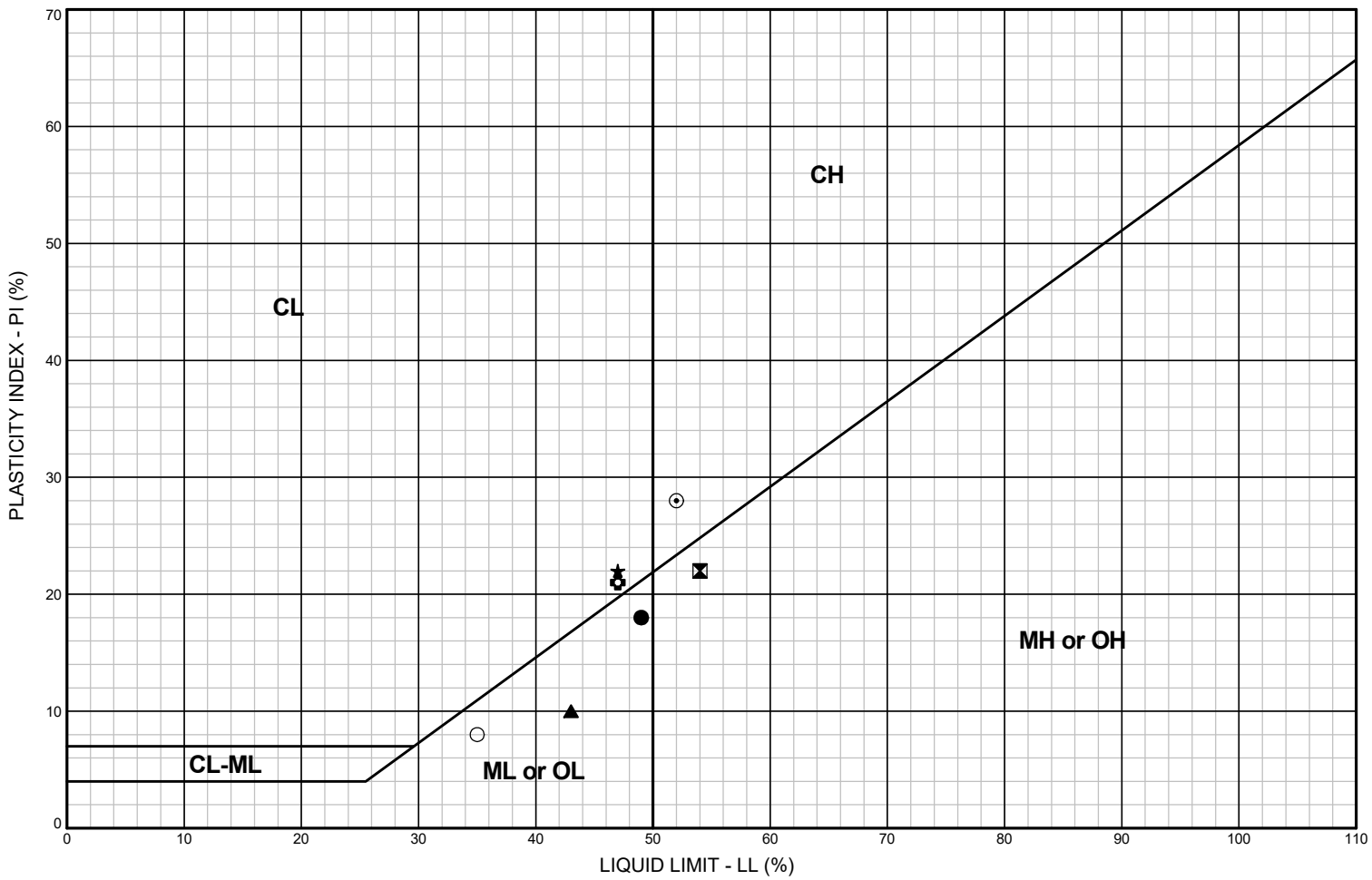

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- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-07, N9	50.0	*ML*	*SILT*	49	31	18	47	
⊠ B-08, N9	50.0	*MH*	*Clayey SILT*	54	32	22	42	98
▲ B-08, N24	150.0	*SM*	*Silty SAND*	43	33	10	36	
★ B-09, N23	116.3	*CL*	*Silty CLAY with trace sand*	47	25	22	30	
⊙ B-09, N25	127.2	*CH*	*CLAY with trace sand*	52	24	28	33	
✿ B-09, N26	131.2	*CL*	*Silty CLAY with trace sand*	47	26	21	31	
○ B-10, N12	47.5	*ML*	*Sandy SILT*	35	27	8	37	64

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ATTERBERG LIMITS RESULTS BY BORING NUMBER

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FIG. E1
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FIG. E1

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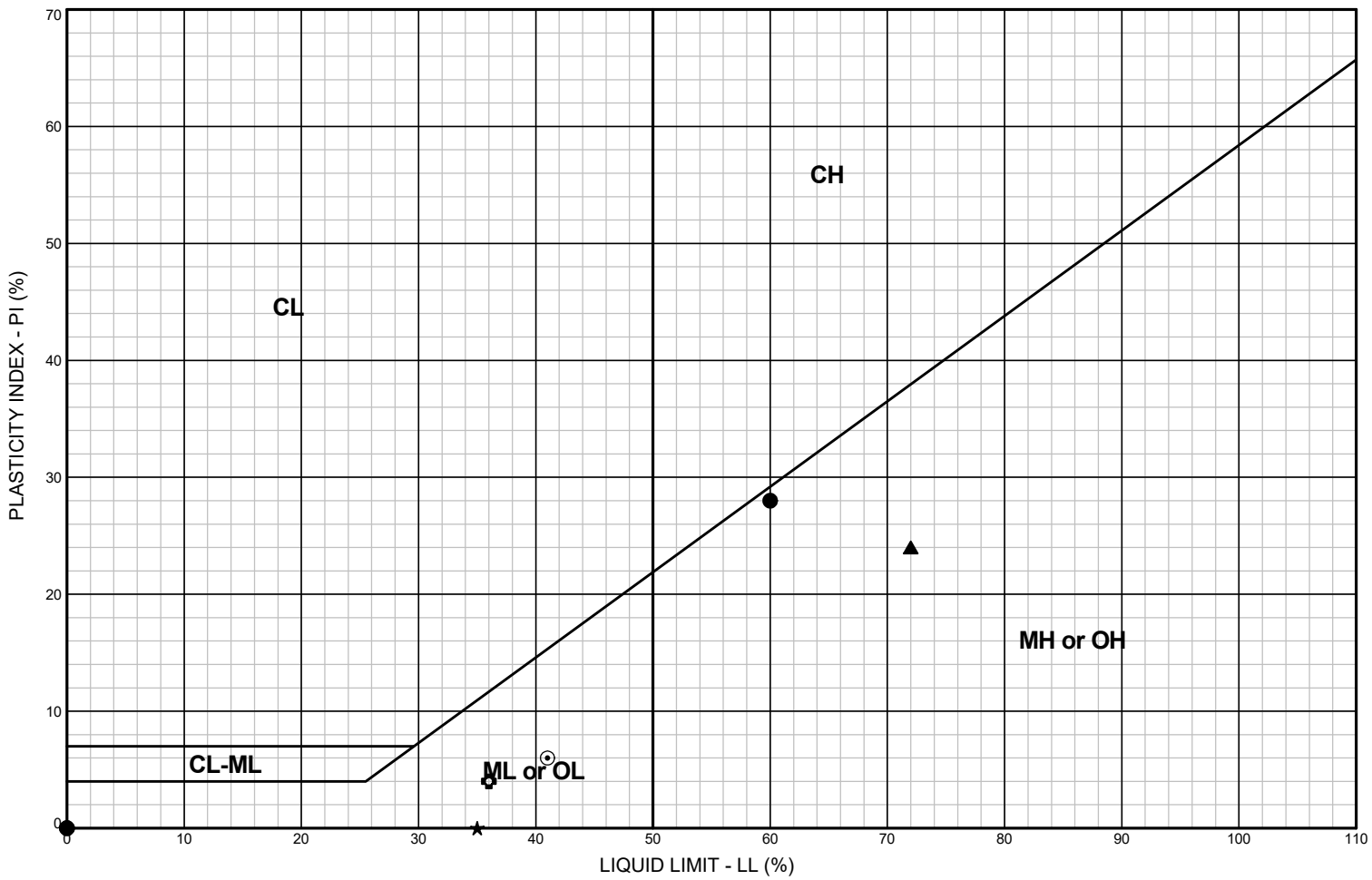

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- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-10, N25	123.0	*MH*	*Sandy clayey SILT*	60	32	28	42	70
B-10, N27b	144.0	*SM*	*Silty SAND*	NP	NP	NP	42	38
▲ B-11, N11	27.5	*OH*	*Organic CLAY with some sand*	72	48	24	89	
★ B-14, N9	25.0	*ML*	*Sandy SILT*	35	35	0	49	55
⊙ B-14, N10	30.0	*ML*	*Sandy SILT*	41	35	6	51	
✿ B-15, N11	35.0	*ML*	*Sandy SILT*	36	32	4	41	60
B-15, U1a	38.0	*ML*	*Sandy SILT*	NP	NP	NP	43	51

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FIG. E1
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FIG. E1

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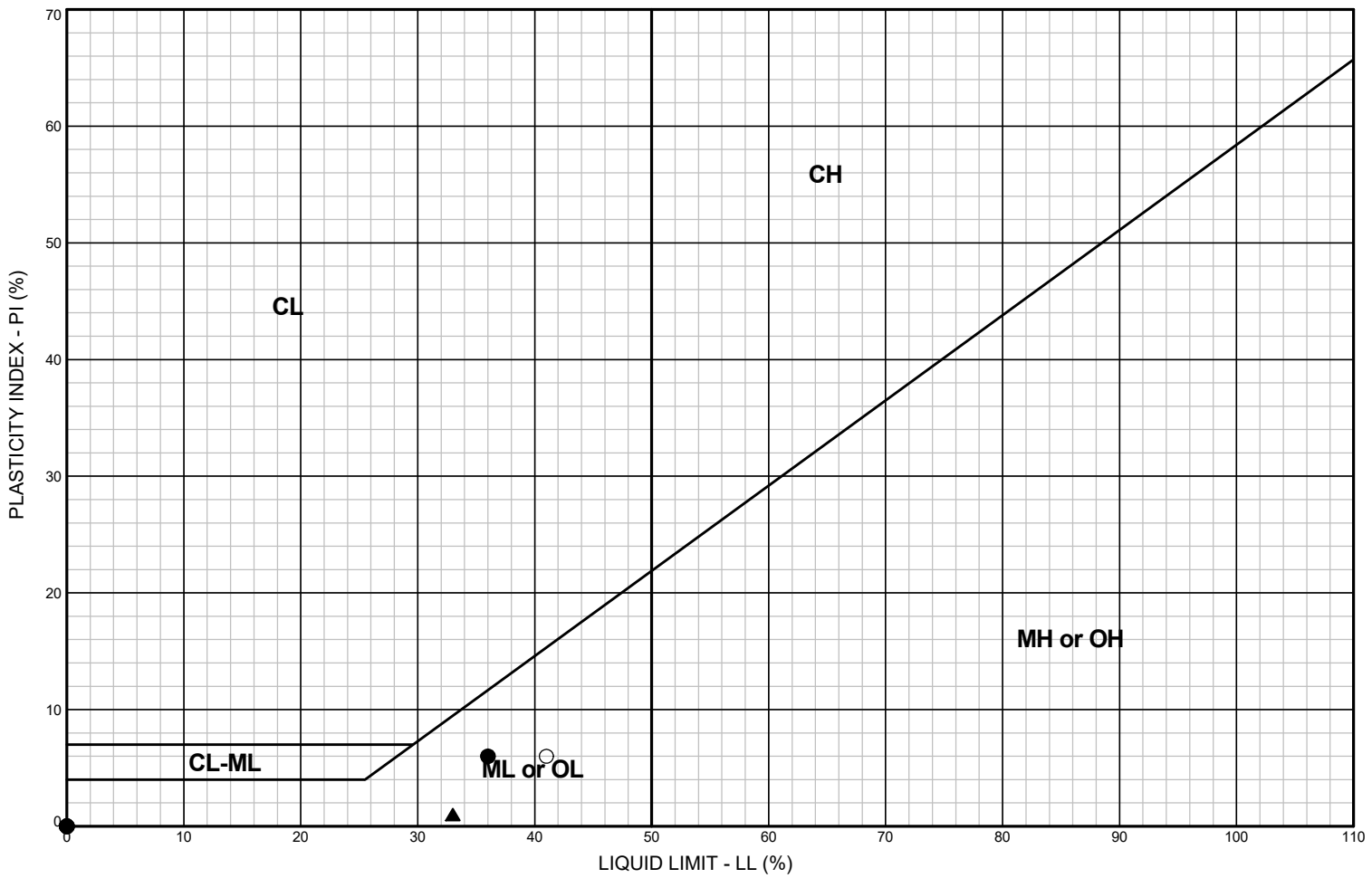

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- Nonplastic (NP) (< 3%)
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- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-15, U1b	39.0	*ML*	*Sandy SILT*	36	30	6	42	
B-15, N13	45.0	*ML*	*Sandy SILT*	NP	NP	NP	46	62
▲ B-15, N15	55.0	*ML*	*Sandy SILT*	33	32	1	40	56
B-15, N16	60.0	*ML*	*Sandy SILT*	NP	NP	NP	39	64
B-15, N20	80.0	*SM*	*Silty SAND*	NP	NP	NP	34	44
B-15, U3	83.0	*SM*	*Silty SAND*	NP	NP	NP	36	
○ B-15, N23	95.0	*ML*	*Sandy SILT*	41	35	6	39	67

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ATTERBERG LIMITS RESULTS BY BORING NUMBER

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FIG. E1
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FIG. E1

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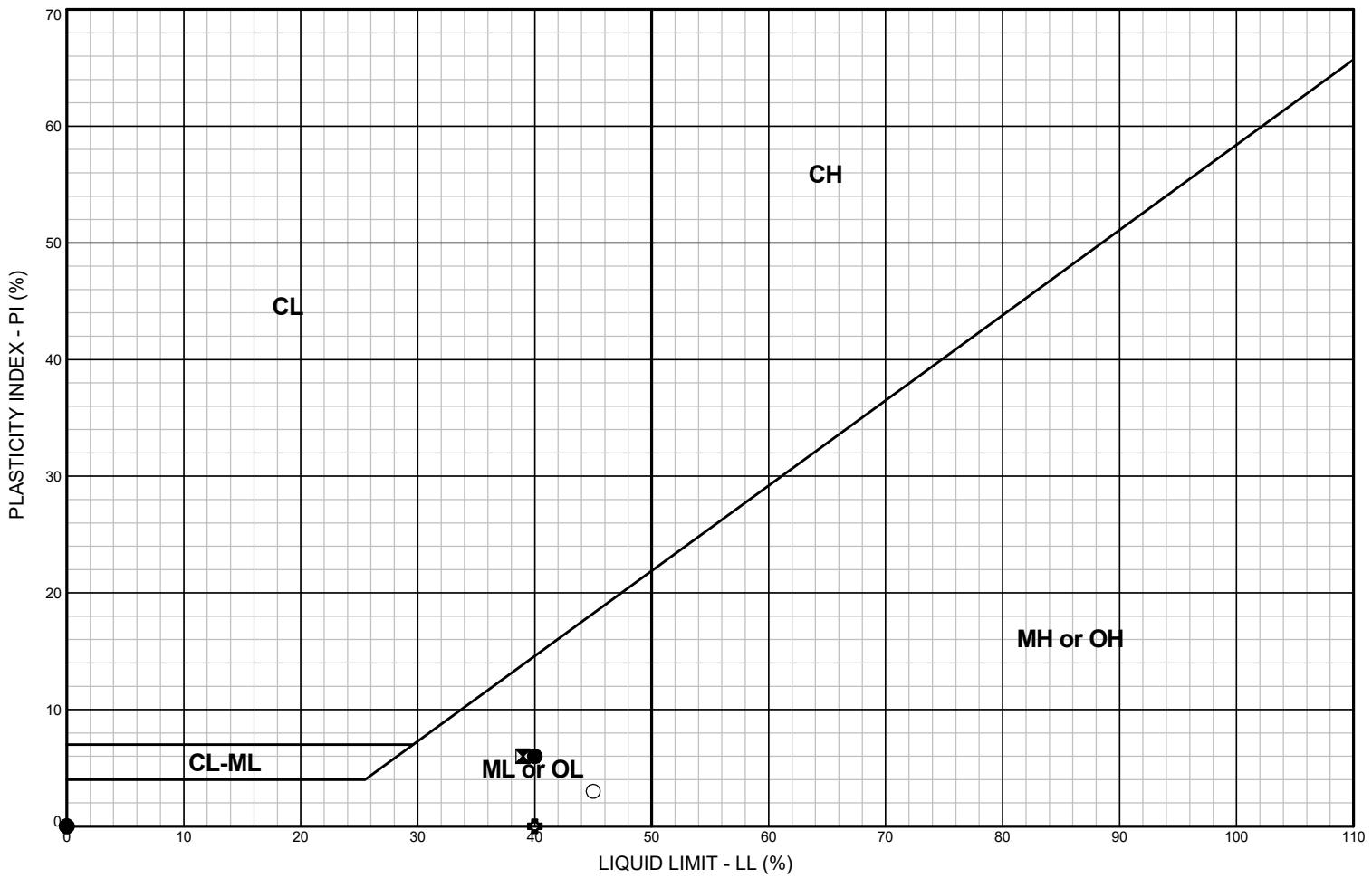

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- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-15, N26	110.0	*ML*	*SILT with some sand*	40	34	6	45	74
⊠ B-15, N28	120.0	*ML*	*Sandy SILT*	39	33	6	42	64
B-16, N9	27.0	*ML*	*Sandy SILT*	NP	NP	NP	46	62
★ B-16, N10	30.0	*ML*	*Sandy SILT*	40	34	6	46	57
B-16, U2	35.0	*ML*	*Sandy SILT*	NP	NP	NP	40	
✿ B-16, N13	45.0	*SM*	*Silty SAND*	40	40	NP	42	43
○ B-16, N15	55.0	*ML*	*Sandy SILT*	45	42	3	48	57

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Portland, Oregon

ATTERBERG LIMITS RESULTS BY BORING NUMBER

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FIG. E1
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FIG. E1

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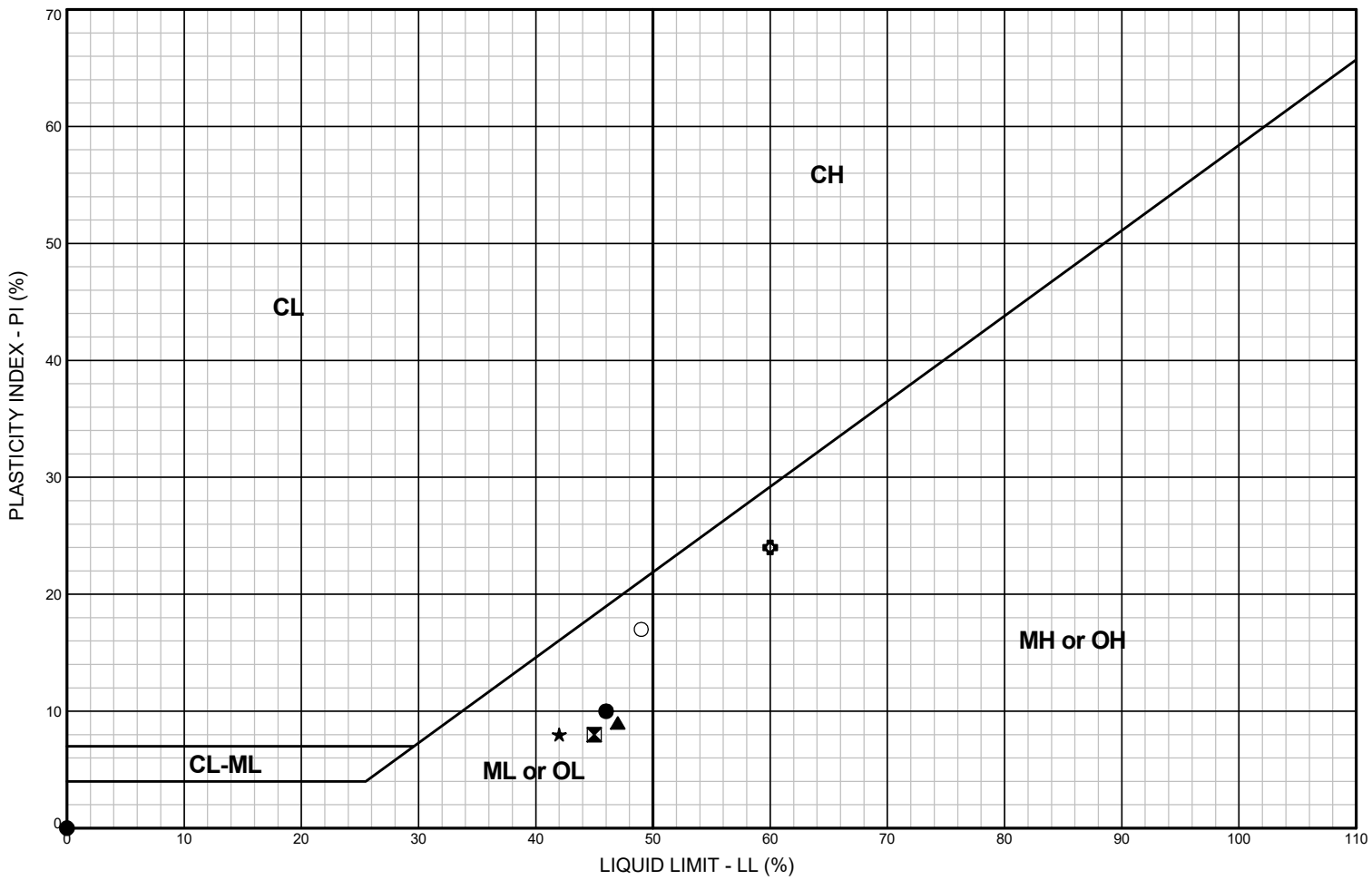

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- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-16, N17	65.0	*ML*	*SILT with some sand*	46	36	10	49	71
⊠ B-16, N21	85.0	*ML*	*Sandy SILT*	45	37	8	46	52
▲ B-16, N25	105.0	*ML*	*Sandy SILT*	47	38	9	41	60
★ B-16, N29	125.0	*ML*	*SILT with some sand*	42	34	8	40	75
B-16, N30	130.0	*SM*	*Silty SAND*	NP	NP	NP	29	35
✿ B-17, N7	17.5	*MH*	*Clayey SILT*	60	36	24	47	97
○ B-17, U1a	23.0	*ML*	*SILT with some sand*	49	32	17	48	78

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ATTERBERG LIMITS RESULTS BY BORING NUMBER

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FIG. E1
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FIG. E1

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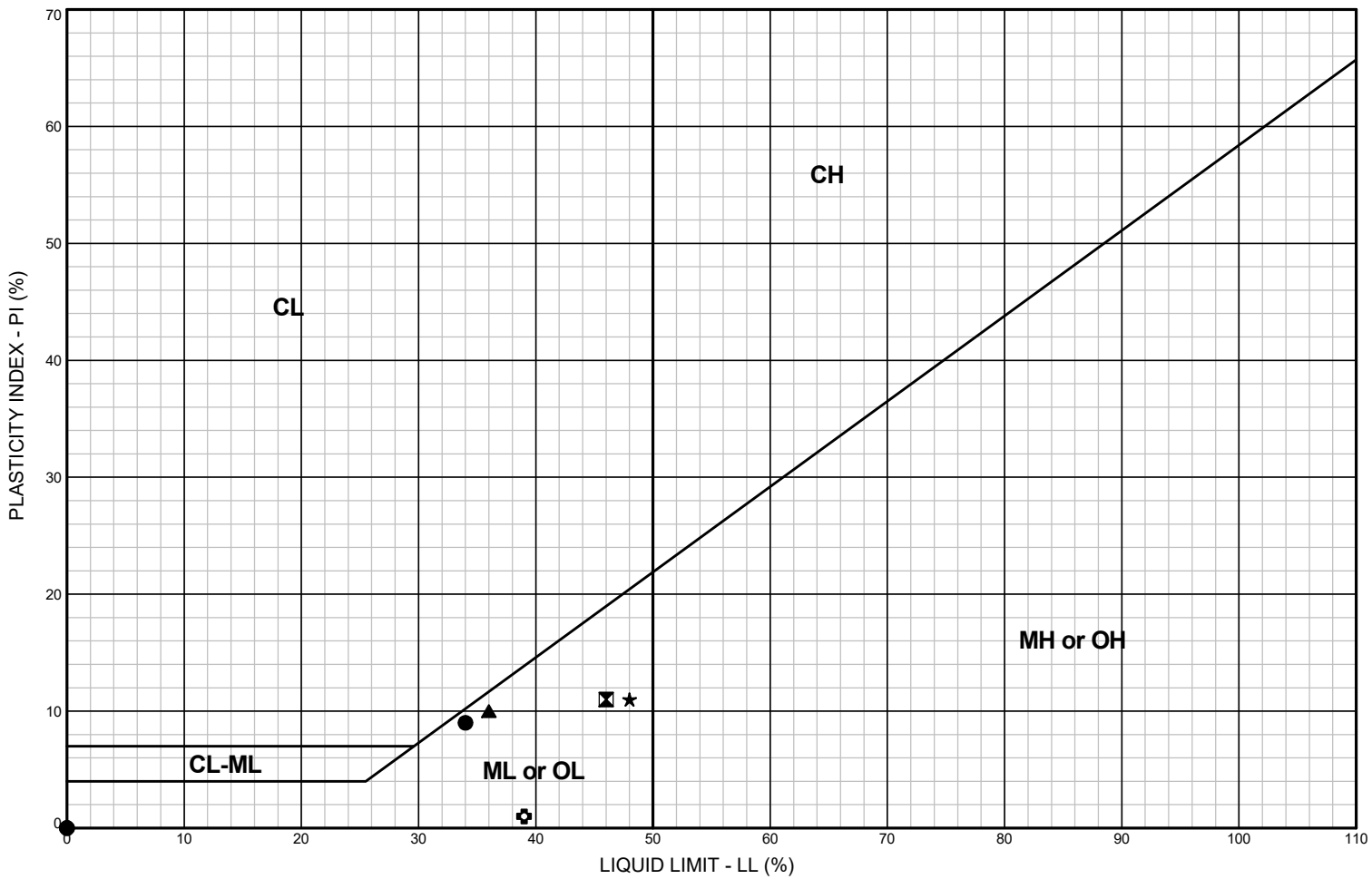

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- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-17, U1b	24.0	*ML*	*SILT with some sand*	34	25	9	50	
⊠ B-17, N9	25.0	*ML*	*SILT*	46	35	11	50	96
▲ B-17, U2b	41.0	*SM*	*Silty SAND*	36	26	10	45	
★ B-17, N12	42.0	*ML*	*SILT with trace sand*	48	37	11	47	92
B-17, N14	50.0	*ML*	*SILT with some sand*	NP	NP	NP	44	77
✿ B-17, N19	75.0	*ML*	*SILT with trace sand*	39	38	1	50	89
B-17, U3b	81.0	*ML*	*SILT with some sand*	NP	NP	NP	39	

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ATTERBERG LIMITS RESULTS BY BORING NUMBER

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FIG. E1
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FIG. E1

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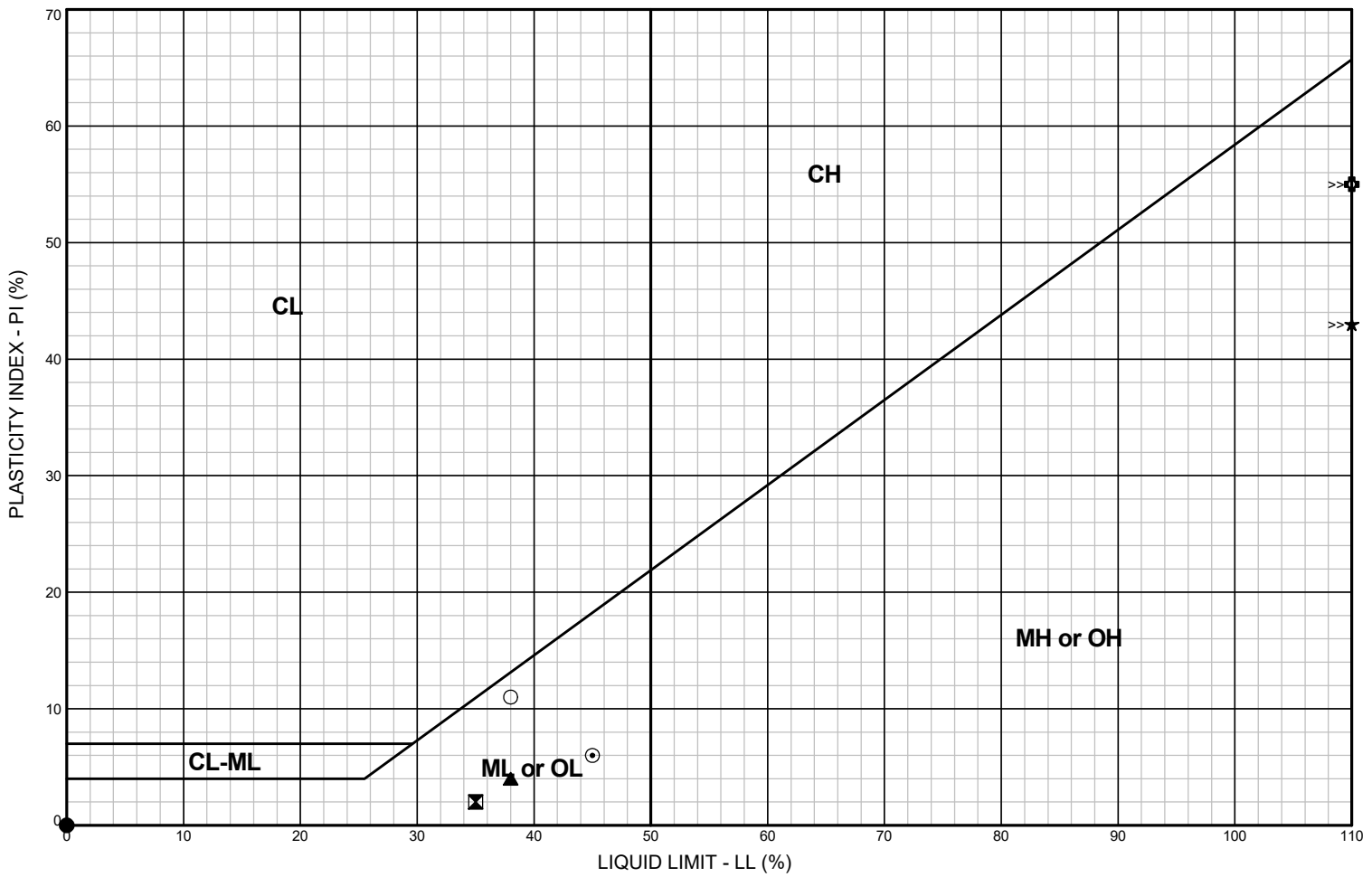

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- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
B-17, U4b	102.5	*SM*	*Silty SAND*	NP	NP	NP	46	
⊠ B-17, N25	103.5	*ML*	*Sandy SILT*	35	33	2	39	54
▲ B-17, N32	140.0	*ML*	*Sandy SILT*	38	34	4	40	59
★ B-18, N11	35.0	*OH*	*Organic CLAY*	120	77	43	105	96
⊙ B-18, U2b	39.0	*OL*	*Organic SILT with some sand*	45	39	6	51	
✿ B-18, N12	40.0	*OH*	*Organic CLAY with trace sand*	130	75	55	94	89
○ B-18, N15	55.0	*ML*	*Sandy SILT*	38	27	11	35	

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FIG. E1
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FIG. E1

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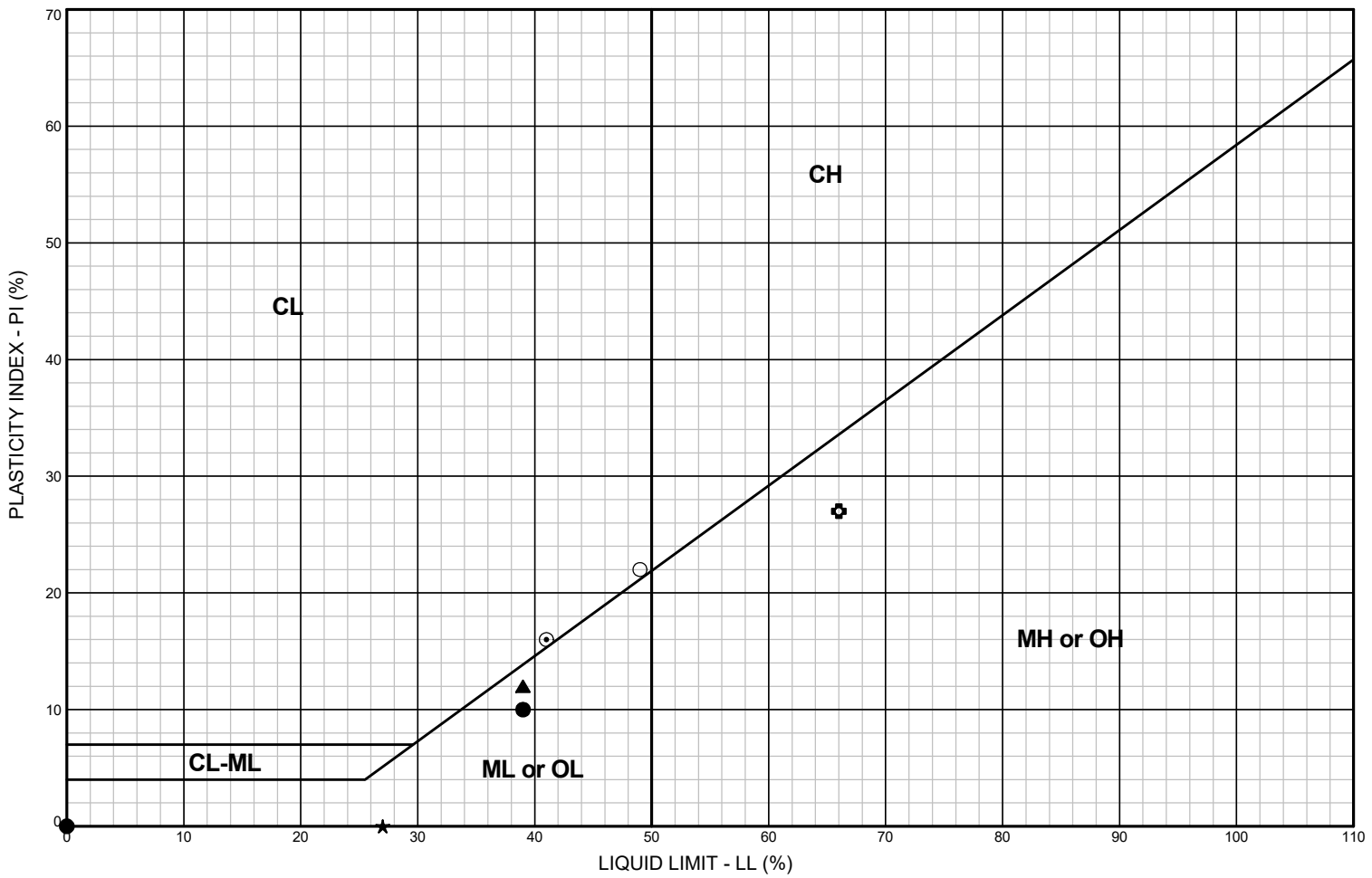

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- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-20, N1	10.0	*ML*	*SILT with trace sand*	39	29	10	41	
B-20, N2	15.0	*ML*	*SILT with some sand*	NP	NP	NP	39	
▲ B-21, N2	10.0	*ML*	*SILT with trace sand*	39	27	12	37	
★ B-21, N4	20.0	*ML*	*SILT with some sand*	27	27	NP	33	
⊙ B-22, S1	10.0	*CL*	*Silty CLAY*	41	25	16		98
✿ B-22, S6b	92.0	*MH*	*Clayey SILT*	66	39	27		96
○ B-23, S3d	45.0	*CL*	*Silty CLAY*	49	27	22		

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FIG. E1
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FIG. E1

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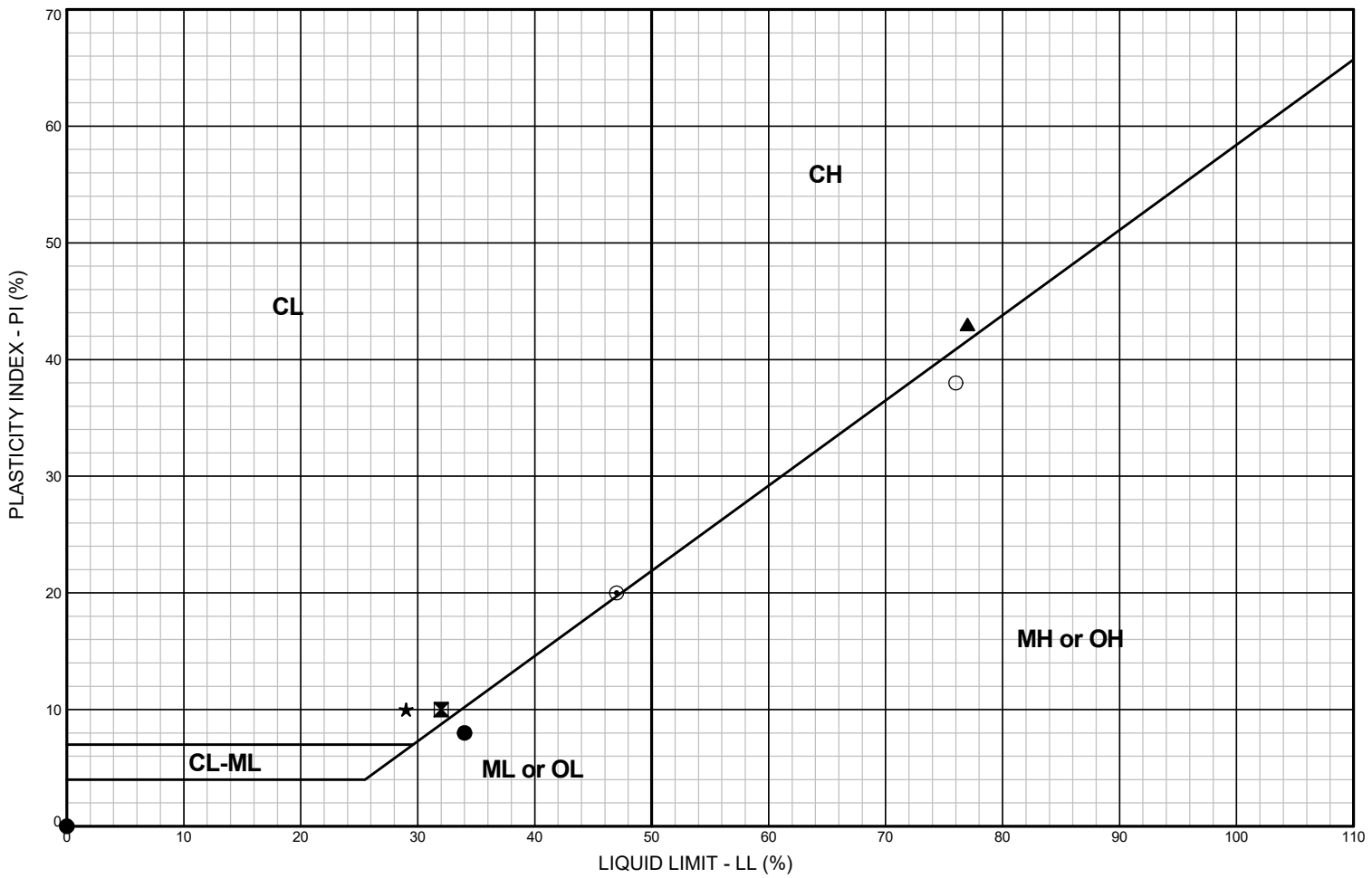

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- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-24, S5b	33.0	*SM*	*Silty SAND*	34	26	8		41
⊠ B-24, S7a	50.0	*SC*	*Clayey SAND*	32	22	10		24
▲ B-24, S19a	120.0	*CH*	*CLAY with trace sand*	77	34	43		
★ B-25, S6b	49.0	*CL*	*Silty CLAY with some sand*	29	19	10		
⊙ B-25, S13	104.0	*CL*	*Sandy silty CLAY*	47	27	20		
B-25, S16b	138.5	*SP-SM*	*SAND with some silt*	NP	NP	NP		
○ B-26, S17b	140.5	*MH*	*Clayey SILT with trace sand*	76	38	38		

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FIG. E1
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FIG. E1

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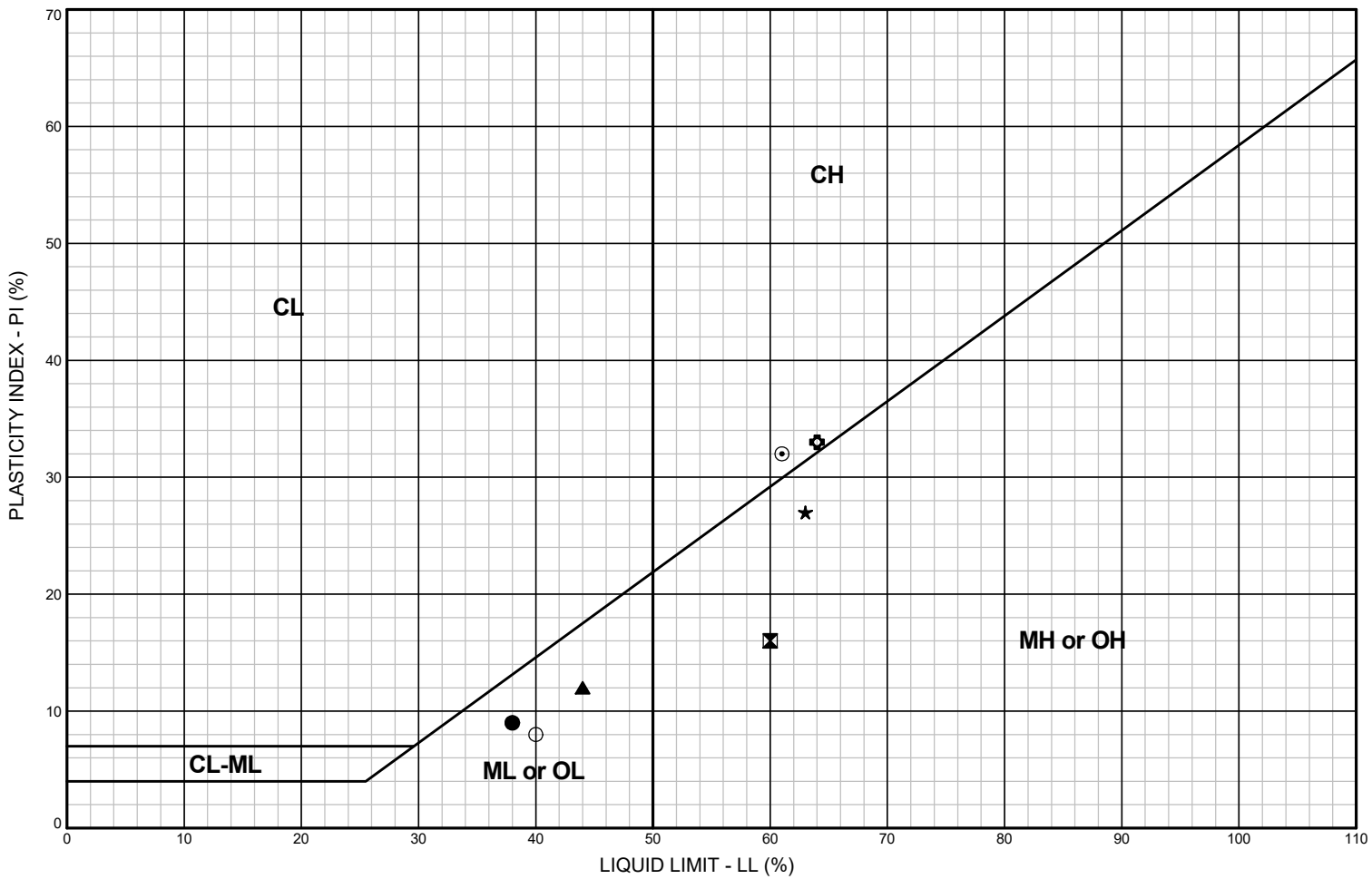

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-27, N16	66.2	*ML*	*SILT with some sand*	38	29	9	38	
⊠ B-27, N19	79.4	*MH*	*Clayey SILT with trace sand*	60	44	16	36	
▲ B-27, N20	84.5	*ML*	*SILT with some sand*	44	32	12	40	
★ B-27, N27	148.6	*MH*	*Clayey SILT with trace sand*	63	36	27	45	
⊙ B-29, S9b	138.0	*CH*	*CLAY with trace sand*	61	29	32		
✿ B-30, S4d	72.0	*CH*	*CLAY*	64	31	33		
○ B-30, S5a	85.0	*ML*	*SILT with trace sand*	40	32	8		

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FIG. E1
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FIG. E1

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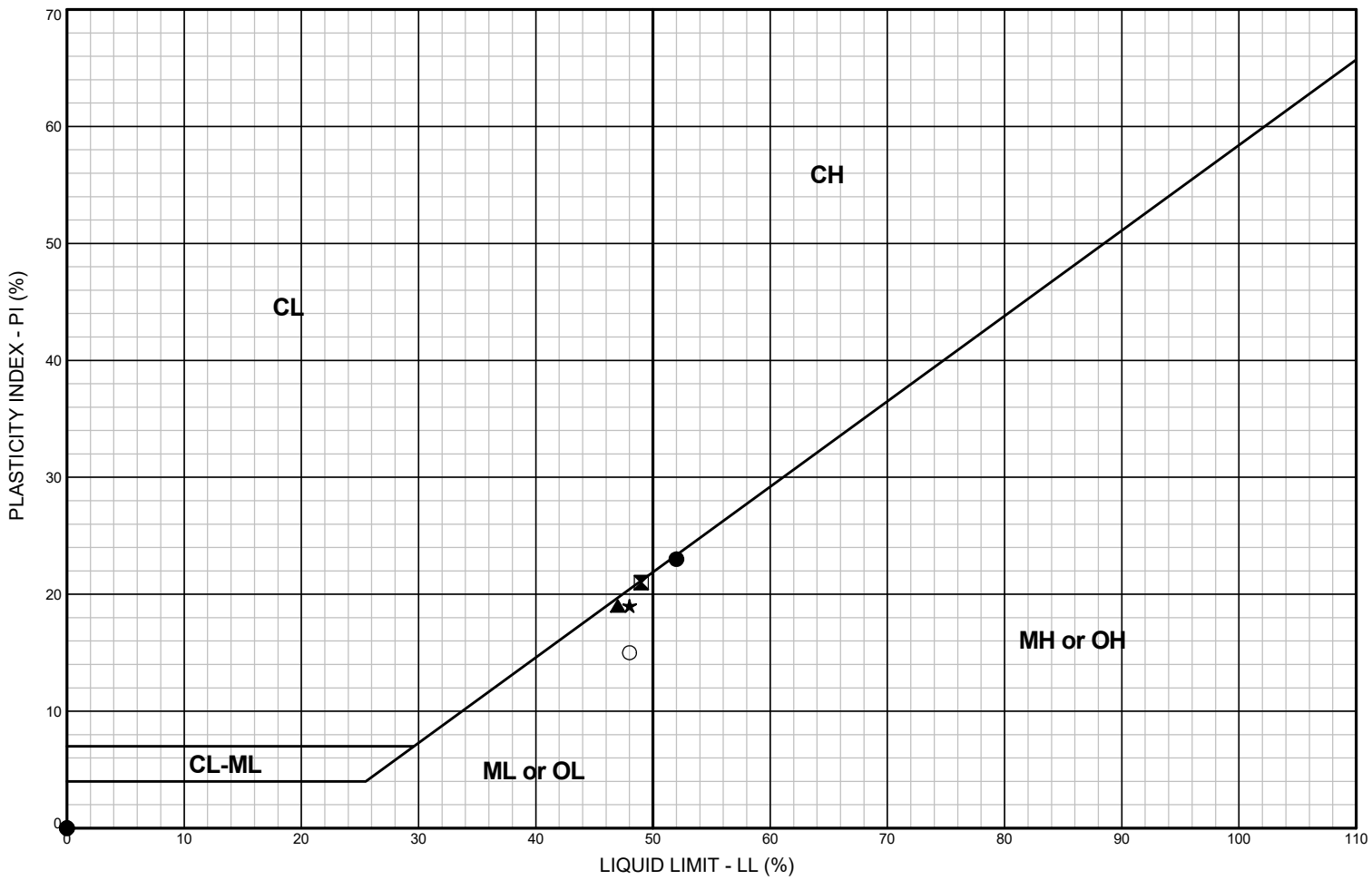

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-32, N5	25.0	*OH*	*Organic CLAY*	52	29	23	45	96
⊠ B-32, N7	35.0	*ML/CL*	*SILT to Silty CLAY with trace sand*	49	28	21	43	93
▲ B-32, N10	50.0	*ML*	*SILT with trace sand*	47	28	19	41	88
★ B-32, N11	55.0	*ML*	*Sandy SILT*	48	29	19	41	65
B-32, U2	63.0	*ML*	*SILT with some sand*	NP	NP	NP	37	
B-32, N13	65.0	*ML*	*Sandy SILT*	NP	NP	NP	48	54
○ B-33, N9	30.0	*ML*	*SILT with some sand*	48	33	15	45	84

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FIG. E1
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FIG. E1

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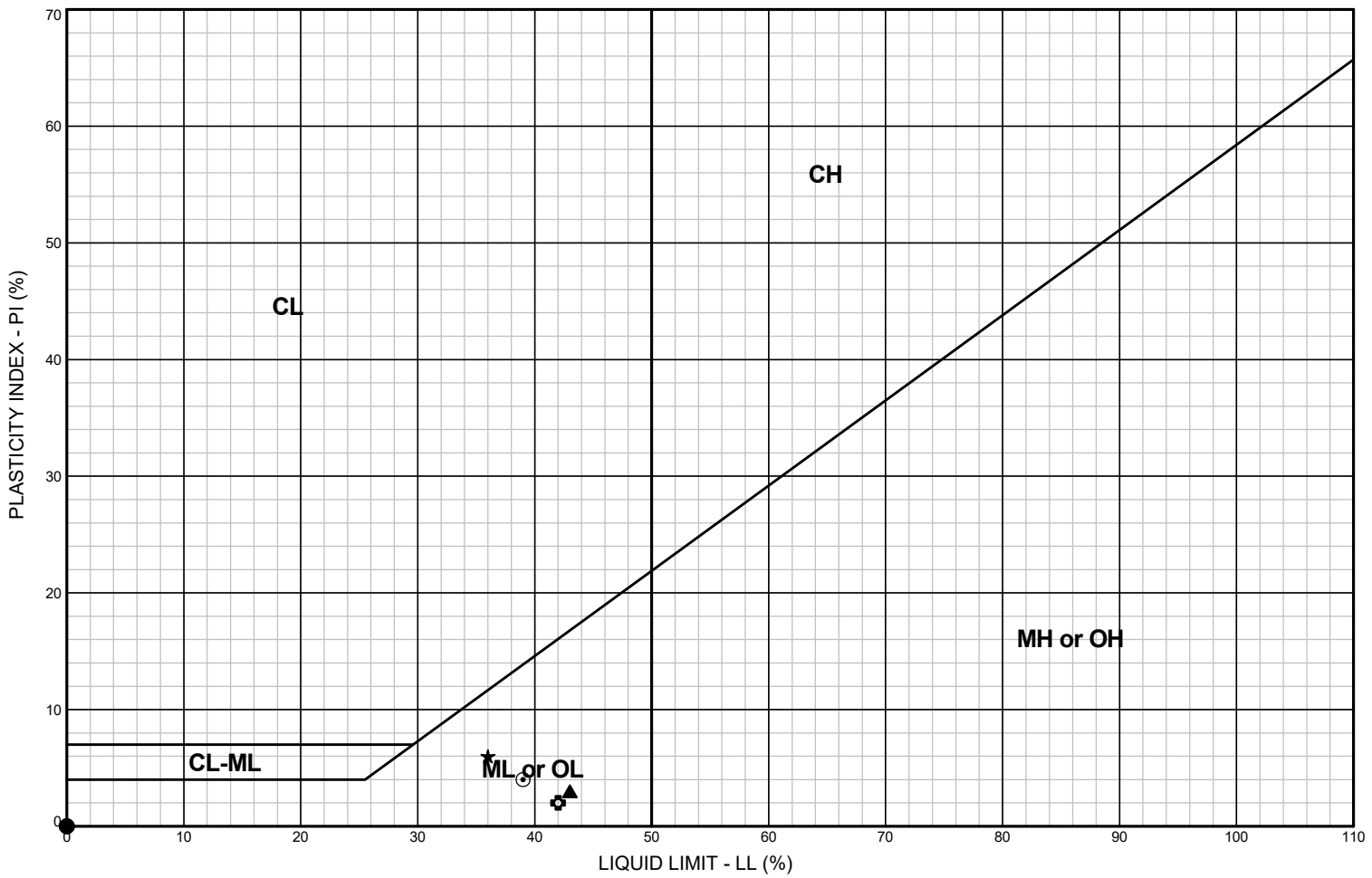

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
B-33, U1	33.0	*ML*	*SILT with some sand*	NP	NP	NP	49	
B-33, N10	35.0	*ML*	*Sandy SILT*	NP	NP	NP	46	70
▲ B-33, N12	45.0	*ML*	*SILT with some sand*	43	40	3	47	77
★ B-33, U2	48.0	*ML*	*SILT with some sand*	36	30	6	44	
⊙ B-33, N13	50.0	*ML*	*Sandy SILT*	39	35	4	45	
✿ B-33, N15	60.0	*ML*	*SILT with some sand*	42	40	2	46	71
B-33, U3	63.0	*ML*	*SILT with some sand*	NP	NP	NP	43	

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FIG. E1
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FIG. E1

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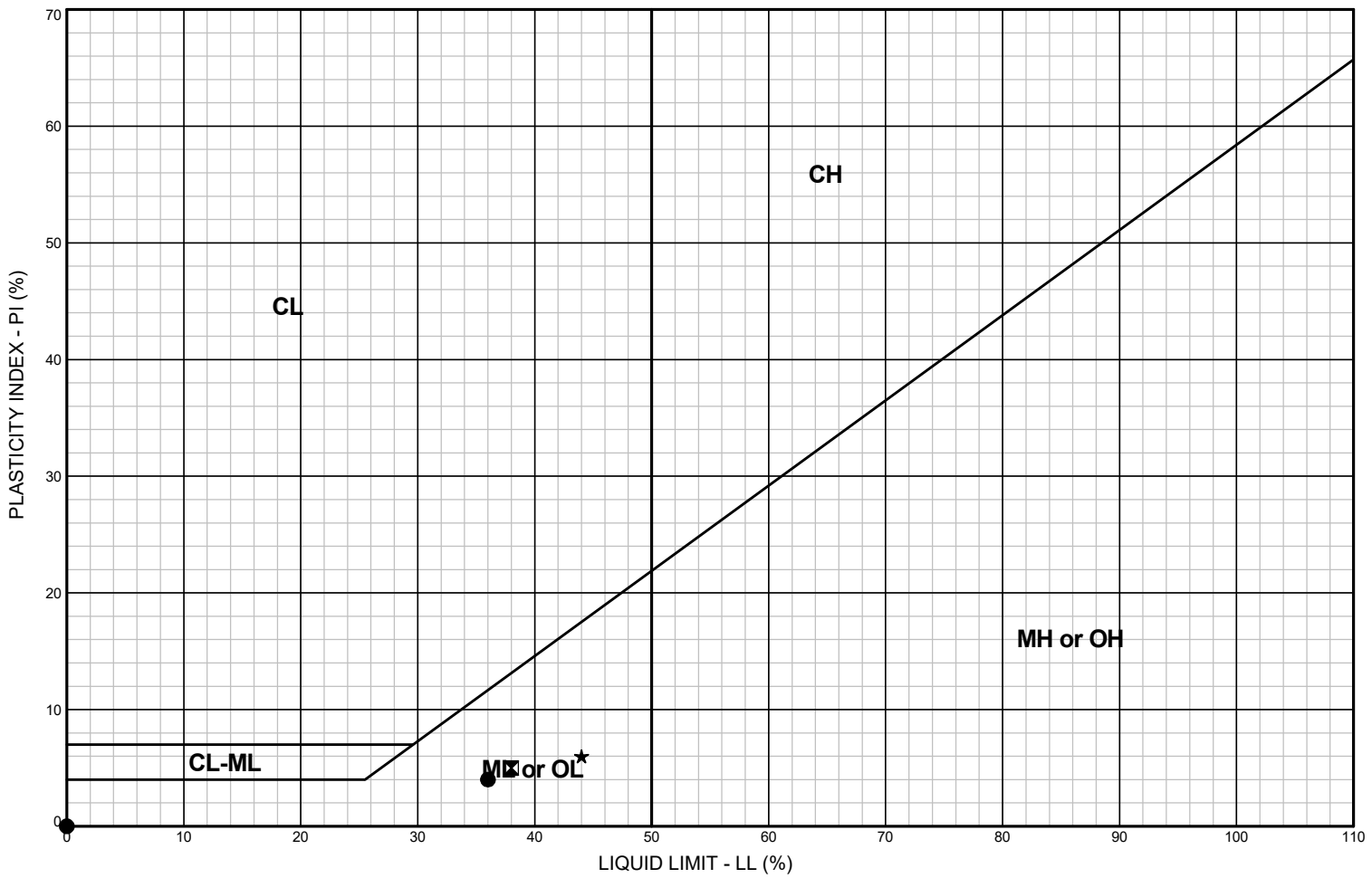

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- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-33, N16	65.0	*ML*	*Sandy SILT*	36	32	4	43	68
⊠ B-33, N22	95.0	*ML*	*SILT with some sand*	38	33	5	43	75
B-33, N26	115.0	*ML*	*Sandy SILT*	NP	NP	NP	41	61
★ B-33, N28	125.0	*ML*	*SILT with some sand*	44	38	6	46	80

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ATTERBERG LIMITS RESULTS BY BORING NUMBER

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FIG. E1
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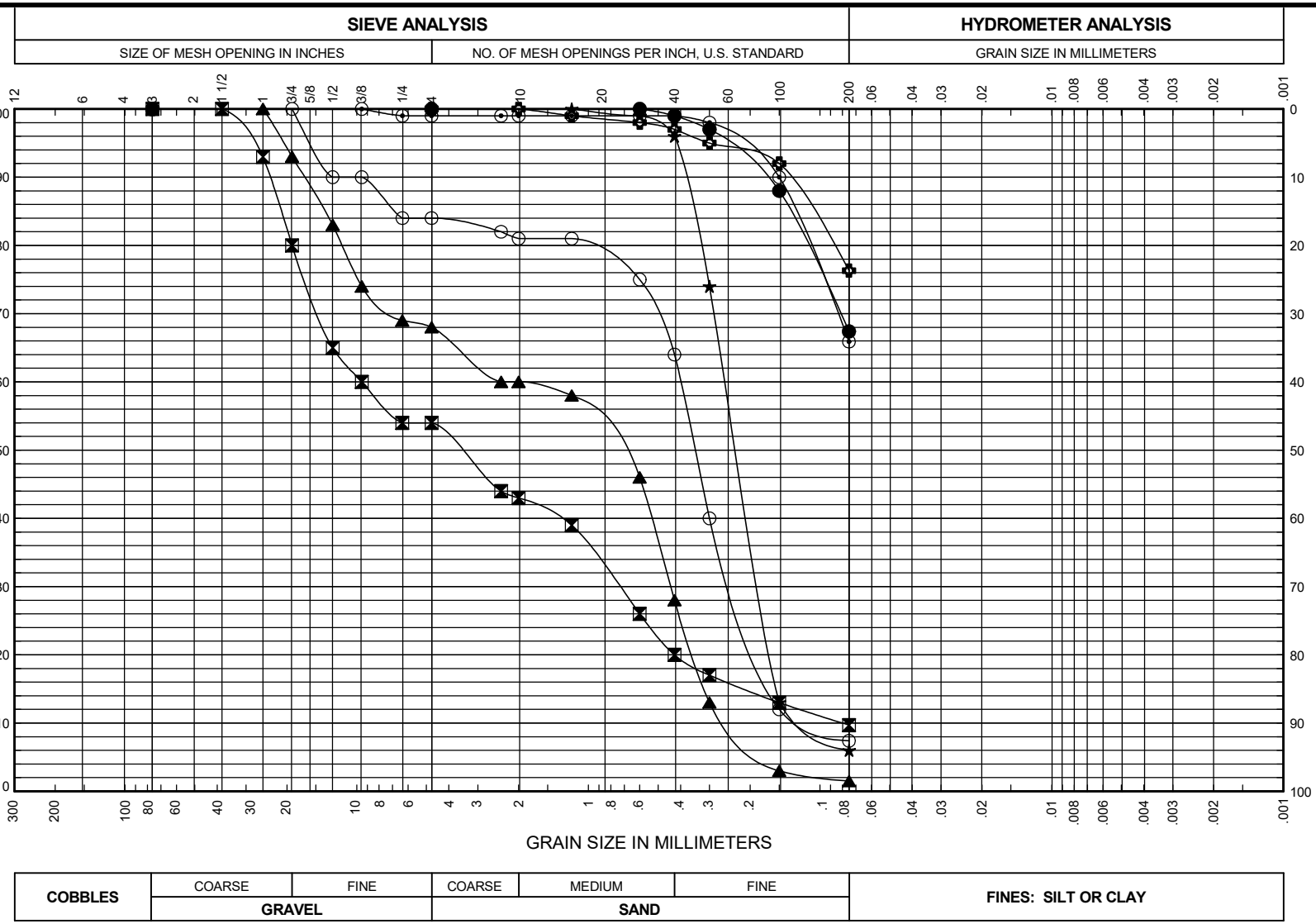
FIG. E1

ATT MAIN 102636.GPJ SHAN WIL.GDT 4/12/22



NOTES:
1) Sieve analyses were performed in general accordance with ASTM D6913, sieve with hydrometer analyses were performed in general accordance with ASTM D422, and amount finer than #200 sieve analyses were performed in general accordance with ASTM D1140 unless otherwise noted in the report.
2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-01, N7	35.0	*ML*	*Sandy SILT*	0	33	67		
⊠ B-01, N10	50.0	*GP-GM*	*Sandy GRAVEL with some silt*	46	44	10		
▲ B-02, N2	16.0	*SP*	*Gravelly SAND with trace silt*	32	67	2		
★ B-02, N6	36.5	*SP-SM*	*SAND with some silt*	0	94	6		
⊙ B-02, N12	67.1	*ML*	*Sandy SILT*	1	33	66		
✿ B-02, N14	77.0	*CH*	*CLAY with some sand*	0	24	76		
○ B-03, N2	10.0	*SP-SM*	*SAND with some silt and some gravel*	16	77	7		

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GRAIN SIZE DISTRIBUTION BY BORING NUMBER

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FIG. E2

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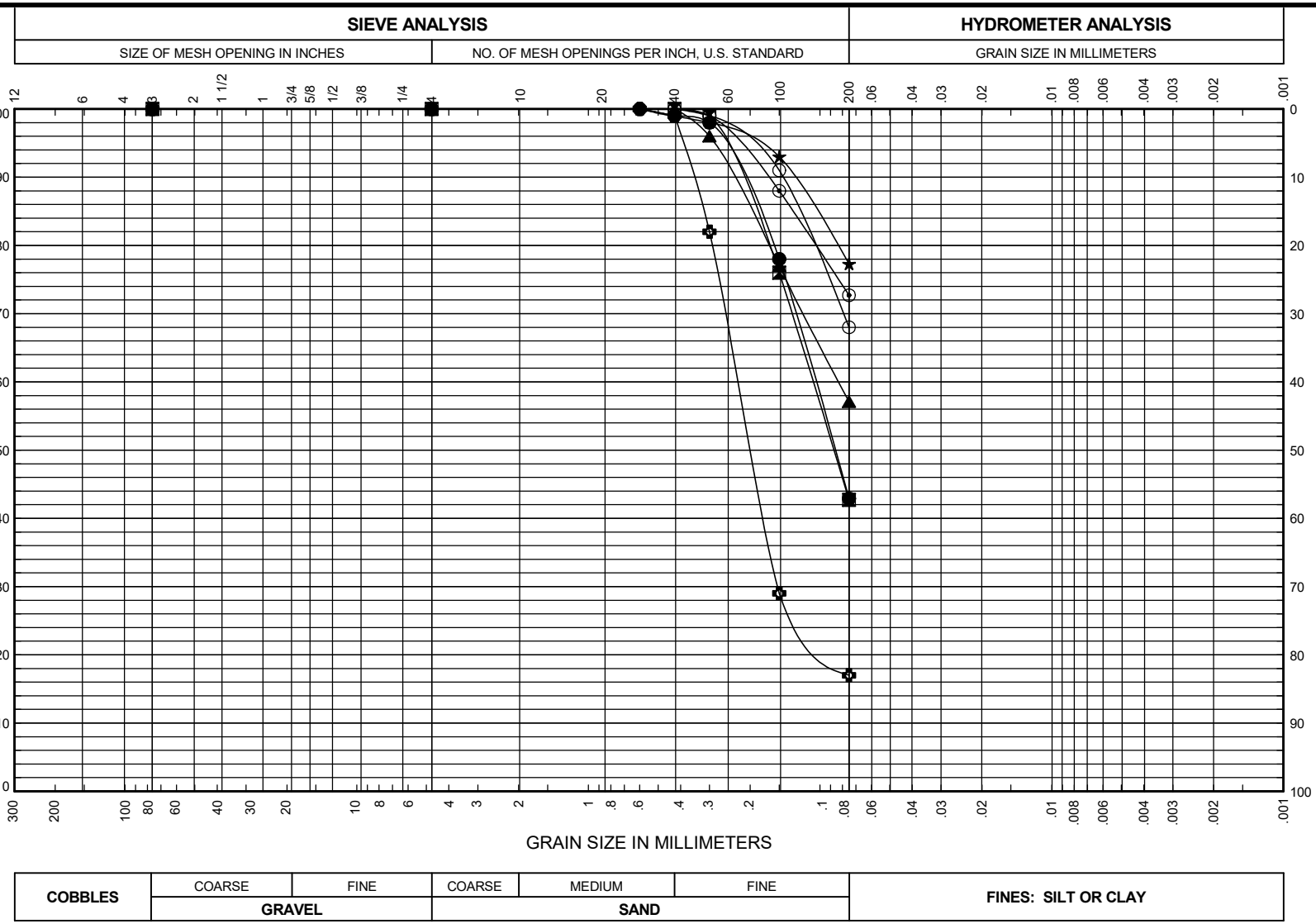

NOTES:
1) Sieve analyses were performed in general accordance with ASTM D6913, sieve with hydrometer analyses were performed in general accordance with ASTM D422, and amount finer than #200 sieve analyses were performed in general accordance with ASTM D1140 unless otherwise noted in the report.
2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-03, N5	25.0	*SM*	*Silty SAND*	0	57	43		
⊠ B-03, N6	32.0	*SM*	*Silty SAND*	0	57	43		
▲ B-03, N14	70.0	*ML*	*Sandy SILT*	0	43	57		
★ B-03, N17	85.0	*ML*	*SILT with some sand*	0	23	77		
⊙ B-03, N20	100.0	*ML*	*SILT with some sand*	0	27	73		
✿ B-03, N23	115.0	*SM*	*Silty SAND*	0	83	17		
○ B-03, N24	120.0	*ML*	*Sandy SILT*	0	32	68		

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GRAIN SIZE DISTRIBUTION BY BORING NUMBER

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FIG. E2
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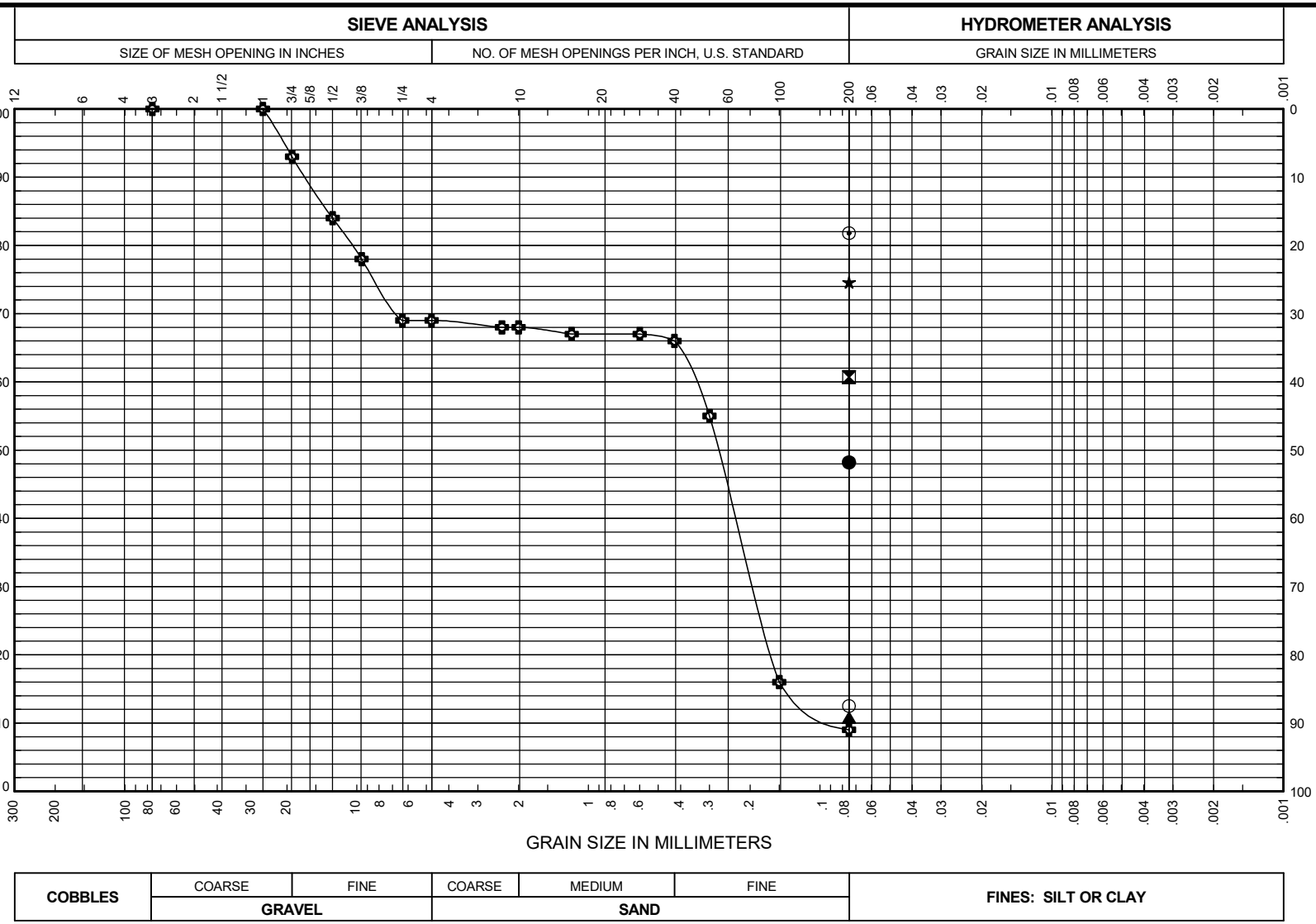
FIG. E2

GSA MAIN 102636.GPJ SHAN WIL.GDT 4/12/22



NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-04, N7	32.0	*SM*	*Silty SAND*	-	-	48	33	
⊠ B-04, N8	35.0	*ML*	*Sandy SILT*	-	-	61	39	
▲ B-04, N13	60.0	*SP-SM*	*SAND with some silt and trace gravel*	-	-	11	23	
★ B-05, N4	20.0	*ML*	*SILT with some sand*	-	-	75	48	
⊙ B-05, N5	25.0	*ML*	*SILT with some sand*	-	-	82	37	
✿ B-05, N10	50.0	*SP-SM*	*Gravelly SAND with some silt*	31	60	9	25	
○ B-05, N12	60.0	*SM*	*Silty SAND*	-	-	13	23	

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FIG. E2

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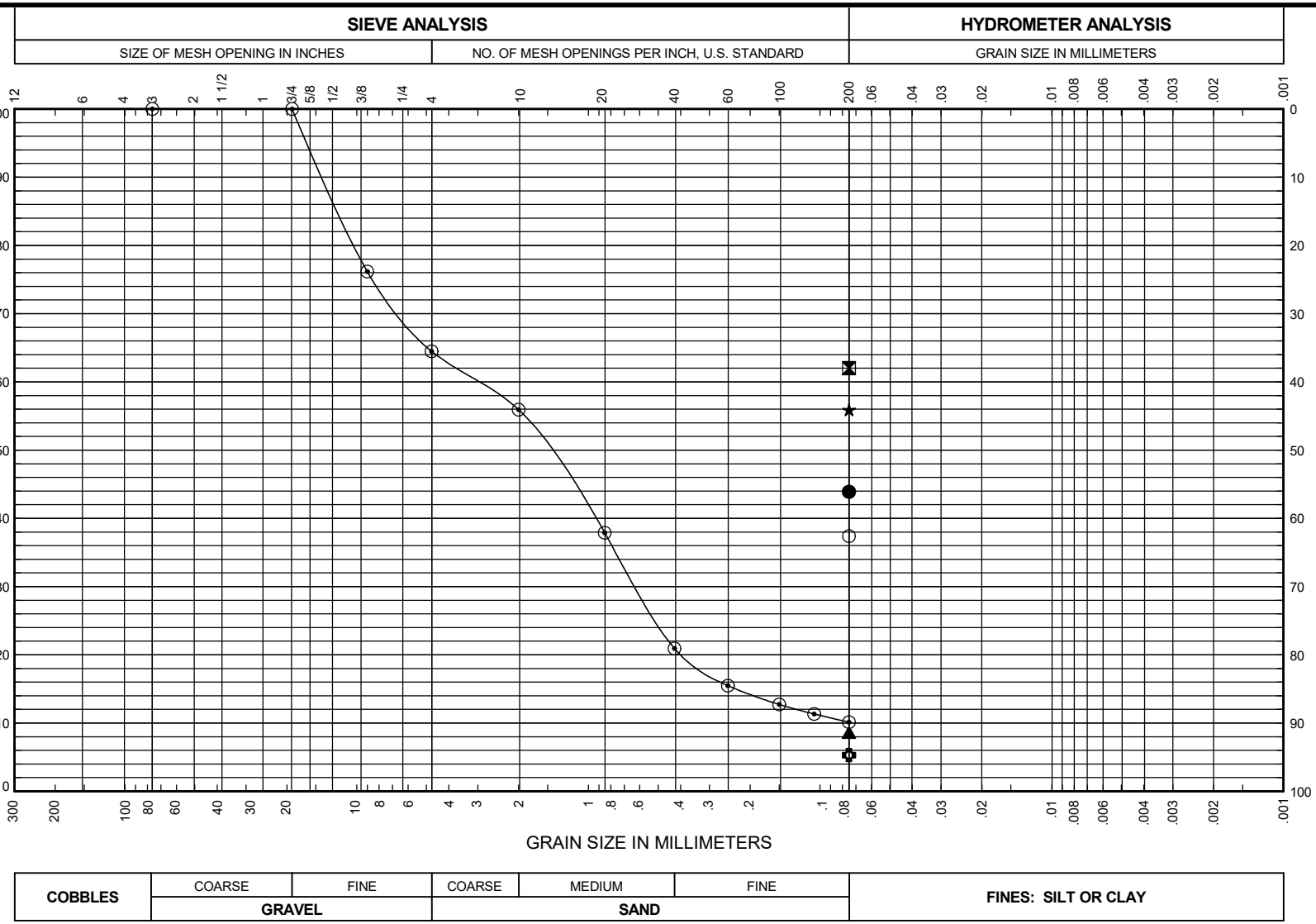

NOTES:
1) Sieve analyses were performed in general accordance with ASTM D6913, sieve with hydrometer analyses were performed in general accordance with ASTM D422, and amount finer than #200 sieve analyses were performed in general accordance with ASTM D1140 unless otherwise noted in the report.
2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.
** Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-06, N3	20.0	*SM*	*Silty SAND*	-	-	44	38	
⊠ B-06, N4	25.0	*ML*	*Sandy SILT*	-	-	62	40	
▲ B-06, N9	60.0	*SP-SM*	*SAND with some silt*	-	-	9	26	
★ B-07, N4	25.0	*ML*	*Sandy SILT*	-	-	56	36	
⊙ B-07, N10*	55.0	*SP-SM*	*Gravelly SAND with some silt*	36	54	10	15	
✿ B-08, N2	17.5	*SP-SM*	*SAND with some silt with trace gravel*	-	-	5	10	
○ B-08, N4*	25.0	*GC*	*Clayey GRAVEL with some sand*	-	-	37	21	

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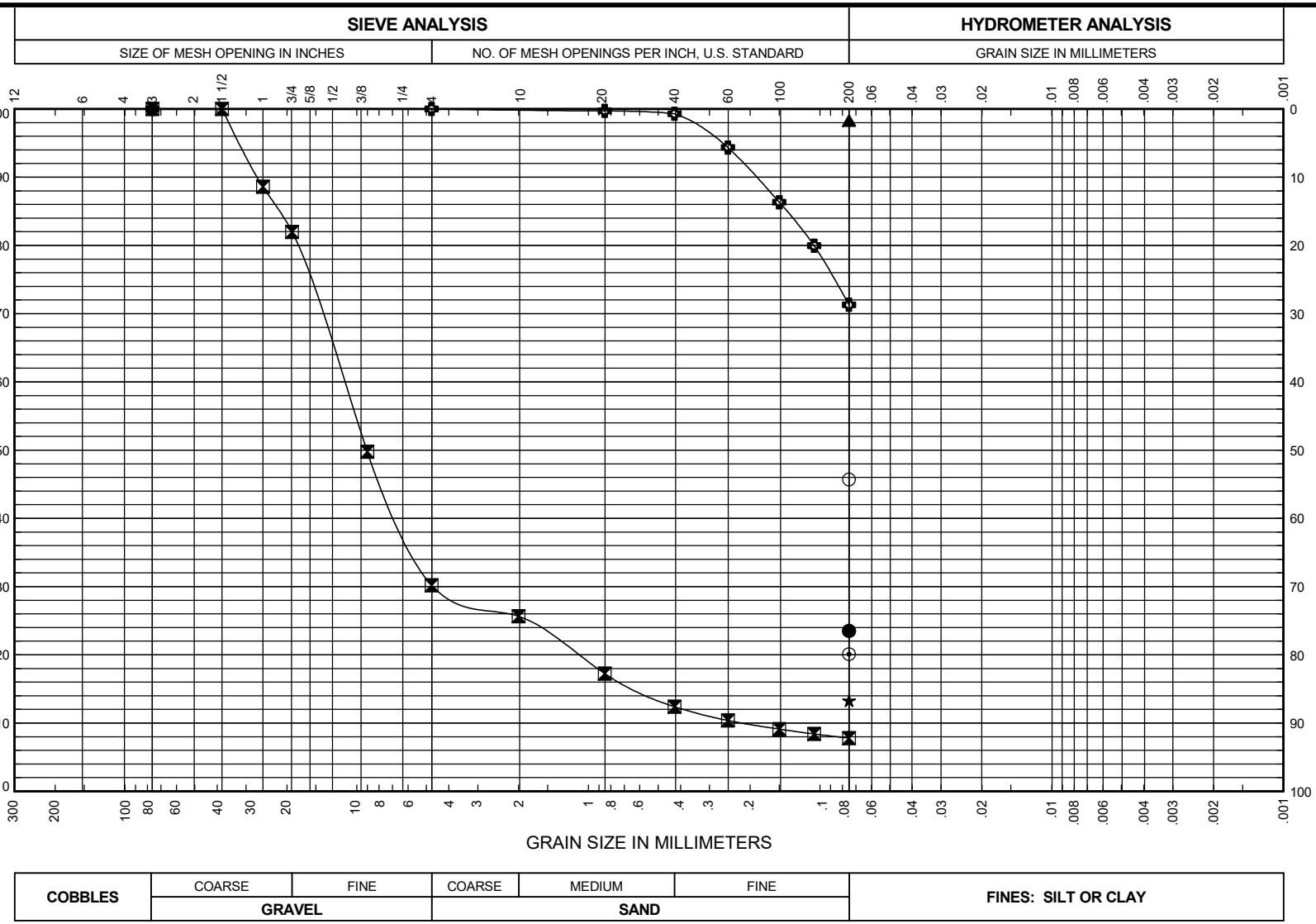

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** Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-08, N5*	30.0	*SM*	*Silty SAND with trace gravel*	-	-	24	29	
⊠ B-08, N7*	40.0	*GP-GM*	*GRAVEL with some silt and sand*	70	22	8	10	
▲ B-08, N9	50.0	*MH*	*Clayey SILT*	-	-	98	42	
★ B-08, N10	53.8	*SM*	*Silty SAND with trace gravel*	-	-	13	21	
⊙ B-08, N15	80.0	*SM*	*Silty SAND*	-	-	20	28	
✿ B-09, N3	12.5	*ML*	*SILT with some sand*	0	29	71	56	
○ B-09, N7	25.4	*SM*	*Silty SAND*	-	-	46	43	

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FIG. E2

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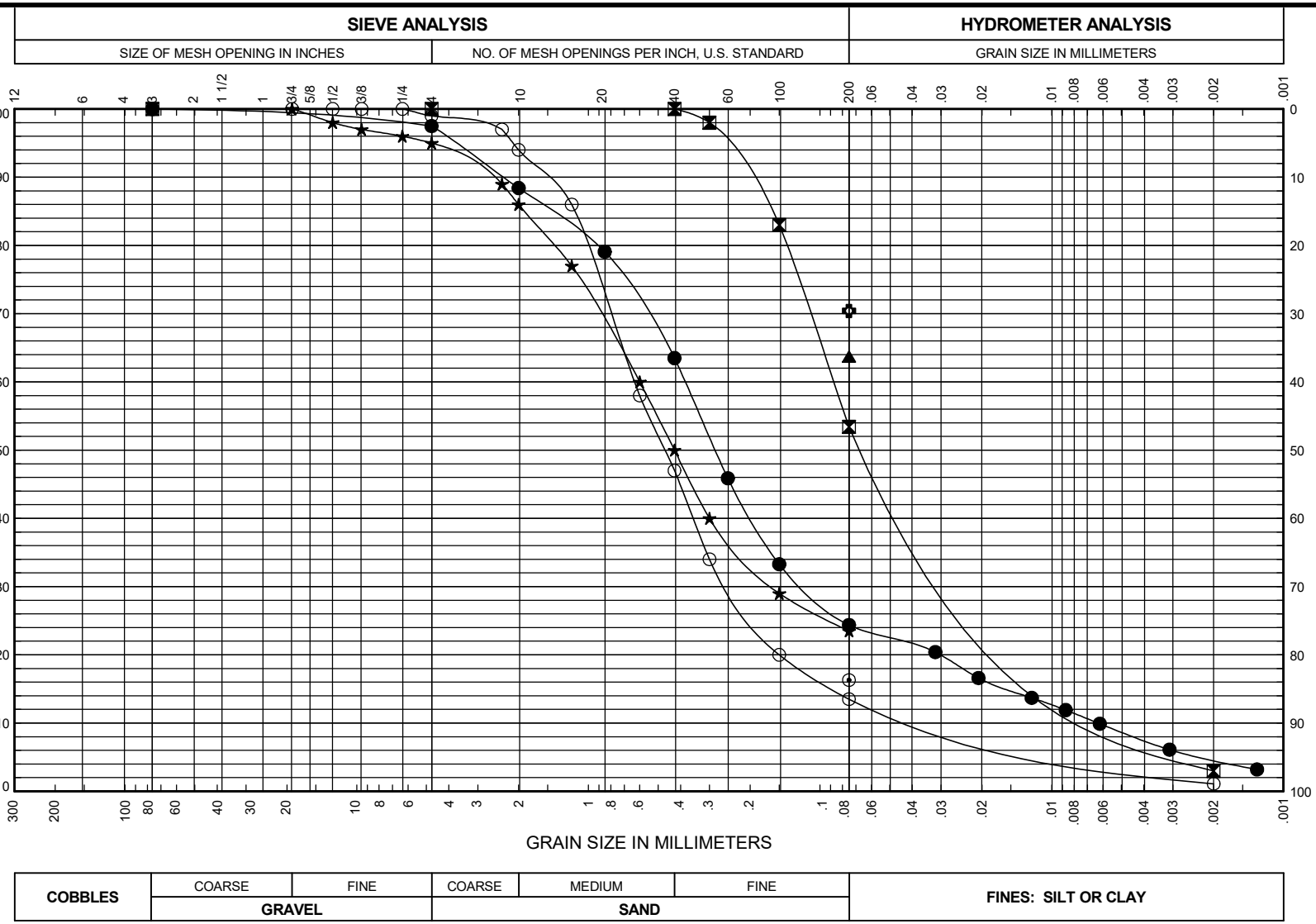

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-09, N27	139.6	*SM*	*Silty SAND*	3	73	24	29	
⊠ B-10, N11	42.5	*ML*	*Sandy SILT*	0	47	53	38	
▲ B-10, N12	47.5	*ML*	*Sandy SILT*	-	-	64	37	
★ B-10, N15	61.3	*SM*	*Silty SAND with trace gravel*	5	72	24	36	
⊙ B-10, N21	94.3	*SM*	*Silty SAND with some gravel*	-	-	16	23	
✿ B-10, N25	123.0	*MH*	*Sandy clayey SILT*	-	-	70	42	
○ B-10, N26	133.5	*SM*	*Silty SAND*	1	86	14	24	

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FIG. E2

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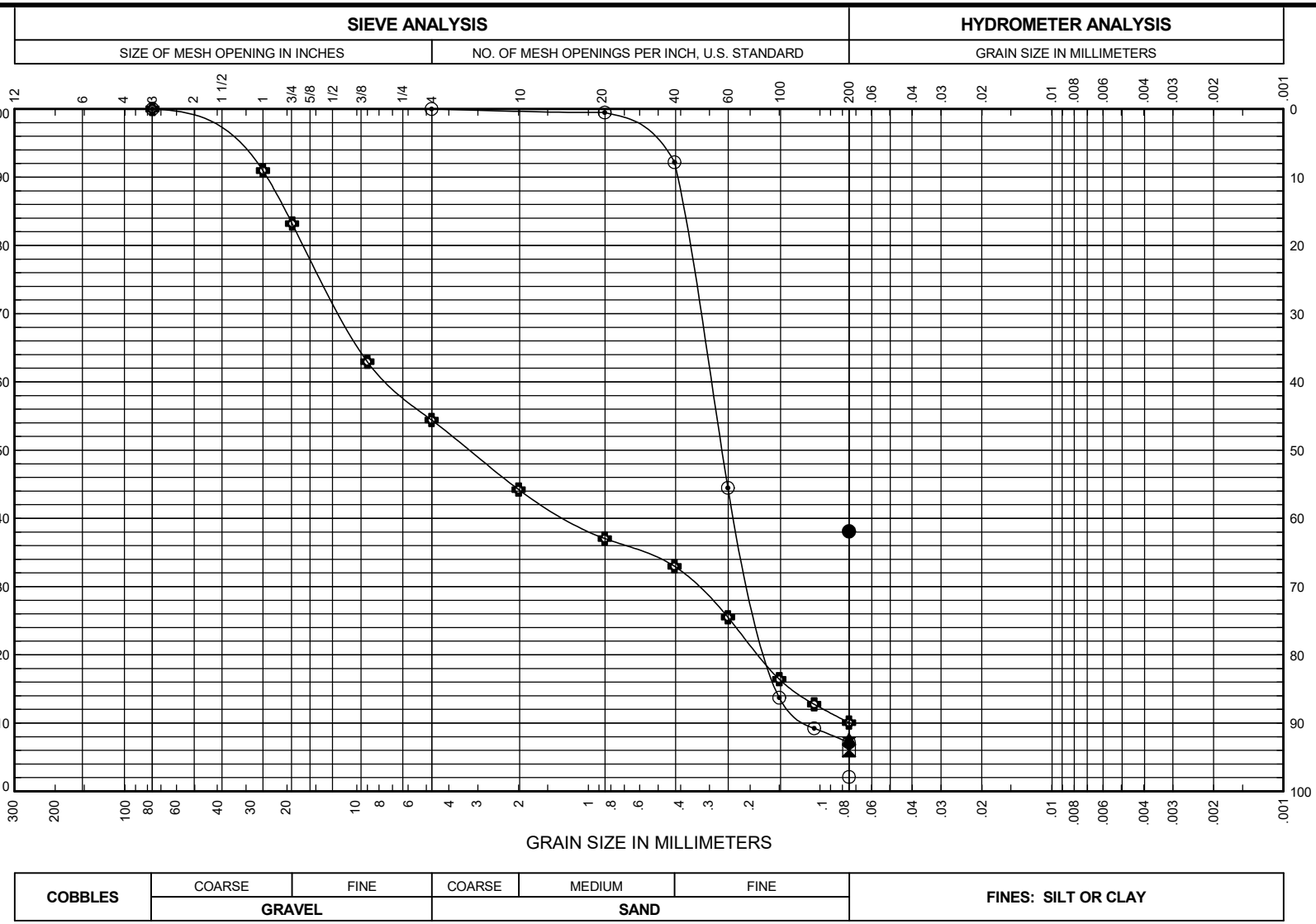

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-10, N27b	144.0	*SM*	*Silty SAND*	-	-	38	42	
⊠ B-11, N1	0.0	*SP-SM*	*SAND with some silt and trace gravel*	-	-	6	26	
▲ B-11, N10	22.5	*SP-SM*	*SAND with some silt and trace gravel*	-	-	8	28	
★ B-11, N13	39.0	*SP-SM*	*SAND with some silt and trace gravel*	-	-	8	31	
⊙ B-11, N15	52.5	*SP-SM*	*SAND with some silt*	0	93	7	34	
✿ B-11, N33	170.0	*GP-GM*	*Sandy GRAVEL with some silt*	46	44	10	25	
○ B-12A, N3	10.0	*SP*	*SAND with trace silt and gravel*	-	-	2	28	

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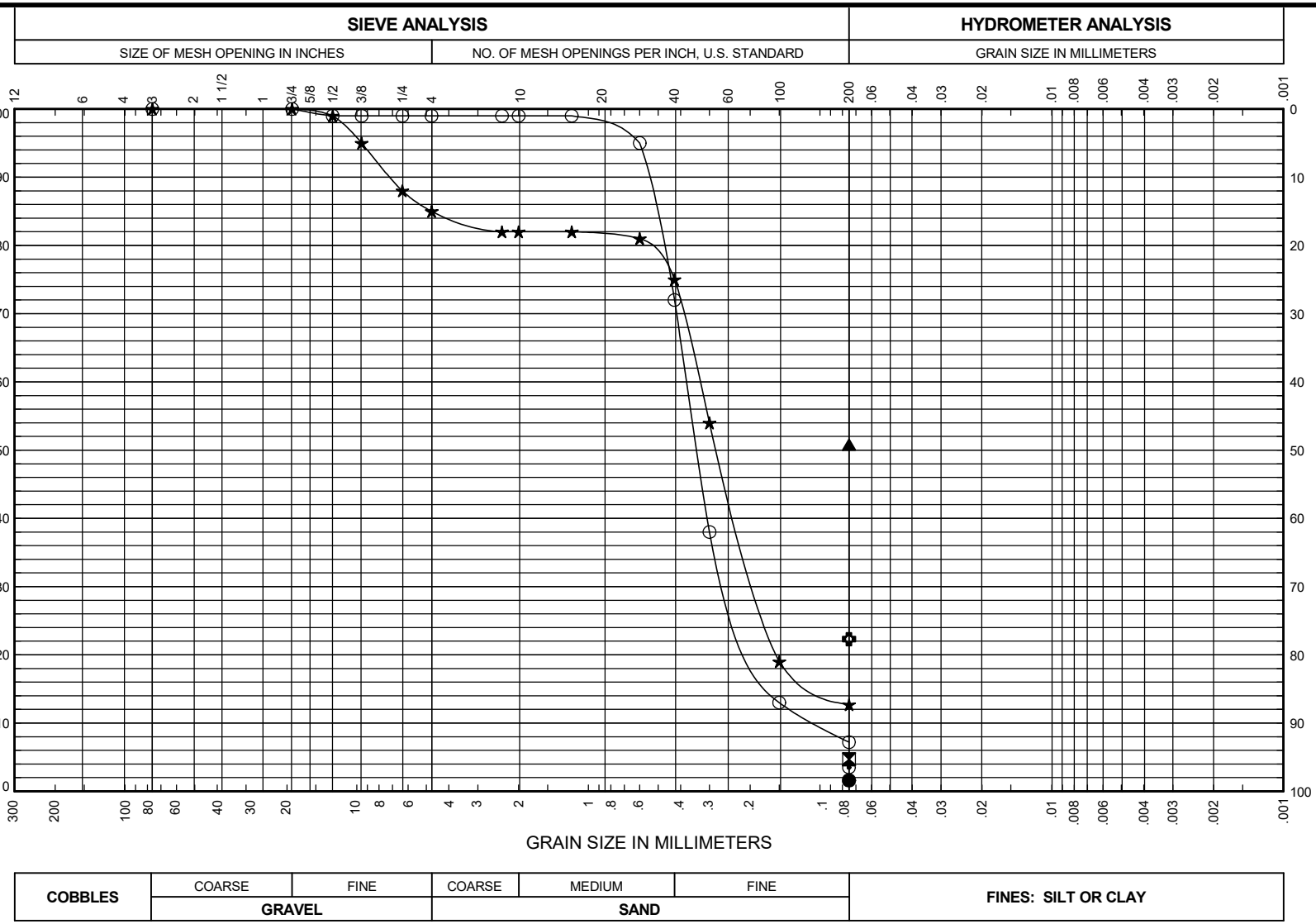

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-12A, N8	25.0	*SP*	*SAND with trace silt*	-	-	2	38	
⊠ B-12A, N12	45.0	*SP*	*SAND with trace silt*	-	-	5	38	
▲ B-13, N3	7.5	*ML*	*Sandy SILT*	-	-	51	54	
★ B-13, N4	10.0	*SM*	*Silty SAND with some gravel*	15	72	13	36	
⊙ B-13, N6	15.0	*SP*	*SAND with trace silt*	-	-	4	30	
✿ B-13, N11	35.0	*SM*	*Silty SAND*	-	-	22	39	
○ B-13, N12	40.0	*SP-SM*	*SAND with some silt*	1	92	7	28	

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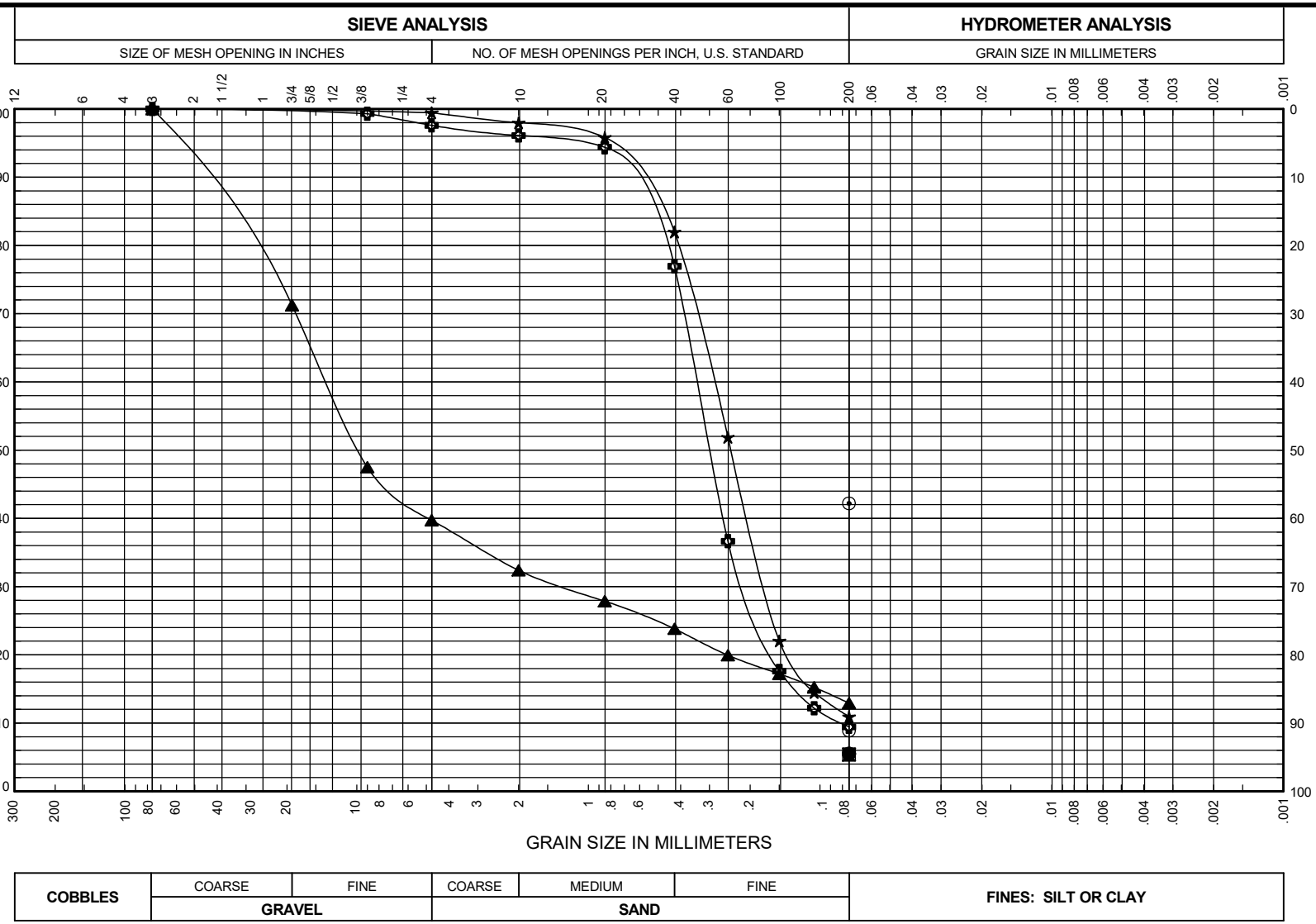

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-13, N14	50.0	*SP-SM*	*SAND with some silt*	-	-	6	31	
⊠ B-13, N20	80.0	*GP-GM*	*GRAVEL with some silt and sand*	-	-	5	11	
▲ B-14, N2	5.0	*GM*	*Silty GRAVEL with some sand*	60	27	13	31	
★ B-14, N4	10.0	*SP-SM*	*SAND with some silt*	1	89	11	38	
⊙ B-14, N5	12.5	*SM*	*Silty SAND*	-	-	42	45	
✿ B-14, N6	15.0	*SP-SM*	*SAND with some silt*	2	88	9	40	
○ B-14, N7	17.5	*SP-SM*	*SAND with some silt*	-	-	9	36	

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FIG. E2

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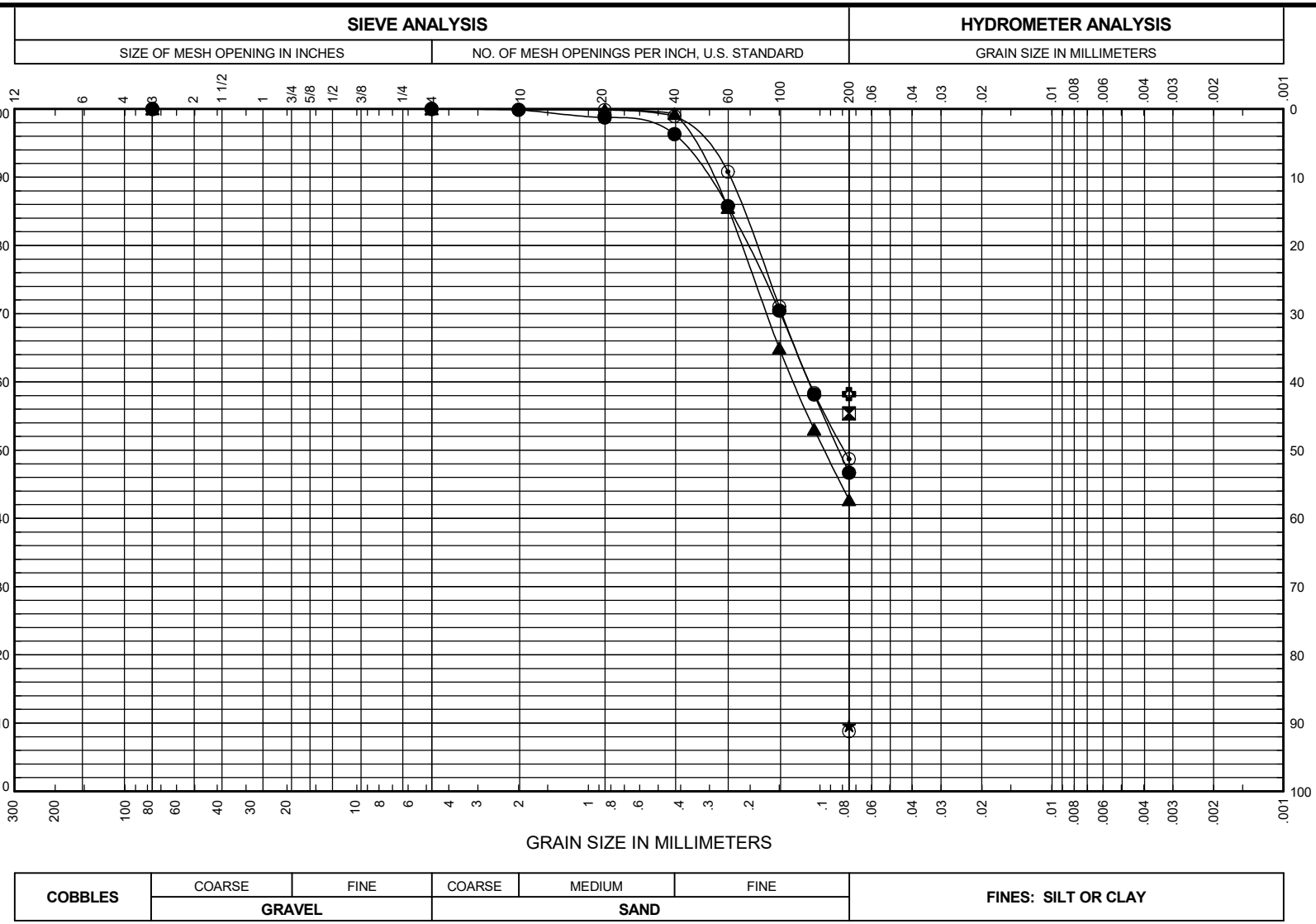

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-14, N8	20.0	*SM*	*Silty SAND*	0	53	47	45	
⊠ B-14, N9	25.0	*ML*	*Sandy SILT*	-	-	55	49	
▲ B-14, N11	35.0	*SM*	*Silty SAND*	0	57	43	45	
★ B-14, N12a	40.0	*SP-SM*	*SAND with some silt*	-	-	10	40	
⊙ B-14, N13	45.0	*SM*	*Silty SAND*	0	51	49	44	
✿ B-14, N14	50.0	*ML*	*Sandy SILT*	-	-	58	45	
○ B-14, N15	65.0	*SP-SM*	*SAND with some silt*	-	-	9	41	

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FIG. E2

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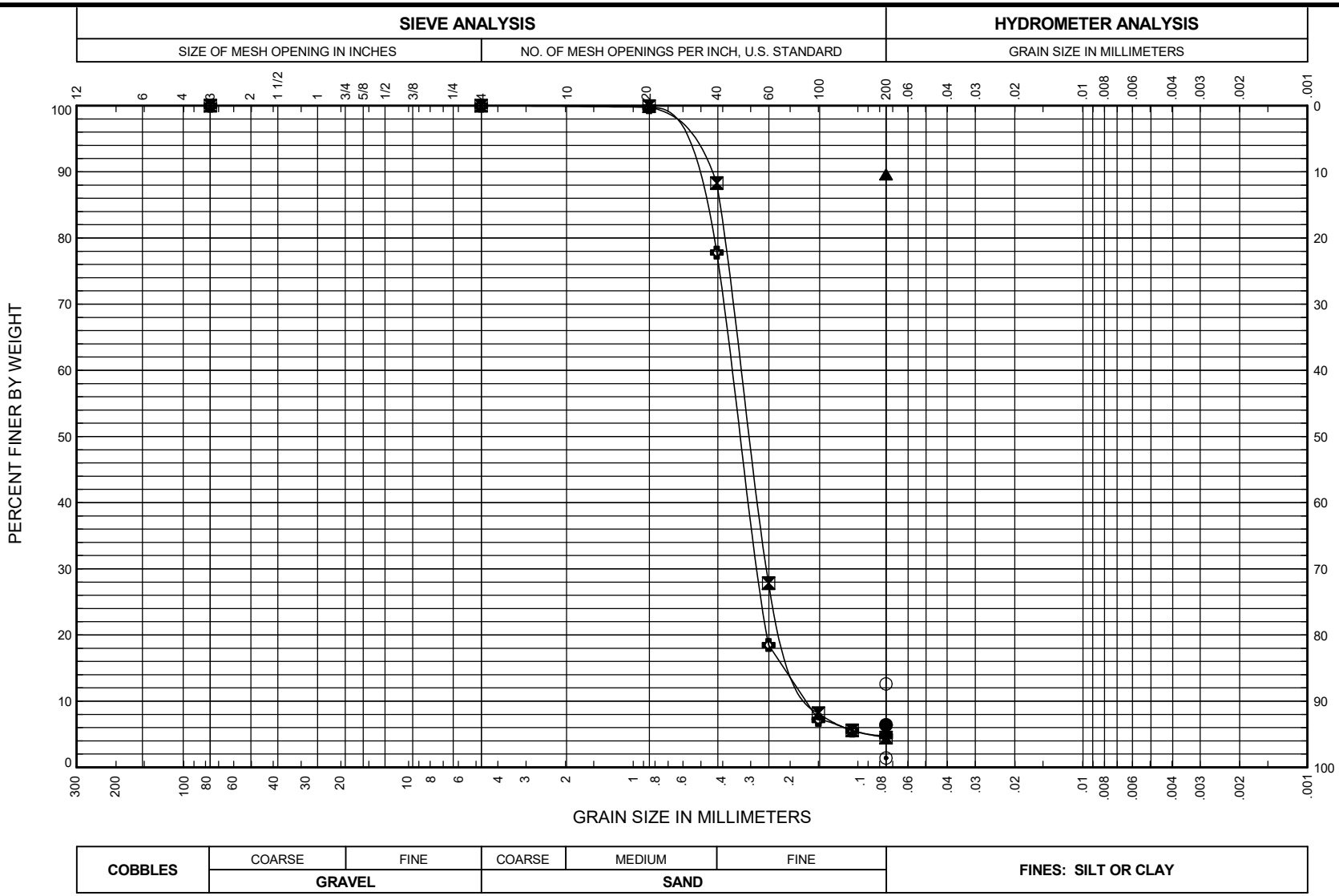

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-14, N16	70.0	*SP-SM*	*SAND with some silt*	-	-	6	41	
⊠ B-14, N18	90.0	*SP*	*SAND with trace silt*	0	96	4	45	
▲ B-14, N19	100.0	*ML*	*SILT with trace sand*	-	-	90	48	
★ B-14, N20	110.0	*SP*	*SAND with trace silt*	-	-	5	45	
⊙ B-14, N21	120.0	*SP*	*SAND with trace silt*	-	-	1	37	
✿ B-14, N22	128.6	*SP*	*SAND with trace silt (tested material not representative; see drill log)*	0	95	5	35	
○ B-15, N9	25.0	*SM*	*Silty SAND*	-	-	13	11	

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FIG. E2

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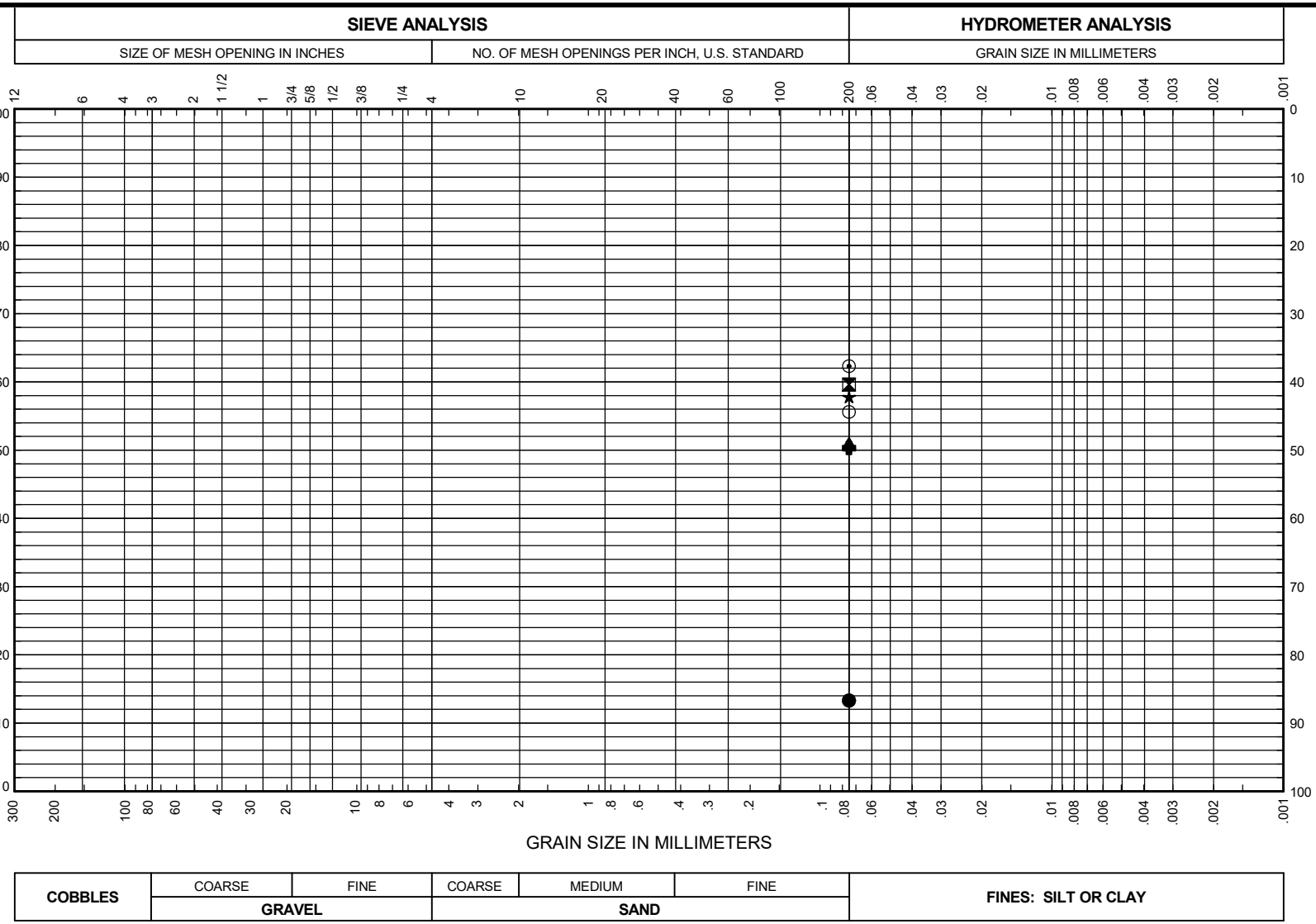

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-15, N10	30.0	*SM*	*Gravelly silty SAND*	-	-	13	26	
⊠ B-15, N11	35.0	*ML*	*Sandy SILT*	-	-	60	41	
▲ B-15, U1a	38.0	*ML*	*Sandy SILT*	-	-	51	43	
★ B-15, N12	40.0	*ML*	*Sandy SILT*	-	-	58	40	
⊙ B-15, N13	45.0	*ML*	*Sandy SILT*	-	-	62	46	
✿ B-15, N14	50.0	*ML/SM*	*Sandy SILT to Silty SAND*	-	-	50	44	
○ B-15, N15	55.0	*ML*	*Sandy SILT*	-	-	56	40	

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FIG. E2

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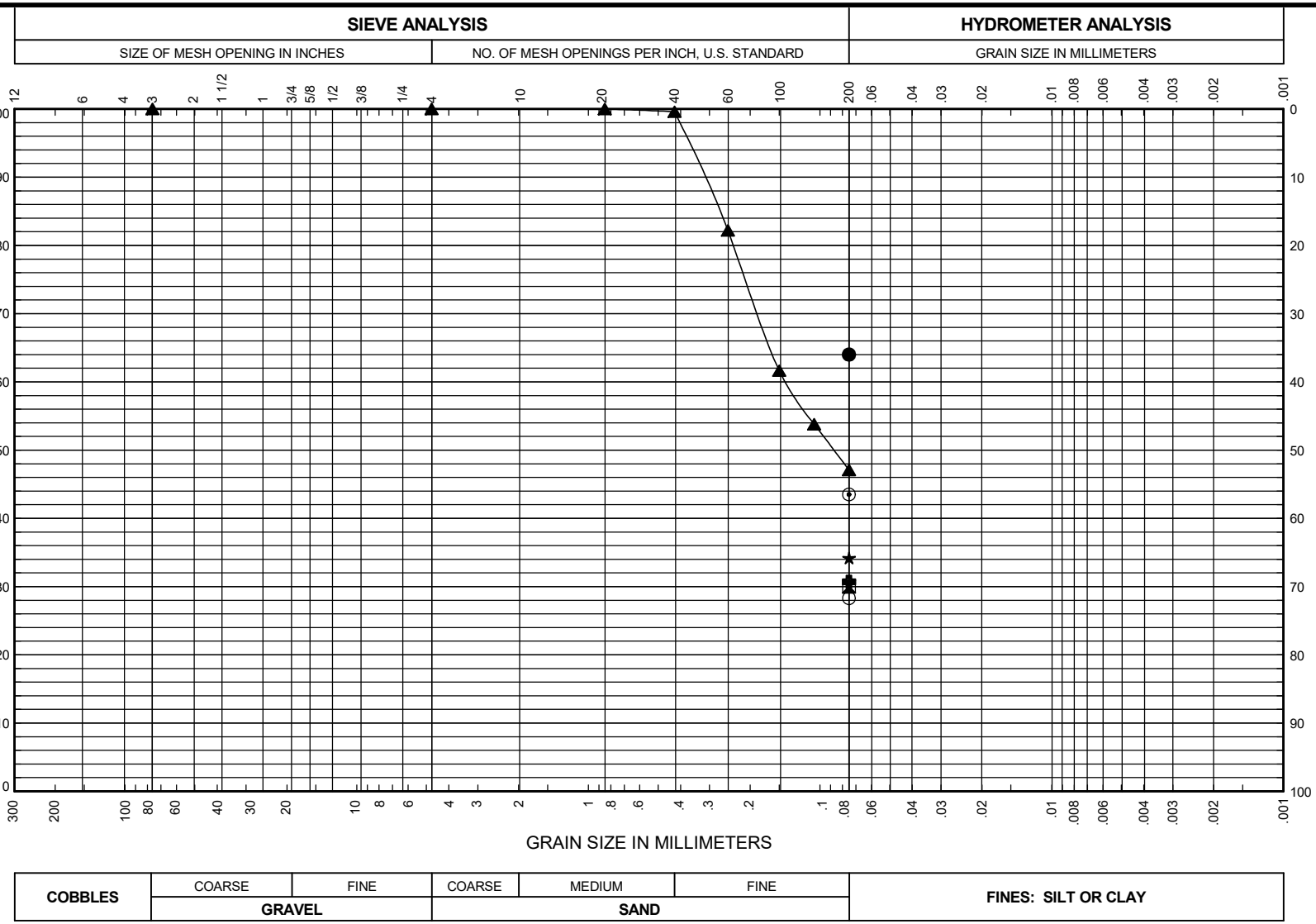

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-15, N16	60.0	*ML*	*Sandy SILT*	-	-	64	39	
⊠ B-15, N17	65.0	*SM*	*Silty SAND*	-	-	30	38	
▲ B-15, N18	70.0	*SM*	*Silty SAND*	0	53	47	39	
★ B-15, N19	75.0	*SM*	*Silty SAND*	-	-	34	44	
⊙ B-15, N20	80.0	*SM*	*Silty SAND*	-	-	44	34	
✿ B-15, N21	85.0	*SM*	*Silty SAND*	-	-	31	41	
○ B-15, N22	90.0	*SM*	*Silty SAND*	-	-	28	39	

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FIG. E2

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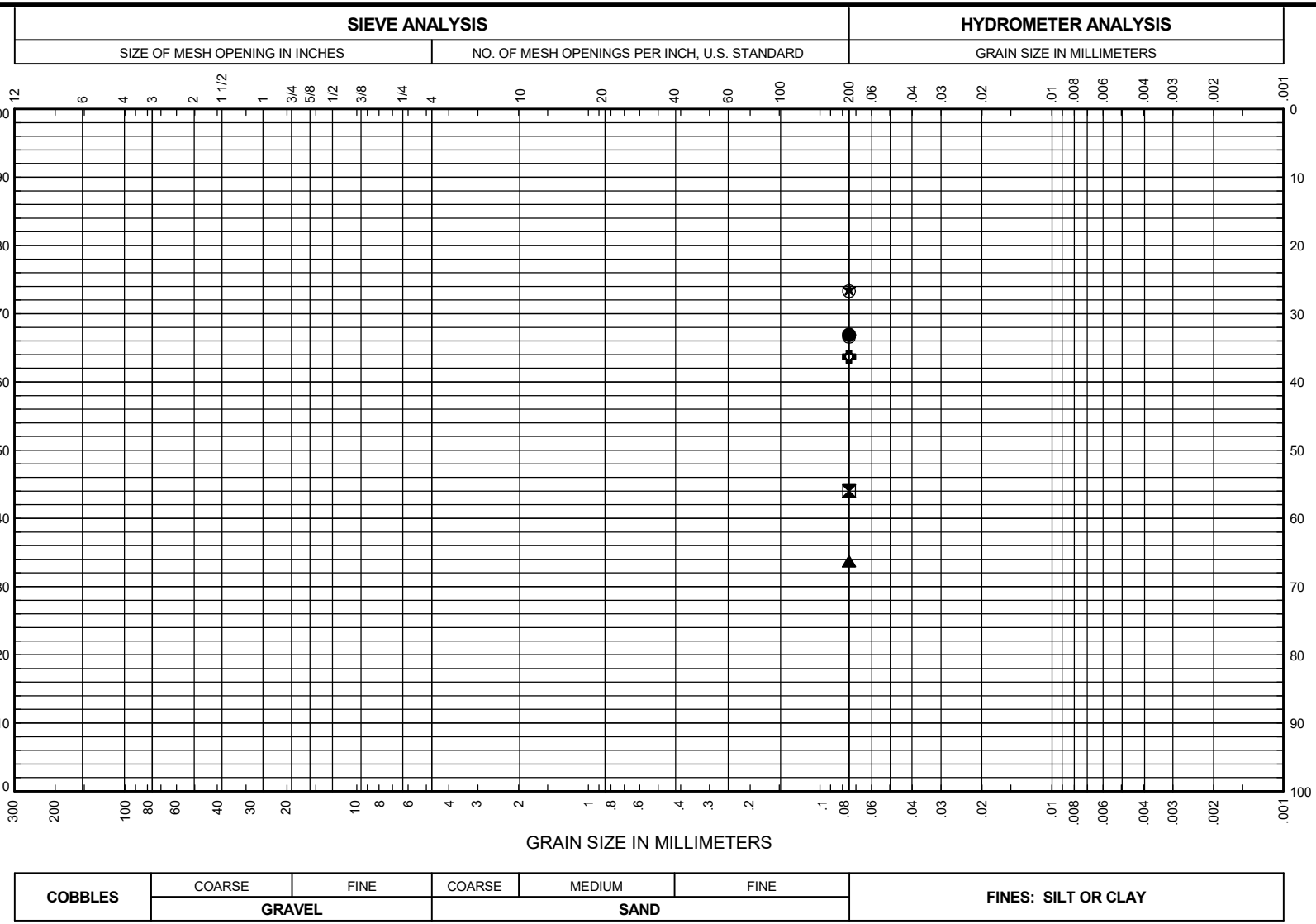

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-15, N23	95.0	*ML*	*Sandy SILT*	-	-	67	39	
⊠ B-15, N24	100.0	*SM*	*Silty SAND*	-	-	44	39	
▲ B-15, N25	105.0	*SM*	*Silty SAND*	-	-	34	40	
★ B-15, N26	110.0	*ML*	*SILT with some sand*	-	-	74	45	
⊙ B-15, N27	115.0	*ML*	*Sandy SILT*	-	-	67	41	
✿ B-15, N28	120.0	*ML*	*Sandy SILT*	-	-	64	42	
○ B-15, N29	125.0	*ML*	*SILT with some sand*	-	-	73	45	

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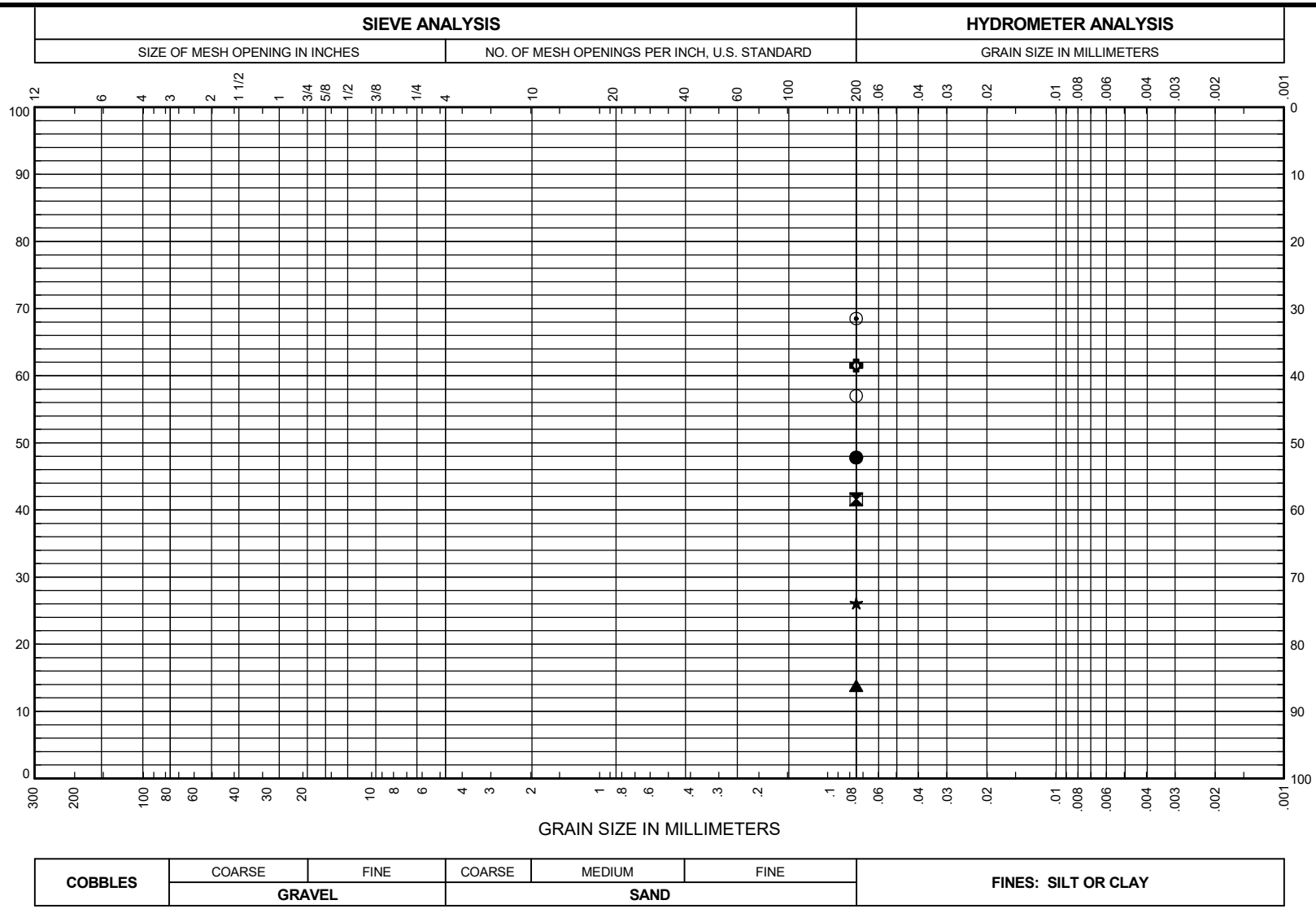

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-15, N30	130.0	*SM*	*Silty SAND*	-	-	48	40	
⊠ B-15, N31	135.0	*SM*	*Silty SAND*	-	-	42	40	
▲ B-15, N32	140.0	*SM*	*Silty SAND*	-	-	14	36	
★ B-15, N33	145.0	*SM*	*Silty SAND*	-	-	26	35	
⊙ B-16, N8	20.0	*ML*	*Sandy SILT*	-	-	69	37	
✿ B-16, N9	27.0	*ML*	*Sandy SILT*	-	-	62	46	
○ B-16, N10	30.0	*ML*	*Sandy SILT*	-	-	57	46	

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FIG. E2

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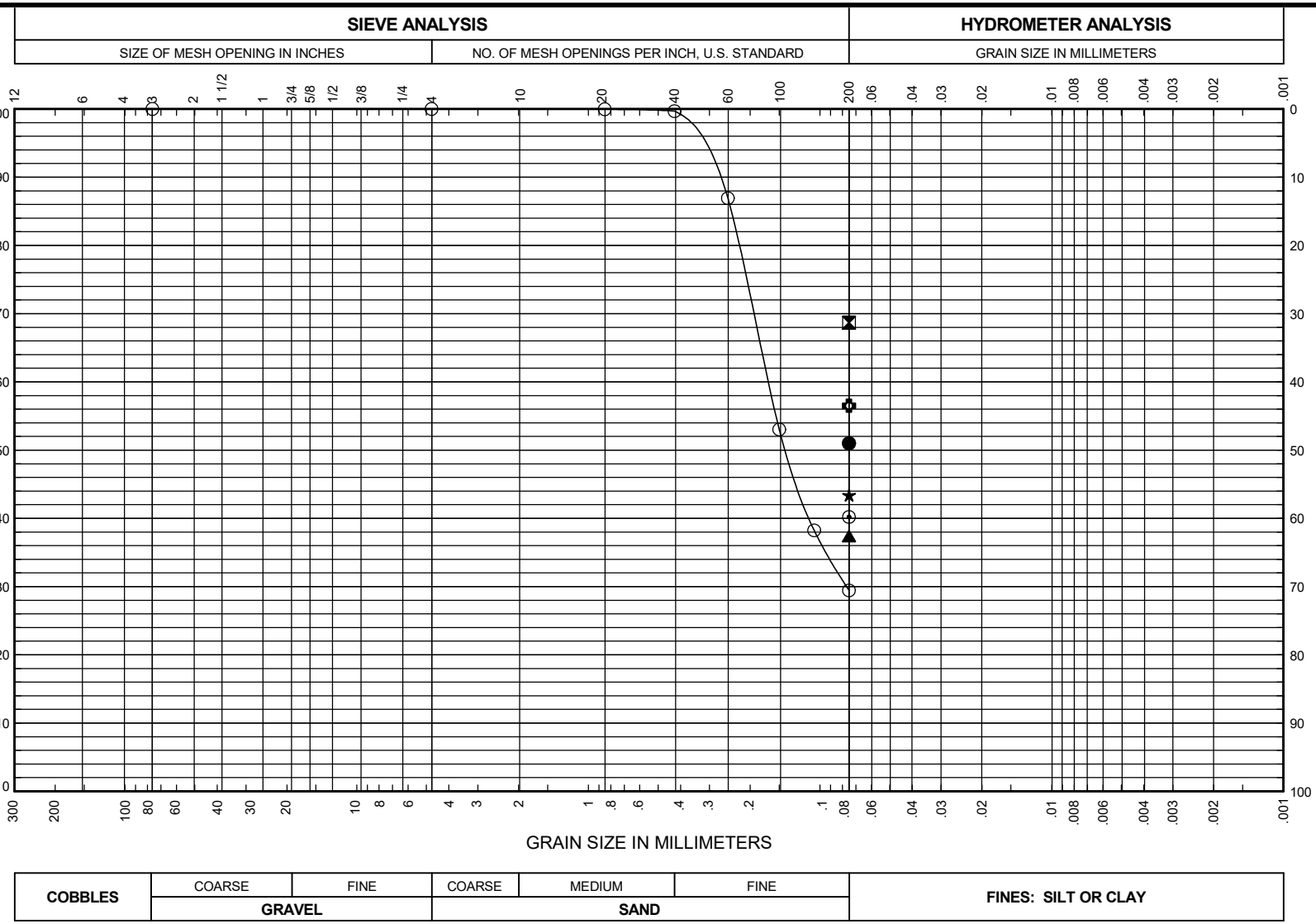

NOTES:
1) Sieve analyses were performed in general accordance with ASTM D6913, sieve with hydrometer analyses were performed in general accordance with ASTM D422, and amount finer than #200 sieve analyses were performed in general accordance with ASTM D1140 unless otherwise noted in the report.
2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-16, N11	37.0	*ML*	*Sandy SILT*	-	-	51	46	
⊠ B-16, N12a	40.0	*ML*	*Sandy SILT*	-	-	69	43	
▲ B-16, N12b	40.8	*SM*	*Silty SAND*	-	-	37	42	
★ B-16, N13	45.0	*SM*	*Silty SAND*	-	-	43	42	
⊙ B-16, N14	50.0	*SM*	*Silty SAND*	-	-	40	42	
✿ B-16, N15	55.0	*ML*	*Sandy SILT*	-	-	57	48	
○ B-16, N16	62.0	*SM*	*Silty SAND*	0	71	29	39	

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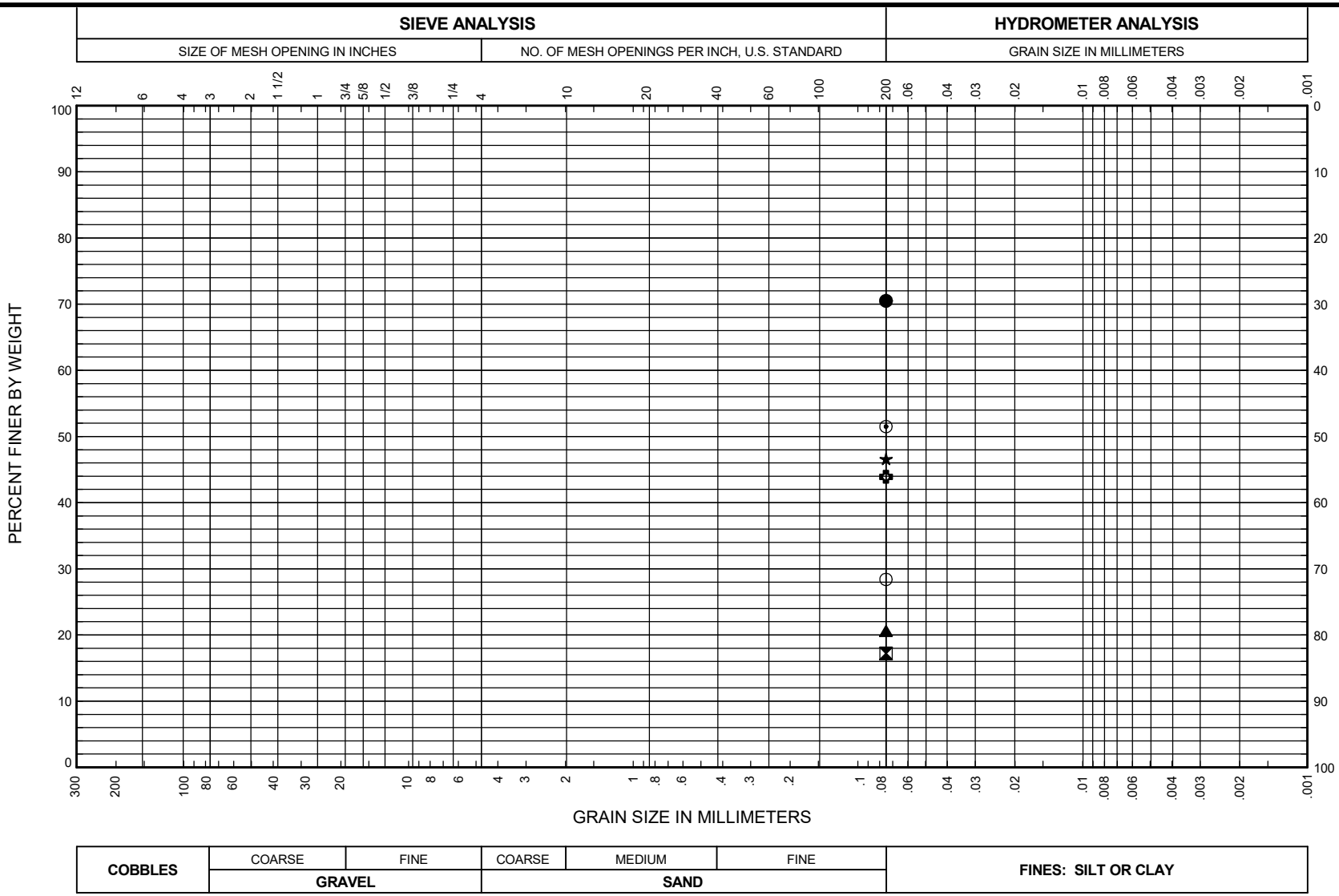

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-16, N17	65.0	*ML*	*SILT with some sand*	-	-	71	49	
⊠ B-16, N18	70.0	*SM*	*Silty SAND*	-	-	17	39	
▲ B-16, N19	75.0	*SM*	*Silty SAND*	-	-	21	35	
★ B-16, N20	80.0	*SM*	*Silty SAND*	-	-	47	45	
⊙ B-16, N21	85.0	*ML*	*Sandy SILT*	-	-	52	46	
✿ B-16, N22	90.0	*SM*	*Silty SAND*	-	-	44	39	
○ B-16, N23	95.0	*SM*	*Silty SAND*	-	-	28	37	

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FIG. E2

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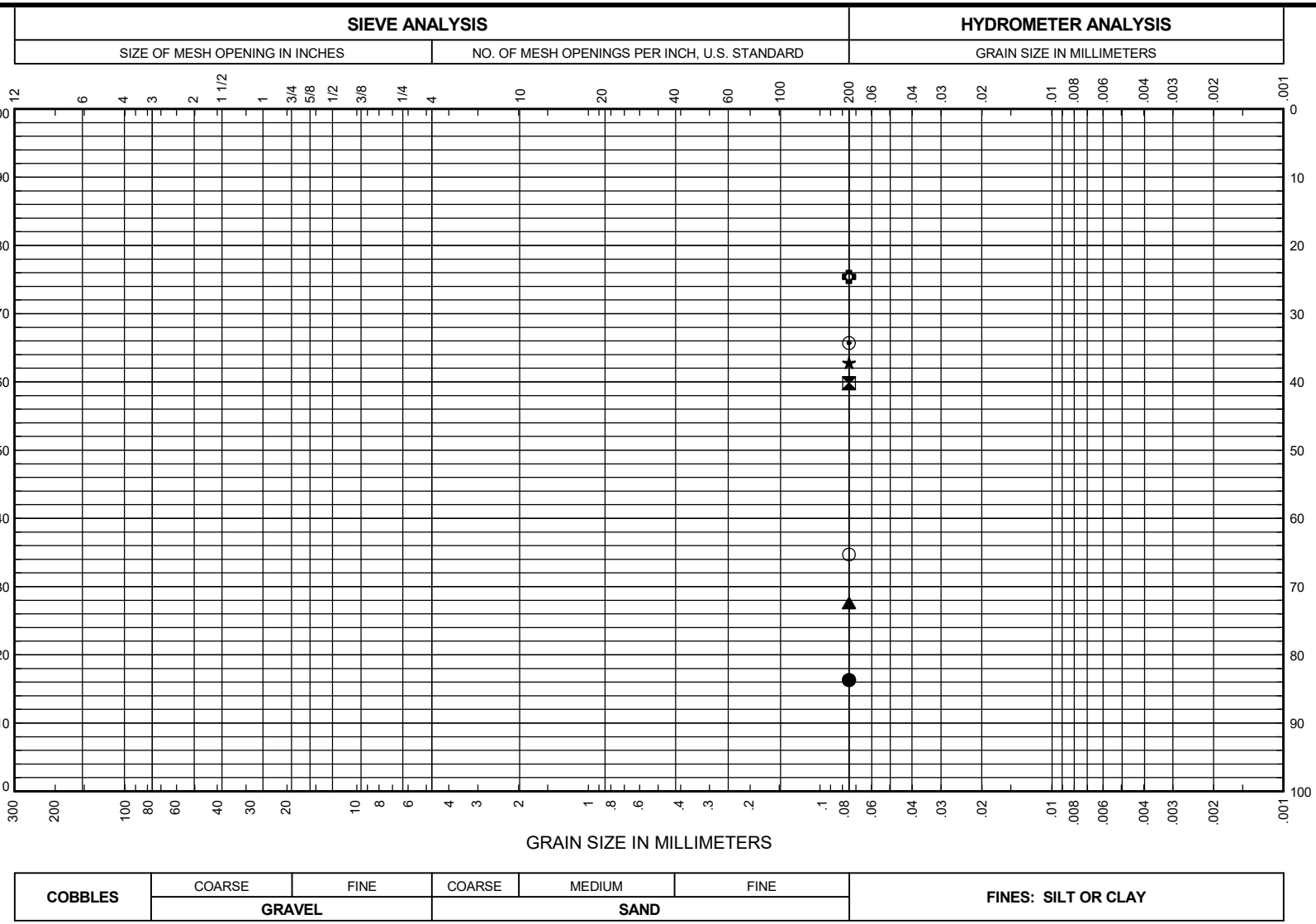

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-16, N24	100.0	*SM*	*Silty SAND*	-	-	16	38	
⊠ B-16, N25	105.0	*ML*	*Sandy SILT*	-	-	60	41	
▲ B-16, N26	112.0	*SM*	*Silty SAND*	-	-	28	41	
★ B-16, N27	115.0	*ML*	*Sandy SILT*	-	-	63	37	
⊙ B-16, N28	120.0	*ML*	*Sandy SILT*	-	-	66	39	
✿ B-16, N29	125.0	*ML*	*SILT with some sand*	-	-	75	40	
○ B-16, N30	130.0	*SM*	*Silty SAND*	-	-	35	29	

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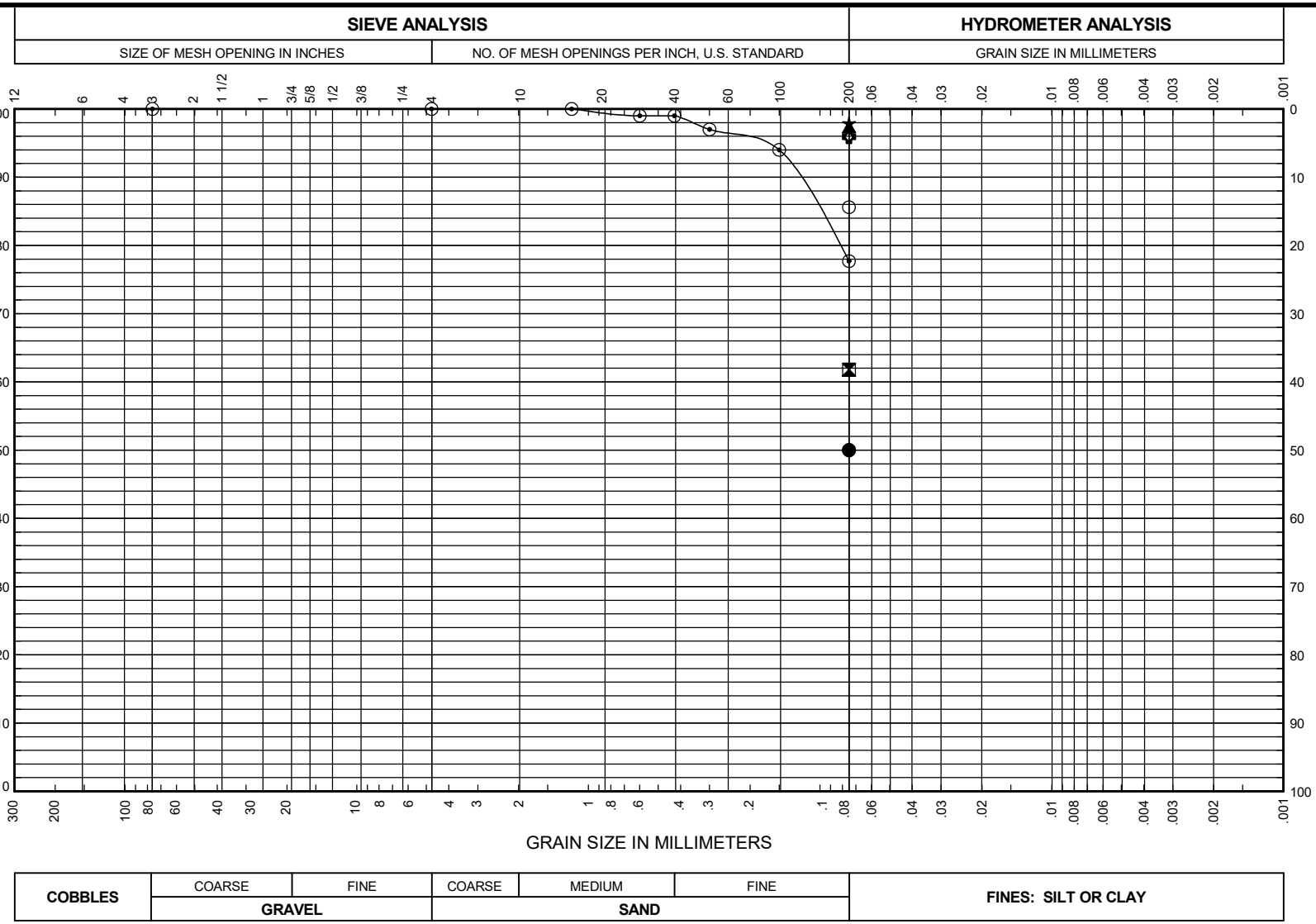

NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-16, N31	135.0	*SM/ML*	*Silty SAND to Sandy SILT*	-	-	50	35	
⊠ B-16, N32	140.0	*ML*	*Sandy SILT*	-	-	62	37	
▲ B-17, N7	17.5	*MH*	*Clayey SILT*	-	-	97	47	
★ B-17, N8	20.0	*MH*	*Clayey SILT*	-	-	98	49	
⊙ B-17, U1a	23.0	*ML*	*SILT with some sand*	0	22	78	48	73
✿ B-17, N9	25.0	*ML*	*SILT*	-	-	96	50	
○ B-17, N10	30.0	*ML*	*SILT with trace sand*	-	-	86	45	

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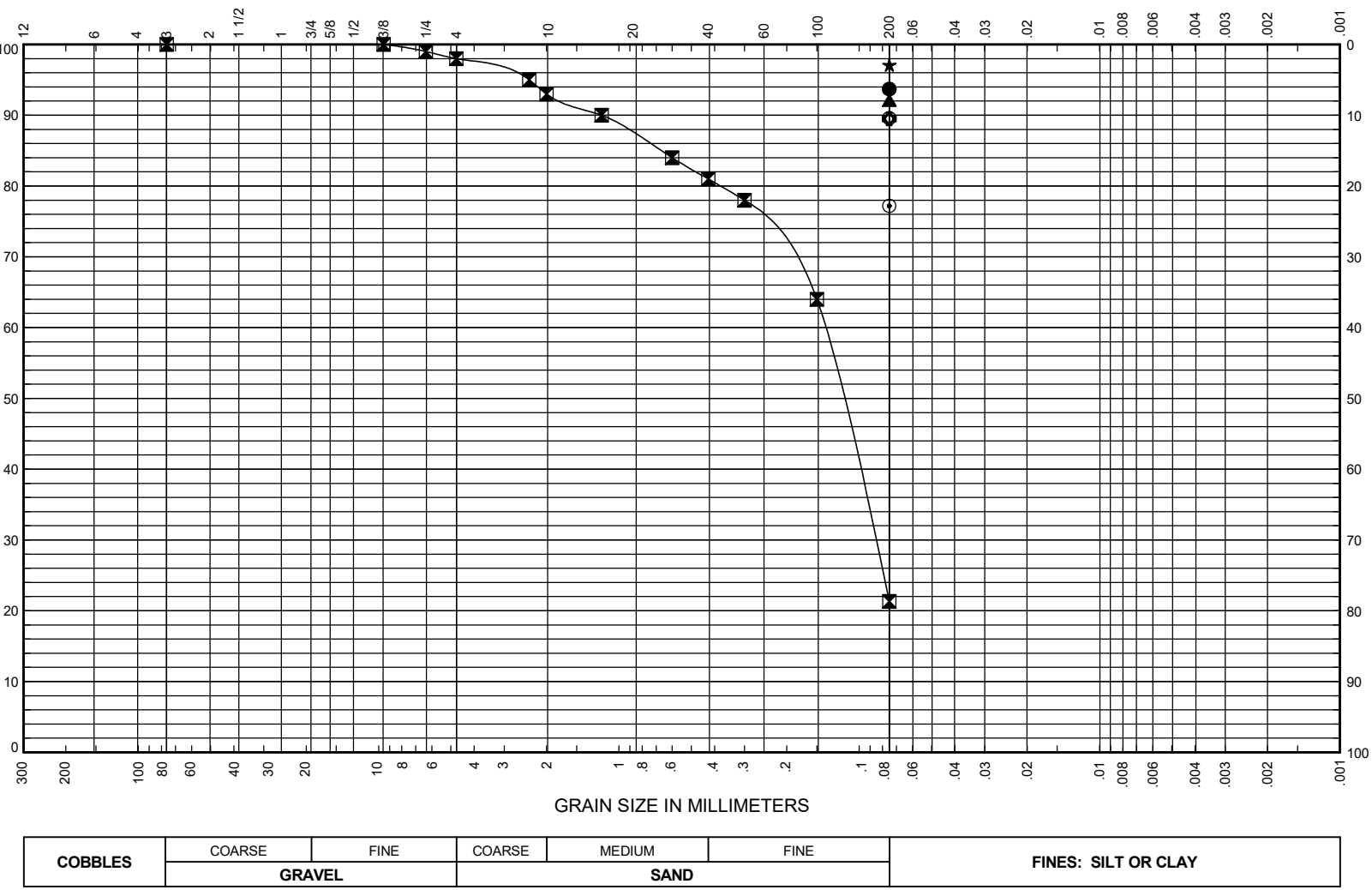

NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-17, N11	35.0	*ML*	*SILT with trace sand*	-	-	94	45	
⊠ B-17, U2a	40.0	*SM*	*Silty SAND*	2	77	21	41	79
▲ B-17, N12	42.0	*ML*	*SILT with trace sand*	-	-	92	47	
★ B-17, N13	45.0	*ML*	*SILT*	-	-	97	53	
⊙ B-17, N14	50.0	*ML*	*SILT with some sand*	-	-	77	44	
✿ B-17, N15	55.0	*ML*	*SILT with trace sand*	-	-	90	44	
○ B-17, N16a	60.0	*ML*	*SILT with trace sand*	-	-	90	50	

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FIG. E2

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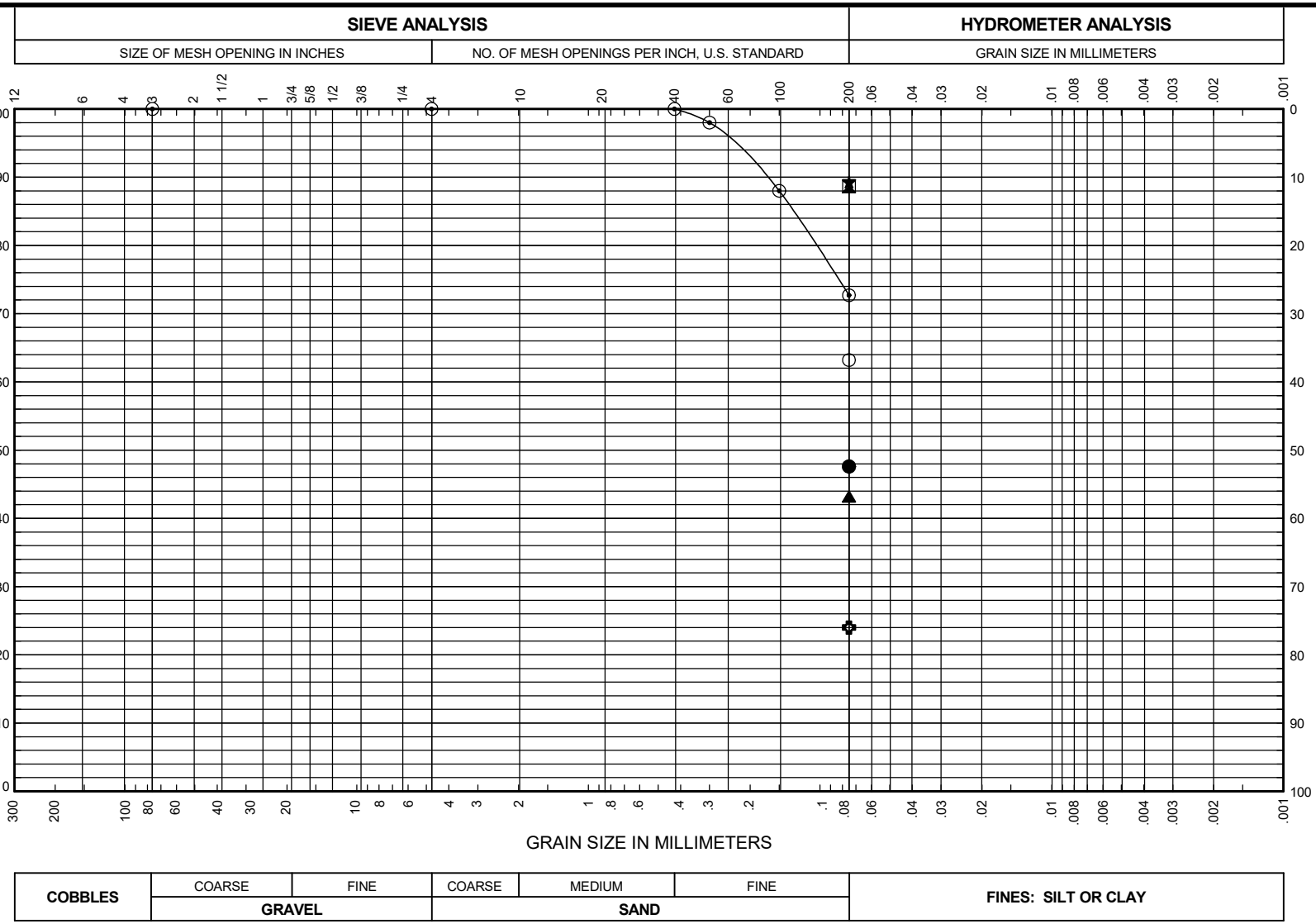

NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-17, N16b	60.4	*SM*	*Silty SAND*	-	-	48	41	
⊠ B-17, N17	65.0	*ML*	*SILT with trace sand*	-	-	89	48	
▲ B-17, N18	70.0	*SM*	*Silty SAND*	-	-	43	48	
★ B-17, N19	75.0	*ML*	*SILT with trace sand*	-	-	89	50	
⊙ B-17, U3a	80.0	*ML*	*SILT with some sand*	0	27	73	39	80
✿ B-17, N20	82.0	*SM*	*Silty SAND*	-	-	24	33	
○ B-17, N21	85.0	*ML*	*Sandy SILT*	-	-	63	48	

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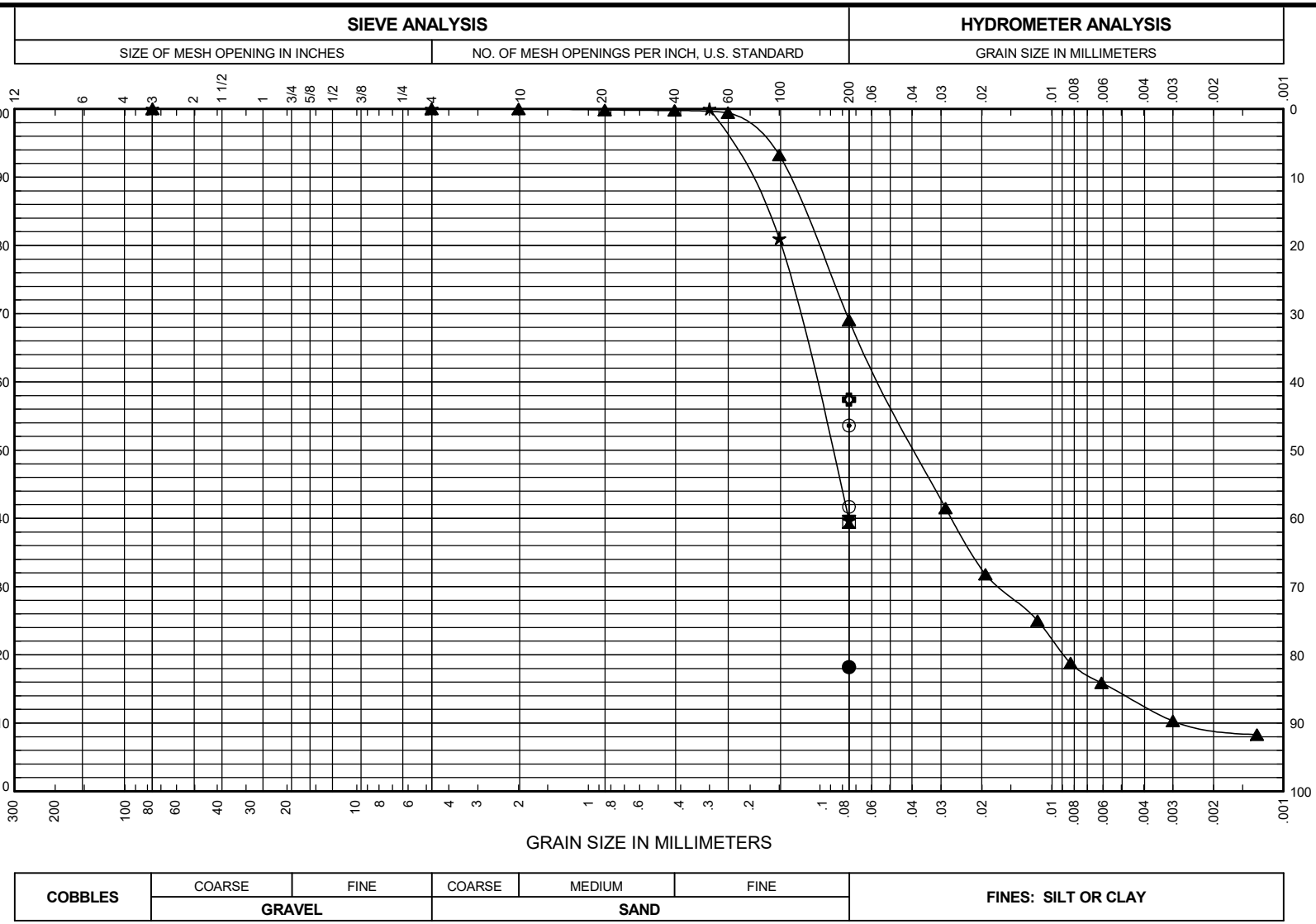

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-17, N22	90.0	*SM*	*Silty SAND*	-	-	18	32	
⊠ B-17, N23	95.0	*SM*	*Silty SAND*	-	-	40	45	
▲ B-17, N24	100.0	*ML*	*Sandy SILT*	0	31	69	48	
★ B-17, U4a	101.5	*SM*	*Silty SAND*	0	60	40	37	78
⊙ B-17, N25	103.5	*ML*	*Sandy SILT*	-	-	54	39	
✿ B-17, N26	110.0	*ML*	*Sandy SILT*	-	-	57	42	
○ B-17, N27	115.0	*SM*	*Silty SAND*	-	-	42	44	

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FIG. E2

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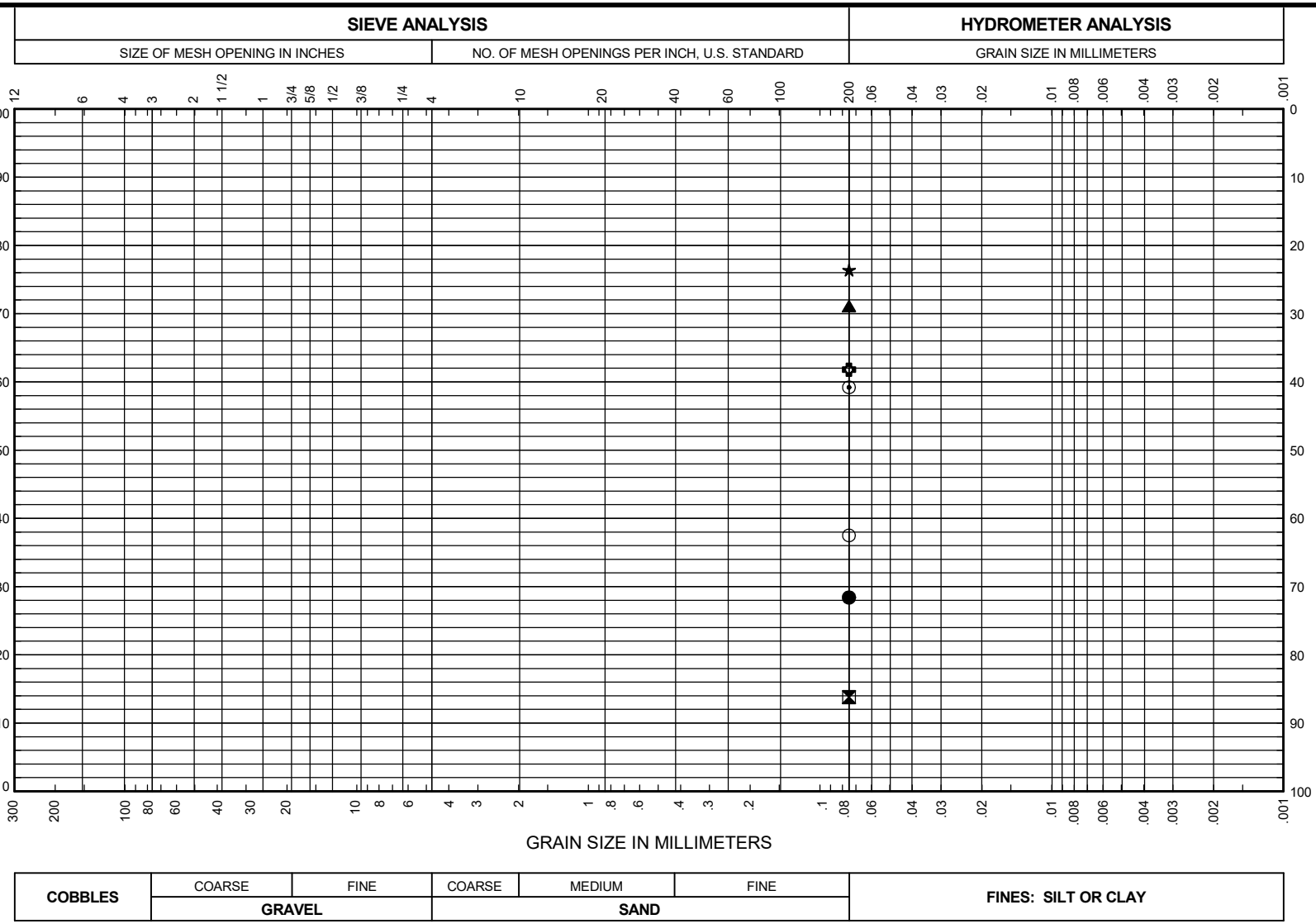

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-17, N28	120.0	*SM*	*Silty SAND*	-	-	28	40	
⊠ B-17, N29	125.0	*SM*	*Silty SAND*	-	-	14	28	
▲ B-17, N30b	130.8	*ML*	*SILT with some sand*	-	-	71	38	
★ B-17, N31	135.0	*ML*	*SILT with some sand*	-	-	76	47	
⊙ B-17, N32	140.0	*ML*	*Sandy SILT*	-	-	59	40	
✿ B-17, N33	145.0	*ML*	*Sandy SILT*	-	-	62	43	
○ B-18, N6	15.0	*SM*	*Silty SAND with some organics*	-	-	38	73	

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FIG. E2

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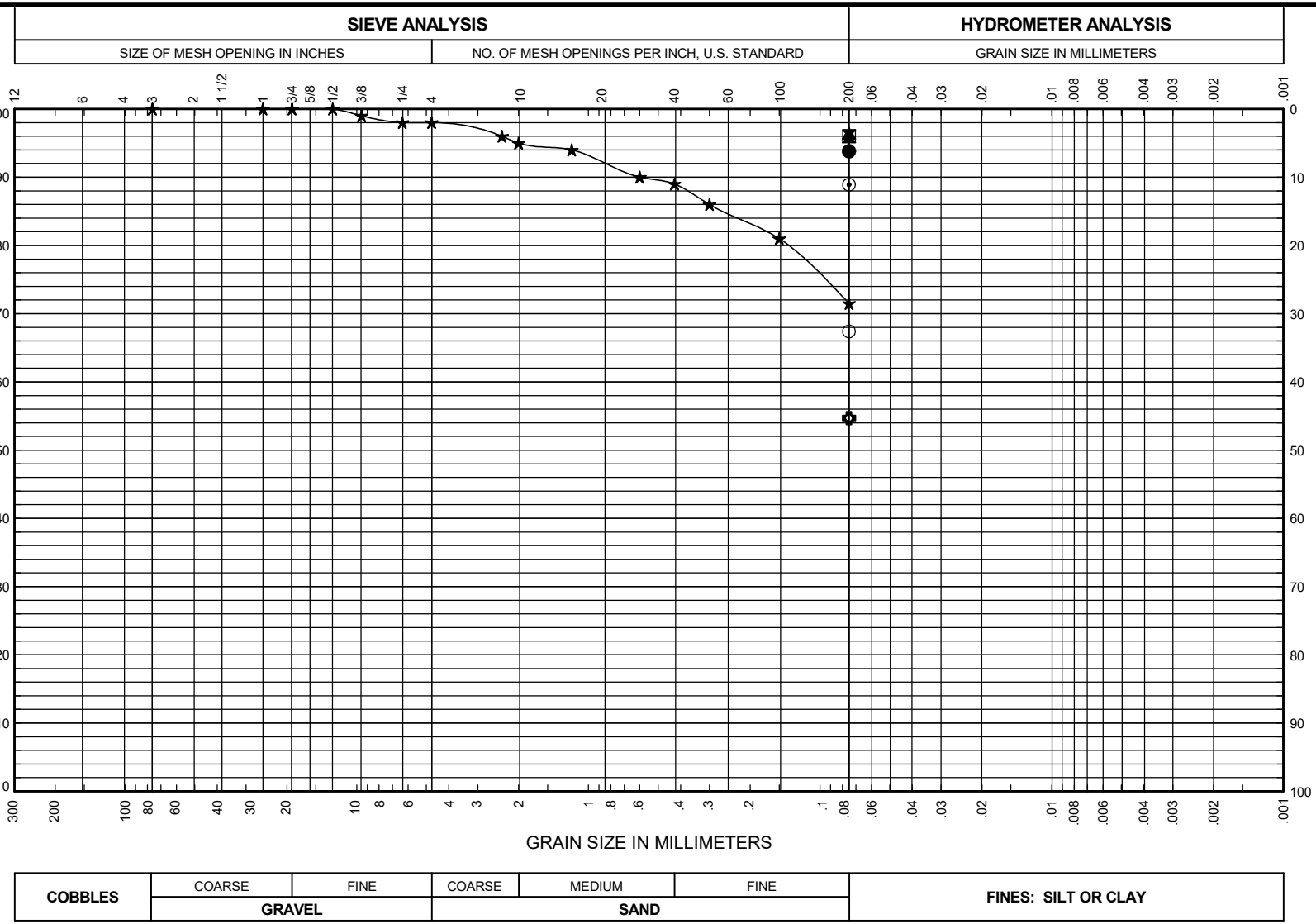

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-18, N9	25.0	*OH*	*Organic CLAY with trace sand*	-	-	94	93	
⊠ B-18, N10	30.0	*OH*	*Organic CLAY*	-	-	96	87	
▲ B-18, N11	35.0	*OH*	*Organic CLAY*	-	-	96	105	
★ B-18, U2a	38.0	*OL*	*Organic SILT with some sand*	2	27	72	103	40
⊙ B-18, N12	40.0	*OH*	*Organic CLAY with trace sand*	-	-	89	94	
✿ B-18, N13a	45.0	*CL*	*Sandy silty CLAY*	-	-	55	26	
○ B-18, N14	50.0	*ML*	*Sandy SILT*	-	-	67	33	

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FIG. E2

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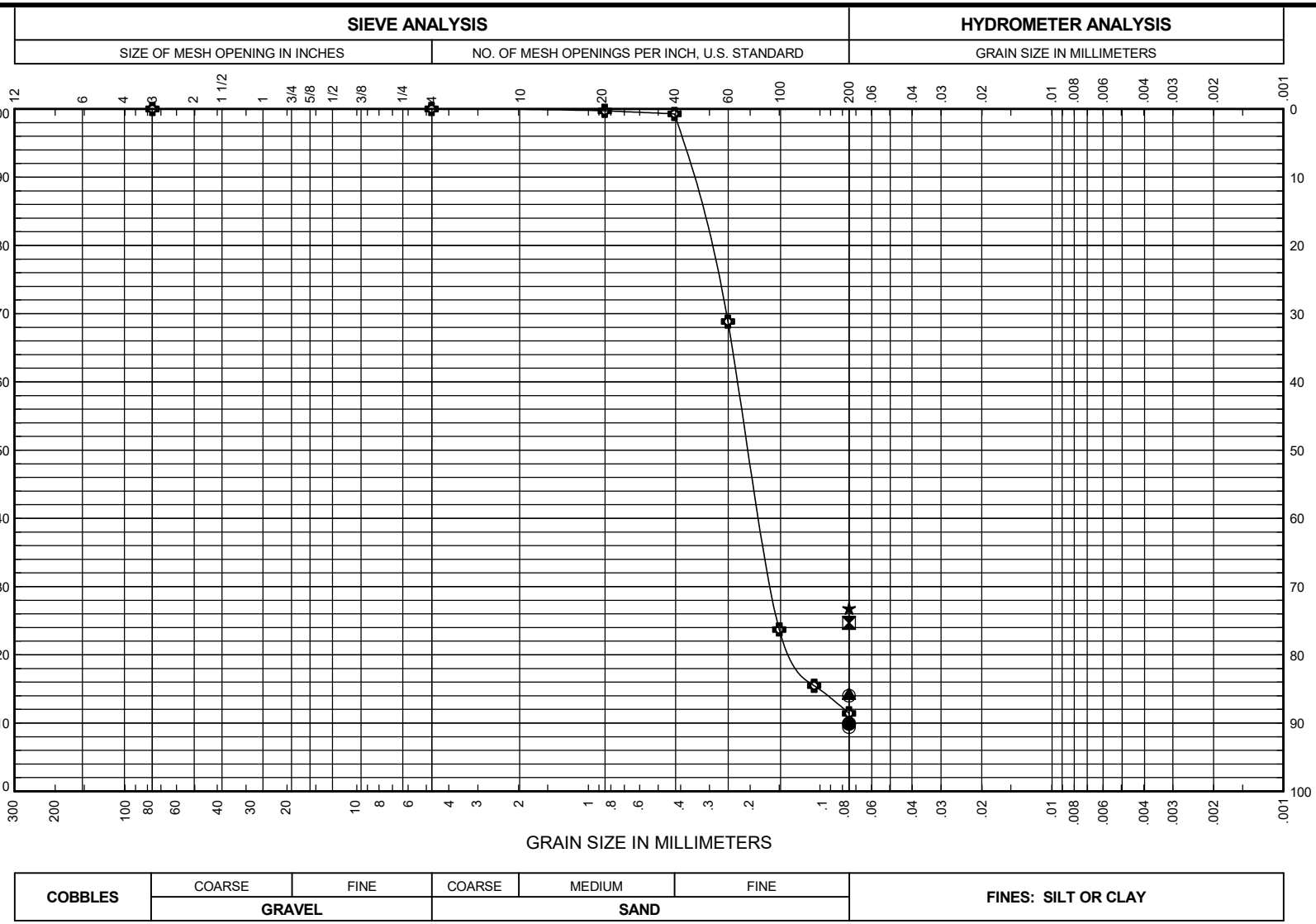

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.
** Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-19, N5	20.0	*SP-SM*	*SAND with some silt*	-	-	10	7	
⊠ B-19, N17a	80.0	*SM*	*Silty SAND*	-	-	25	31	
▲ B-20, N3*	19.5	*GM*	*Silty GRAVEL with some sand*	-	-	14	11	
★ B-20, N4	25.0	*SM*	*Silty SAND*	-	-	27	23	
⊙ B-20, N5*	30.0	*SM*	*Silty SAND with trace gravel*	-	-	14	19	
✿ B-21, N11	55.0	*SP-SM*	*SAND with some silt*	0	89	11	25	
○ B-21, N12	60.0	*SP-SM*	*SAND with some silt*	-	-	9	22	

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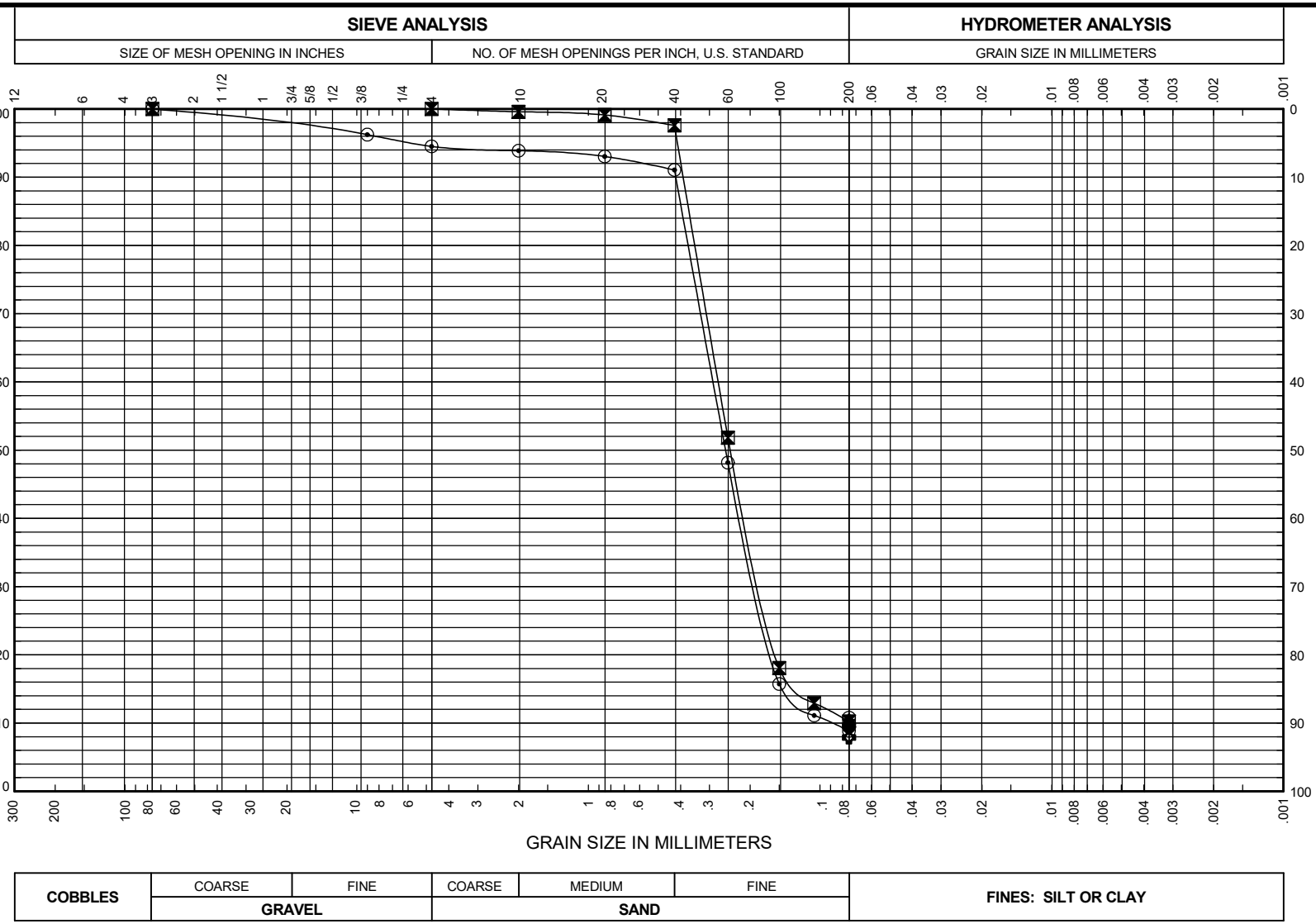

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-21, N13	65.0	*SP-SM*	*SAND with some silt and trace gravel*	-	-	10	19	
⊠ B-21, N14	70.0	*SP-SM*	*SAND with some silt*	0	90	10	23	
▲ B-21, N15	75.0	*SP-SM*	*SAND with some silt*	-	-	11	24	
★ B-21, N16	80.0	*SP-SM*	*SAND with some silt*	-	-	10	25	
⊙ B-21, N17	85.0	*SP-SM*	*SAND with some silt and trace gravel*	5	86	9	22	
✿ B-21, N18	90.0	*SP-SM*	*SAND with some silt and trace gravel*	-	-	8	22	
○ B-21, N19	95.0	*SP-SM*	*SAND with some silt and trace gravel*	-	-	11	25	

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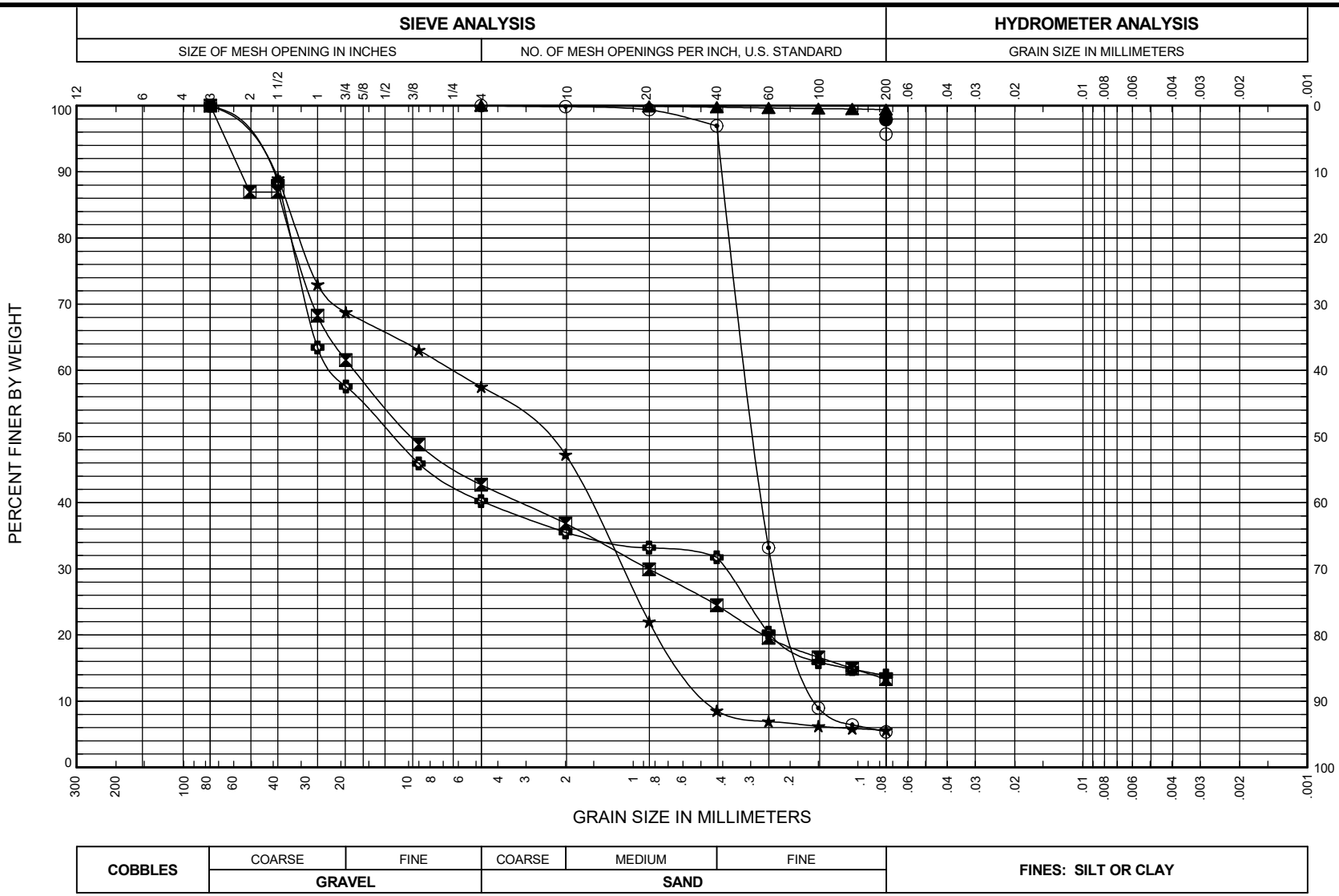

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-22, S1	10.0	*CL*	*Silty CLAY*	-	-	98		
⊠ B-22, S3a	30.0	*GM*	*Silty GRAVEL with some sand*	57	29	13		
▲ B-22, S3b	44.0	*ML*	*SILT*	0	1	99		
★ B-22, S4a	50.0	*SP-SM*	*Gravelly SAND with some silt*	42	52	6		
⊙ B-22, S4d	63.0	*SP-SM*	*SAND with some silt*	0	95	5		
✿ B-22, S6a	90.0	*GM*	*Silty GRAVEL with some sand*	60	26	14		
○ B-22, S6b	92.0	*MH*	*Clayey SILT*	-	-	96		

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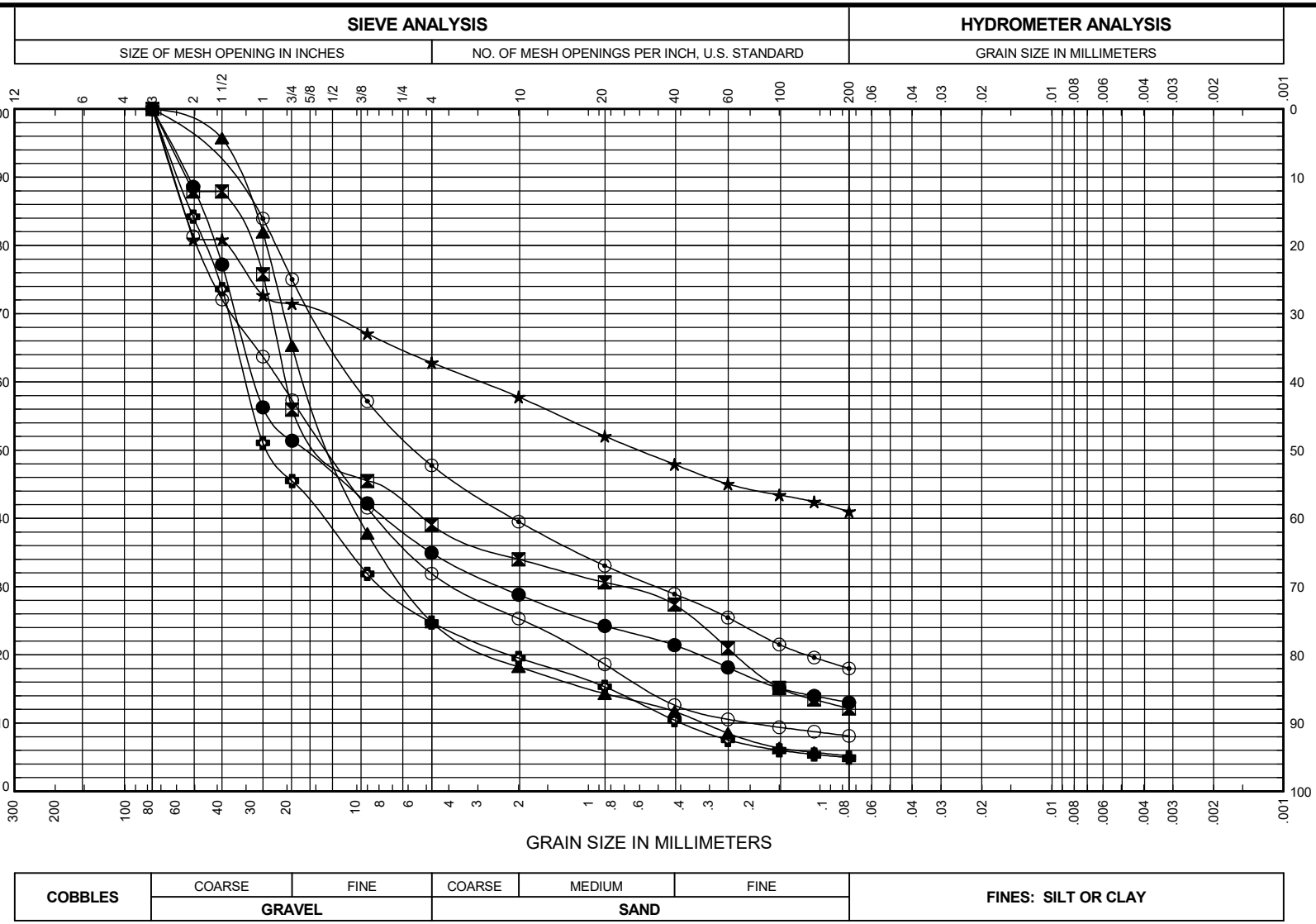

NOTES:
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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-22, S7	100.0	*GC*	*Clayey GRAVEL with some sand*	65	22	13		
⊠ B-22, S9b	116.0	*GM*	*Silty GRAVEL with some sand*	61	27	12		
▲ B-22, S11a	130.0	*GP-GM*	*Sandy GRAVEL with some silt*	75	20	5		
★ B-23, S1a	6.0	*GM*	*Silty GRAVEL with some sand*	37	22	41		
⊙ B-23, S2c	28.0	*GM*	*Sandy silty GRAVEL*	52	30	18		
✿ B-23, S3c	32.5	*GP-GM*	*GRAVEL with some silt and sand*	75	20	5		
○ B-23, S4	50.0	*GP-GM*	*GRAVEL with some silt and sand*	68	24	8		

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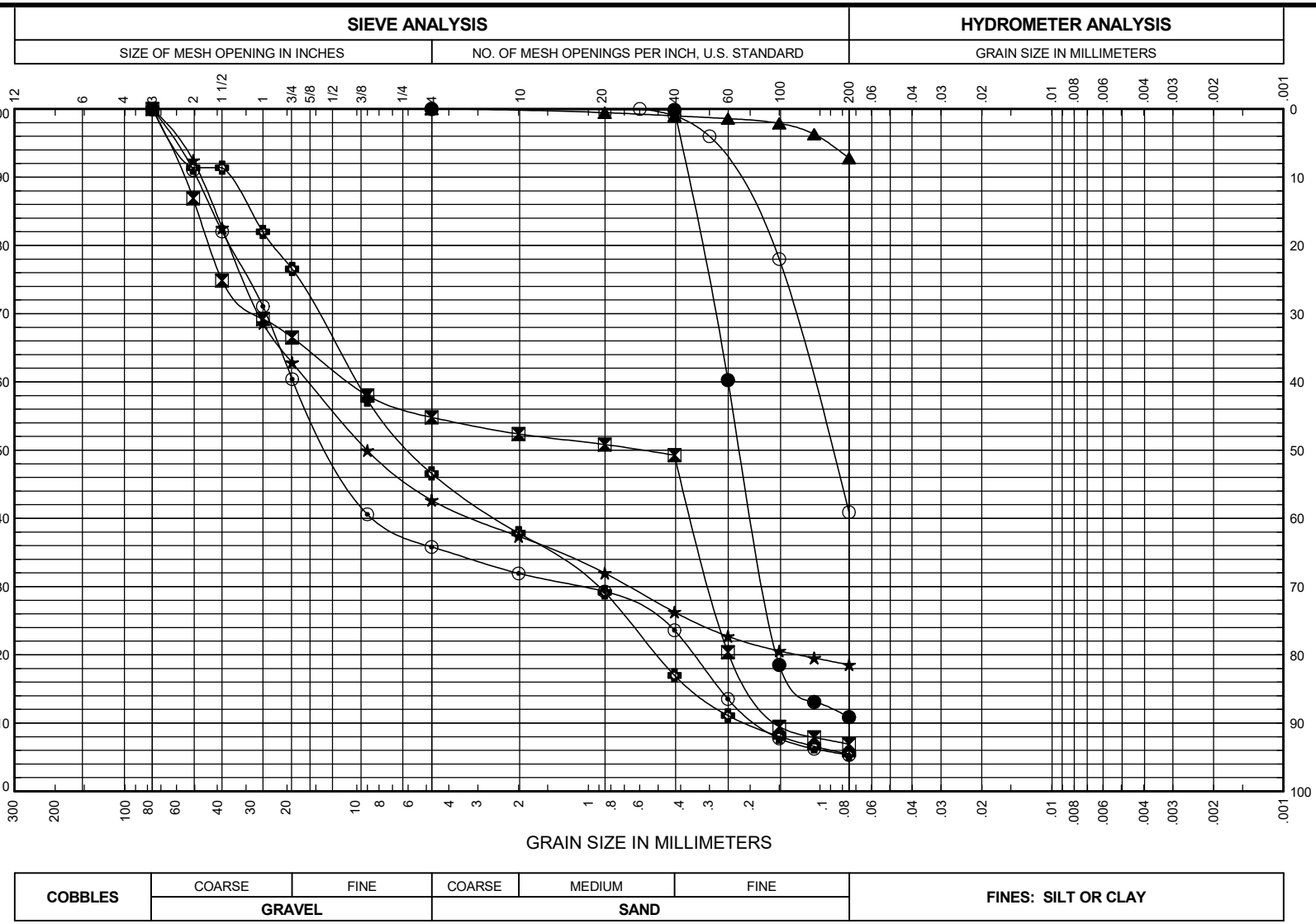

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** Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-23, S5b	63.0	*SP-SM*	*SAND with some silt*	0	89	11		
⊠ B-23, S6b	82.0	*SP-SM*	*Gravelly SAND with some silt*	45	48	7		
▲ B-23, S7a	90.1	*ML*	*SILT with trace sand*	0	7	93		
★ B-23, S7c	94.0	*GM*	*Silty GRAVEL with some sand*	57	24	19		
⊙ B-23, S9a	117.0	*GP-GM*	*Sandy GRAVEL with some silt*	64	30	5		
✿ B-24, S2*	10.0	*GP-GM*	*Sandy GRAVEL with some silt*	53	41	5		
○ B-24, S5b	33.0	*SM*	*Silty SAND*	0	59	41		

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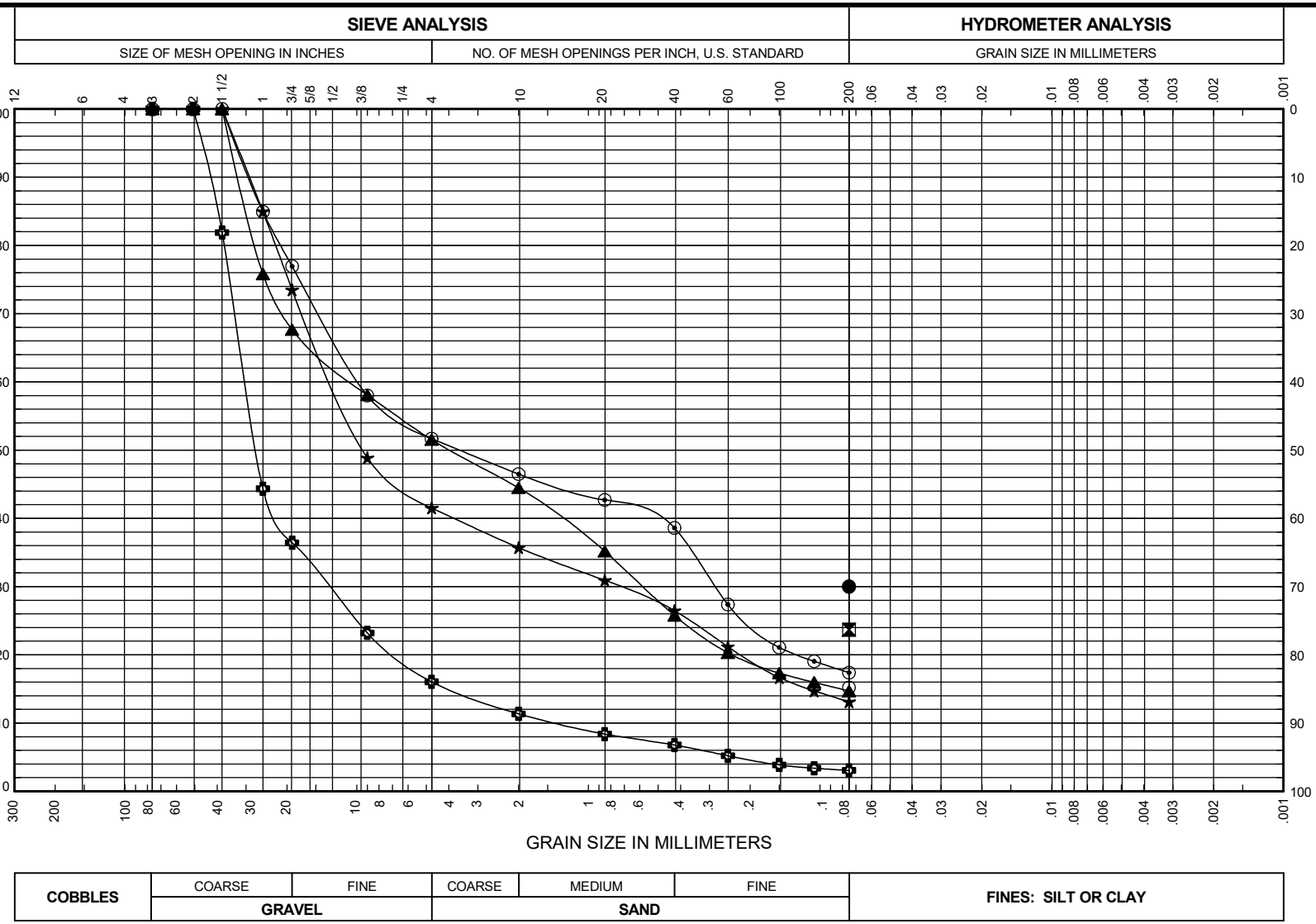

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** Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-24, S6b	42.0	*SM*	*Silty SAND*	-	-	30		
⊠ B-24, S7a	50.0	*SC*	*Clayey SAND*	-	-	24		
▲ B-24, S8*	60.0	*GM*	*Sandy silty GRAVEL*	48	37	15		
★ B-24, S10*	75.0	*GM*	*Silty GRAVEL with some sand*	58	28	13		
⊙ B-24, S13*	90.0	*GM*	*Sandy silty GRAVEL*	48	34	17		
✿ B-24, S17b*	113.0	*GP*	*GRAVEL with trace silt and sand*	84	13	3		
○ B-24, S21	140.0	*SM*	*Silty SAND*	-	-	15		

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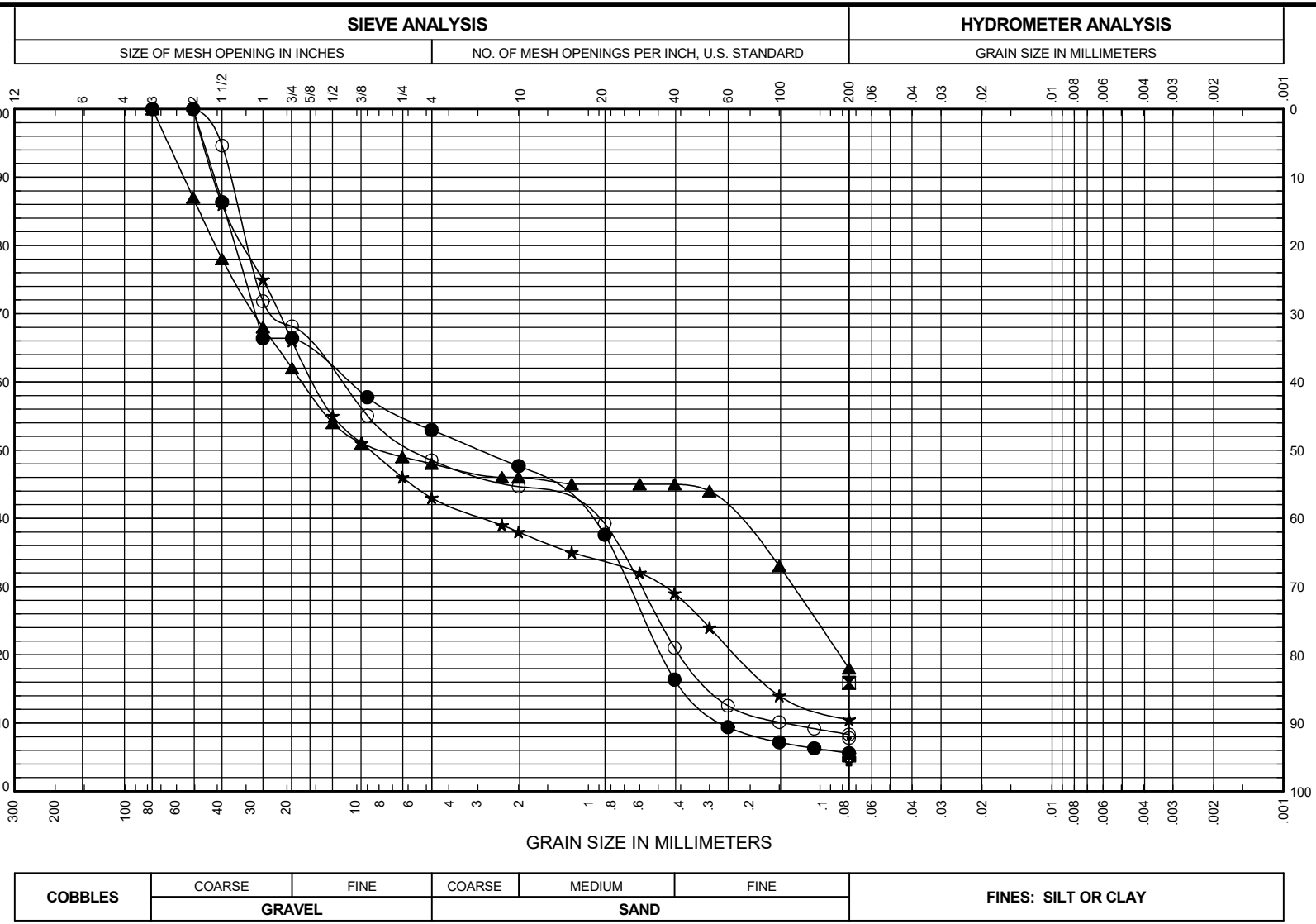

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** Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-25, S3*	14.0	*SP-SM*	*Gravelly SAND with some silt*	47	47	6		
⊠ B-25, S5b	36.0	*SM*	*Silty SAND*	-	-	16		
▲ B-25, S6a	44.0	*GM*	*Sandy silty GRAVEL*	52	30	18		
★ B-25, S11	84.0	*GP-GM*	*Sandy GRAVEL with some silt*	57	33	11		
⊙ B-25, S17a	144.0	*SP-SM*	*SAND with some silt*	-	-	8		
✿ B-25, S19	159.0	*SP*	*SAND with trace silt*	-	-	5		
○ B-26, S4c*	33.0	*GP-GM*	*Sandy GRAVEL with some silt*	51	40	8		

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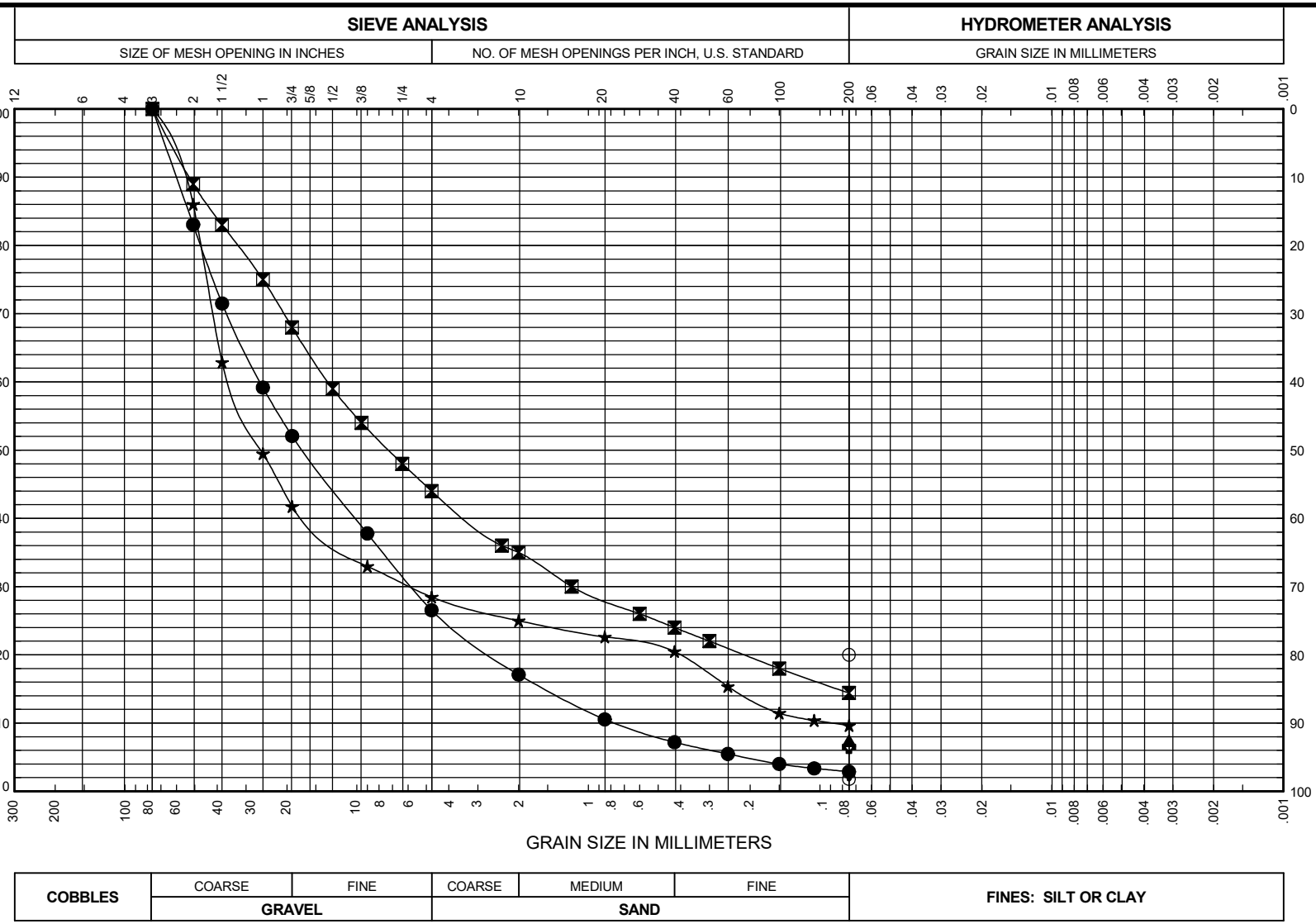

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** Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-26, S6*	48.0	*GW*	*GRAVEL with some sand and trace silt*	73	24	3		
⊠ B-26, S8b	70.5	*GC*	*Clayey GRAVEL with some sand*	56	30	14		
▲ B-26, S9a	78.0	*GP-GM*	*Sandy GRAVEL with some silt*	-	-	7		
★ B-26, S15*	128.0	*GP-GC*	*GRAVEL with some clay and sand*	72	19	10		
⊙ B-27, N3	10.5	*SP*	*Gravelly SAND with trace silt*	-	-	2	19	
✿ B-27, N6	18.6	*SP-SM*	*SAND with some silt and gravel*	-	-	7	26	
○ B-27, N14	55.7	*SM*	*Silty SAND with trace gravel*	-	-	20	36	

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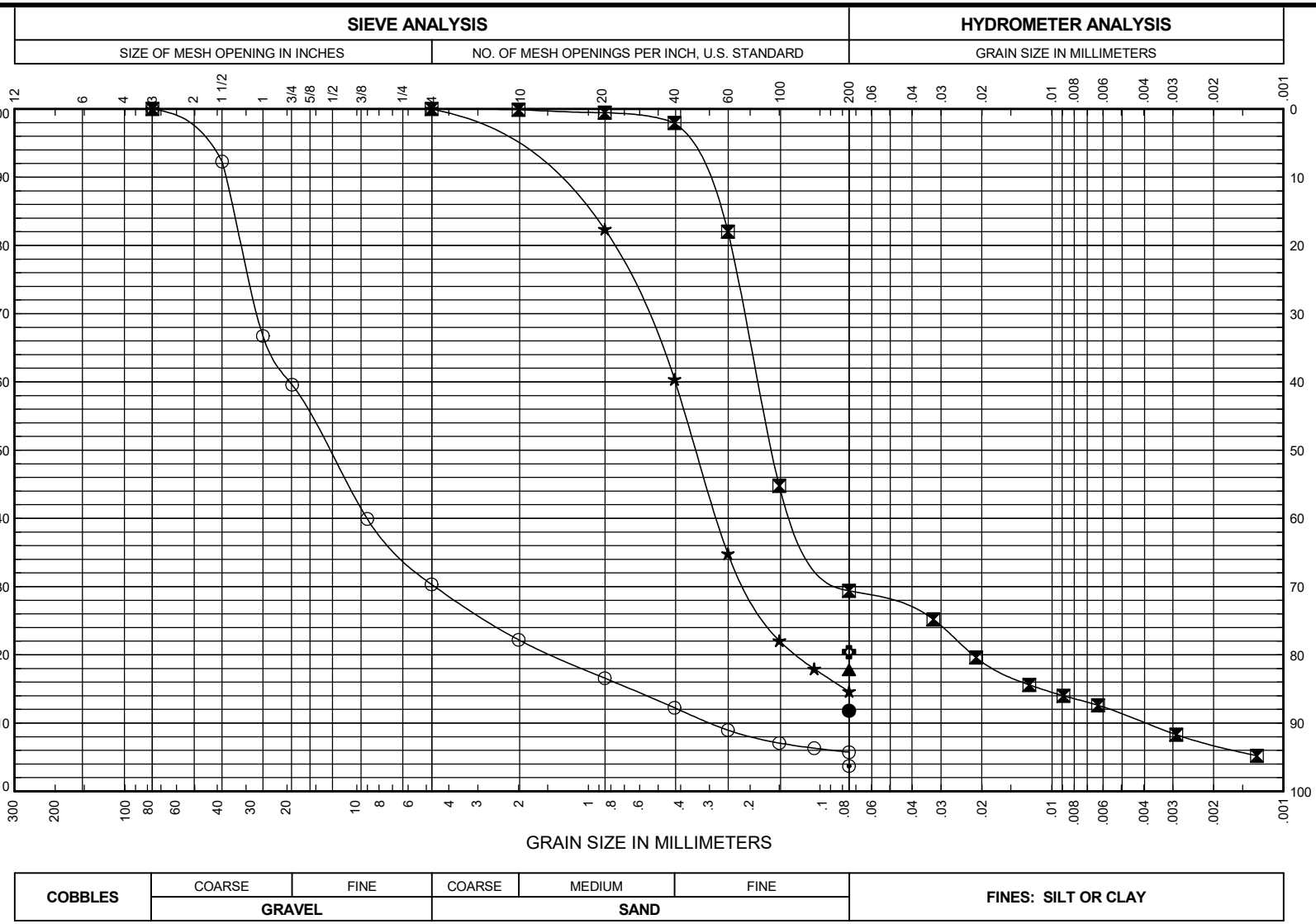

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-27, N24	111.2	*SM*	*Silty SAND*	-	-	12	28	
⊠ B-27, N25	121.1	*SC*	*Clayey SAND*	0	71	29	34	
▲ B-27, N26	138.1	*SM*	*Silty SAND*	-	-	18	30	
★ B-27, N28	160.3	*SM*	*Silty SAND*	0	85	15	27	
⊙ B-28, S1b	8.5	*SP*	*SAND with trace silt and gravel*	-	-	4		
✿ B-28, S2d	29.7	*SM*	*Silty SAND*	-	-	20		
○ B-28, S3b	47.5	*GP-GM*	*GRAVEL with some silt and sand*	70	25	6		

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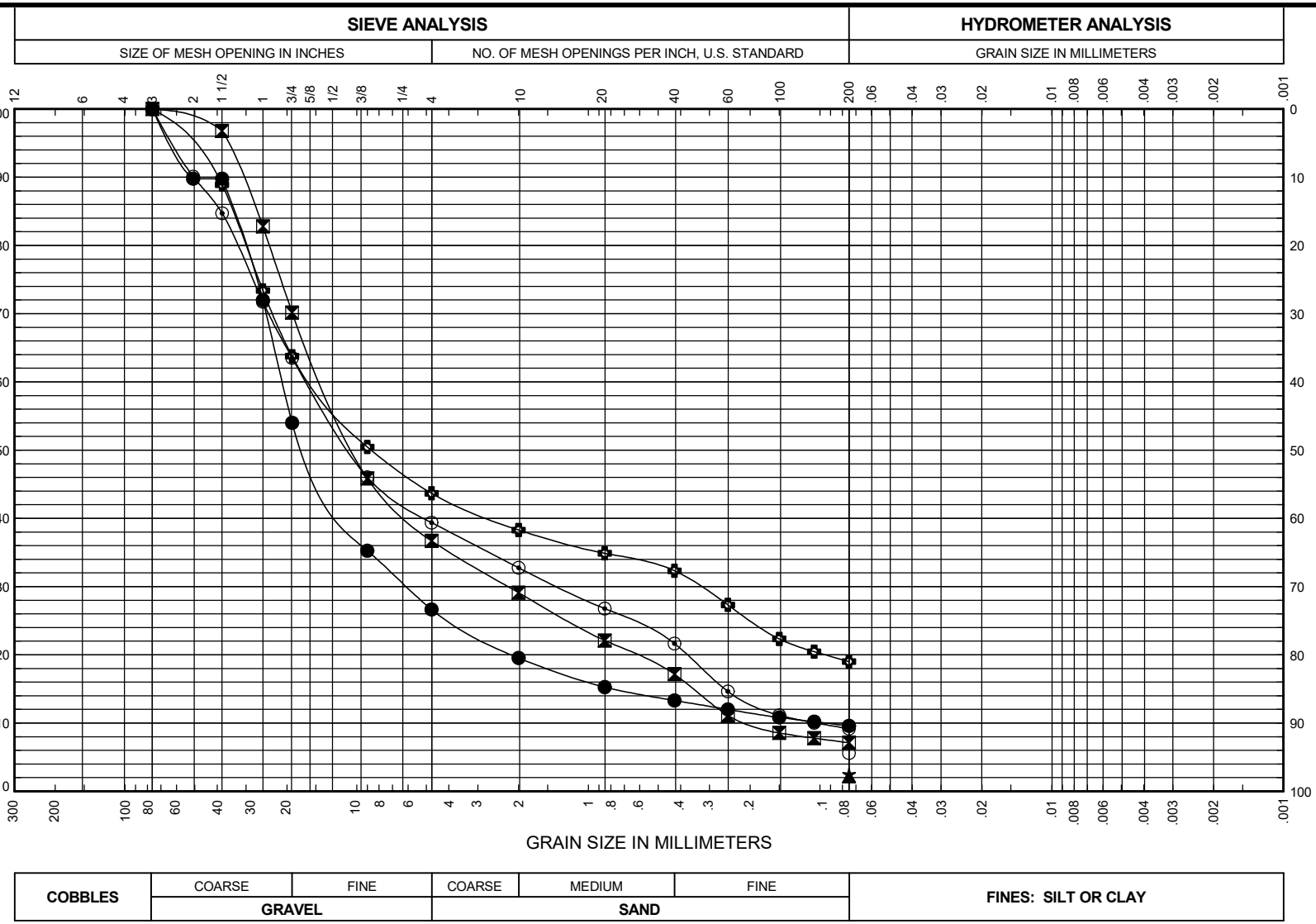

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-28, S5a	84.0	*GP-GM*	*GRAVEL with some silt and sand*	73	17	10		
⊠ B-28, S7c	123.0	*GW-GM*	*GRAVEL with some silt and sand*	63	30	7		
▲ B-29, S2	25.0	*SP*	*SAND with trace silt and gravel*	-	-	2		
★ B-29, S3	40.0	*SP*	*SAND with trace silt and gravel*	-	-	3		
⊙ B-29, S4d	76.0	*GW-GM*	*Sandy GRAVEL with some silt*	61	30	9		
✿ B-29, S8c	129.0	*GM*	*Silty GRAVEL with some sand*	56	25	19		
○ B-29, S10b	152.0	*SP-SM*	*SAND with some silt*	-	-	6		

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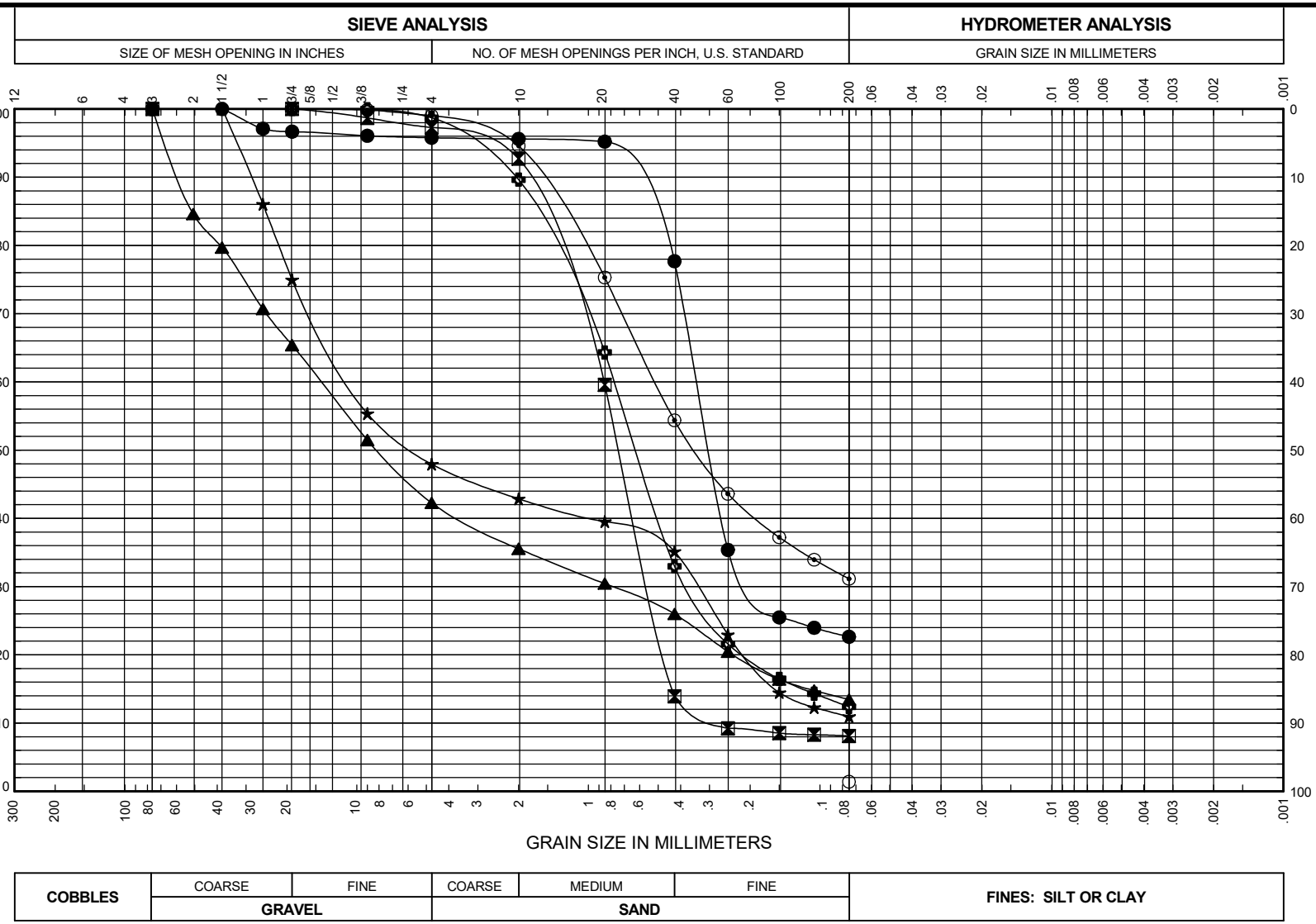

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-30, S2b	26.0	*SM*	*Silty SAND*	4	73	23		
⊠ B-30, S3a	44.0	*SP-SM*	*SAND with some silt*	3	89	8		
▲ B-30, S5c	91.0	*GC*	*Clayey GRAVEL with some sand*	58	29	13		
★ B-30, S7a	106.0	*GP-GC*	*Sandy GRAVEL with some clay*	52	37	11		
⊙ B-30, S8c	127.0	*SC*	*Clayey SAND*	1	68	31		
✿ B-30, S10	146.0	*SM*	*Silty SAND*	1	86	12		
○ B-31, S1b	1.0	*GP*	*Sandy GRAVEL with trace silt*	-	-	1		

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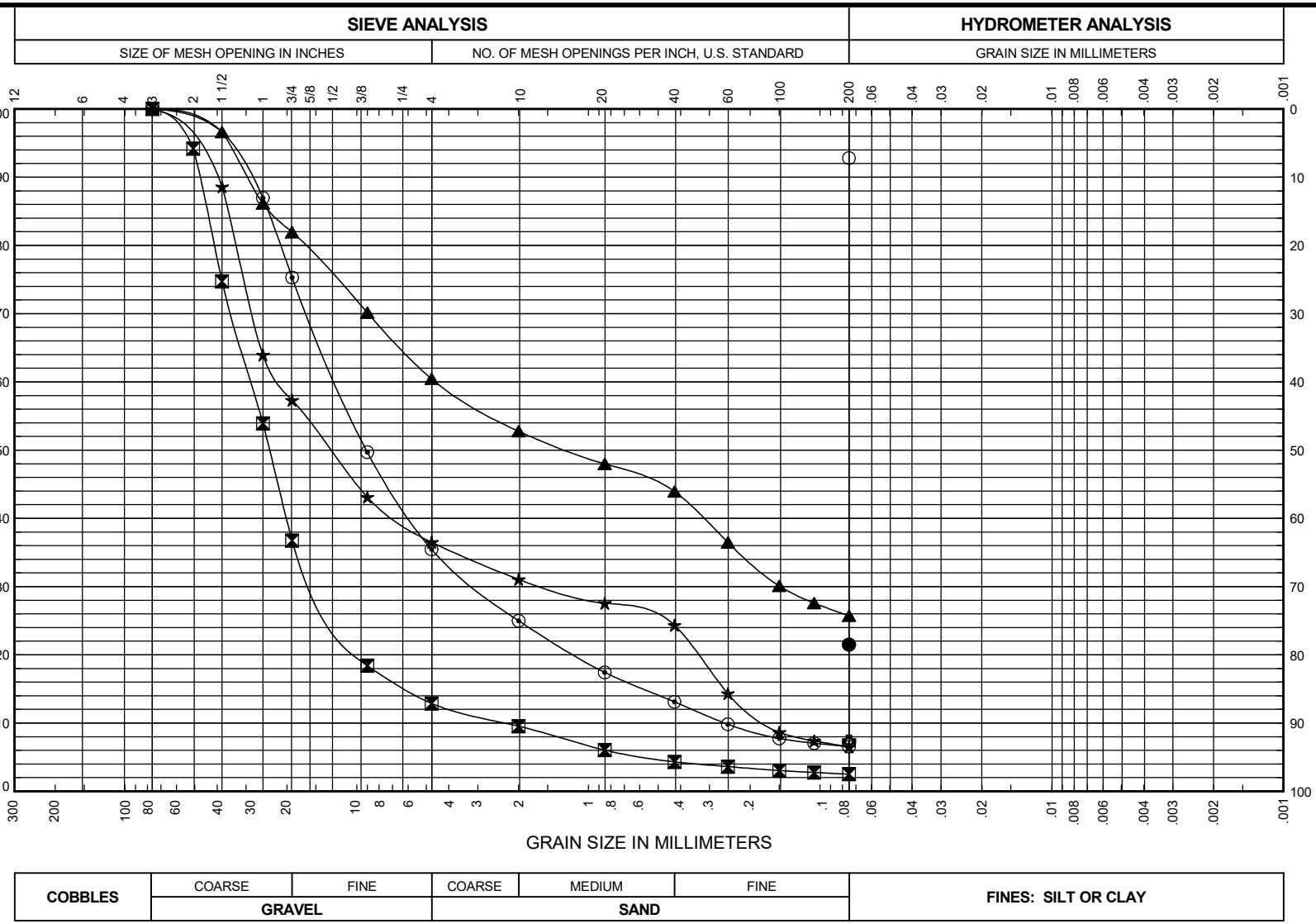

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● B-31, S3a	30.7	*SM*	*Silty SAND*	-	-	22		
⊠ B-31, S4b	55.0	*GP*	*GRAVEL with trace silt and sand*	87	10	3		
▲ B-31, S5	70.1	*GC*	*Sandy clayey GRAVEL*	40	35	26		
★ B-31, S7	101.8	*GP-GM*	*Sandy GRAVEL with some silt*	63	30	7		
⊙ B-31, S9b	128.0	*GW-GC*	*GRAVEL with some clay and sand*	65	29	7		
✿ B-32, N2	12.5	*SP-SM*	*SAND with some silt and trace gravel*	-	-	7	24	
○ B-32, N3	15.0	*OH*	*Organic CLAY with trace sand*	-	-	93	48	

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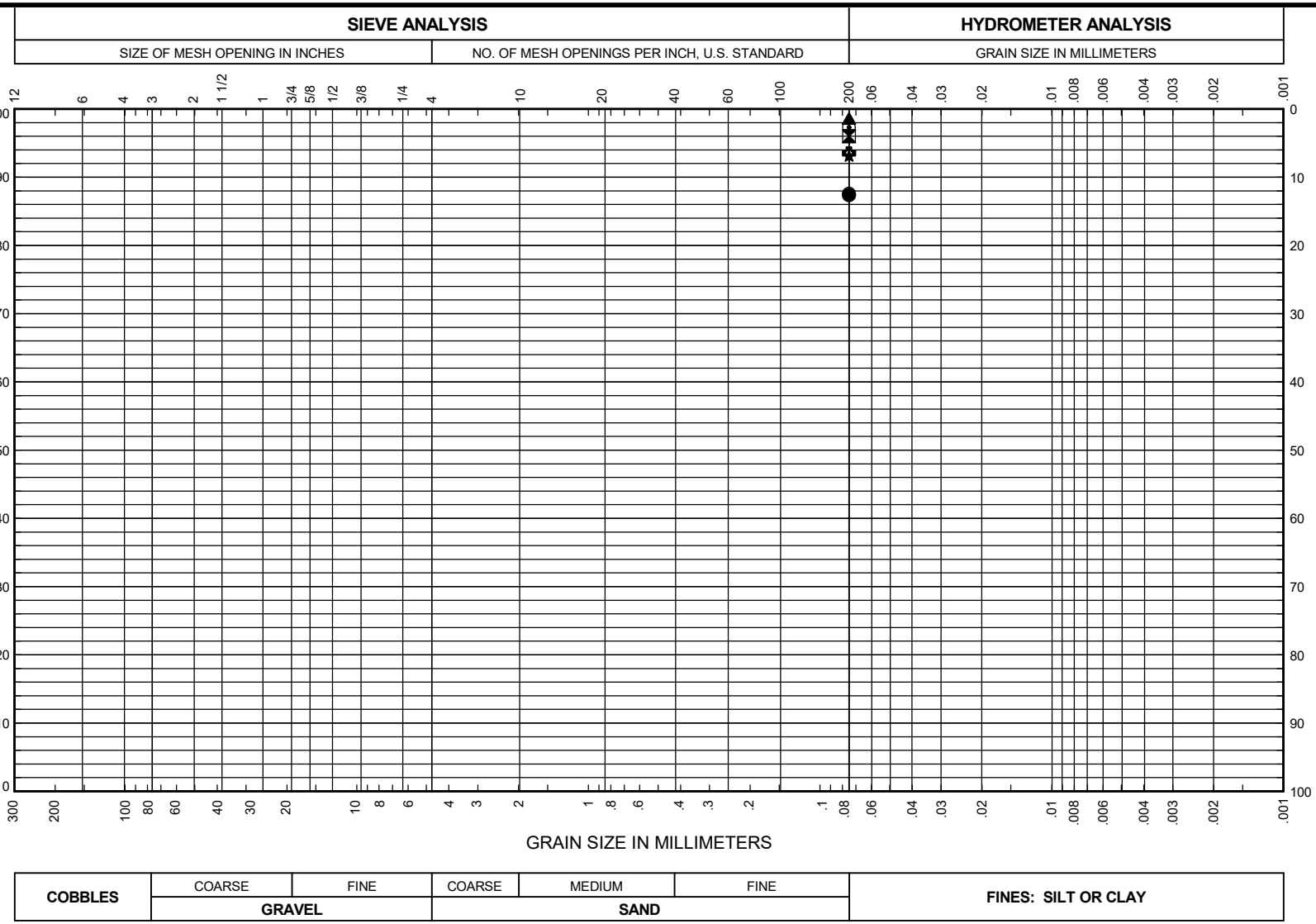

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● B-32, N4	20.0	*OH*	*Organic CLAY with trace sand*	-	-	87	50	
⊠ B-32, N5	25.0	*OH*	*Organic CLAY*	-	-	96	45	
▲ B-32, N6	30.0	*ML/CL*	*SILT to Silty CLAY*	-	-	99	51	
★ B-32, N7	35.0	*ML/CL*	*SILT to Silty CLAY with trace sand*	-	-	93	43	
⊙ B-32, N8	40.0	*ML/CL*	*SILT to Silty CLAY*	-	-	97	43	
✿ B-32, N9	45.0	*ML*	*SILT with trace sand*	-	-	94	46	
○ B-32, N10	50.0	*ML*	*SILT with trace sand*	-	-	88	41	

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FIG. E2

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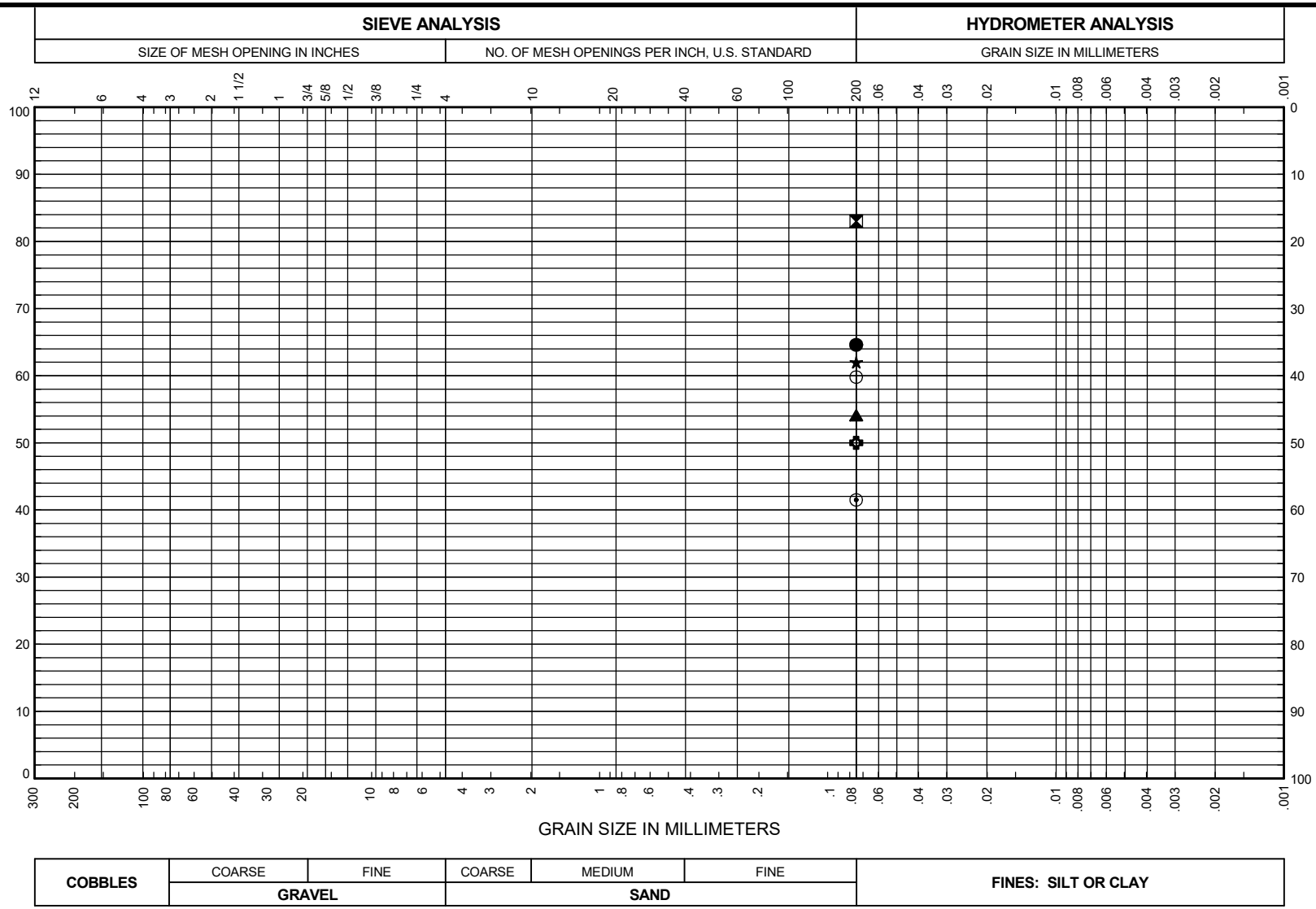

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● B-32, N11	55.0	*ML*	*Sandy SILT*	-	-	65	41	
⊠ B-32, N12	60.0	*ML*	*SILT with some sand*	-	-	83	48	
▲ B-32, N13	65.0	*ML*	*Sandy SILT*	-	-	54	48	
★ B-32, N14	70.0	*ML*	*Sandy SILT*	-	-	62	44	
⊙ B-32, N15	75.0	*SM*	*Silty SAND*	-	-	42	44	
✿ B-32, N16	80.0	*SM/ML*	*Silty SAND to Sandy SILT*	-	-	50	45	
○ B-32, N17	85.0	*ML*	*Sandy SILT*	-	-	60	46	

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FIG. E2

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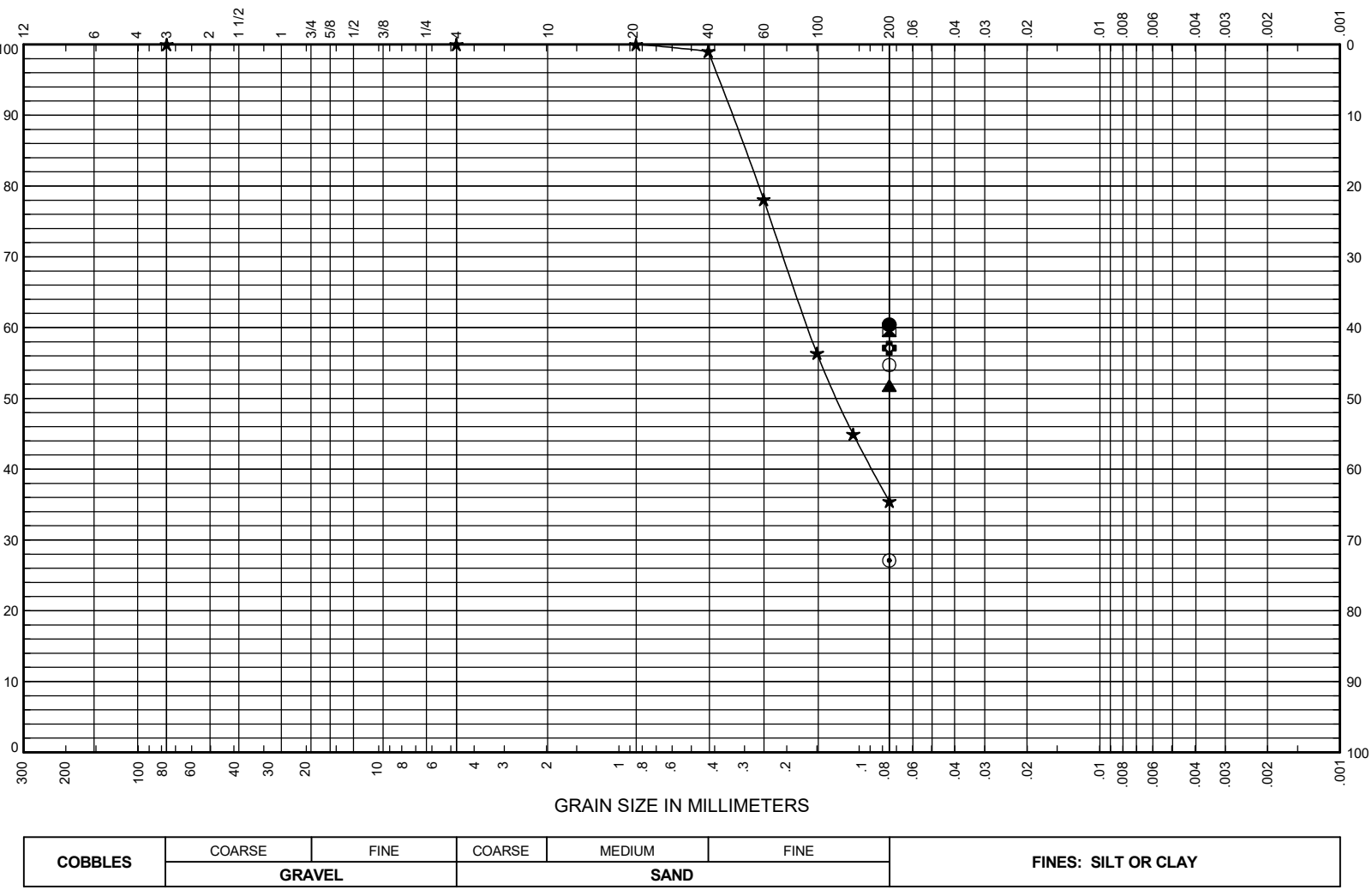

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-32, N18	90.0	*ML*	*Sandy SILT*	-	-	60	43	
⊠ B-32, N19	95.0	*ML*	*Sandy SILT*	-	-	60	43	
▲ B-32, N20	100.0	*ML*	*Sandy SILT*	-	-	52	42	
★ B-32, N21	105.0	*SM*	*Silty SAND*	0	65	35	38	
⊙ B-32, N22	110.0	*SM*	*Silty SAND*	-	-	27	39	
✿ B-32, N23	115.0	*ML*	*Sandy SILT*	-	-	57	43	
○ B-32, N26	130.0	*ML*	*Sandy SILT*	-	-	55	35	

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FIG. E2

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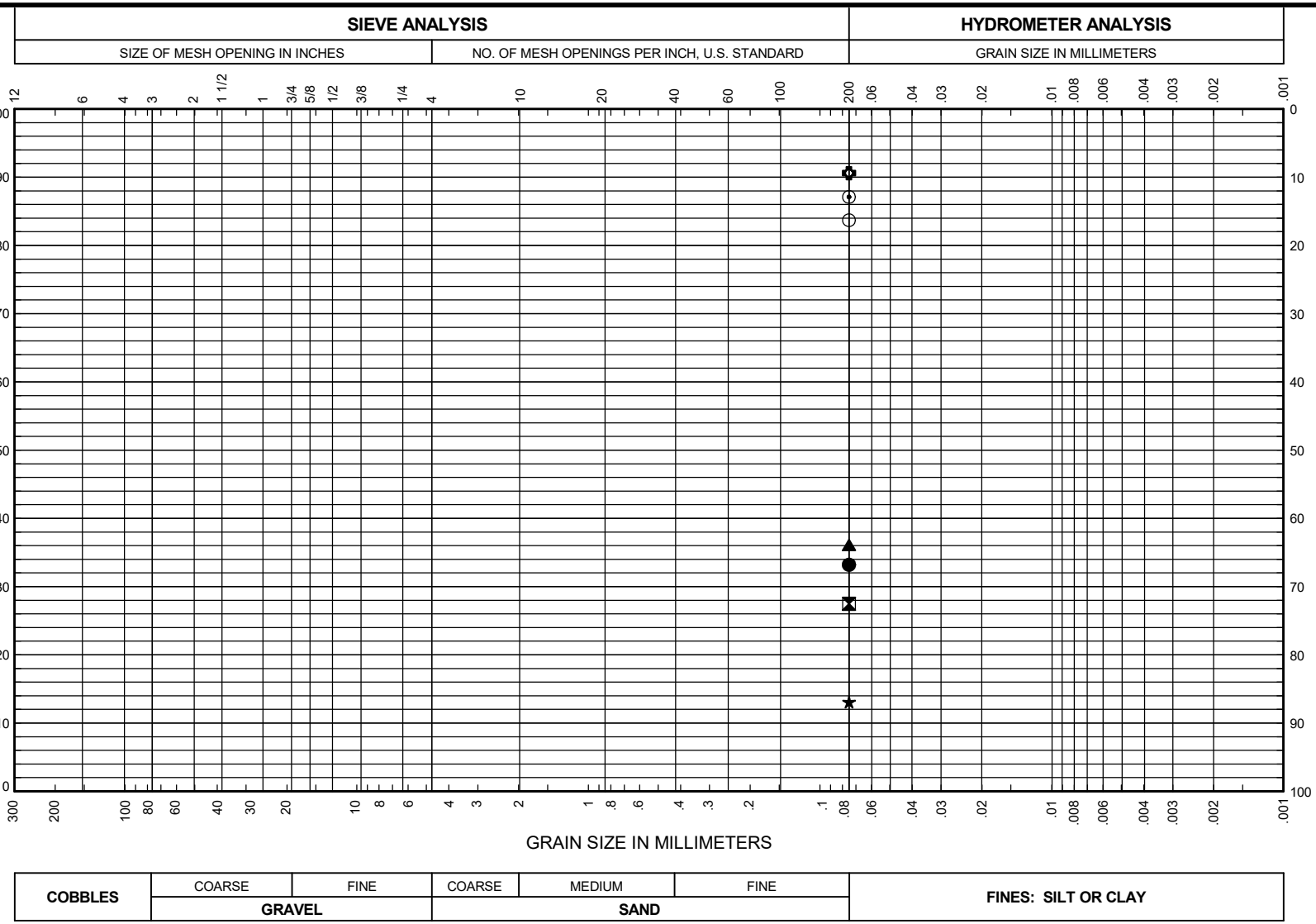

NOTES:
1) Sieve analyses were performed in general accordance with ASTM D6913, sieve with hydrometer analyses were performed in general accordance with ASTM D422, and amount finer than #200 sieve analyses were performed in general accordance with ASTM D1140 unless otherwise noted in the report.
2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-32, N27	135.0	*SM*	*Silty SAND*	-	-	33	32	
⊠ B-32, N28	140.0	*SM*	*Silty SAND*	-	-	28	32	
▲ B-32, N30	150.0	*SM*	*Silty SAND*	-	-	36	36	
★ B-32, N31	155.0	*GM*	*Silty GRAVEL with some sand*	-	-	13	15	
⊙ B-33, N7	22.5	*CL*	*Silty CLAY with trace sand*	-	-	87	52	
✿ B-33, N8	25.0	*CL*	*Silty CLAY with trace sand*	-	-	91	48	
○ B-33, N9	30.0	*ML*	*SILT with some sand*	-	-	84	45	

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Portland, Oregon

GRAIN SIZE DISTRIBUTION BY BORING NUMBER

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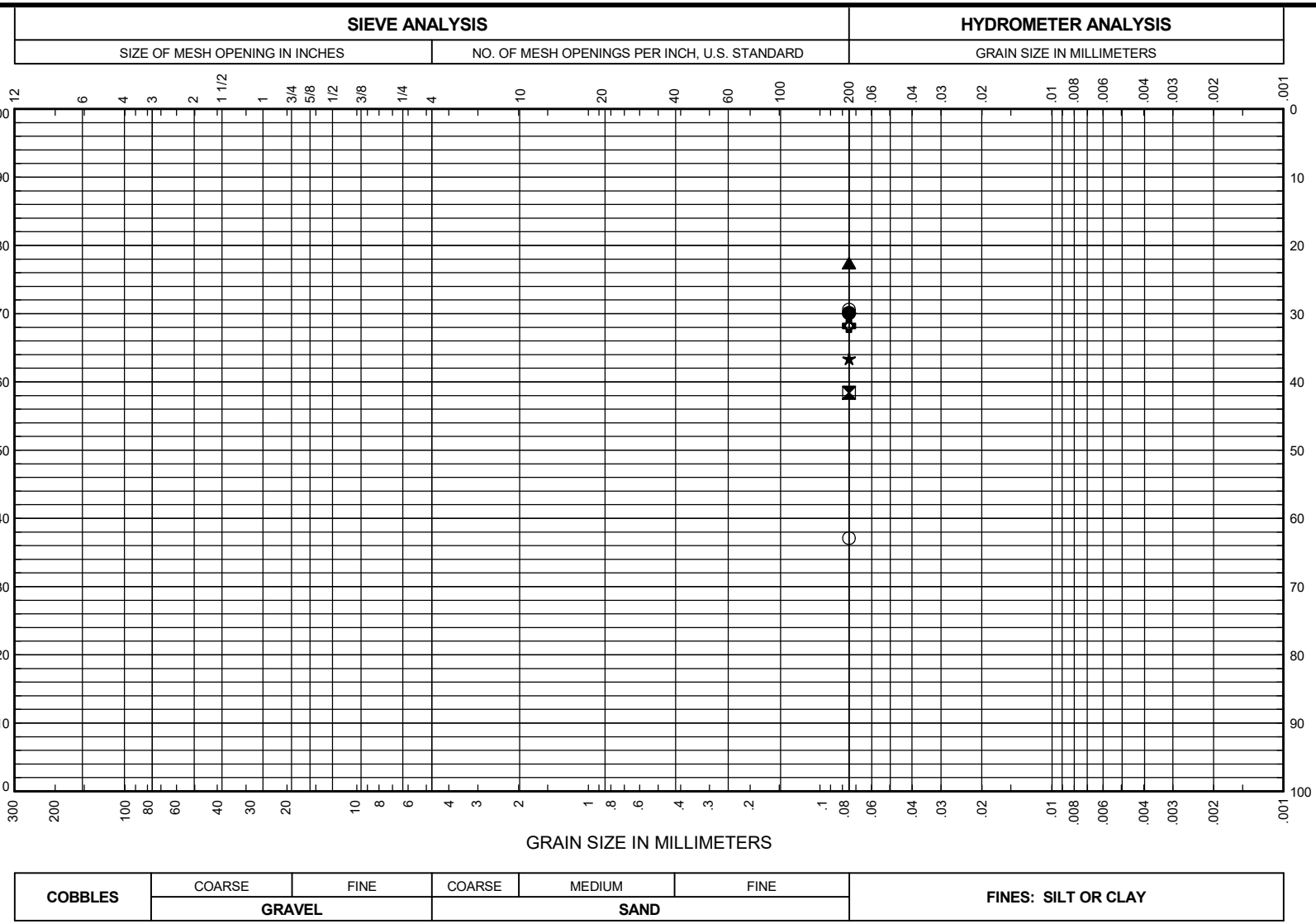
FIG. E2

GSA MAIN 102636.GPJ SHAN WIL.GDT 4/12/22



NOTES:
1) Sieve analyses were performed in general accordance with ASTM D6913, sieve with hydrometer analyses were performed in general accordance with ASTM D422, and amount finer than #200 sieve analyses were performed in general accordance with ASTM D1140 unless otherwise noted in the report.
2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-33, N10	35.0	*ML*	*Sandy SILT*	-	-	70	46	
⊠ B-33, N11	40.0	*ML*	*Sandy SILT*	-	-	58	43	
▲ B-33, N12	45.0	*ML*	*SILT with some sand*	-	-	77	47	
★ B-33, N14	55.0	*ML*	*Sandy SILT*	-	-	63	45	
⊙ B-33, N15	60.0	*ML*	*SILT with some sand*	-	-	71	46	
✿ B-33, N16	65.0	*ML*	*Sandy SILT*	-	-	68	43	
○ B-33, N17	70.0	*SM*	*Silty SAND*	-	-	37	40	

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Portland, Oregon

GRAIN SIZE DISTRIBUTION BY BORING NUMBER

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FIG. E2
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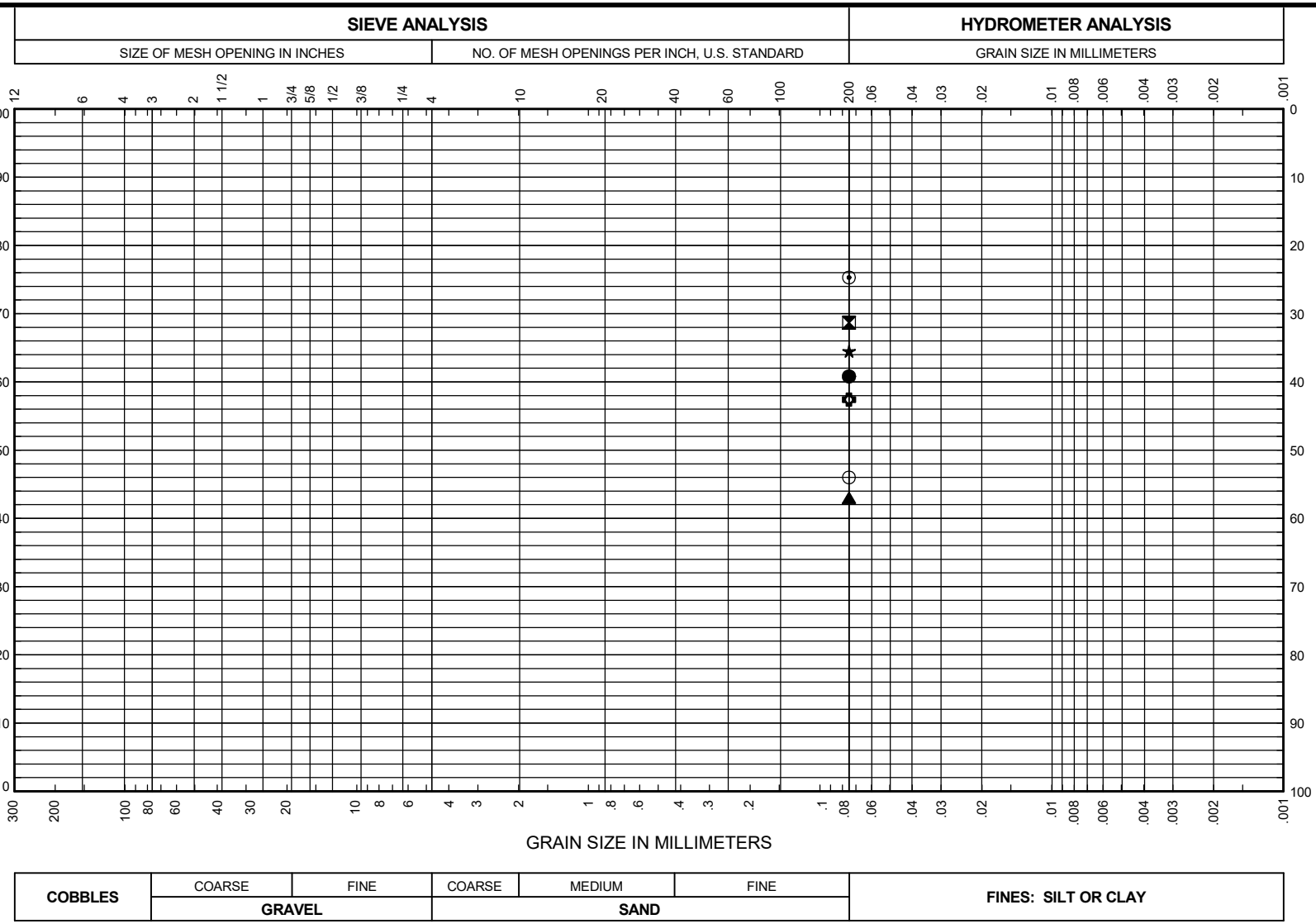
FIG. E2

GSA MAIN 102636.GPJ SHAN WIL.GDT 4/12/22



NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-33, N18	75.0	*ML*	*Sandy SILT*	-	-	61	44	
⊠ B-33, N19	80.0	*ML*	*Sandy SILT*	-	-	69	40	
▲ B-33, N20	85.0	*SM*	*Silty SAND*	-	-	43	42	
★ B-33, N21	90.0	*ML*	*Sandy SILT*	-	-	65	43	
⊙ B-33, N22	95.0	*ML*	*SILT with some sand*	-	-	75	43	
✿ B-33, N23	100.0	*ML*	*Sandy SILT*	-	-	57	44	
○ B-33, N24	105.0	*SM*	*Silty SAND*	-	-	46	39	

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GRAIN SIZE DISTRIBUTION BY BORING NUMBER

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FIG. E2
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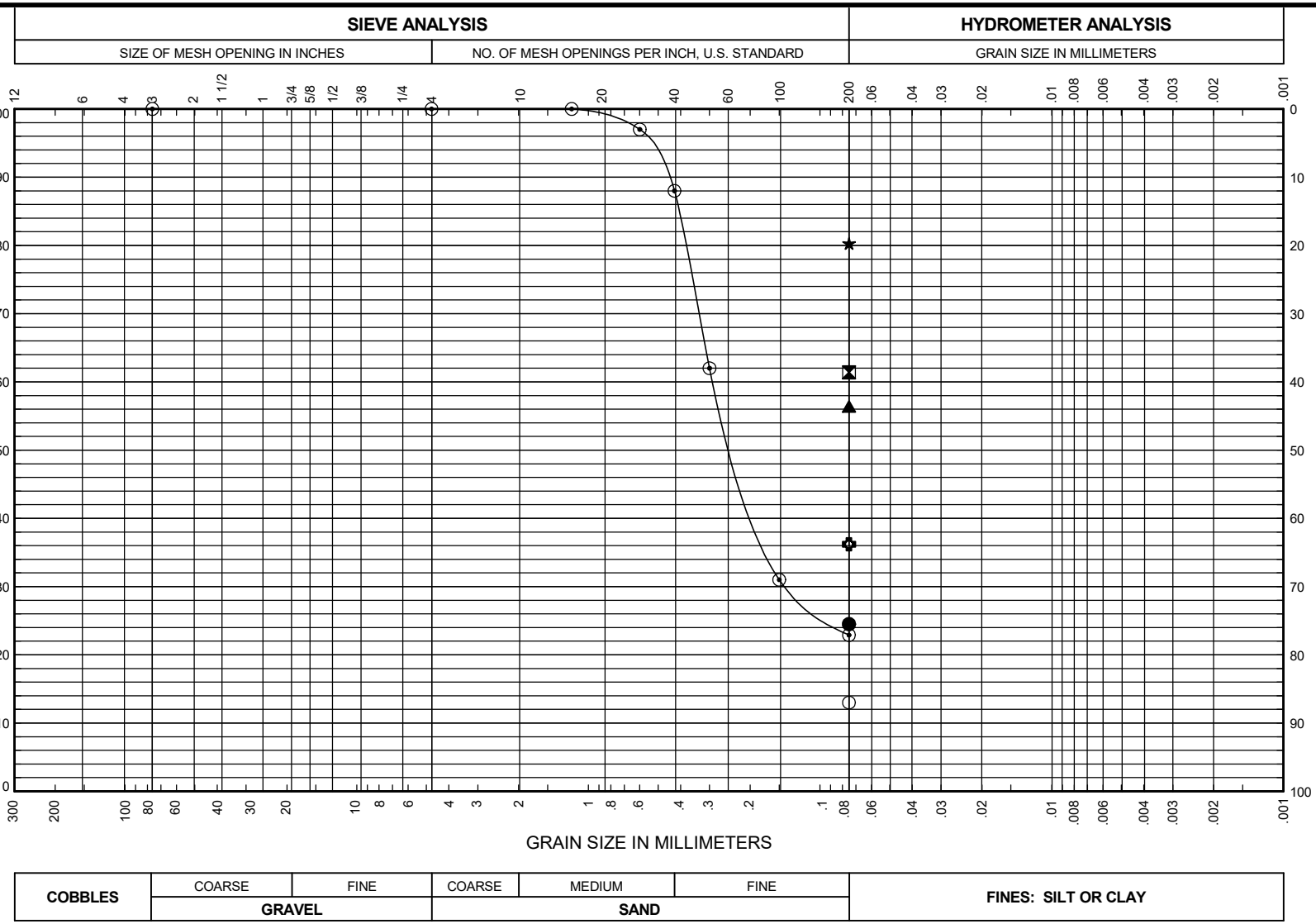
FIG. E2

GSA MAIN 102636.GPJ SHAN WIL.GDT 4/12/22



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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-33, N25	110.0	*SM*	*Silty SAND*	-	-	25	39	
⊠ B-33, N26	115.0	*ML*	*Sandy SILT*	-	-	61	41	
▲ B-33, N27	120.0	*ML*	*Sandy SILT*	-	-	56	38	
★ B-33, N28	125.0	*ML*	*SILT with some sand*	-	-	80	46	
⊙ B-33, U5	127.0	*SM*	*Silty SAND*	0	77	23	29	95
✿ B-33, N29	129.0	*SM*	*Silty SAND*	-	-	36	34	
○ B-33, N30	135.0	*SM*	*Silty SAND*	-	-	13	31	

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Portland, Oregon

GRAIN SIZE DISTRIBUTION BY BORING NUMBER

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FIG. E2
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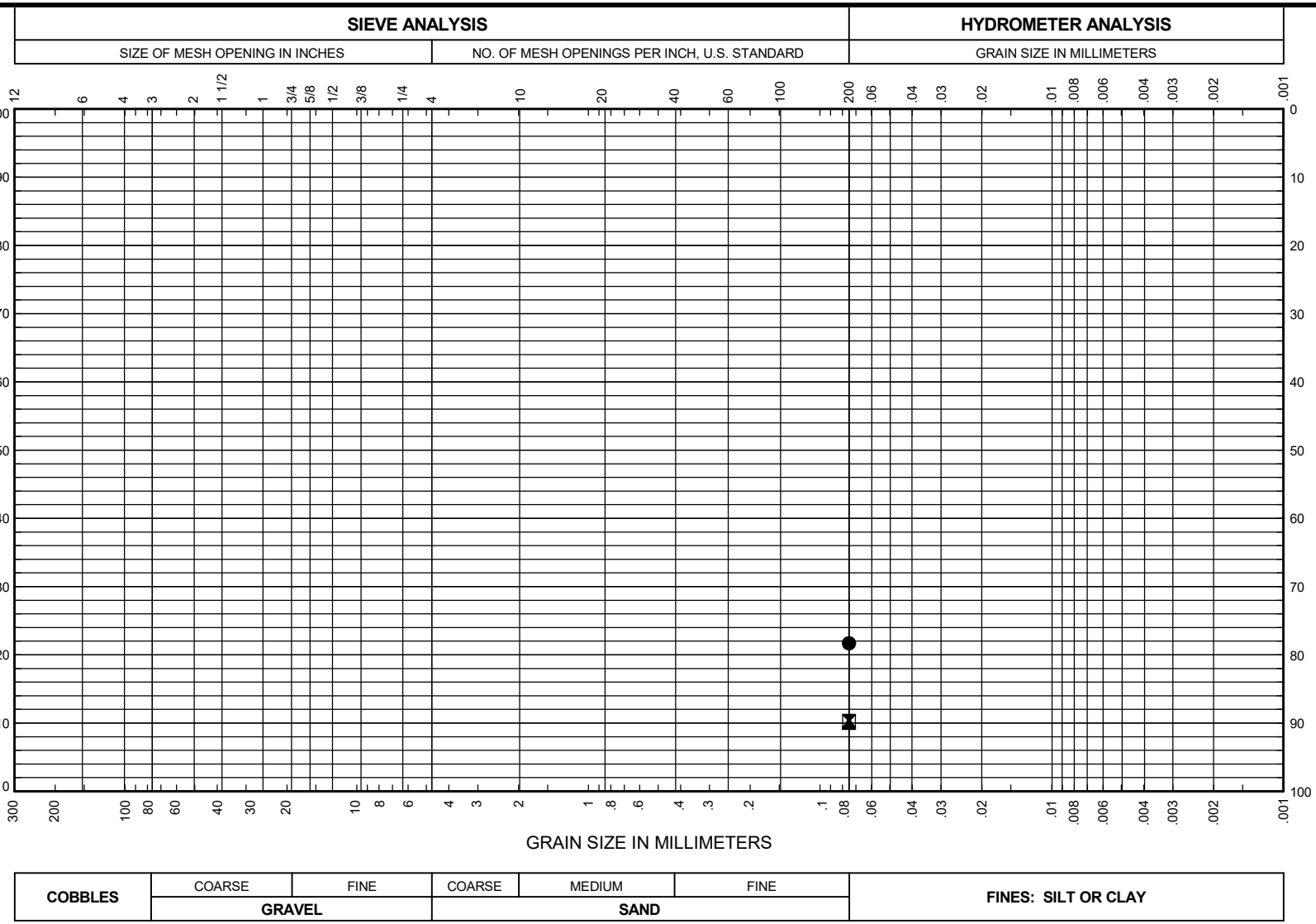
FIG. E2

GSA MAIN 102636.GPJ SHAN WIL.GDT 4/12/22



NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-33, N31	140.0	*SM*	*Gravelly silty SAND*	-	-	22	33	
⊠ B-33, N35	165.0	*SP-SM*	*SAND with some silt and gravel*	-	-	10	24	
▲ B-33, N37	175.0	*SP-SM*	*SAND with some silt and gravel*	-	-	10	13	

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GRAIN SIZE DISTRIBUTION BY BORING NUMBER

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FIG. E2
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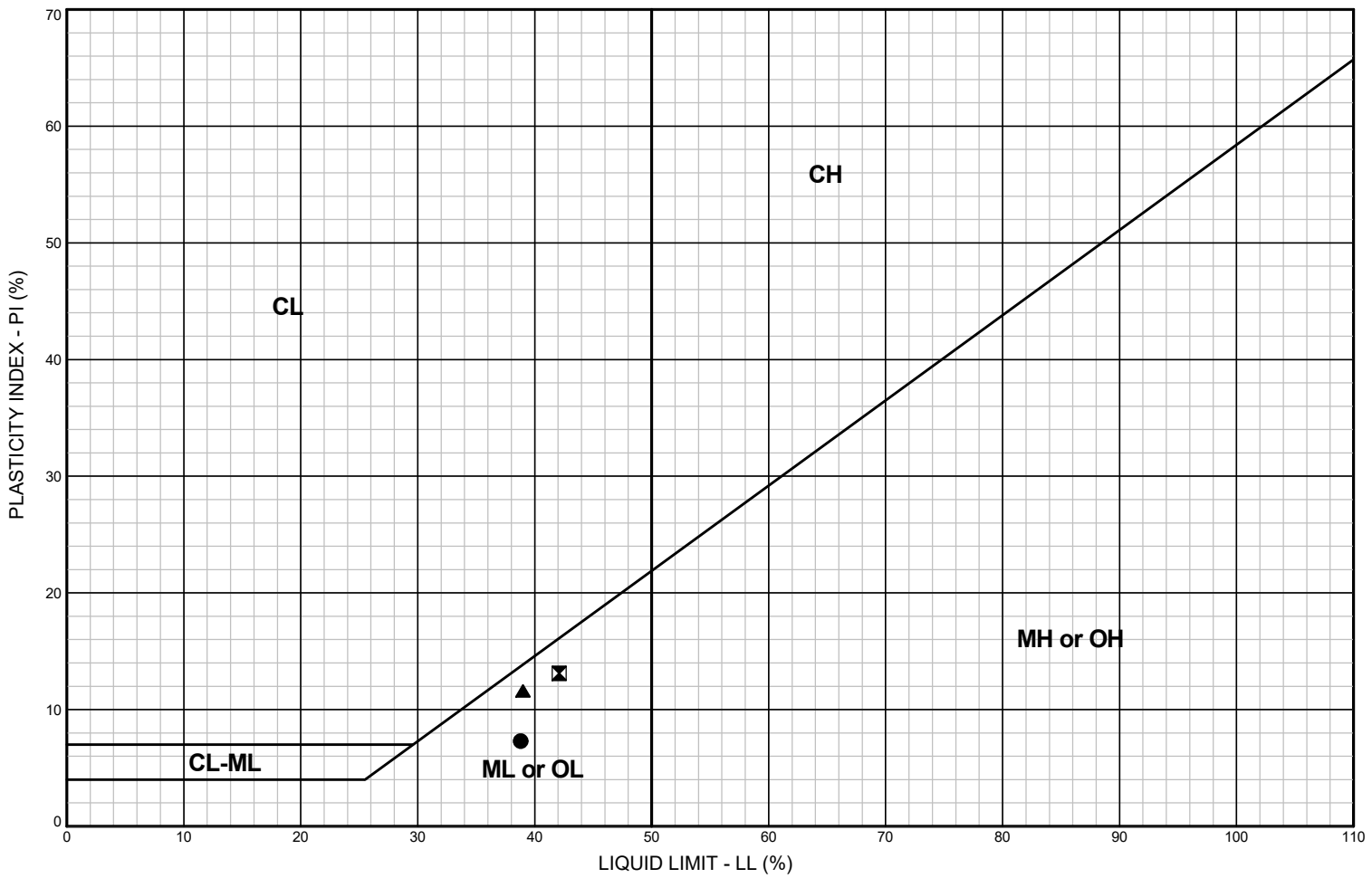
FIG. E2

GSA MAIN 102636.GPJ SHAN WIL.GDT 4/12/22



NOTES

1) Atterberg limits tests were performed in general accordance with ASTM D4318 unless otherwise noted in the report.

2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

3) Plasticity adjectives used in sample descriptions correspond to plasticity index as follows:
- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-07, N2	15.0	*ML*	*SILT with trace sand*	39	32	7	37	
⊠ B-07, N3	20.0	*ML*	*SILT with trace sand*	42	29	13	39	
▲ B-21, N2	10.0	*ML*	*SILT with trace sand*	39	27	12	37	

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Portland, Oregon

ATTERBERG LIMITS RESULTS FILL

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FIG. E3

FIG. E3

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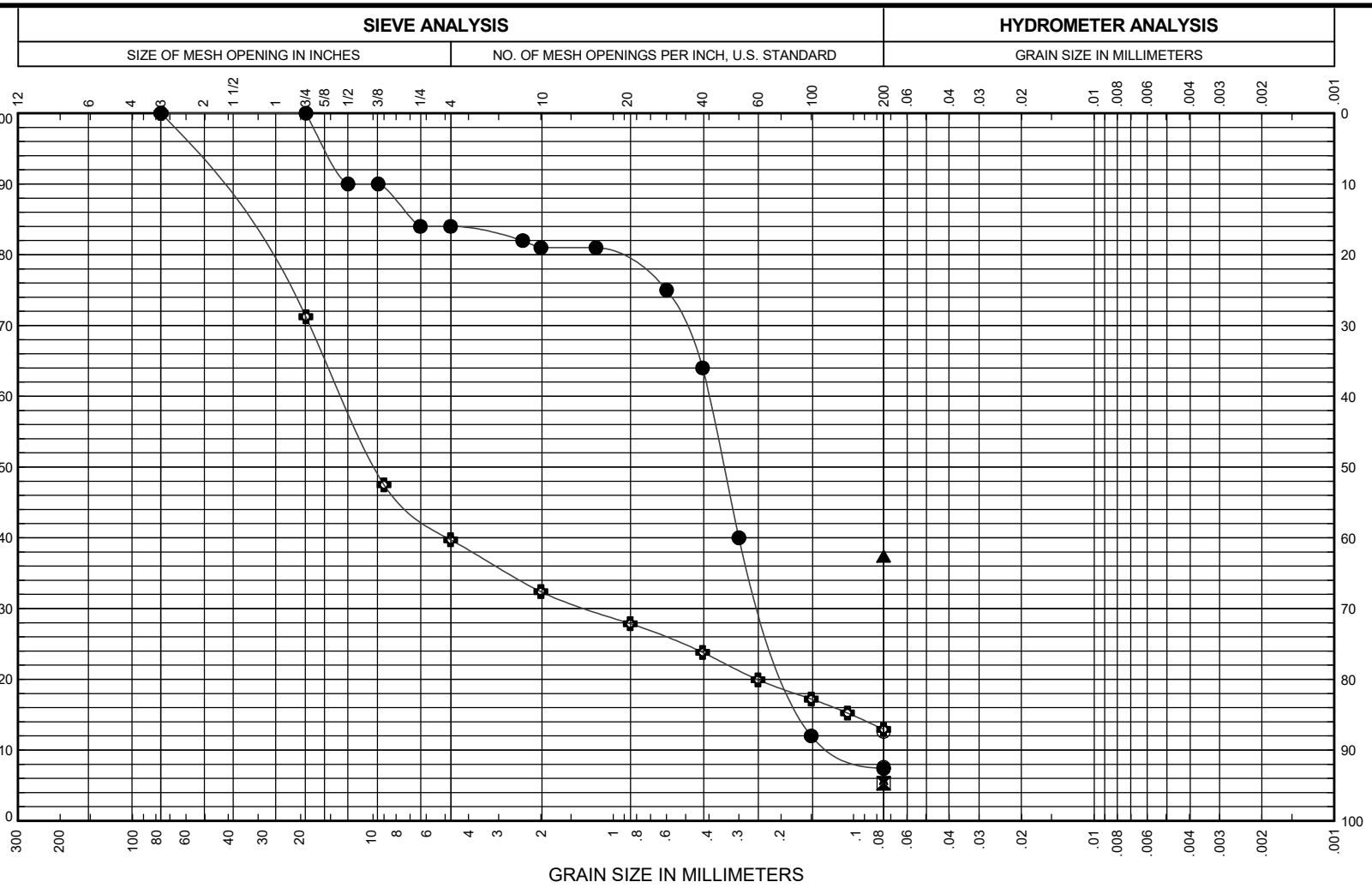

NOTES:
1) Sieve analyses were performed in general accordance with ASTM D6913, sieve with hydrometer analyses were performed in general accordance with ASTM D422, and amount finer than #200 sieve analyses were performed in general accordance with ASTM D1140 unless otherwise noted in the report.
2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.
** Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-03, N2	10.0	*SP-SM*	*SAND with some silt and some gravel*	16	77	7		
⊠ B-08, N2	17.5	*SP-SM*	*SAND with some silt with trace gravel*	-	-	5	10	
▲ B-08, N4*	25.0	*GC*	*Clayey GRAVEL with some sand*	-	-	37	21	
★ B-11, N1	0.0	*SP-SM*	*SAND with some silt and trace gravel*	-	-	6	26	
⊙ B-11, N10	22.5	*SP-SM*	*SAND with some silt and trace gravel*	-	-	8	28	
✿ B-14, N2	5.0	*GM*	*Silty GRAVEL with some sand*	60	27	13	31	
○ B-15, N9	25.0	*SM*	*Silty SAND*	-	-	13	11	

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GRAIN SIZE DISTRIBUTION
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FIG. E4
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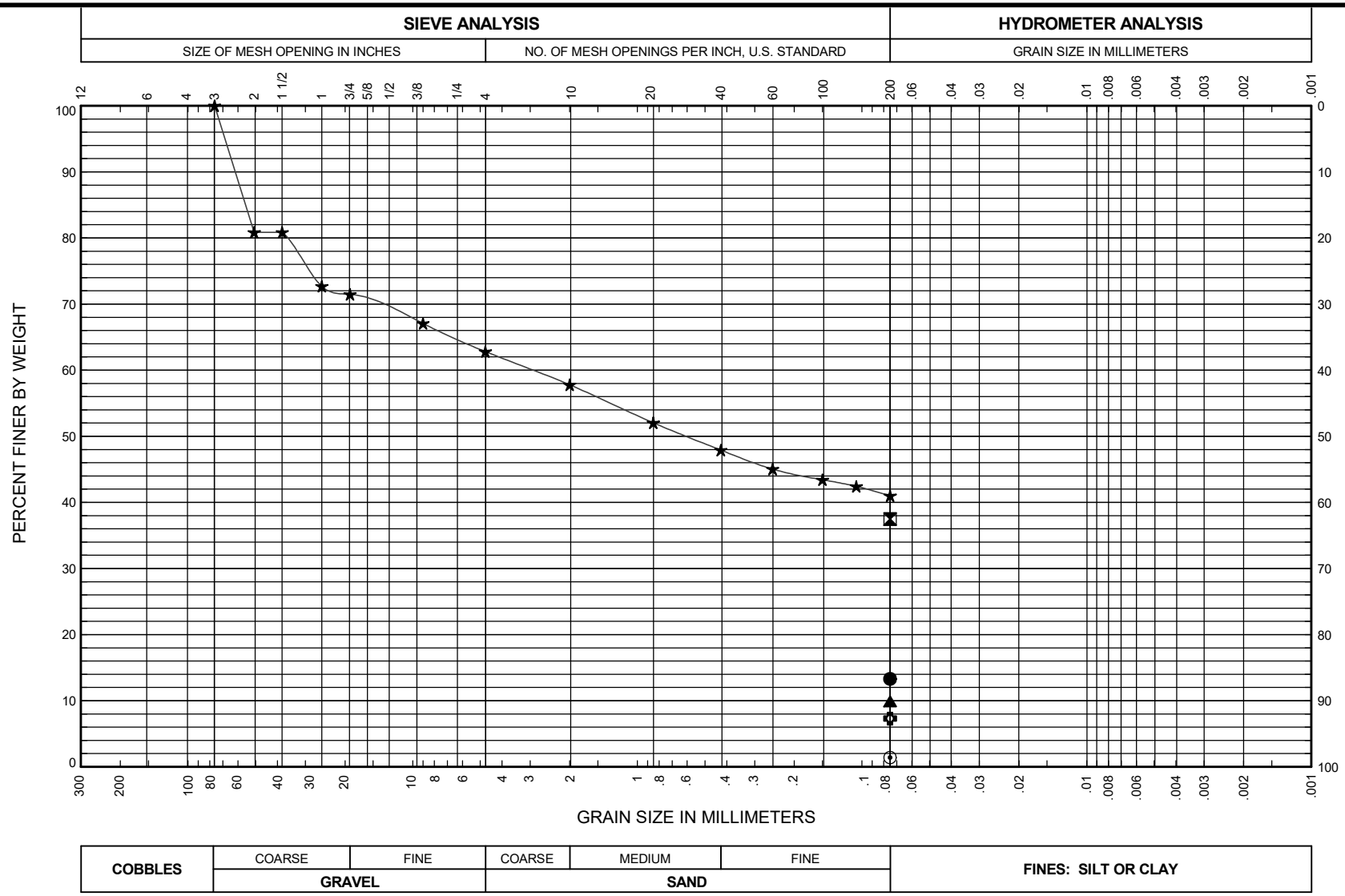
FIG. E4

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



NOTES:
1) Sieve analyses were performed in general accordance with ASTM D6913, sieve with hydrometer analyses were performed in general accordance with ASTM D422, and amount finer than #200 sieve analyses were performed in general accordance with ASTM D1140 unless otherwise noted in the report.
2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-15, N10	30.0	*SM*	*Gravelly silty SAND*	-	-	13	26	
⊠ B-18, N6	15.0	*SM*	*Silty SAND with some organics*	-	-	38	73	
▲ B-19, N5	20.0	*SP-SM*	*SAND with some silt*	-	-	10	7	
★ B-23, S1a	6.0	*GM*	*Silty GRAVEL with some sand*	37	22	41		
⊙ B-31, S1b	1.0	*GP*	*Sandy GRAVEL with trace silt*	-	-	1		
✿ B-32, N2	12.5	*SP-SM*	*SAND with some silt and trace gravel*	-	-	7	24	

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GRAIN SIZE DISTRIBUTION
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FIG. E4
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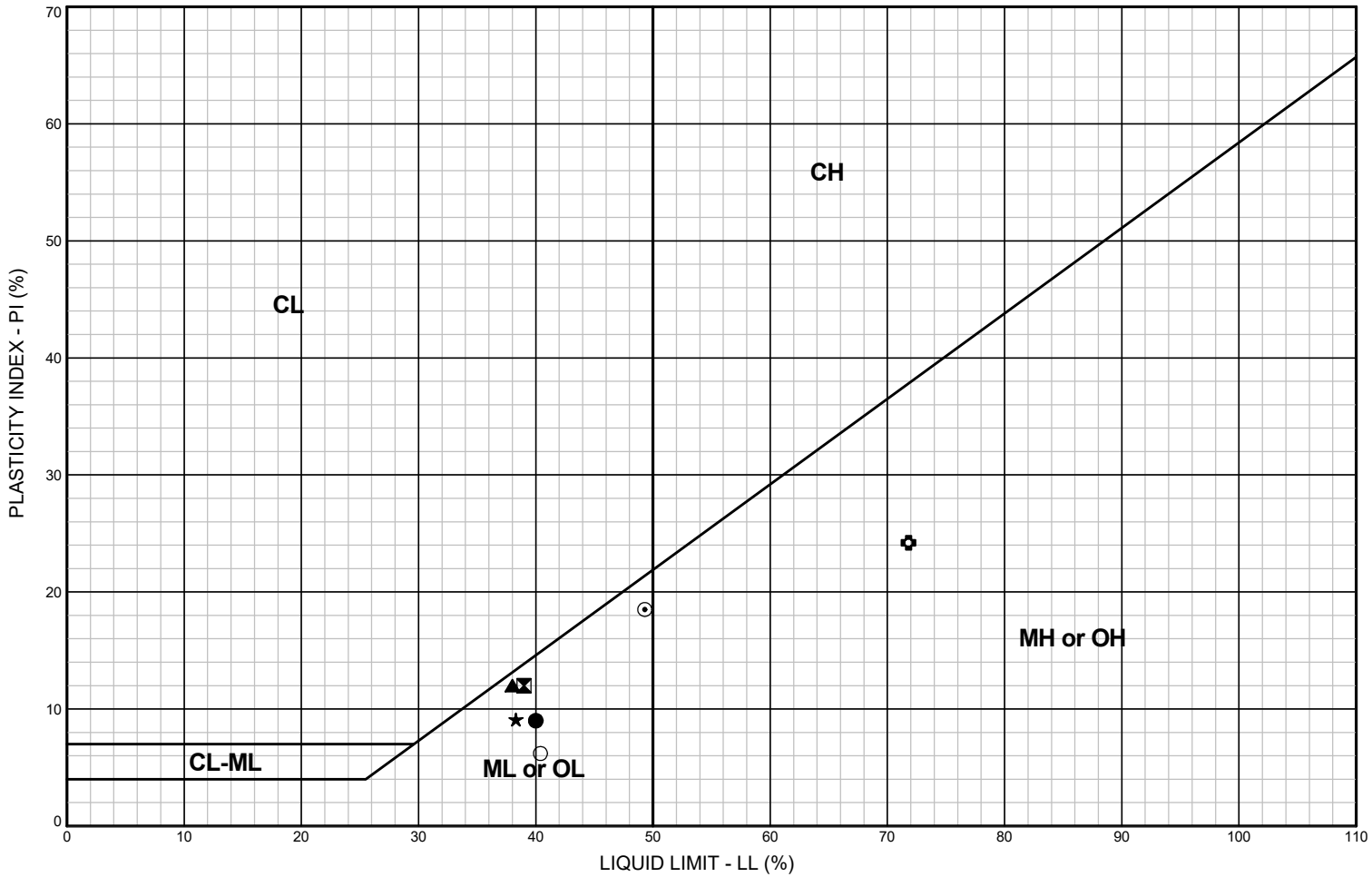
FIG. E4

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



NOTES

1) Atterberg limits tests were performed in general accordance with ASTM D4318 unless otherwise noted in the report.

2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

3) Plasticity adjectives used in sample descriptions correspond to plasticity index as follows:
- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-03, N20	100.0	*ML*	*SILT with some sand*	40	31	9		72.7
⊠ B-04, N6	25.0	*ML*	*SILT with trace sand*	39	27	12	43	
▲ B-05, N3	15.0	*ML*	*SILT with trace sand*	38	26	12	38	
★ B-06, N2	15.0	*ML*	*SILT with trace sand*	38	29	9	42	
⊙ B-07, N9	50.0	*ML*	*SILT*	49	31	18	47	
✿ B-11, N11	27.5	*OH*	*Organic CLAY with some sand*	72	48	24	89	
○ B-15, N26	110.0	*ML*	*SILT with some sand*	40	34	6	45	73.6

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ATTERBERG LIMITS RESULTS
FINE-GRAINED ALLUVIUM

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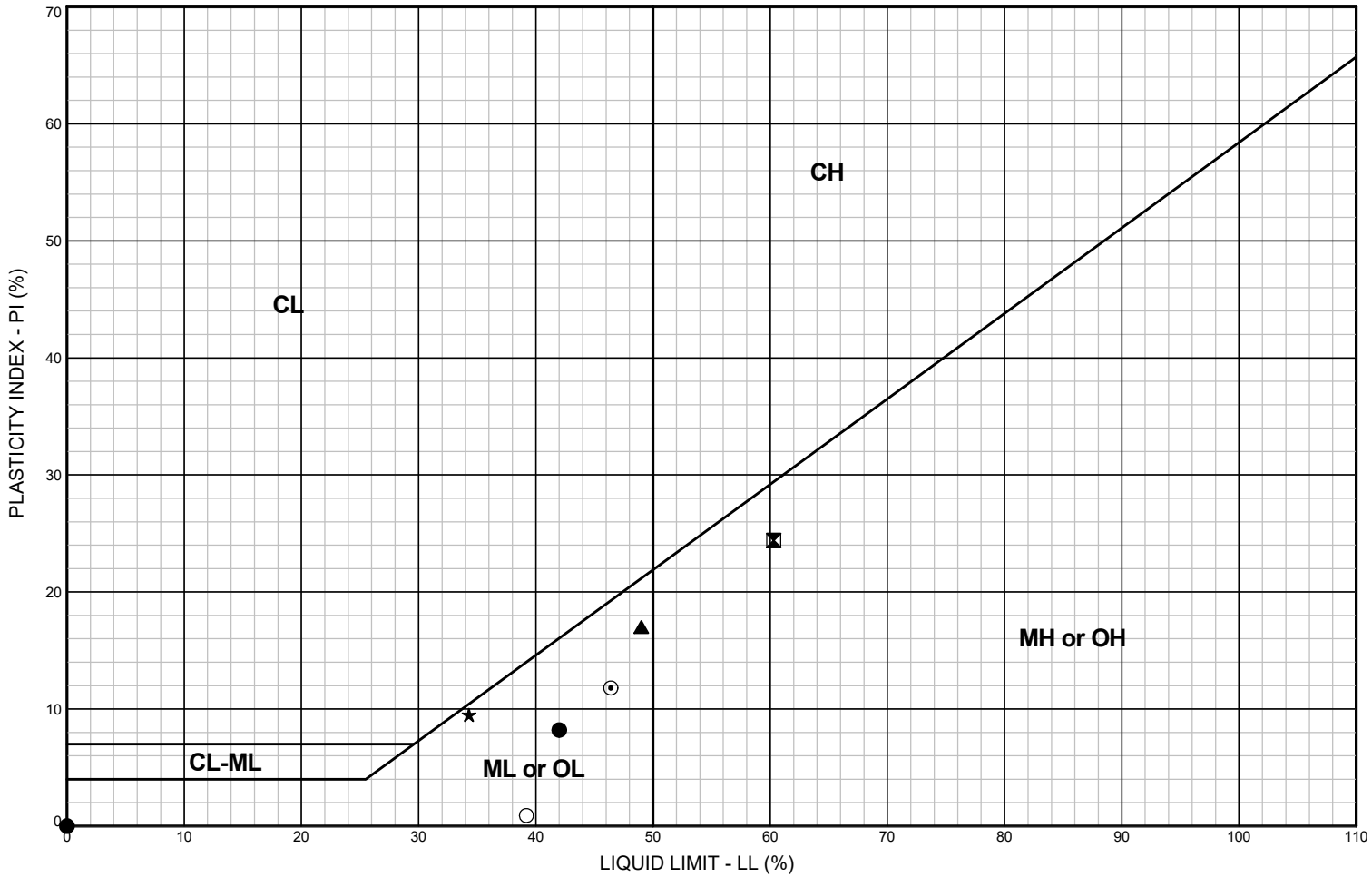
FIG. E5
Sheet 1 of 6

FIG. E5

ATT_UNIT_COMPLETE 102636.GPJ SHAN_WIL.GDT 4/12/22



NOTES

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- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-16, N29	125.0	*ML*	*SILT with some sand*	42	34	8	40	75.4
⊠ B-17, N7	17.5	*MH*	*Clayey SILT*	60	36	24	47	97.3
▲ B-17, U1a	23.0	*ML*	*SILT with some sand*	49	32	17	48	77.7
★ B-17, U1b	24.0	*ML*	*SILT with some sand*	34	25	9	50	
⊙ B-17, N9	25.0	*ML*	*SILT*	46	35	11	50	95.9
B-17, N14	50.0	*ML*	*SILT with some sand*	NP	NP	NP	44	77.2
○ B-17, N19	75.0	*ML*	*SILT with trace sand*	39	38	1	50	89.3

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ATTERBERG LIMITS RESULTS
FINE-GRAINED ALLUVIUM

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FIG. E5
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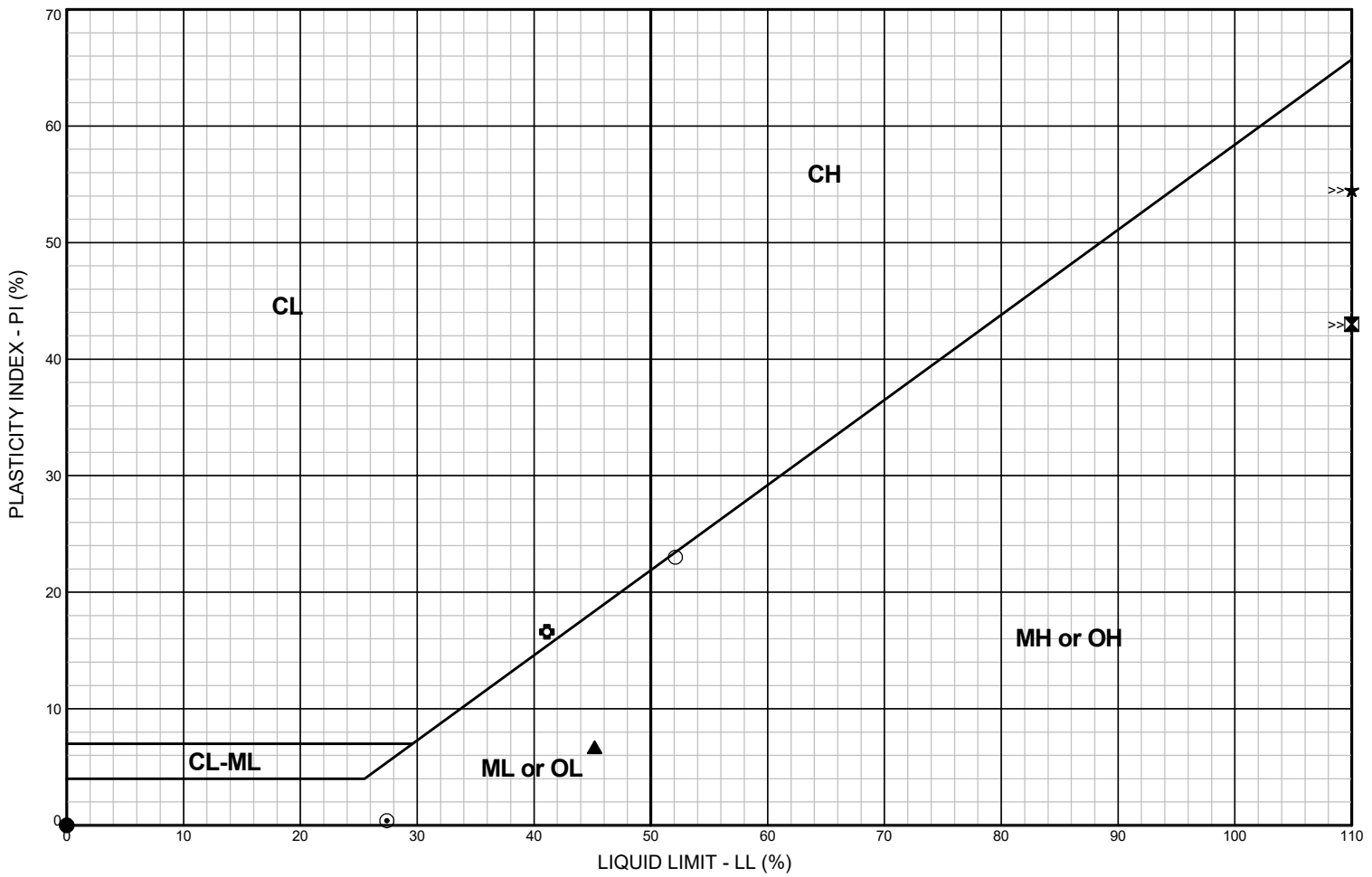
FIG. E5

ATT_UNIT_COMPLETE 102636.GPJ SHAN_WIL.GDT 4/12/22



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- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
B-17, U3b	81.0	*ML*	*SILT with some sand*	NP	NP	NP	39	
⊠ B-18, N11	35.0	*OH*	*Organic CLAY*	120	77	43	105	96.4
▲ B-18, U2b	39.0	*OL*	*Organic SILT with some sand*	45	39	6	51	
★ B-18, N12	40.0	*OH*	*Organic CLAY with trace sand*	130	75	55	94	88.9
⊙ B-21, N4	20.0	*ML*	*SILT with some sand*	27	27	NP	33	
✿ B-22, S1	10.0	*CL*	*Silty CLAY*	41	25	16		97.9
○ B-32, N5	25.0	*OH*	*Organic CLAY*	52	29	23	45	96.0

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Portland, Oregon

ATTERBERG LIMITS RESULTS
FINE-GRAINED ALLUVIUM

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FIG. E5
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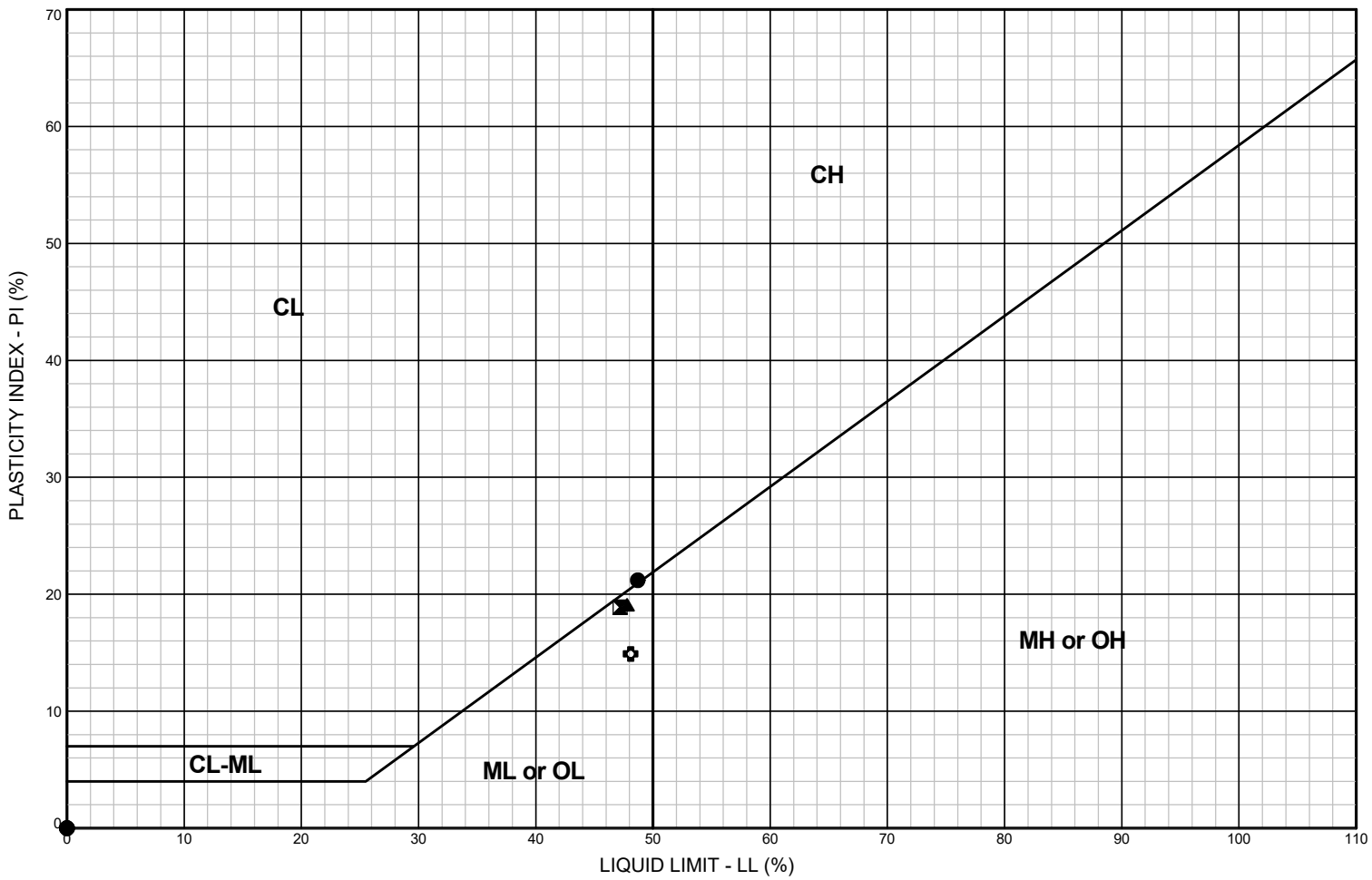
FIG. E5

ATT_UNIT_COMPLETE 102636.GPJ SHAN_WIL.GDT 4/12/22



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- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-32, N7	35.0	*ML/CL*	*SILT to Silty CLAY with trace sand*	49	28	21	43	93.2
⊠ B-32, N10	50.0	*ML*	*SILT with trace sand*	47	28	19	41	87.6
▲ B-32, N11	55.0	*ML*	*Sandy SILT*	48	29	19	41	64.6
B-32, U2	63.0	*ML*	*SILT with some sand*	NP	NP	NP	37	
B-32, N13	65.0	*ML*	*Sandy SILT*	NP	NP	NP	48	54.1
✿ B-33, N9	30.0	*ML*	*SILT with some sand*	48	33	15	45	83.7
B-33, U1	33.0	*ML*	*SILT with some sand*	NP	NP	NP	49	

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ATTERBERG LIMITS RESULTS
FINE-GRAINED ALLUVIUM

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FIG. E5
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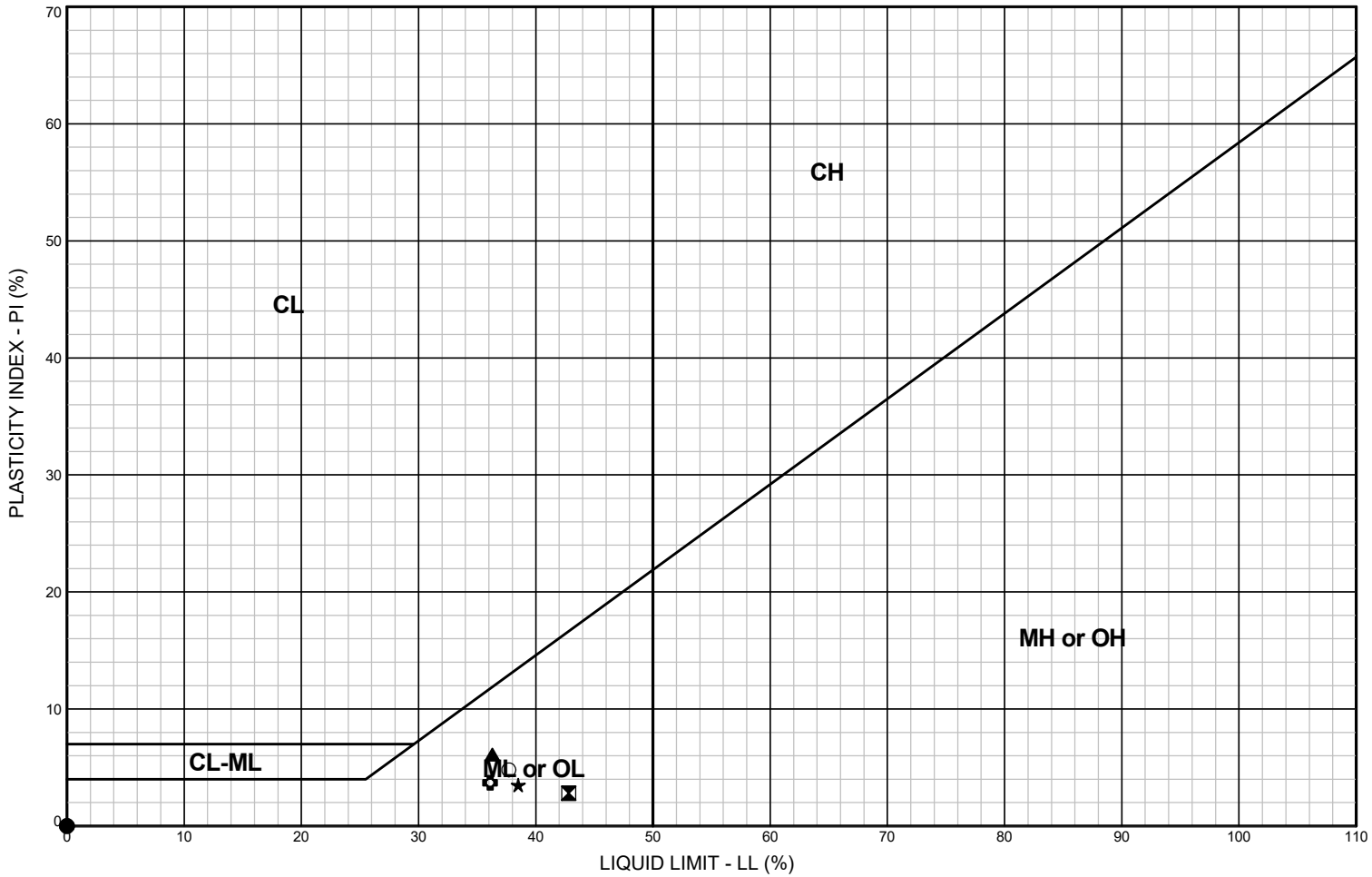
FIG. E5

ATT_UNIT_COMPLETE 102636.GPJ SHAN_WIL.GDT 4/12/22



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- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
B-33, N10	35.0	*ML*	*Sandy SILT*	NP	NP	NP	46	70.1
⊠ B-33, N12	45.0	*ML*	*SILT with some sand*	43	40	3	47	77.4
▲ B-33, U2	48.0	*ML*	*SILT with some sand*	36	30	6	44	
★ B-33, N13	50.0	*ML*	*Sandy SILT*	39	35	4	45	
B-33, U3	63.0	*ML*	*SILT with some sand*	NP	NP	NP	43	
✿ B-33, N16	65.0	*ML*	*Sandy SILT*	36	32	4	43	68.2
○ B-33, N22	95.0	*ML*	*SILT with some sand*	38	33	5	43	75.3

Earthquake Ready Burnside Bridge
Portland, Oregon

ATTERBERG LIMITS RESULTS
FINE-GRAINED ALLUVIUM

April 2022 102636-009

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FIG. E5
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FIG. E5

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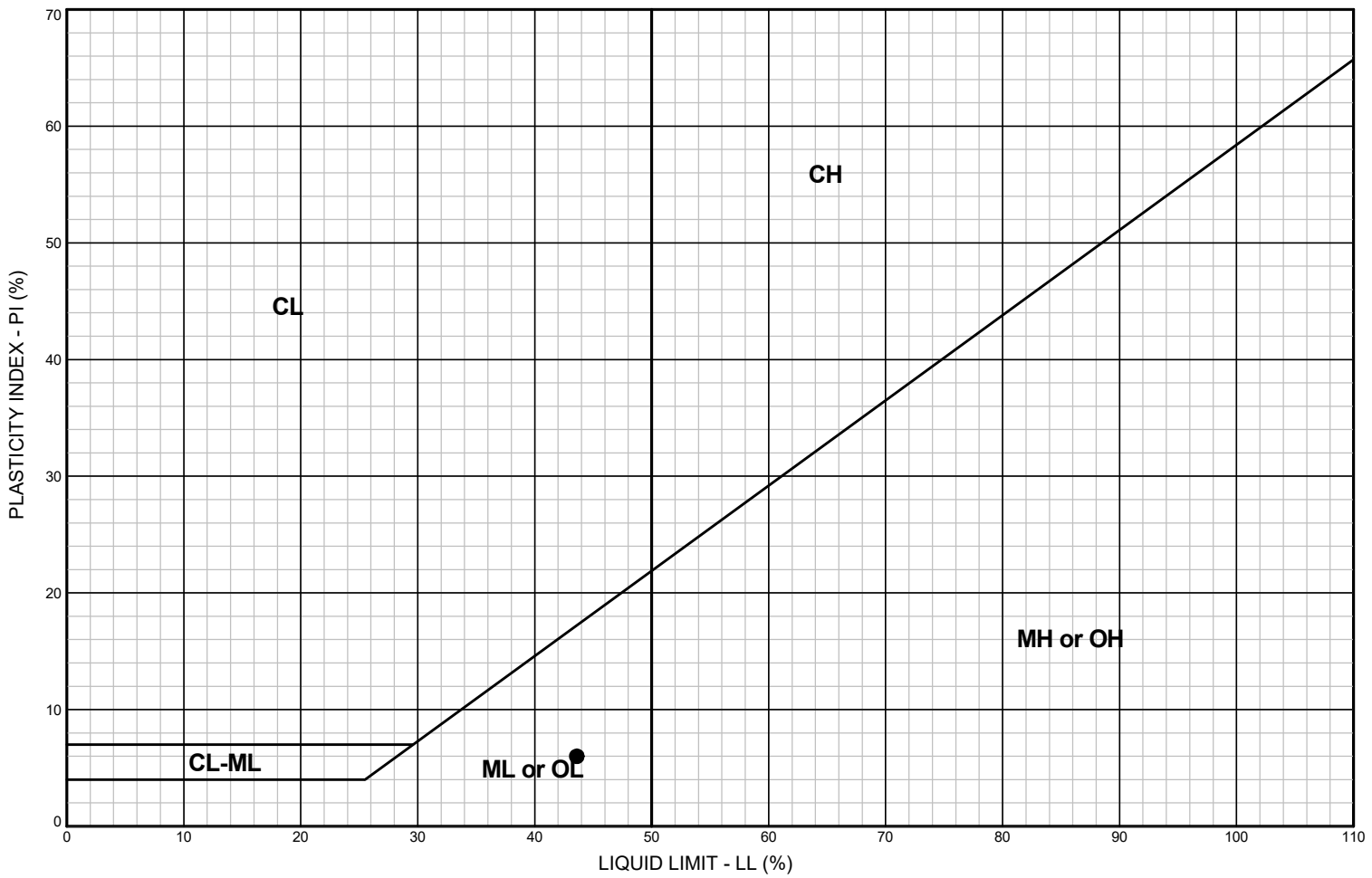

NOTES

1) Atterberg limits tests were performed in general accordance with ASTM D4318 unless otherwise noted in the report.

2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

3) Plasticity adjectives used in sample descriptions correspond to plasticity index as follows:
- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-33, N28	125.0	*ML*	*SILT with some sand*	44	38	6	46	80.3

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ATTERBERG LIMITS RESULTS
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FIG. E5
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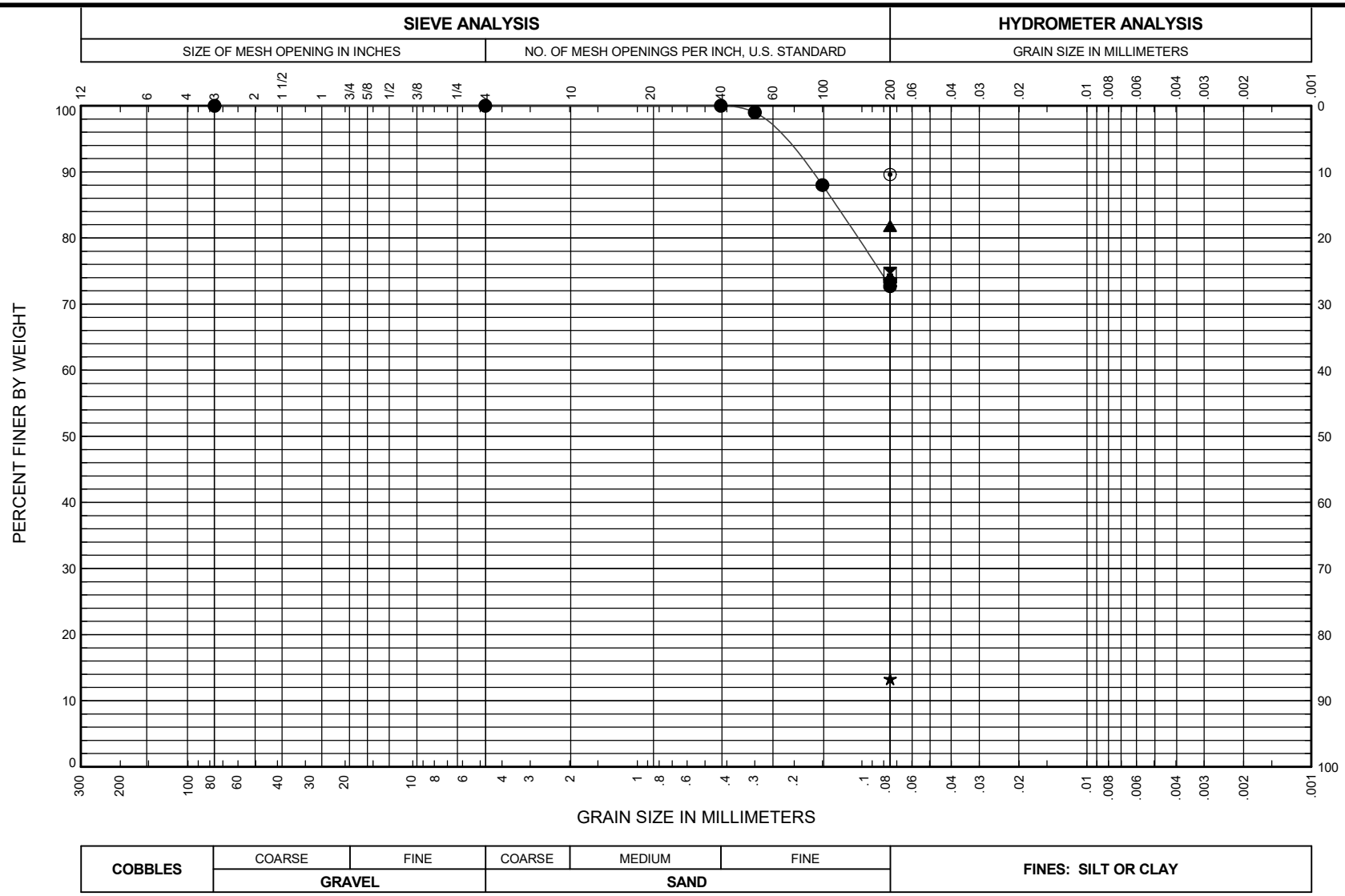
FIG. E5

ATT_UNIT_COMPLETE 102636.GPJ SHAN_WIL.GDT 4/12/22



NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-03, N20	100.0	*ML*	*SILT with some sand*	0	27	73		
⊠ B-05, N4	20.0	*ML*	*SILT with some sand*	-	-	75	48	
▲ B-05, N5	25.0	*ML*	*SILT with some sand*	-	-	82	37	
★ B-08, N10	53.8	*SM*	*Silty SAND with trace gravel*	-	-	13	21	
⊙ B-14, N19	100.0	*ML*	*SILT with trace sand*	-	-	90	48	
✿ B-15, N26	110.0	*ML*	*SILT with some sand*	-	-	74	45	
○ B-15, N29	125.0	*ML*	*SILT with some sand*	-	-	73	45	

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GRAIN SIZE DISTRIBUTION
FINE-GRAINED ALLUVIUM

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FIG. E6
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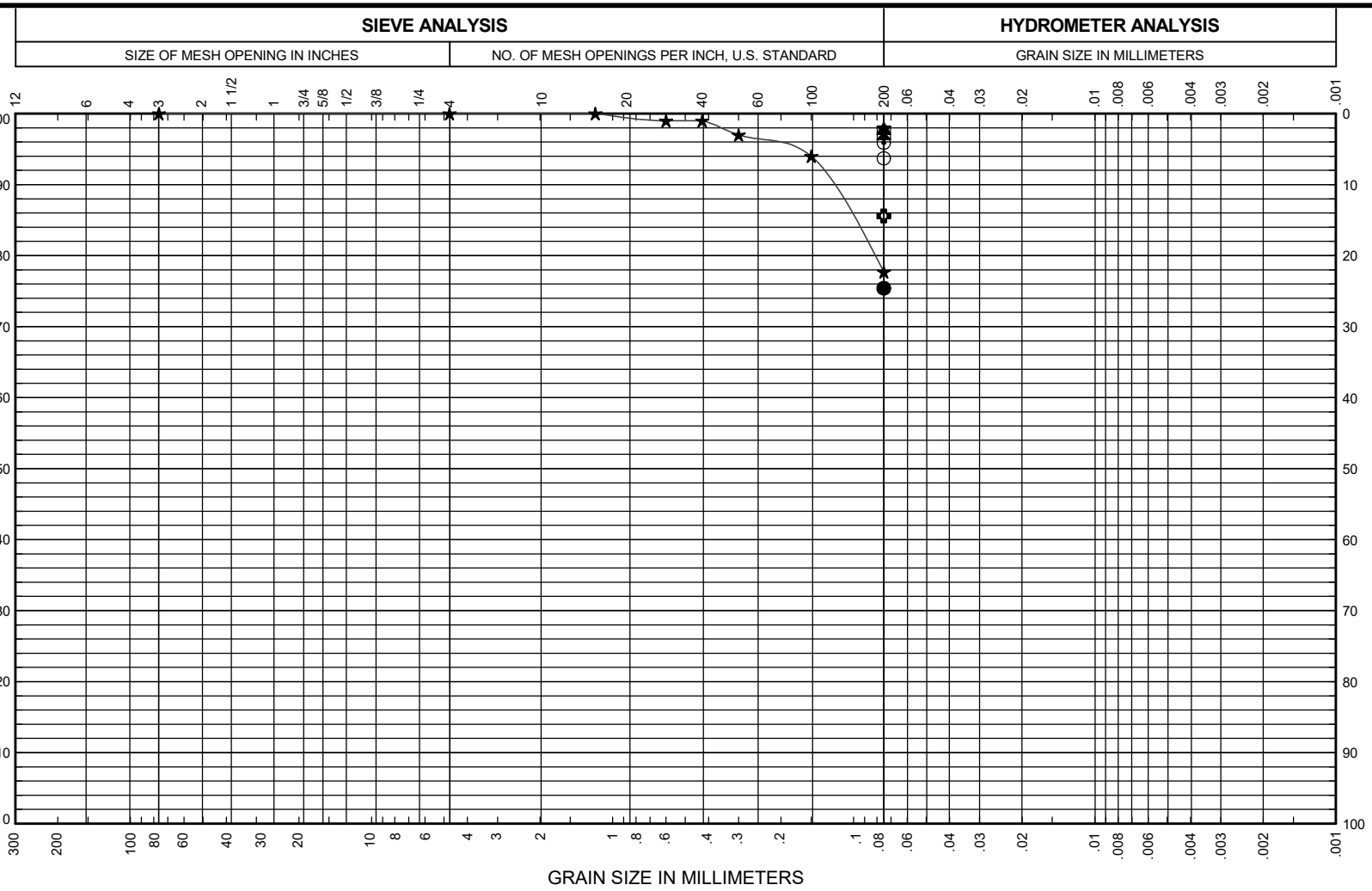
FIG. E6

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-16, N29	125.0	*ML*	*SILT with some sand*	-	-	75	40	
⊠ B-17, N7	17.5	*MH*	*Clayey SILT*	-	-	97	47	
▲ B-17, N8	20.0	*MH*	*Clayey SILT*	-	-	98	49	
★ B-17, U1a	23.0	*ML*	*SILT with some sand*	0	22	78	48	73
⊙ B-17, N9	25.0	*ML*	*SILT*	-	-	96	50	
✿ B-17, N10	30.0	*ML*	*SILT with trace sand*	-	-	86	45	
○ B-17, N11	35.0	*ML*	*SILT with trace sand*	-	-	94	45	

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GRAIN SIZE DISTRIBUTION
FINE-GRAINED ALLUVIUM

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FIG. E6
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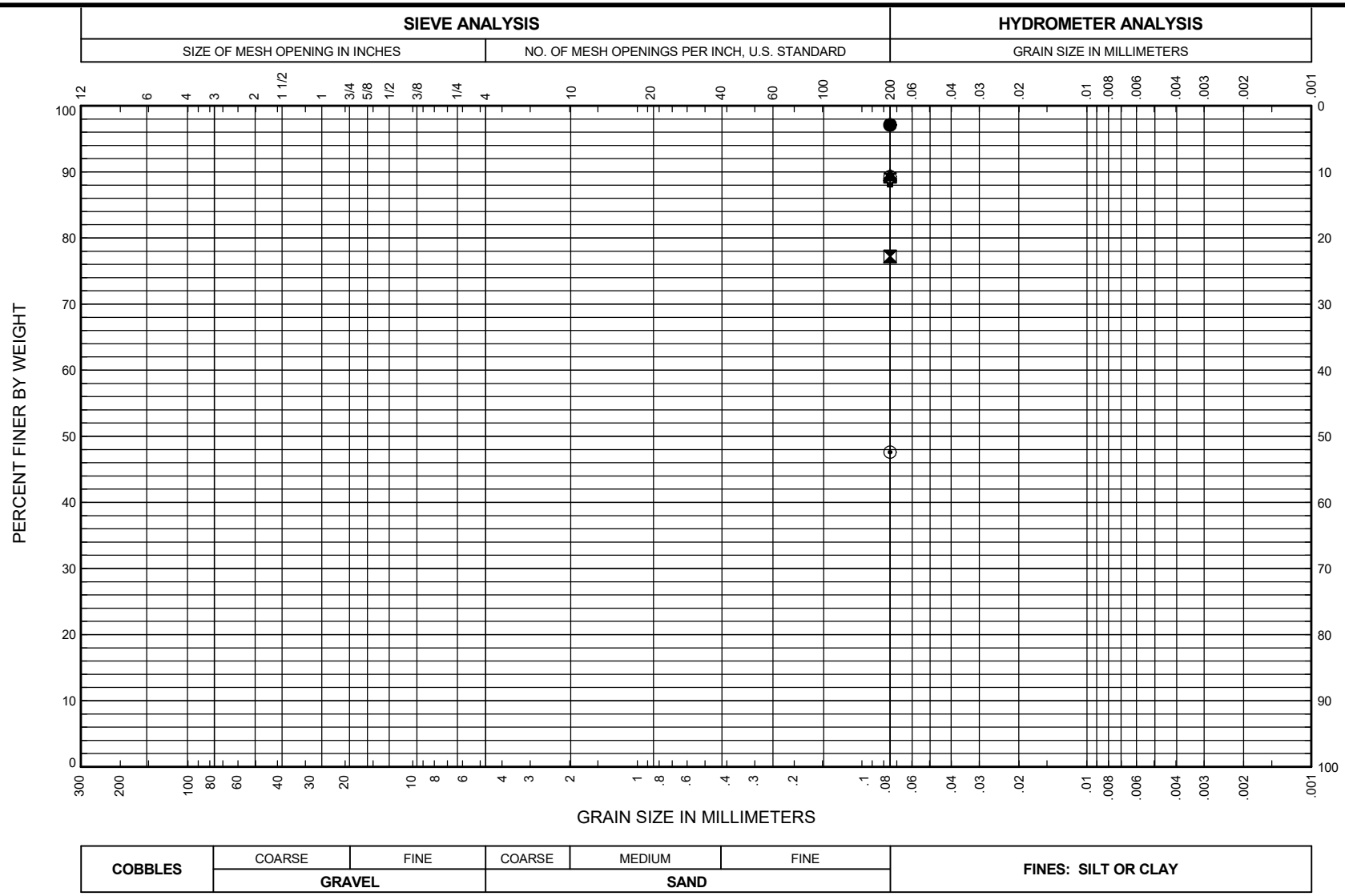
FIG. E6

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-17, N13	45.0	*ML*	*SILT*	-	-	97	53	
⊠ B-17, N14	50.0	*ML*	*SILT with some sand*	-	-	77	44	
▲ B-17, N15	55.0	*ML*	*SILT with trace sand*	-	-	90	44	
★ B-17, N16a	60.0	*ML*	*SILT with trace sand*	-	-	90	50	
⊙ B-17, N16b	60.4	*SM*	*Silty SAND*	-	-	48	41	
✿ B-17, N17	65.0	*ML*	*SILT with trace sand*	-	-	89	48	
○ B-17, N19	75.0	*ML*	*SILT with trace sand*	-	-	89	50	

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GRAIN SIZE DISTRIBUTION
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FIG. E6
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FIG. E6

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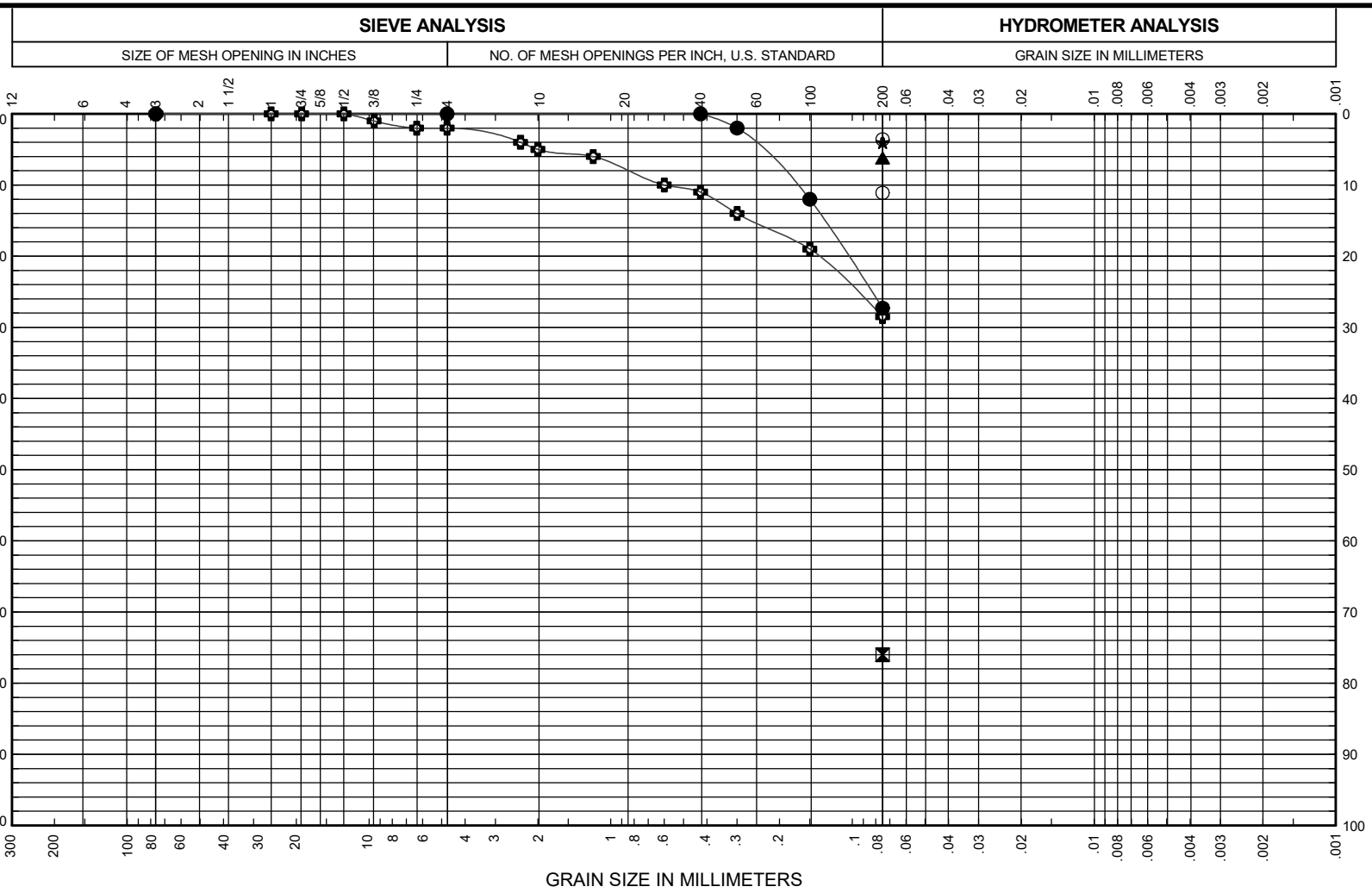

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-17, U3a	80.0	*ML*	*SILT with some sand*	0	27	73	39	80
⊠ B-17, N20	82.0	*SM*	*Silty SAND*	-	-	24	33	
▲ B-18, N9	25.0	*OH*	*Organic CLAY with trace sand*	-	-	94	93	
★ B-18, N10	30.0	*OH*	*Organic CLAY*	-	-	96	87	
⊙ B-18, N11	35.0	*OH*	*Organic CLAY*	-	-	96	105	
✿ B-18, U2a	38.0	*OL*	*Organic SILT with some sand*	2	27	72	103	40
○ B-18, N12	40.0	*OH*	*Organic CLAY with trace sand*	-	-	89	94	

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GRAIN SIZE DISTRIBUTION
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FIG. E6

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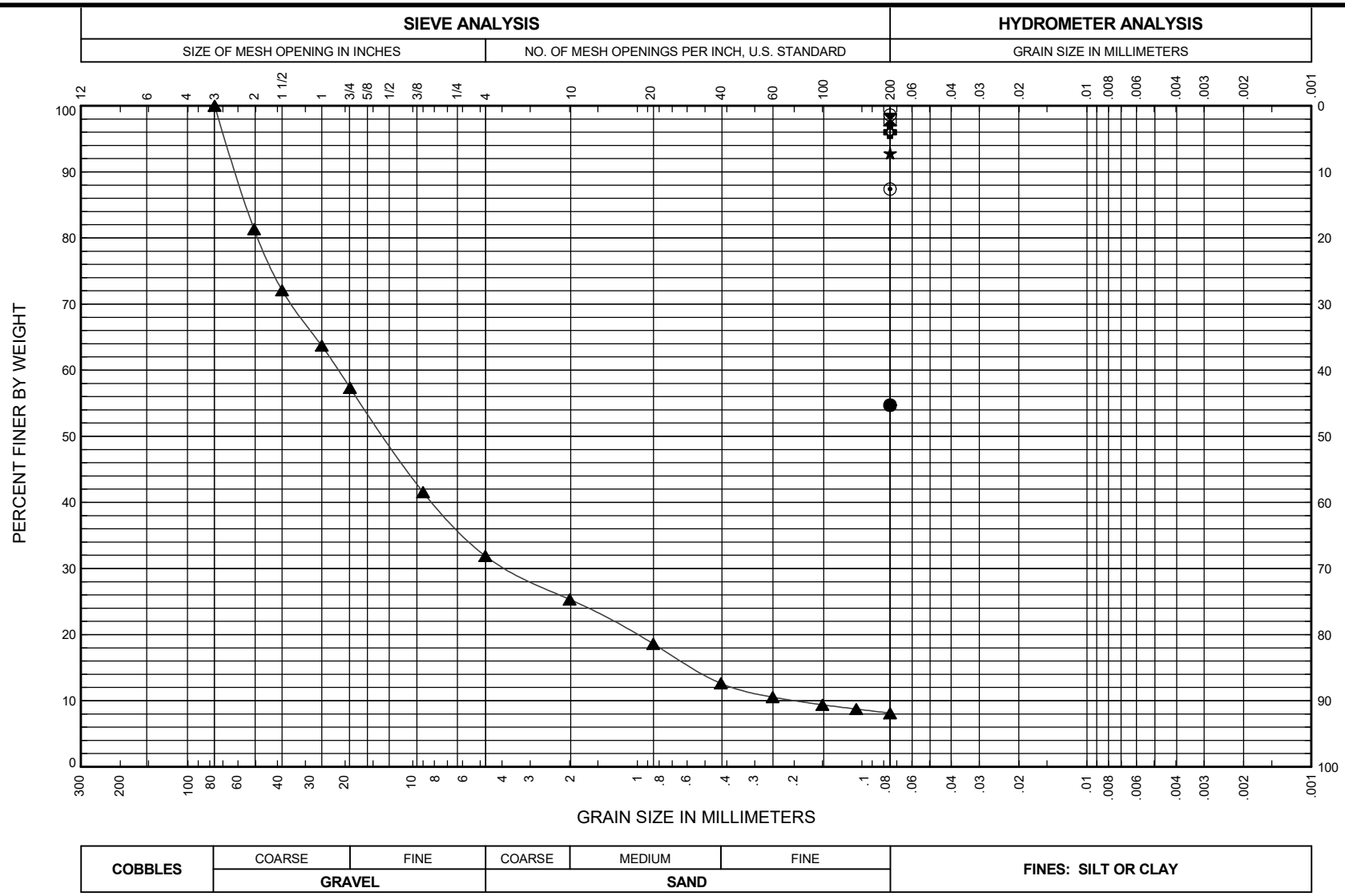

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-18, N13a	45.0	*CL*	*Sandy silty CLAY*	-	-	55	26	
⊠ B-22, S1	10.0	*CL*	*Silty CLAY*	-	-	98		
▲ B-23, S4	50.0	*GP-GM*	*GRAVEL with some silt and sand*	68	24	8		
★ B-32, N3	15.0	*OH*	*Organic CLAY with trace sand*	-	-	93	48	
⊙ B-32, N4	20.0	*OH*	*Organic CLAY with trace sand*	-	-	87	50	
✿ B-32, N5	25.0	*OH*	*Organic CLAY*	-	-	96	45	
○ B-32, N6	30.0	*ML/CL*	*SILT to Silty CLAY*	-	-	99	51	

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GRAIN SIZE DISTRIBUTION
FINE-GRAINED ALLUVIUM

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FIG. E6

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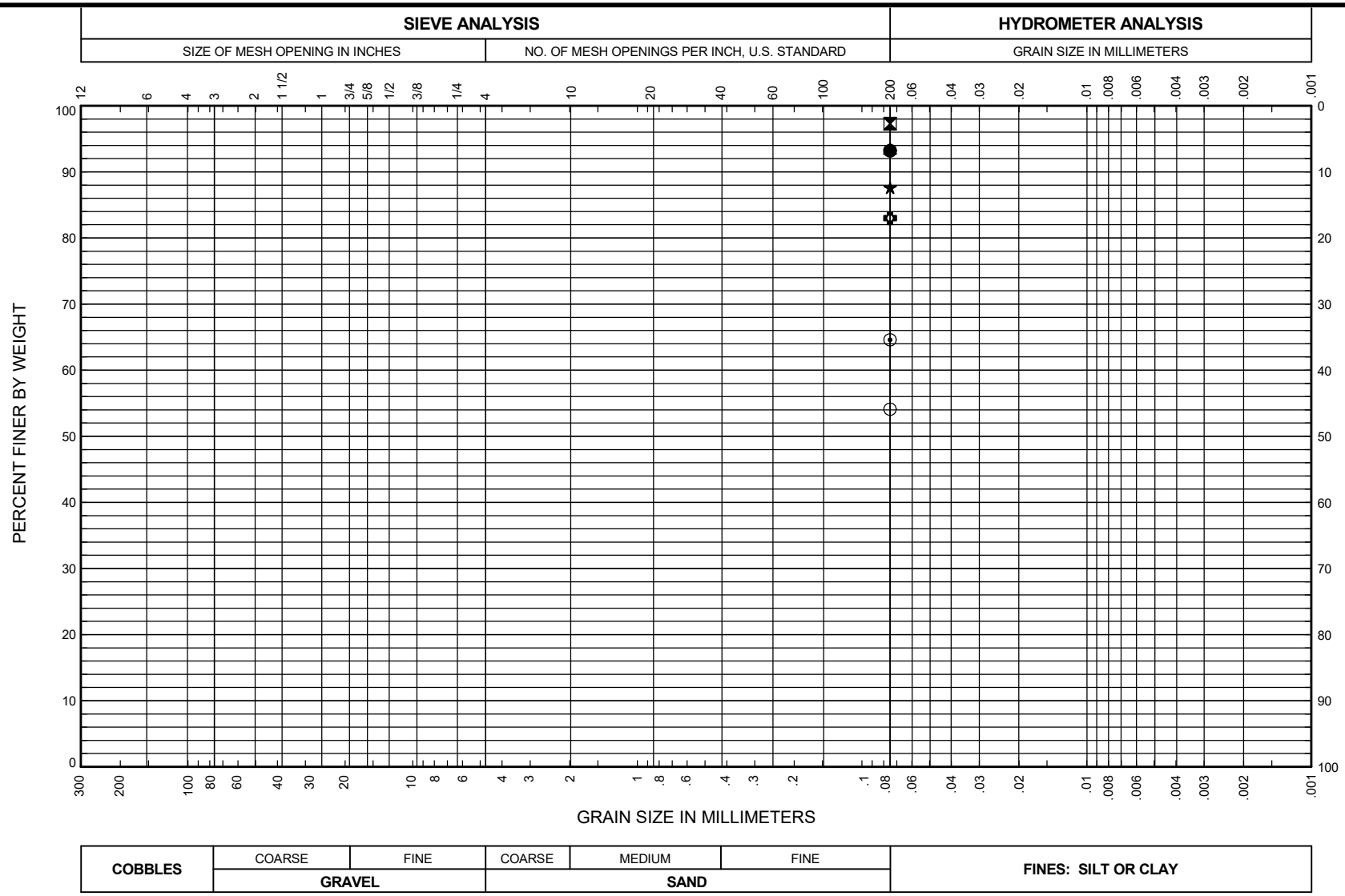

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-32, N7	35.0	*ML/CL*	*SILT to Silty CLAY with trace sand*	-	-	93	43	
⊠ B-32, N8	40.0	*ML/CL*	*SILT to Silty CLAY*	-	-	97	43	
▲ B-32, N9	45.0	*ML*	*SILT with trace sand*	-	-	94	46	
★ B-32, N10	50.0	*ML*	*SILT with trace sand*	-	-	88	41	
⊙ B-32, N11	55.0	*ML*	*Sandy SILT*	-	-	65	41	
✿ B-32, N12	60.0	*ML*	*SILT with some sand*	-	-	83	48	
○ B-32, N13	65.0	*ML*	*Sandy SILT*	-	-	54	48	

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GRAIN SIZE DISTRIBUTION
FINE-GRAINED ALLUVIUM

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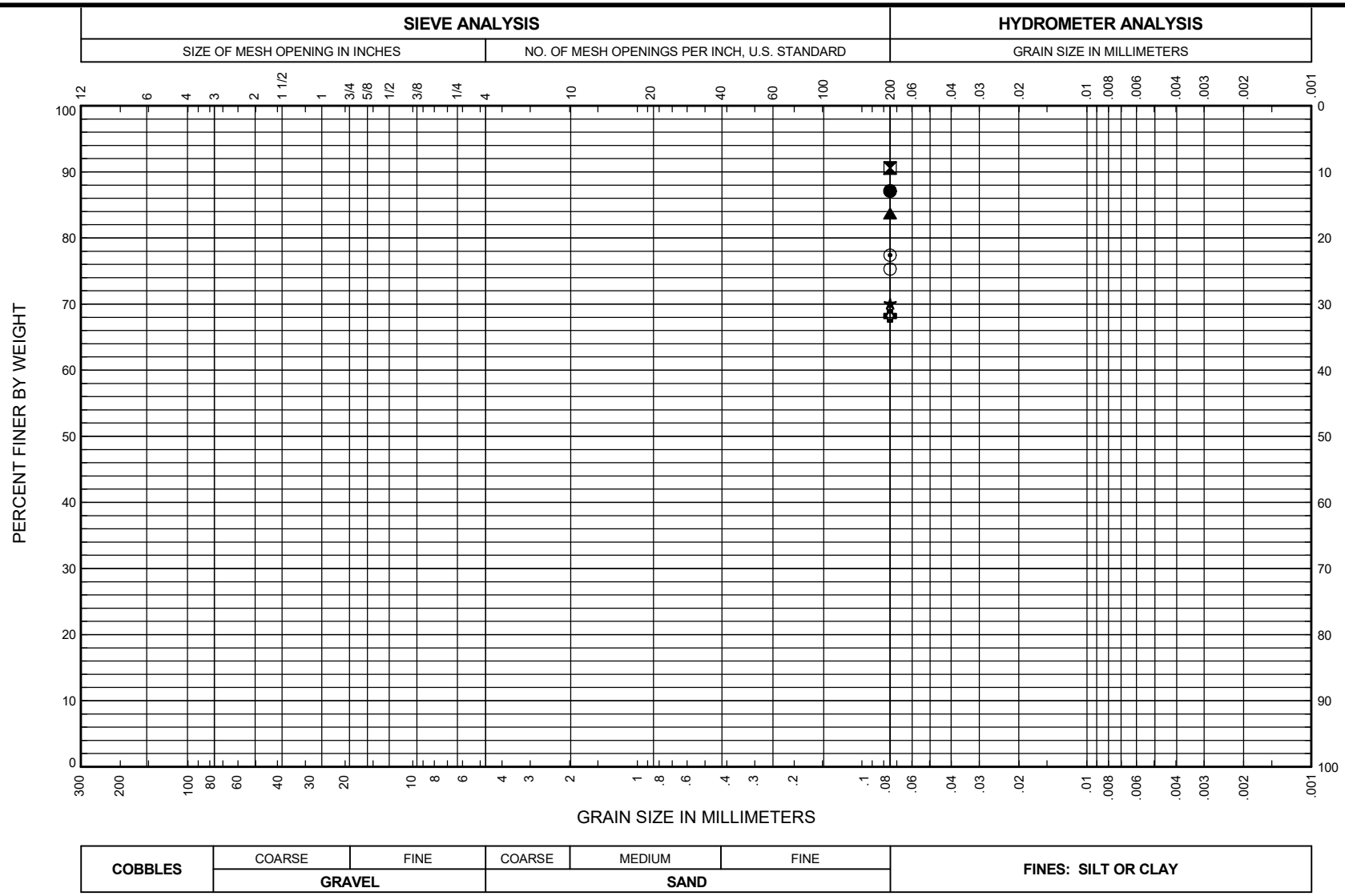
FIG. E6

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-33, N7	22.5	*CL*	*Silty CLAY with trace sand*	-	-	87	52	
⊠ B-33, N8	25.0	*CL*	*Silty CLAY with trace sand*	-	-	91	48	
▲ B-33, N9	30.0	*ML*	*SILT with some sand*	-	-	84	45	
★ B-33, N10	35.0	*ML*	*Sandy SILT*	-	-	70	46	
⊙ B-33, N12	45.0	*ML*	*SILT with some sand*	-	-	77	47	
✿ B-33, N16	65.0	*ML*	*Sandy SILT*	-	-	68	43	
○ B-33, N22	95.0	*ML*	*SILT with some sand*	-	-	75	43	

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GRAIN SIZE DISTRIBUTION
FINE-GRAINED ALLUVIUM

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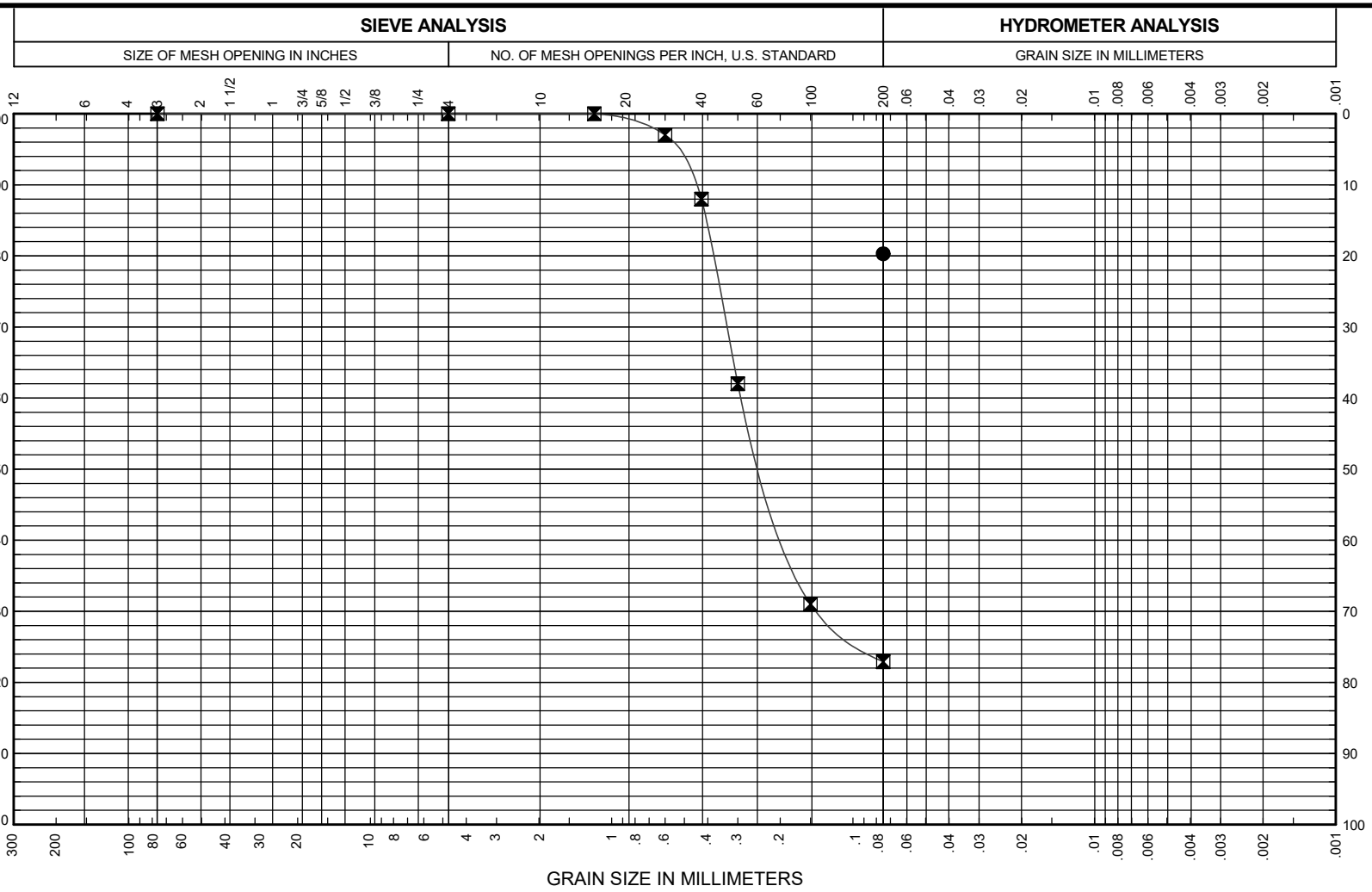
FIG. E6

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-33, N28	125.0	*ML*	*SILT with some sand*	-	-	80	46	
⊠ B-33, U5	127.0	*SM*	*Silty SAND*	0	77	23	29	95

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GRAIN SIZE DISTRIBUTION
FINE-GRAINED ALLUVIUM

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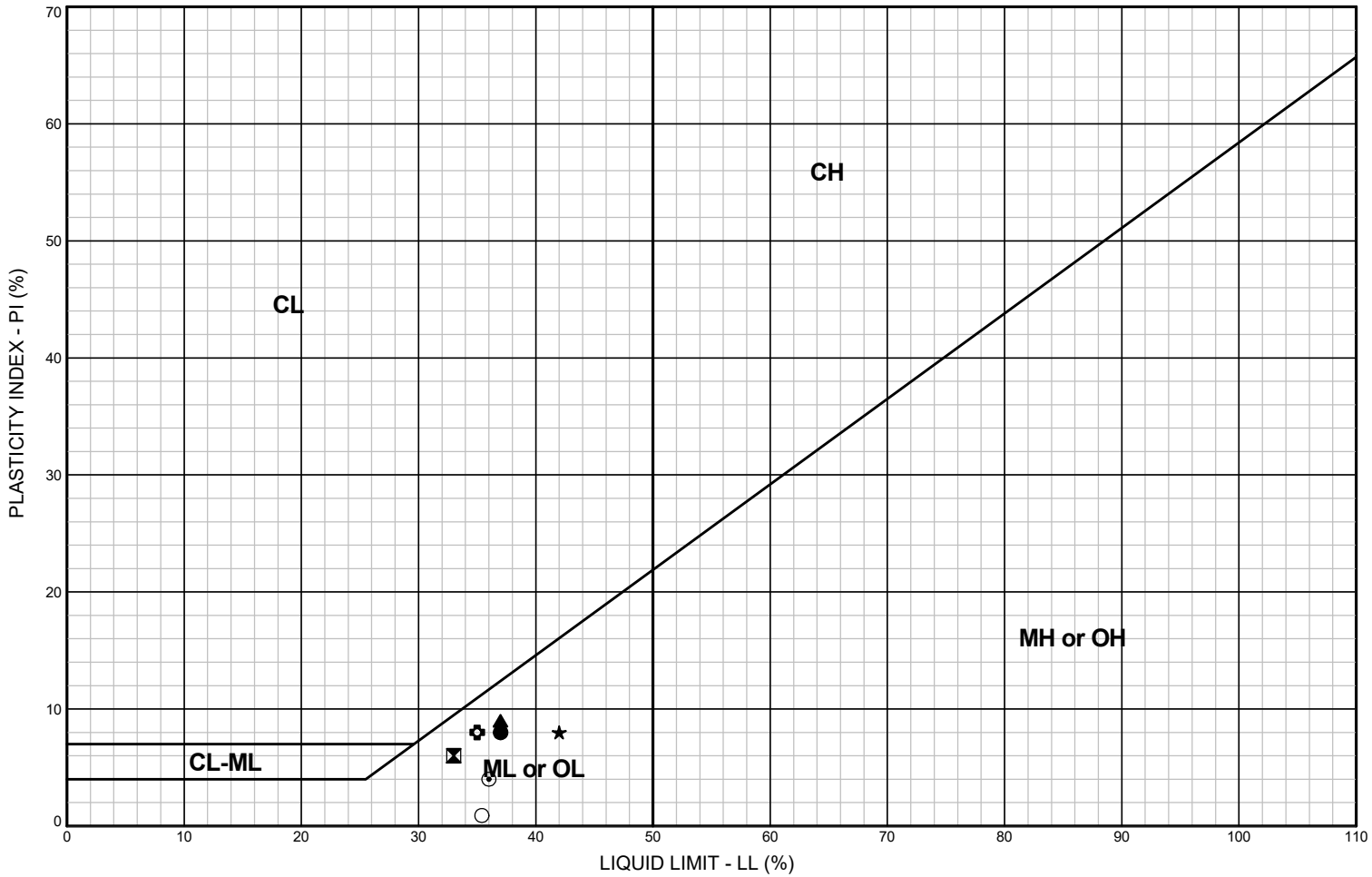
FIG. E6

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-01, N7	35.0	*ML*	*Sandy SILT*	37	29	8		67.4
⊠ B-03, N5	25.0	*SM*	*Silty SAND*	33	27	6		42.9
▲ B-03, N14	70.0	*ML*	*Sandy SILT*	37	28	9		57.1
★ B-03, N17	85.0	*ML*	*SILT with some sand*	42	34	8		77.3
⊙ B-03, N24	120.0	*ML*	*Sandy SILT*	36	32	4		68.0
✿ B-10, N12	47.5	*ML*	*Sandy SILT*	35	27	8	37	63.7
○ B-14, N9	25.0	*ML*	*Sandy SILT*	35	35	0	49	55.4

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ATTERBERG LIMITS RESULTS
SAND/SILT ALLUVIUM

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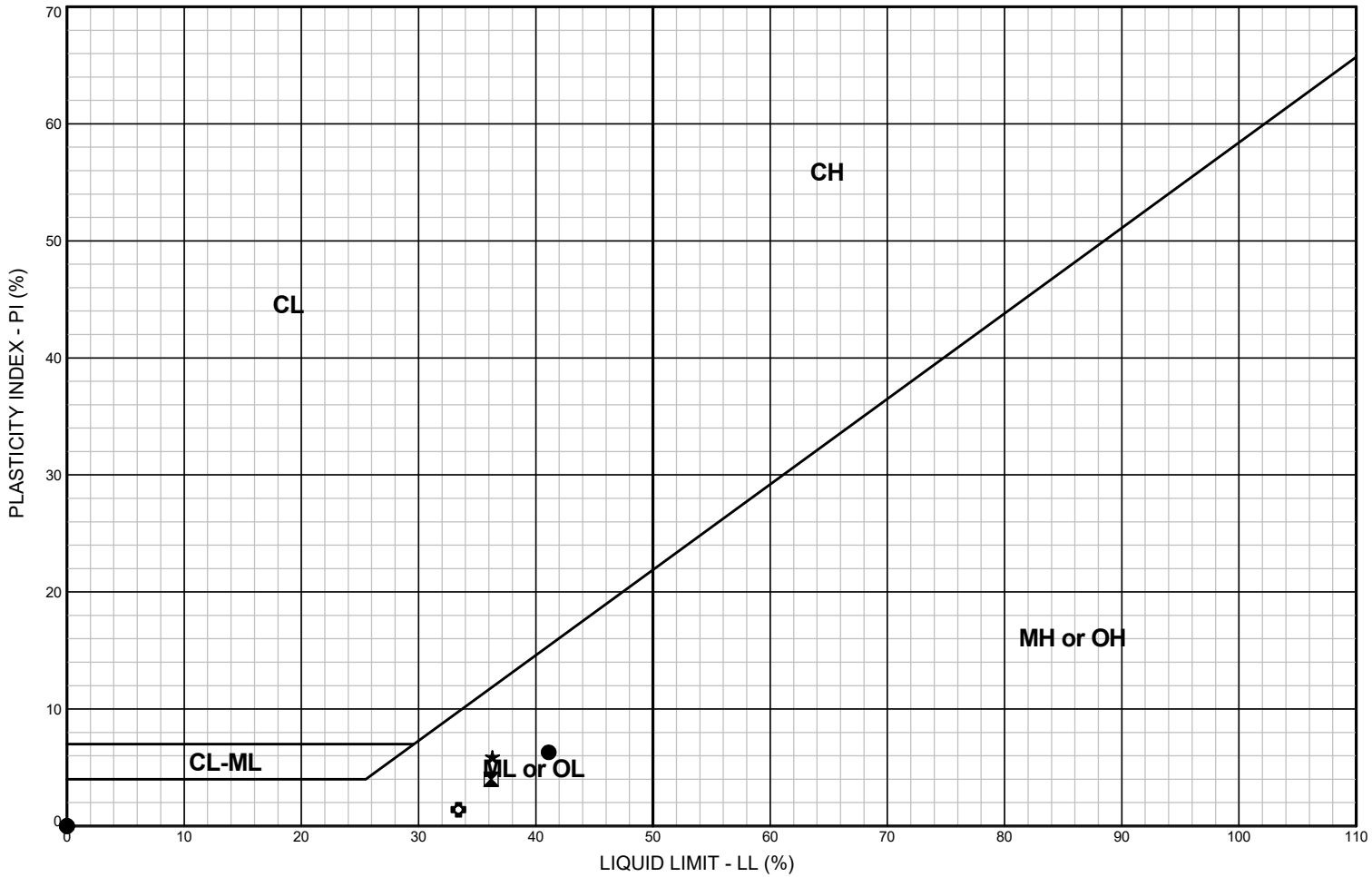
FIG. E7

ATT_UNIT_COMPLETE 102636.GPJ SHAN_WIL.GDT 4/12/22



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- High Plasticity (> 30%)

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● B-14, N10	30.0	*ML*	*Sandy SILT*	41	35	6	51	
⊠ B-15, N11	35.0	*ML*	*Sandy SILT*	36	32	4	41	59.6
B-15, U1a	38.0	*ML*	*Sandy SILT*	NP	NP	NP	43	51.0
★ B-15, U1b	39.0	*ML*	*Sandy SILT*	36	30	6	42	
B-15, N13	45.0	*ML*	*Sandy SILT*	NP	NP	NP	46	62.3
✿ B-15, N15	55.0	*ML*	*Sandy SILT*	33	32	1	40	55.6
B-15, N16	60.0	*ML*	*Sandy SILT*	NP	NP	NP	39	64.0

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ATTERBERG LIMITS RESULTS
SAND/SILT ALLUVIUM

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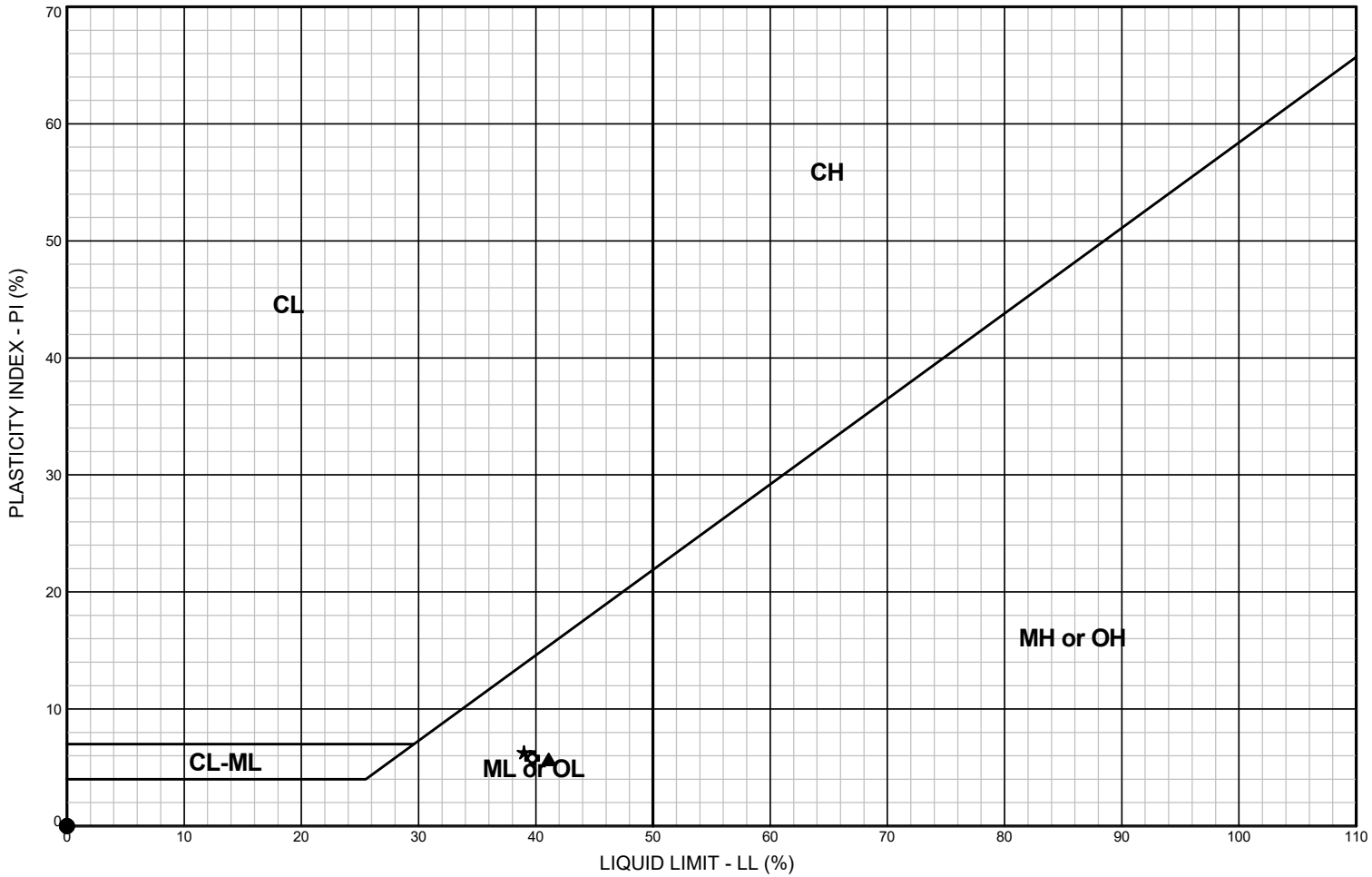
FIG. E7

ATT_UNIT_COMPLETE 102636.GPJ SHAN_WIL.GDT 4/12/22



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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
B-15, N20	80.0	*SM*	*Silty SAND*	NP	NP	NP	34	43.5
B-15, U3	83.0	*SM*	*Silty SAND*	NP	NP	NP	36	
▲ B-15, N23	95.0	*ML*	*Sandy SILT*	41	35	6	39	66.9
★ B-15, N28	120.0	*ML*	*Sandy SILT*	39	33	6	42	63.7
B-16, N9	27.0	*ML*	*Sandy SILT*	NP	NP	NP	46	61.5
✿ B-16, N10	30.0	*ML*	*Sandy SILT*	40	34	6	46	57.0
B-16, U2	35.0	*ML*	*Sandy SILT*	NP	NP	NP	40	

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ATTERBERG LIMITS RESULTS
SAND/SILT ALLUVIUM

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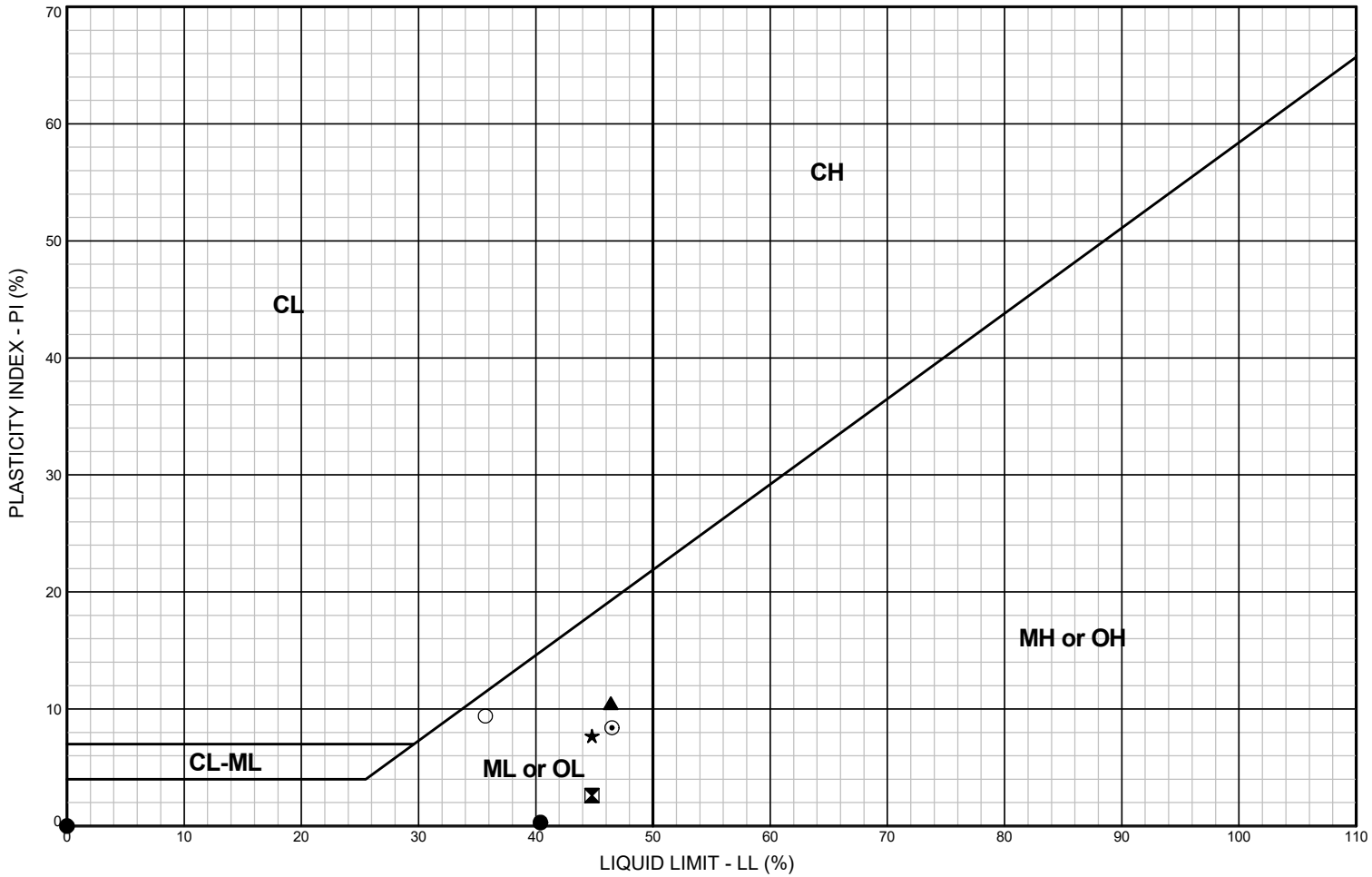
FIG. E7

ATT_UNIT_COMPLETE 102636.GPJ SHAN_WIL.GDT 4/12/22



NOTES

1) Atterberg limits tests were performed in general accordance with ASTM D4318 unless otherwise noted in the report.

2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

3) Plasticity adjectives used in sample descriptions correspond to plasticity index as follows:
- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-16, N13	45.0	*SM*	*Silty SAND*	40	40	NP	42	43.4
⊠ B-16, N15	55.0	*ML*	*Sandy SILT*	45	42	3	48	56.5
▲ B-16, N17	65.0	*ML*	*SILT with some sand*	46	36	10	49	70.5
★ B-16, N21	85.0	*ML*	*Sandy SILT*	45	37	8	46	51.5
⊙ B-16, N25	105.0	*ML*	*Sandy SILT*	47	38	9	41	59.8
B-16, N30	130.0	*SM*	*Silty SAND*	NP	NP	NP	29	34.7
○ B-17, U2b	41.0	*SM*	*Silty SAND*	36	26	10	45	

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Portland, Oregon

ATTERBERG LIMITS RESULTS SAND/SILT ALLUVIUM

April 2022 102636-009

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FIG. E7
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FIG. E7

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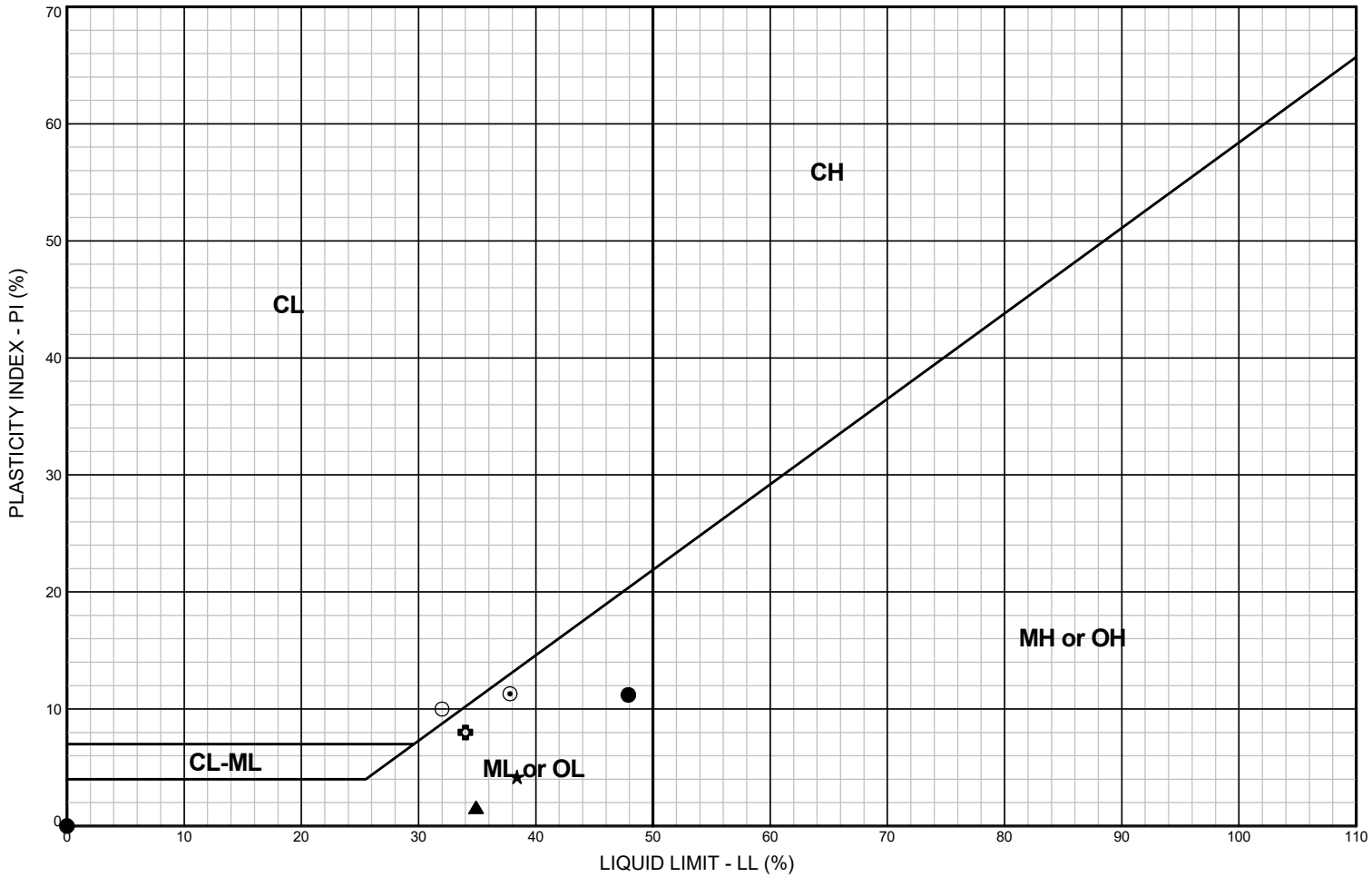

NOTES

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- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-17, N12	42.0	*ML*	*SILT with trace sand*	48	37	11	47	92.1
B-17, U4b	102.5	*SM*	*Silty SAND*	NP	NP	NP	46	
▲ B-17, N25	103.5	*ML*	*Sandy SILT*	35	33	2	39	53.6
★ B-17, N32	140.0	*ML*	*Sandy SILT*	38	34	4	40	59.2
⊙ B-18, N15	55.0	*ML*	*Sandy SILT*	38	27	11	35	
✿ B-24, S5b	33.0	*SM*	*Silty SAND*	34	26	8		40.9
○ B-24, S7a	50.0	*SC*	*Clayey SAND*	32	22	10		23.7

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ATTERBERG LIMITS RESULTS SAND/SILT ALLUVIUM

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FIG. E7

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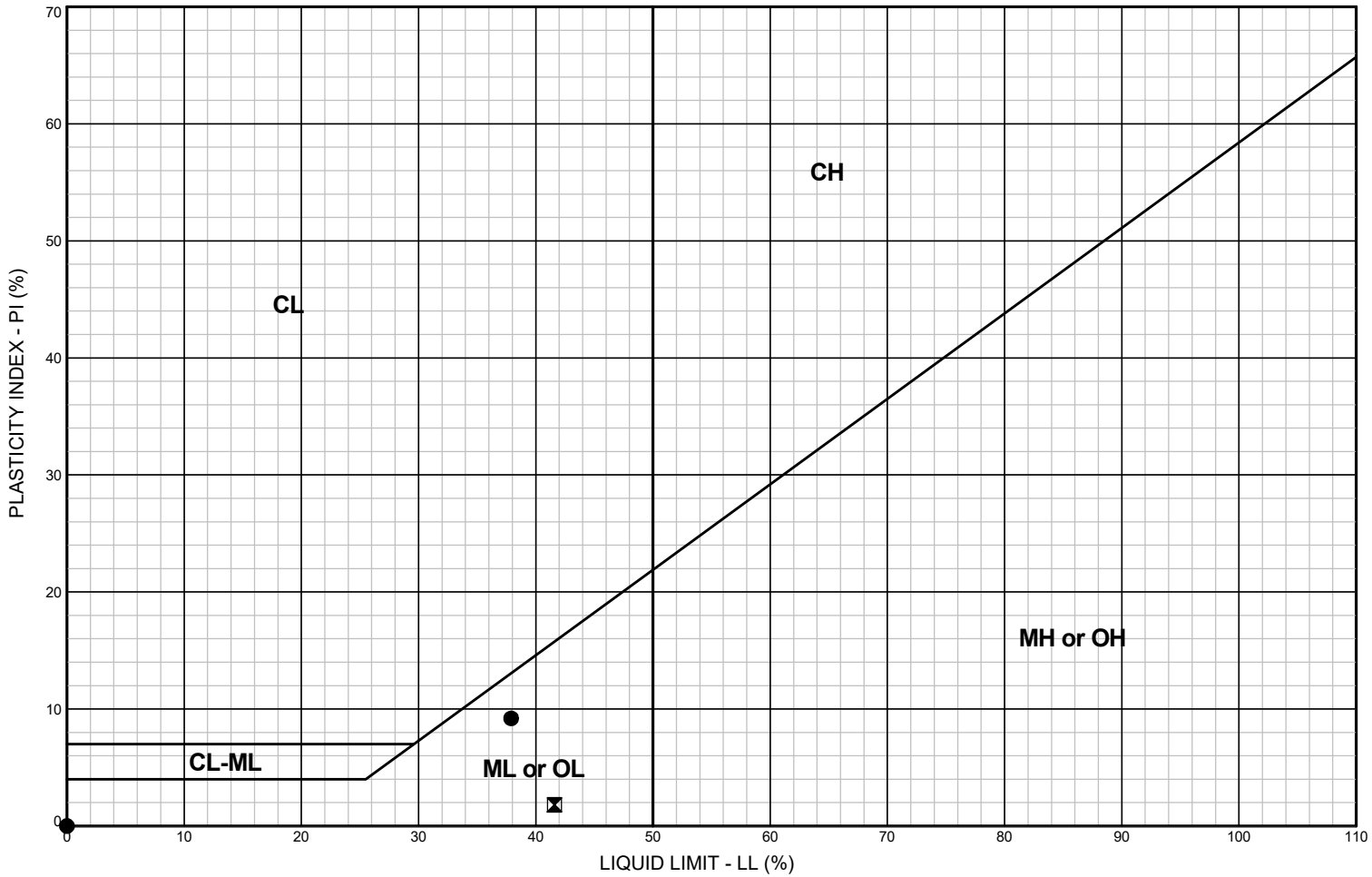

NOTES

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3) Plasticity adjectives used in sample descriptions correspond to plasticity index as follows:
- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-27, N16	66.2	*ML*	*SILT with some sand*	38	29	9	38	
⊠ B-33, N15	60.0	*ML*	*SILT with some sand*	42	40	2	46	70.6
B-33, N26	115.0	*ML*	*Sandy SILT*	NP	NP	NP	41	61.4

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ATTERBERG LIMITS RESULTS
SAND/SILT ALLUVIUM

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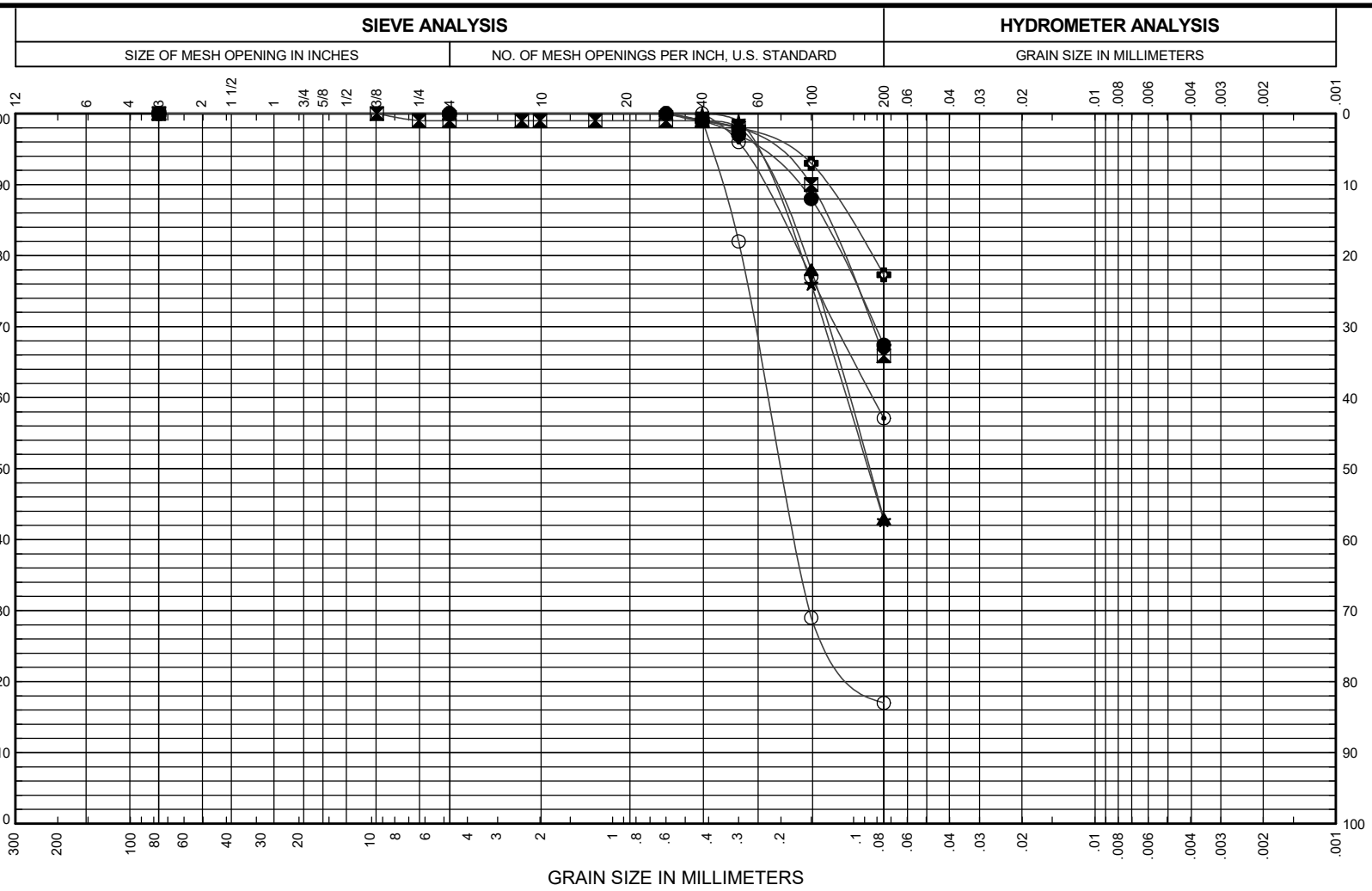
FIG. E7

ATT_UNIT_COMPLETE 102636.GPJ SHAN_WIL.GDT 4/12/22



NOTES:
1) Sieve analyses were performed in general accordance with ASTM D6913, sieve with hydrometer analyses were performed in general accordance with ASTM D422, and amount finer than #200 sieve analyses were performed in general accordance with ASTM D1140 unless otherwise noted in the report.
2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-01, N7	35.0	*ML*	*Sandy SILT*	0	33	67		
⊠ B-02, N12	67.1	*ML*	*Sandy SILT*	1	33	66		
▲ B-03, N5	25.0	*SM*	*Silty SAND*	0	57	43		
★ B-03, N6	32.0	*SM*	*Silty SAND*	0	57	43		
⊙ B-03, N14	70.0	*ML*	*Sandy SILT*	0	43	57		
✿ B-03, N17	85.0	*ML*	*SILT with some sand*	0	23	77		
○ B-03, N23	115.0	*SM*	*Silty SAND*	0	83	17		

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GRAIN SIZE DISTRIBUTION
SAND/SILT ALLUVIUM

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FIG. E8
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FIG. E8

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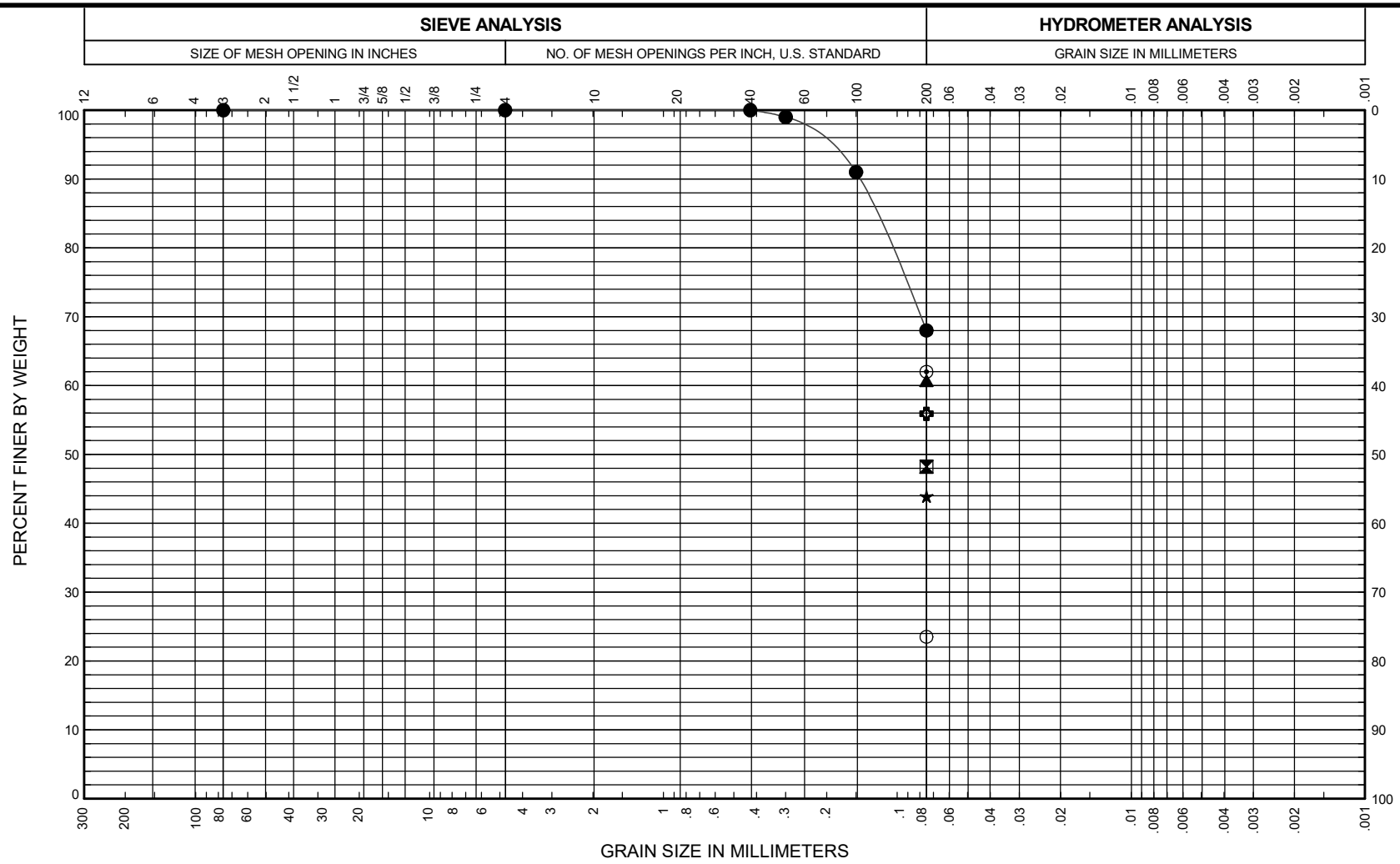

NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.
* *Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-03, N24	120.0	*ML*	*Sandy SILT*	0	32	68		
⊠ B-04, N7	32.0	*SM*	*Silty SAND*	-	-	48	33	
▲ B-04, N8	35.0	*ML*	*Sandy SILT*	-	-	61	39	
★ B-06, N3	20.0	*SM*	*Silty SAND*	-	-	44	38	
⊙ B-06, N4	25.0	*ML*	*Sandy SILT*	-	-	62	40	
✿ B-07, N4	25.0	*ML*	*Sandy SILT*	-	-	56	36	
○ B-08, N5*	30.0	*SM*	*Silty SAND with trace gravel*	-	-	24	29	

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GRAIN SIZE DISTRIBUTION
SAND/SILT ALLUVIUM

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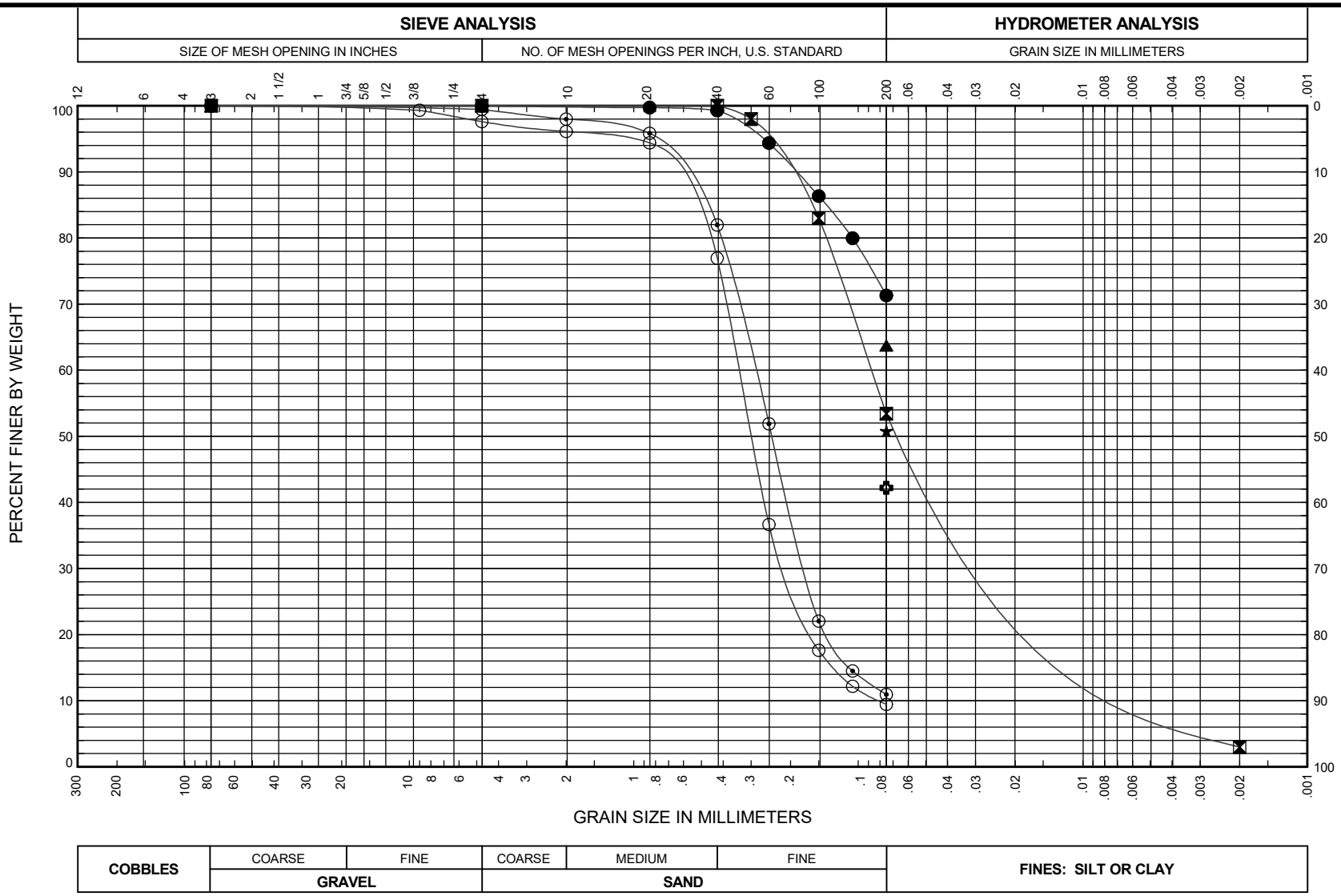
FIG. E8

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-09, N3	12.5	*ML*	*SILT with some sand*	0	29	71	56	
⊠ B-10, N11	42.5	*ML*	*Sandy SILT*	0	47	53	38	
▲ B-10, N12	47.5	*ML*	*Sandy SILT*	-	-	64	37	
★ B-13, N3	7.5	*ML*	*Sandy SILT*	-	-	51	54	
⊙ B-14, N4	10.0	*SP-SM*	*SAND with some silt*	1	89	11	38	
✿ B-14, N5	12.5	*SM*	*Silty SAND*	-	-	42	45	
○ B-14, N6	15.0	*SP-SM*	*SAND with some silt*	2	88	9	40	

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GRAIN SIZE DISTRIBUTION
SAND/SILT ALLUVIUM

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FIG. E8
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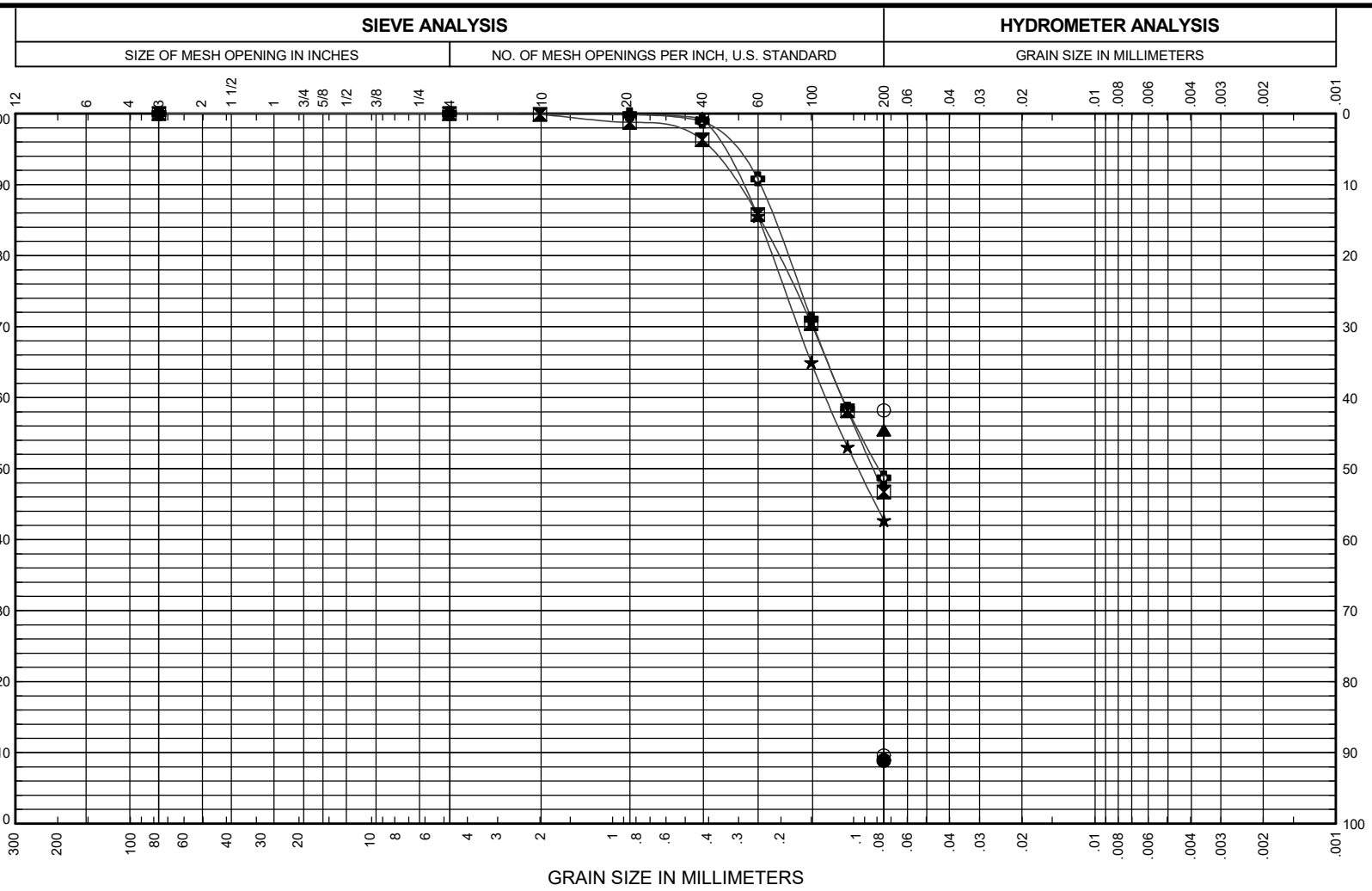
FIG. E8

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-14, N7	17.5	*SP-SM*	*SAND with some silt*	-	-	9	36	
⊠ B-14, N8	20.0	*SM*	*Silty SAND*	0	53	47	45	
▲ B-14, N9	25.0	*ML*	*Sandy SILT*	-	-	55	49	
★ B-14, N11	35.0	*SM*	*Silty SAND*	0	57	43	45	
⊙ B-14, N12a	40.0	*SP-SM*	*SAND with some silt*	-	-	10	40	
✿ B-14, N13	45.0	*SM*	*Silty SAND*	0	51	49	44	
○ B-14, N14	50.0	*ML*	*Sandy SILT*	-	-	58	45	

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GRAIN SIZE DISTRIBUTION
SAND/SILT ALLUVIUM

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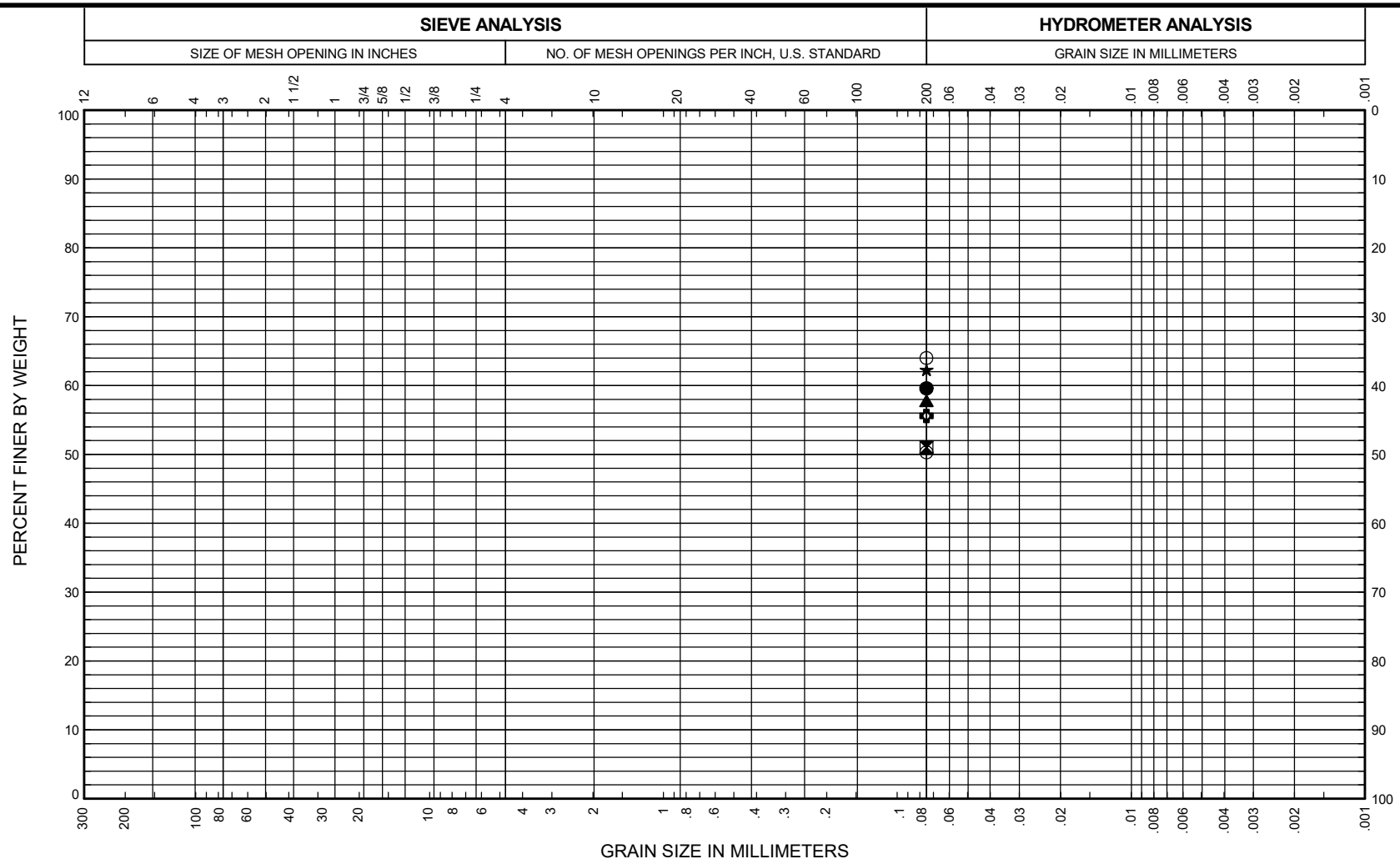
FIG. E8

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-15, N11	35.0	*ML*	*Sandy SILT*	-	-	60	41	
⊠ B-15, U1a	38.0	*ML*	*Sandy SILT*	-	-	51	43	
▲ B-15, N12	40.0	*ML*	*Sandy SILT*	-	-	58	40	
★ B-15, N13	45.0	*ML*	*Sandy SILT*	-	-	62	46	
⊙ B-15, N14	50.0	*ML/SM*	*Sandy SILT to Silty SAND*	-	-	50	44	
✿ B-15, N15	55.0	*ML*	*Sandy SILT*	-	-	56	40	
○ B-15, N16	60.0	*ML*	*Sandy SILT*	-	-	64	39	

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GRAIN SIZE DISTRIBUTION
SAND/SILT ALLUVIUM

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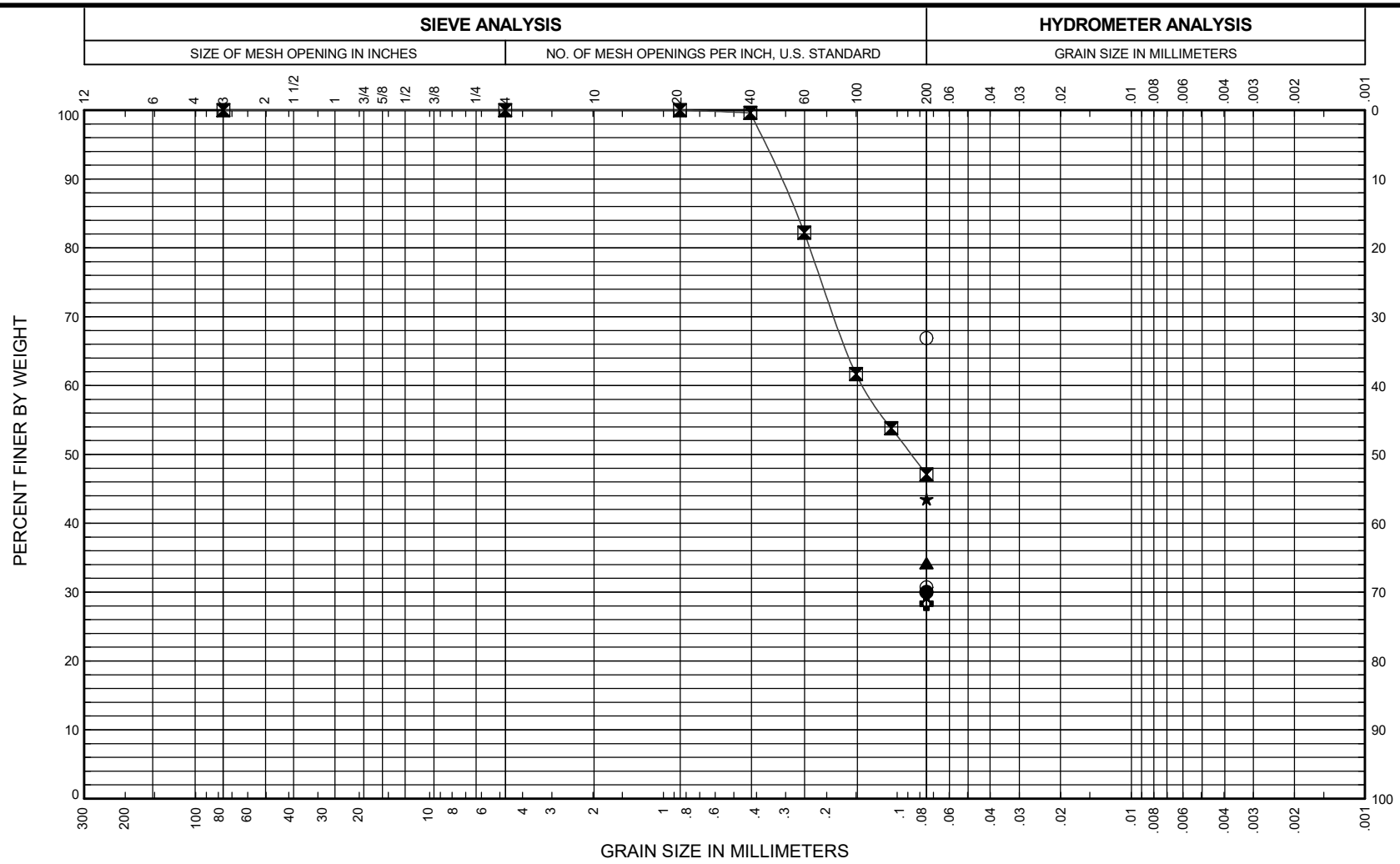
FIG. E8

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-15, N17	65.0	*SM*	*Silty SAND*	-	-	30	38	
⊠ B-15, N18	70.0	*SM*	*Silty SAND*	0	53	47	39	
▲ B-15, N19	75.0	*SM*	*Silty SAND*	-	-	34	44	
★ B-15, N20	80.0	*SM*	*Silty SAND*	-	-	44	34	
⊙ B-15, N21	85.0	*SM*	*Silty SAND*	-	-	31	41	
✿ B-15, N22	90.0	*SM*	*Silty SAND*	-	-	28	39	
○ B-15, N23	95.0	*ML*	*Sandy SILT*	-	-	67	39	

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GRAIN SIZE DISTRIBUTION
SAND/SILT ALLUVIUM

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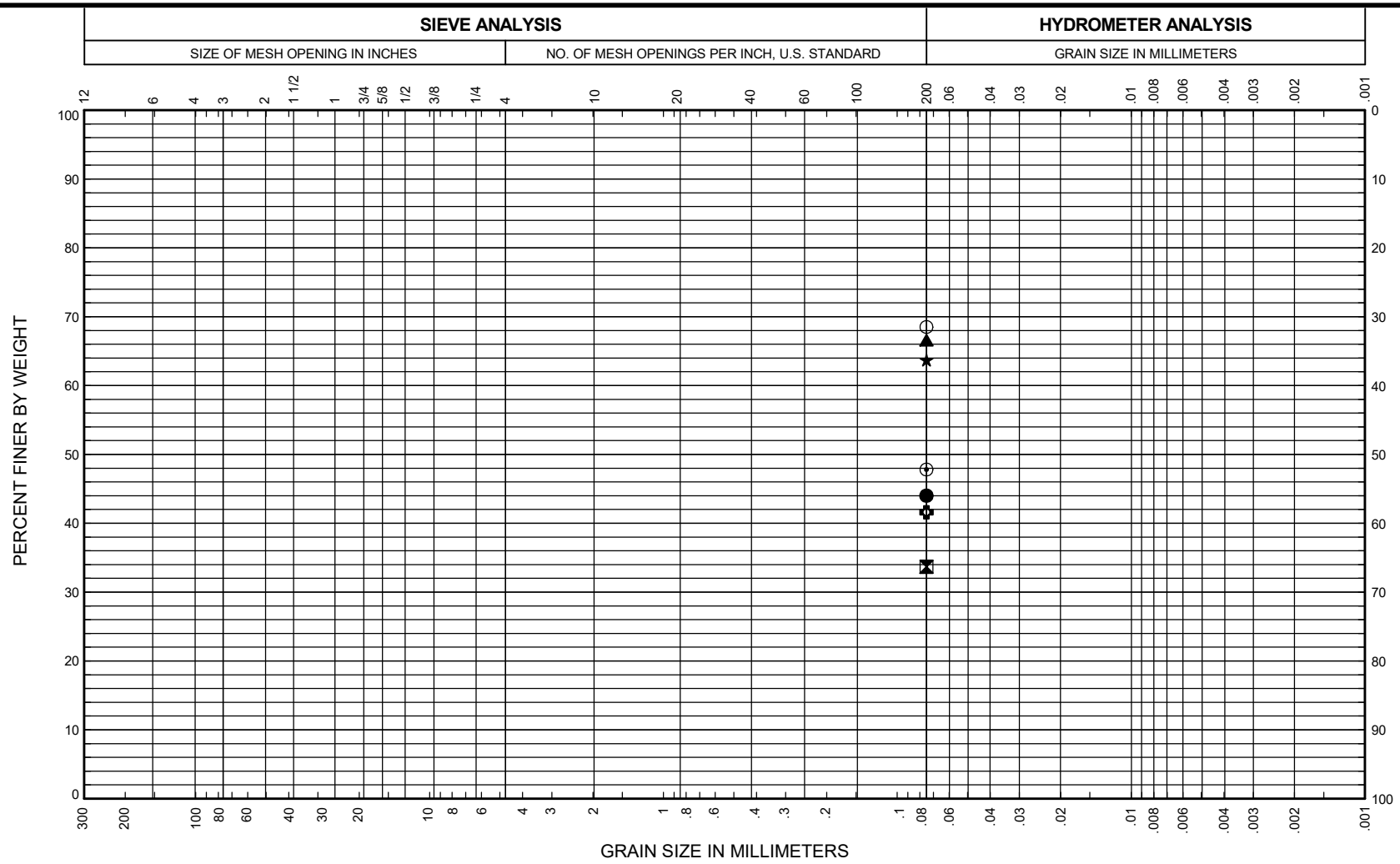
FIG. E8

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-15, N24	100.0	*SM*	*Silty SAND*	-	-	44	39	
⊠ B-15, N25	105.0	*SM*	*Silty SAND*	-	-	34	40	
▲ B-15, N27	115.0	*ML*	*Sandy SILT*	-	-	67	41	
★ B-15, N28	120.0	*ML*	*Sandy SILT*	-	-	64	42	
⊙ B-15, N30	130.0	*SM*	*Silty SAND*	-	-	48	40	
✿ B-15, N31	135.0	*SM*	*Silty SAND*	-	-	42	40	
○ B-16, N8	20.0	*ML*	*Sandy SILT*	-	-	69	37	

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GRAIN SIZE DISTRIBUTION
SAND/SILT ALLUVIUM

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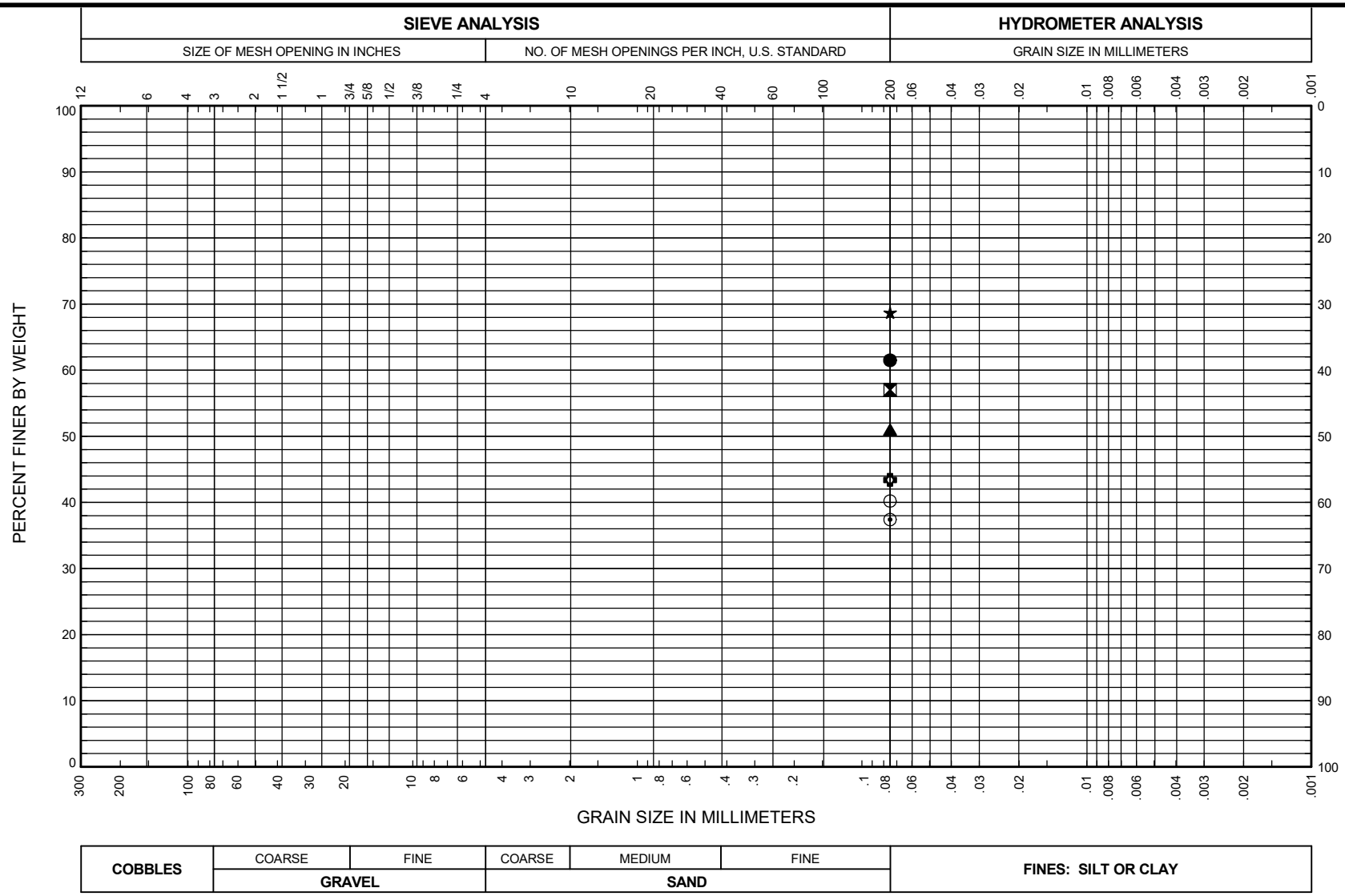
FIG. E8

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-16, N9	27.0	*ML*	*Sandy SILT*	-	-	62	46	
⊠ B-16, N10	30.0	*ML*	*Sandy SILT*	-	-	57	46	
▲ B-16, N11	37.0	*ML*	*Sandy SILT*	-	-	51	46	
★ B-16, N12a	40.0	*ML*	*Sandy SILT*	-	-	69	43	
⊙ B-16, N12b	40.8	*SM*	*Silty SAND*	-	-	37	42	
✿ B-16, N13	45.0	*SM*	*Silty SAND*	-	-	43	42	
○ B-16, N14	50.0	*SM*	*Silty SAND*	-	-	40	42	

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Portland, Oregon

GRAIN SIZE DISTRIBUTION
SAND/SILT ALLUVIUM

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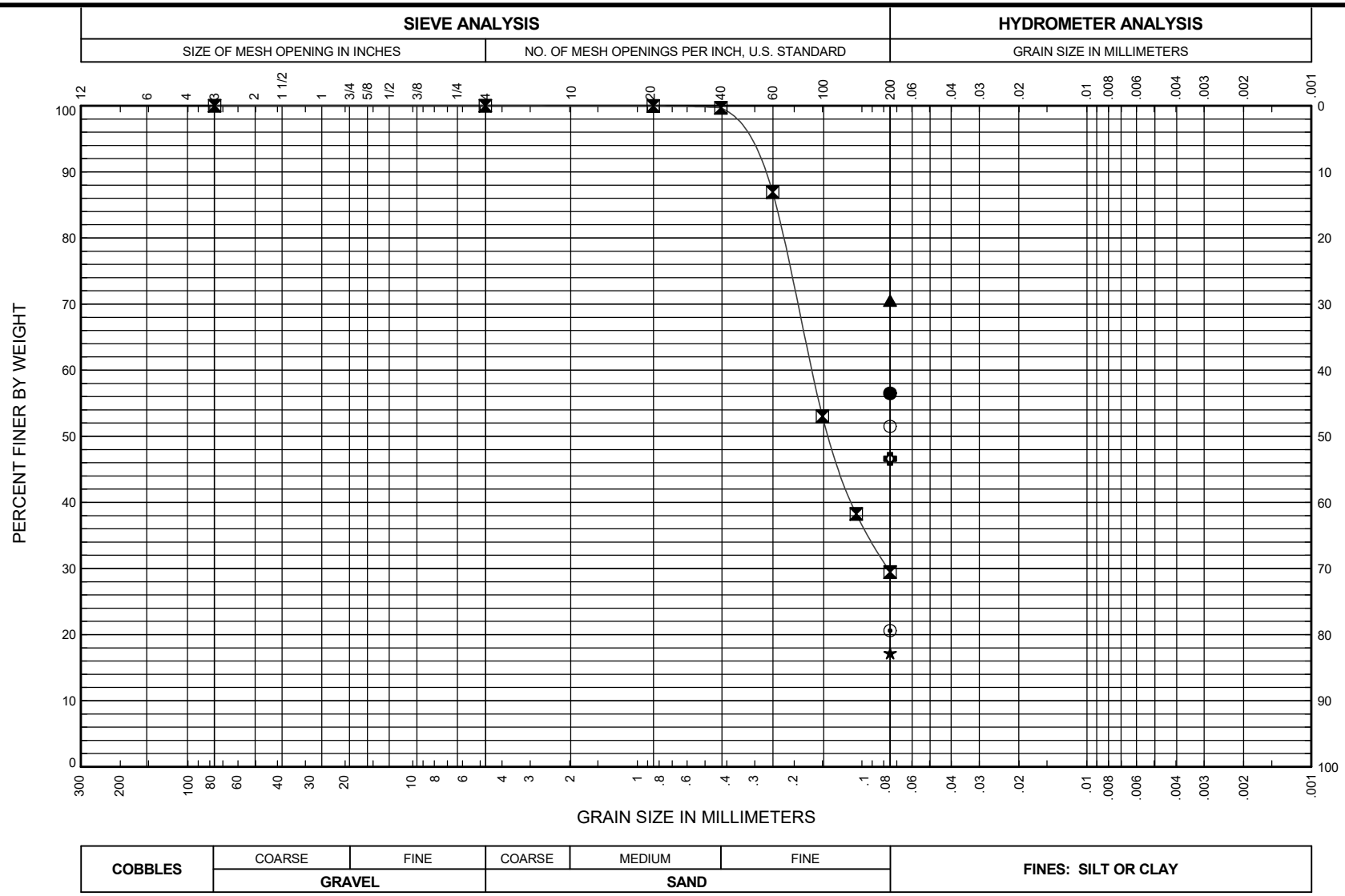
GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-16, N15	55.0	*ML*	*Sandy SILT*	-	-	57	48	
⊠ B-16, N16	62.0	*SM*	*Silty SAND*	0	71	29	39	
▲ B-16, N17	65.0	*ML*	*SILT with some sand*	-	-	71	49	
★ B-16, N18	70.0	*SM*	*Silty SAND*	-	-	17	39	
⊙ B-16, N19	75.0	*SM*	*Silty SAND*	-	-	21	35	
✿ B-16, N20	80.0	*SM*	*Silty SAND*	-	-	47	45	
○ B-16, N21	85.0	*ML*	*Sandy SILT*	-	-	52	46	

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GRAIN SIZE DISTRIBUTION
SAND/SILT ALLUVIUM

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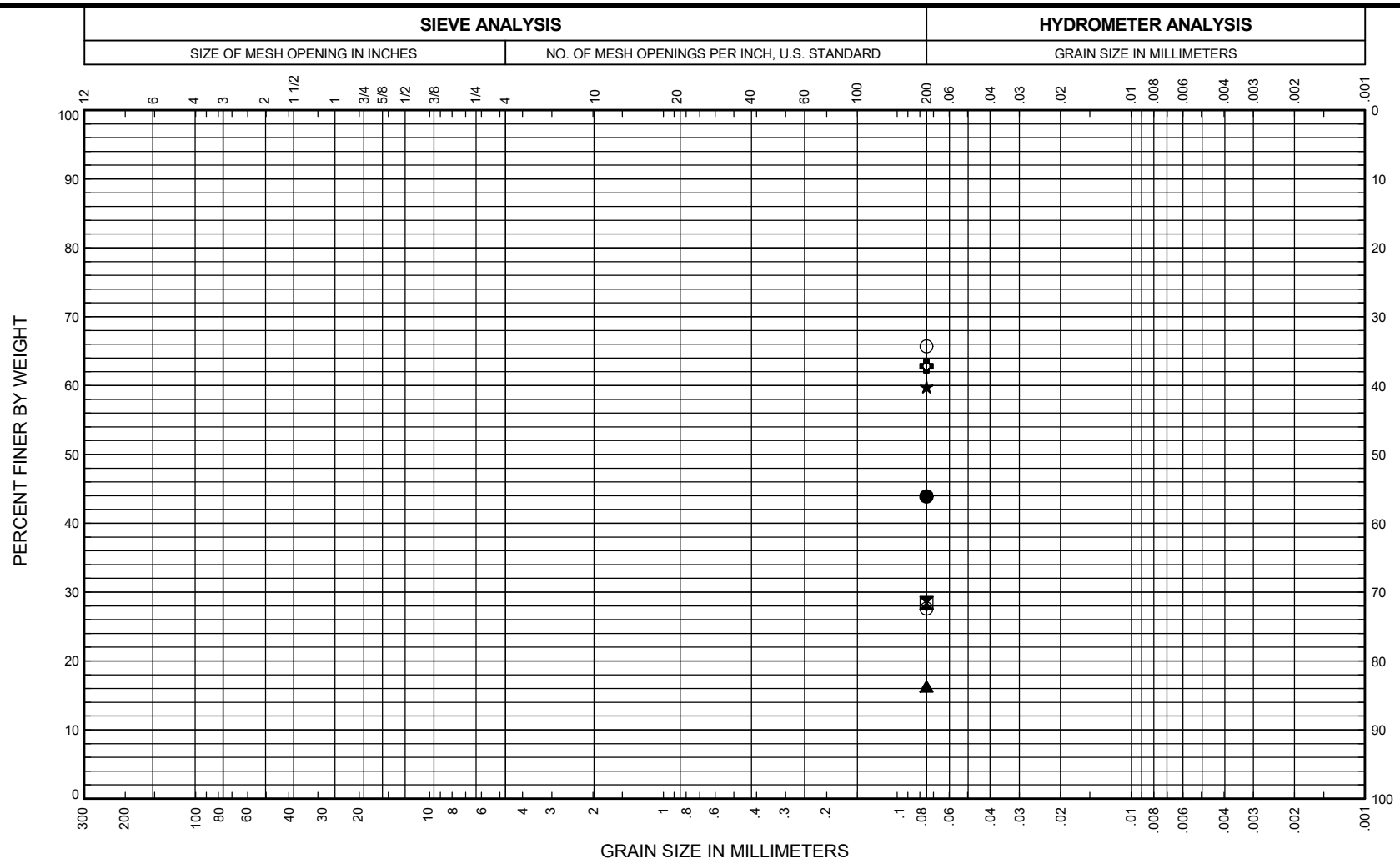
FIG. E8

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-16, N22	90.0	*SM*	*Silty SAND*	-	-	44	39	
⊠ B-16, N23	95.0	*SM*	*Silty SAND*	-	-	28	37	
▲ B-16, N24	100.0	*SM*	*Silty SAND*	-	-	16	38	
★ B-16, N25	105.0	*ML*	*Sandy SILT*	-	-	60	41	
⊙ B-16, N26	112.0	*SM*	*Silty SAND*	-	-	28	41	
✿ B-16, N27	115.0	*ML*	*Sandy SILT*	-	-	63	37	
○ B-16, N28	120.0	*ML*	*Sandy SILT*	-	-	66	39	

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GRAIN SIZE DISTRIBUTION
SAND/SILT ALLUVIUM

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FIG. E8
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FIG. E8

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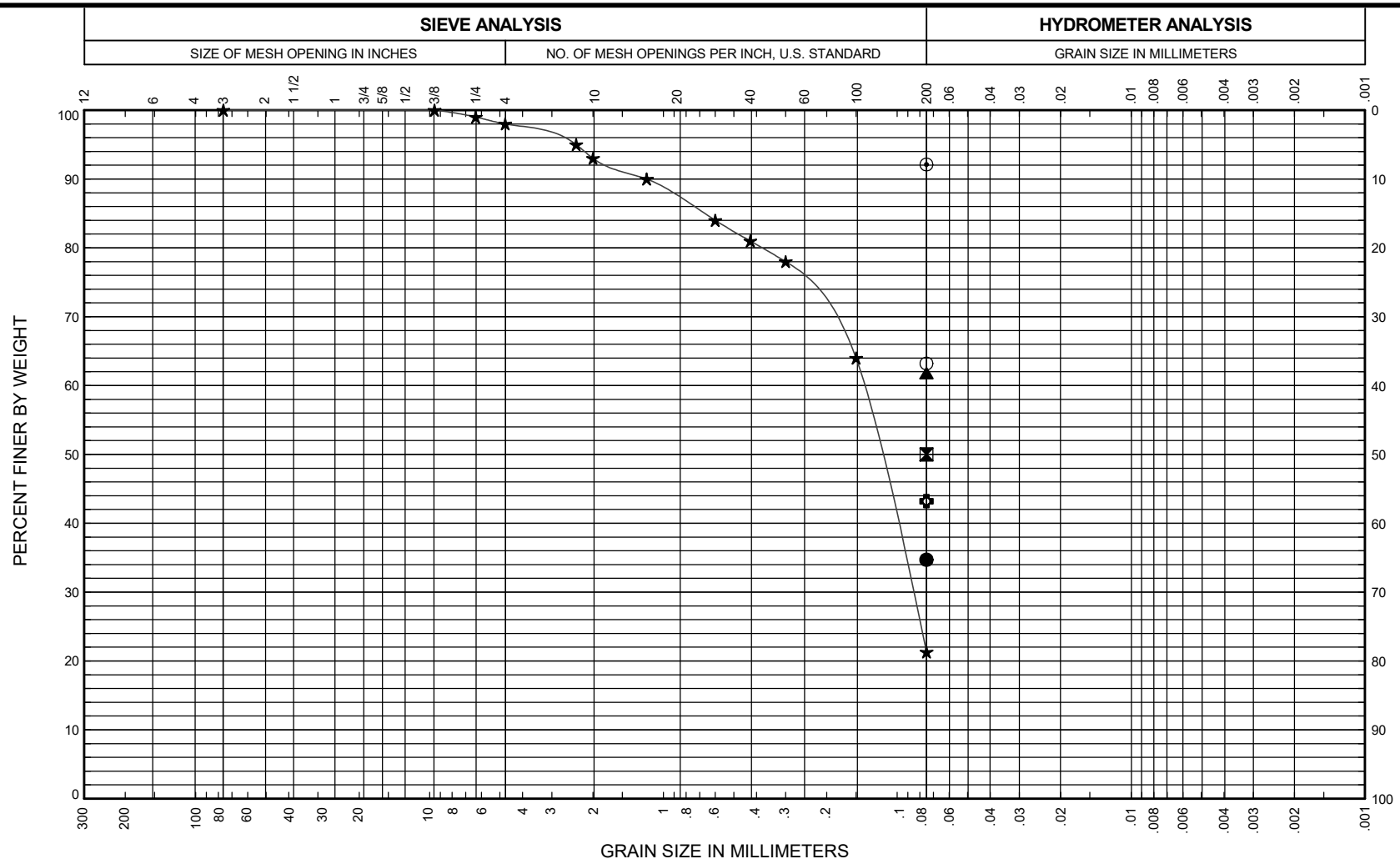

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-16, N30	130.0	*SM*	*Silty SAND*	-	-	35	29	
⊠ B-16, N31	135.0	*SM/ML*	*Silty SAND to Sandy SILT*	-	-	50	35	
▲ B-16, N32	140.0	*ML*	*Sandy SILT*	-	-	62	37	
★ B-17, U2a	40.0	*SM*	*Silty SAND*	2	77	21	41	79
⊙ B-17, N12	42.0	*ML*	*SILT with trace sand*	-	-	92	47	
✿ B-17, N18	70.0	*SM*	*Silty SAND*	-	-	43	48	
○ B-17, N21	85.0	*ML*	*Sandy SILT*	-	-	63	48	

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GRAIN SIZE DISTRIBUTION
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FIG. E8

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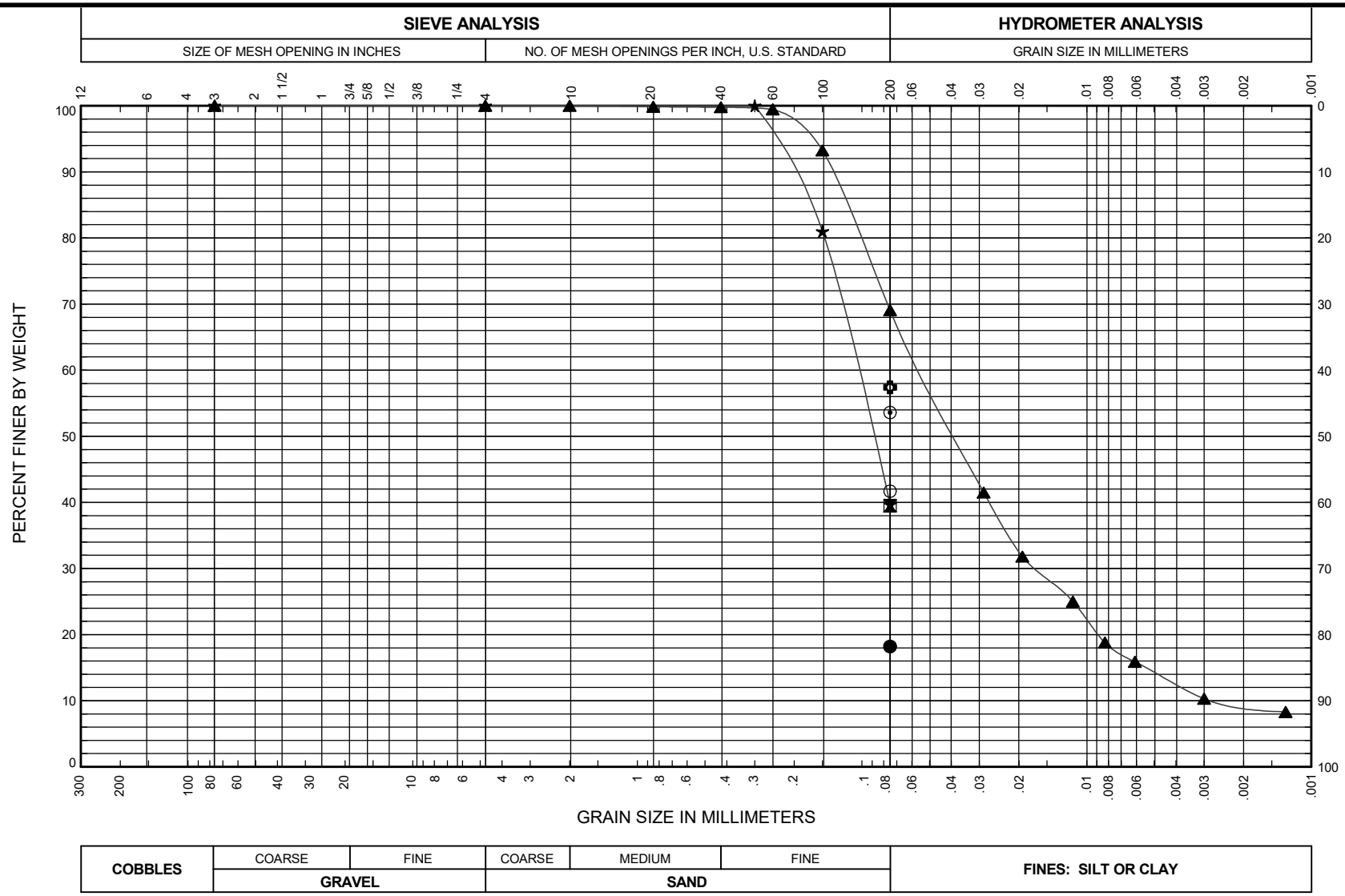

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-17, N22	90.0	*SM*	*Silty SAND*	-	-	18	32	
⊠ B-17, N23	95.0	*SM*	*Silty SAND*	-	-	40	45	
▲ B-17, N24	100.0	*ML*	*Sandy SILT*	0	31	69	48	
★ B-17, U4a	101.5	*SM*	*Silty SAND*	0	60	40	37	78
⊙ B-17, N25	103.5	*ML*	*Sandy SILT*	-	-	54	39	
✿ B-17, N26	110.0	*ML*	*Sandy SILT*	-	-	57	42	
○ B-17, N27	115.0	*SM*	*Silty SAND*	-	-	42	44	

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GRAIN SIZE DISTRIBUTION
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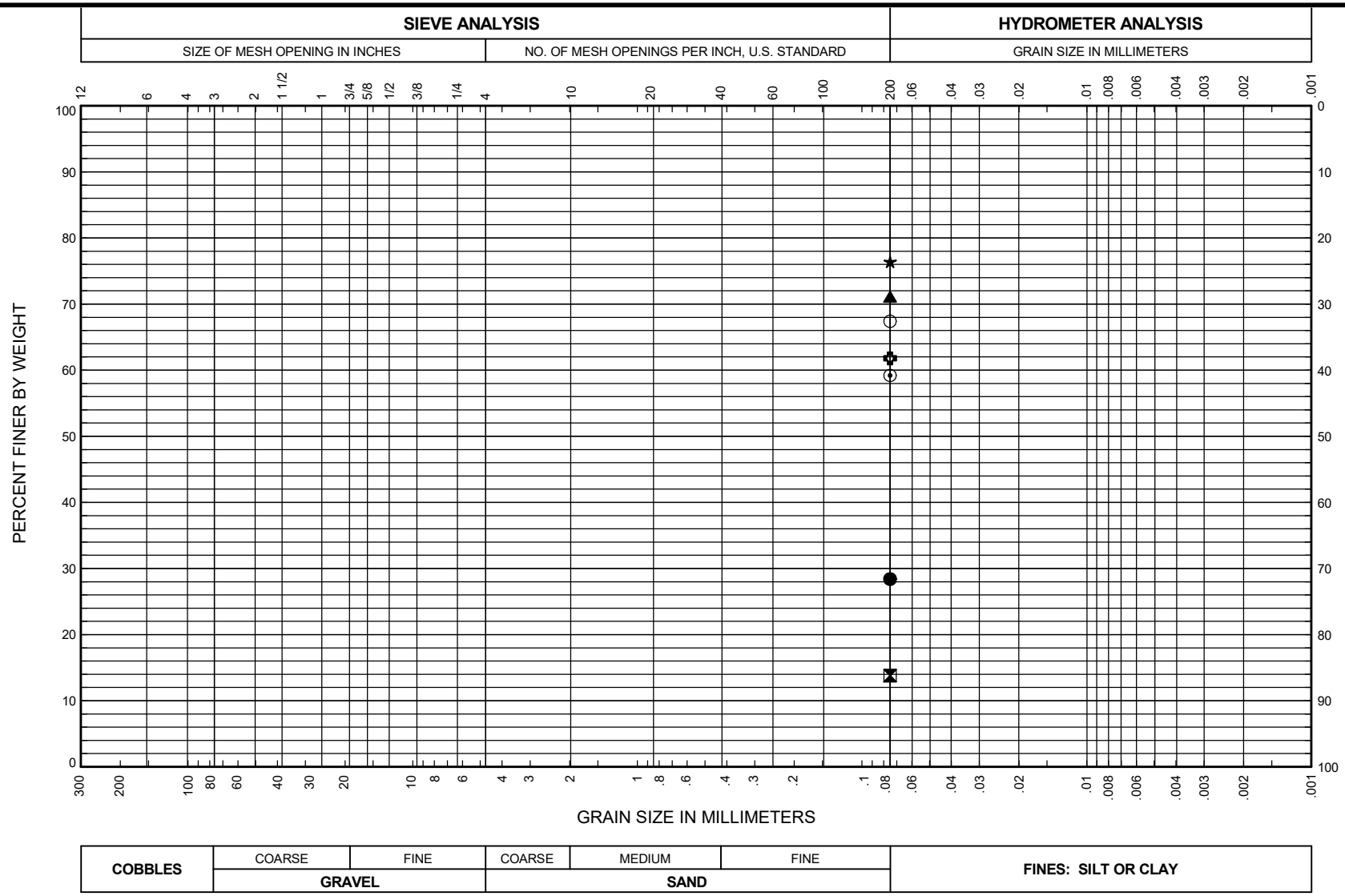
FIG. E8

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-17, N28	120.0	*SM*	*Silty SAND*	-	-	28	40	
⊠ B-17, N29	125.0	*SM*	*Silty SAND*	-	-	14	28	
▲ B-17, N30b	130.8	*ML*	*SILT with some sand*	-	-	71	38	
★ B-17, N31	135.0	*ML*	*SILT with some sand*	-	-	76	47	
⊙ B-17, N32	140.0	*ML*	*Sandy SILT*	-	-	59	40	
✿ B-17, N33	145.0	*ML*	*Sandy SILT*	-	-	62	43	
○ B-18, N14	50.0	*ML*	*Sandy SILT*	-	-	67	33	

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GRAIN SIZE DISTRIBUTION
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FIG. E8

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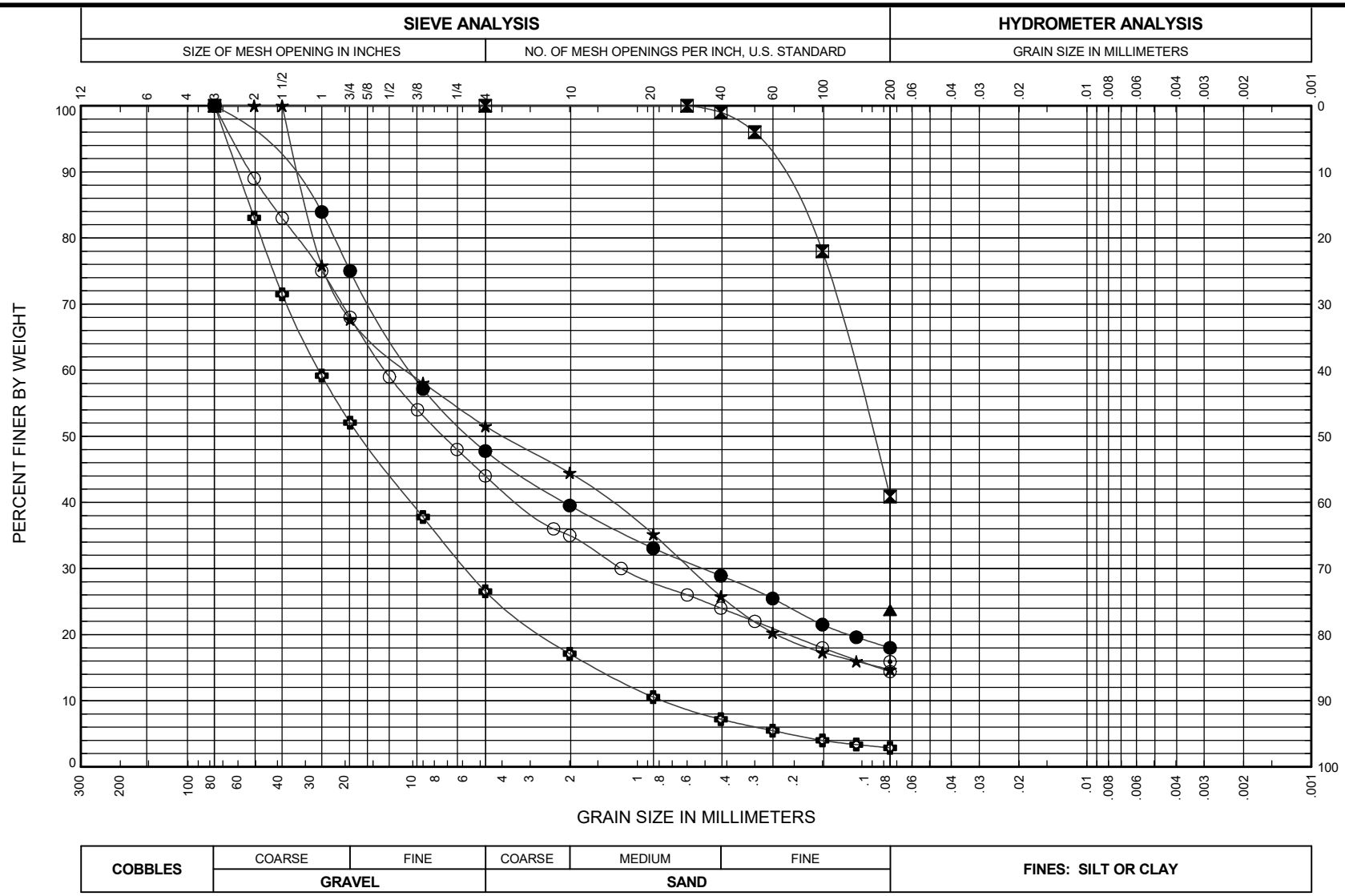

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.
* *Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-23, S2c	28.0	*GM*	*Sandy silty GRAVEL*	52	30	18		
⊠ B-24, S5b	33.0	*SM*	*Silty SAND*	0	59	41		
▲ B-24, S7a	50.0	*SC*	*Clayey SAND*	-	-	24		
★ B-24, S8*	60.0	*GM*	*Sandy silty GRAVEL*	48	37	15		
⊙ B-25, S5b	36.0	*SM*	*Silty SAND*	-	-	16		
✿ B-26, S6*	48.0	*GW*	*GRAVEL with some sand and trace silt*	73	24	3		
○ B-26, S8b	70.5	*GC*	*Clayey GRAVEL with some sand*	56	30	14		

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GRAIN SIZE DISTRIBUTION
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FIG. E8

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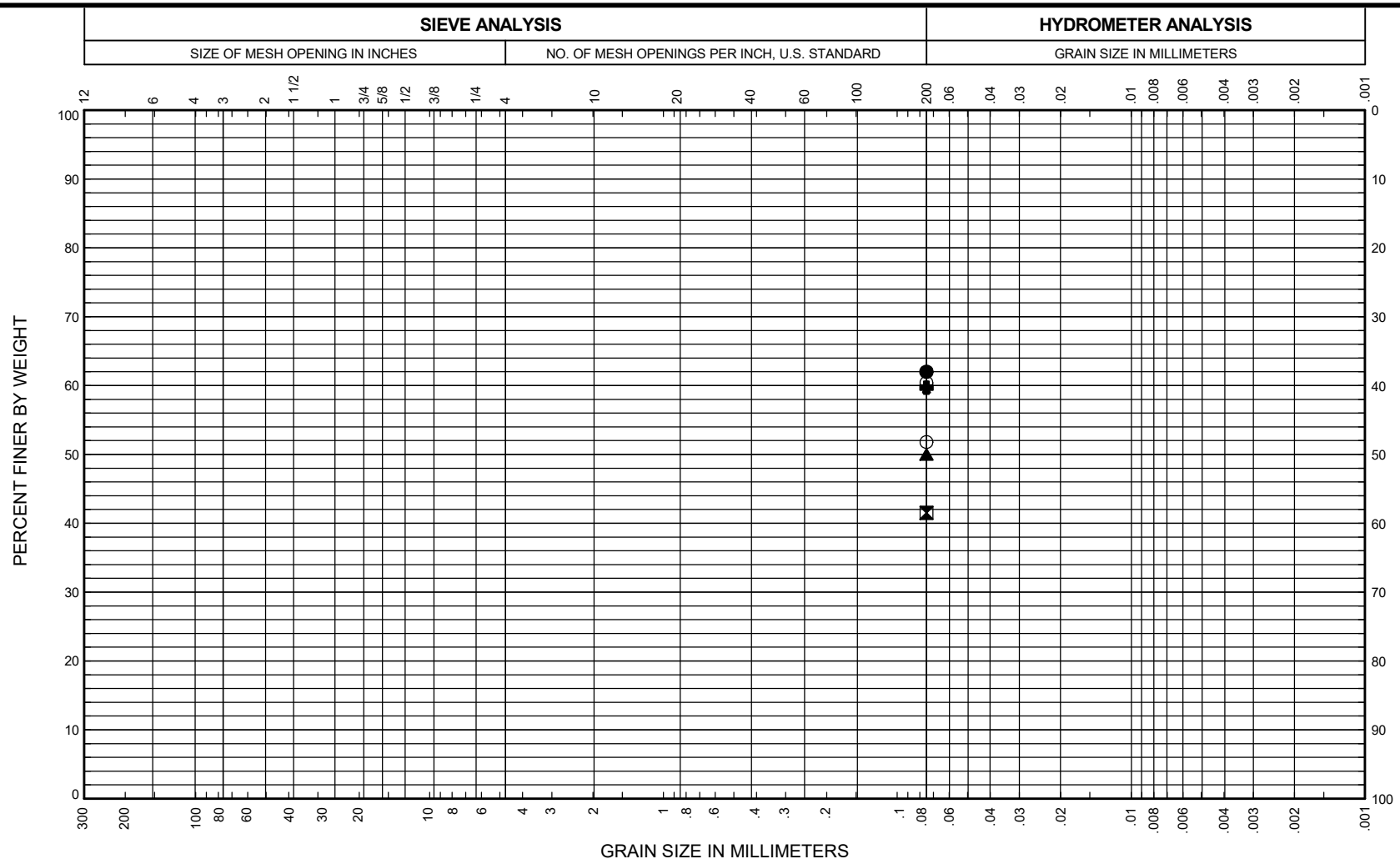

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-32, N14	70.0	*ML*	*Sandy SILT*	-	-	62	44	
⊠ B-32, N15	75.0	*SM*	*Silty SAND*	-	-	42	44	
▲ B-32, N16	80.0	*SM/ML*	*Silty SAND to Sandy SILT*	-	-	50	45	
★ B-32, N17	85.0	*ML*	*Sandy SILT*	-	-	60	46	
⊙ B-32, N18	90.0	*ML*	*Sandy SILT*	-	-	60	43	
✿ B-32, N19	95.0	*ML*	*Sandy SILT*	-	-	60	43	
○ B-32, N20	100.0	*ML*	*Sandy SILT*	-	-	52	42	

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FIG. E8

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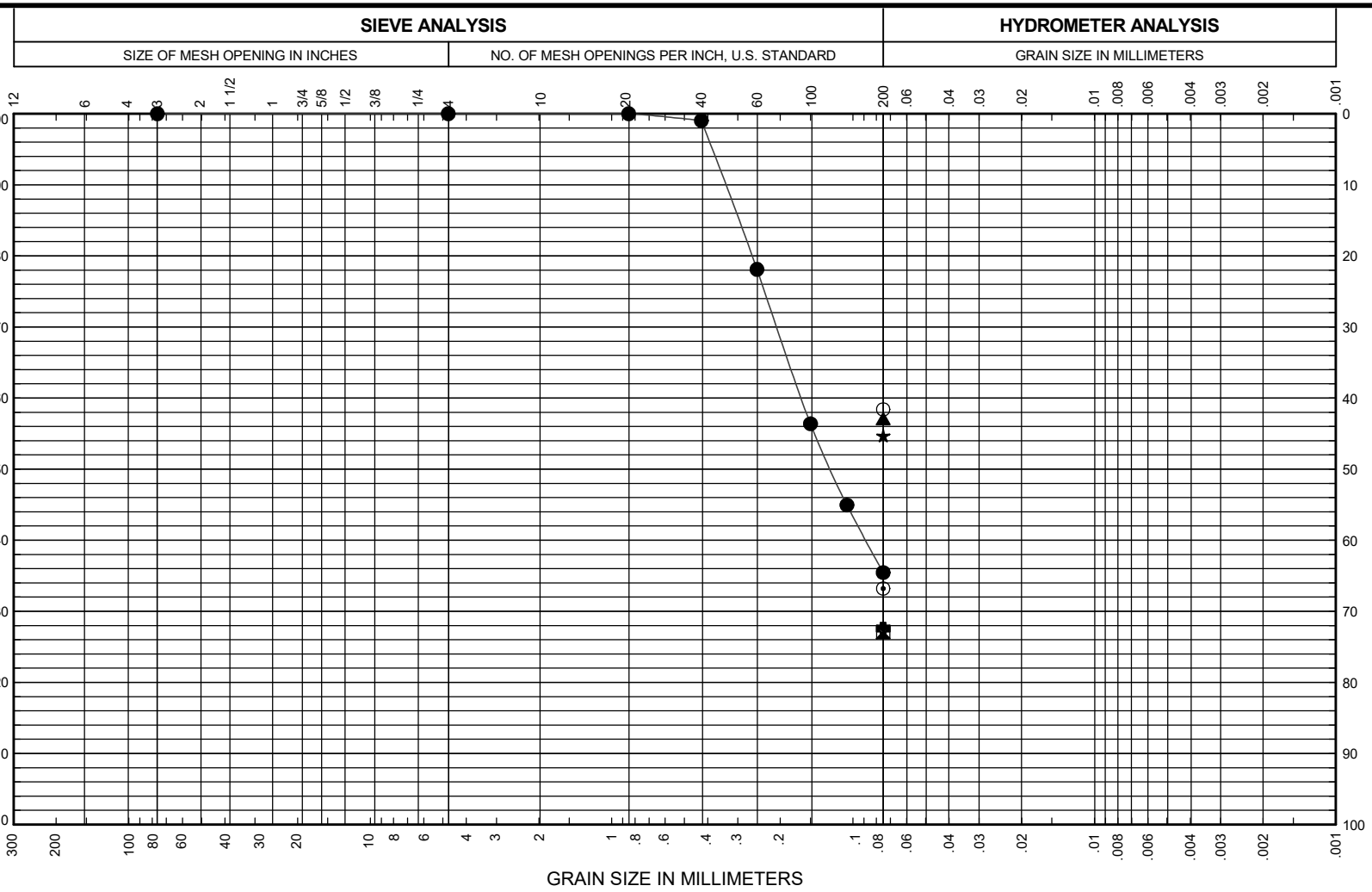

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-32, N21	105.0	*SM*	*Silty SAND*	0	65	35	38	
⊠ B-32, N22	110.0	*SM*	*Silty SAND*	-	-	27	39	
▲ B-32, N23	115.0	*ML*	*Sandy SILT*	-	-	57	43	
★ B-32, N26	130.0	*ML*	*Sandy SILT*	-	-	55	35	
⊙ B-32, N27	135.0	*SM*	*Silty SAND*	-	-	33	32	
✿ B-32, N28	140.0	*SM*	*Silty SAND*	-	-	28	32	
○ B-33, N11	40.0	*ML*	*Sandy SILT*	-	-	58	43	

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GRAIN SIZE DISTRIBUTION
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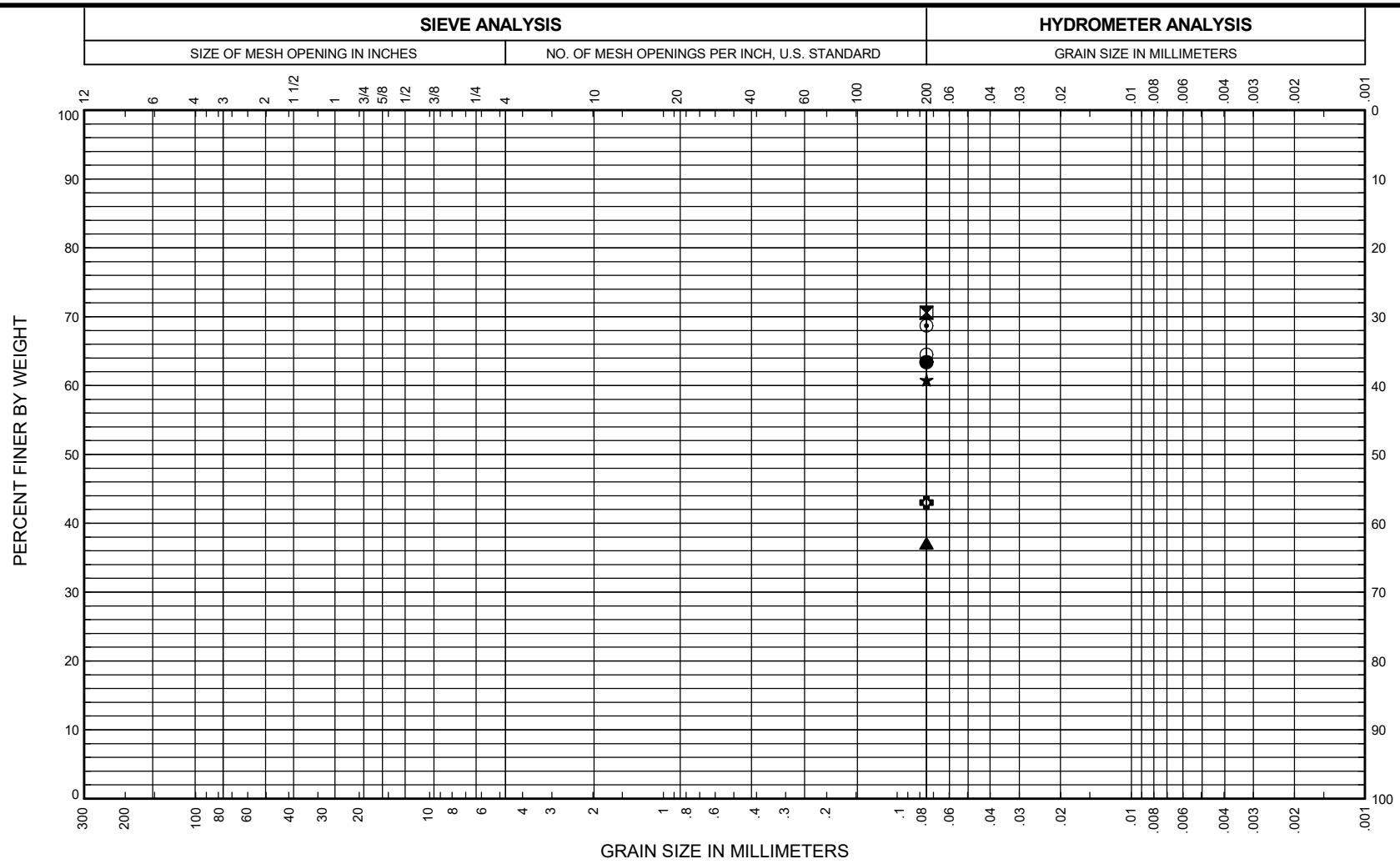
FIG. E8

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-33, N14	55.0	*ML*	*Sandy SILT*	-	-	63	45	
⊠ B-33, N15	60.0	*ML*	*SILT with some sand*	-	-	71	46	
▲ B-33, N17	70.0	*SM*	*Silty SAND*	-	-	37	40	
★ B-33, N18	75.0	*ML*	*Sandy SILT*	-	-	61	44	
⊙ B-33, N19	80.0	*ML*	*Sandy SILT*	-	-	69	40	
✿ B-33, N20	85.0	*SM*	*Silty SAND*	-	-	43	42	
○ B-33, N21	90.0	*ML*	*Sandy SILT*	-	-	65	43	

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GRAIN SIZE DISTRIBUTION
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FIG. E8

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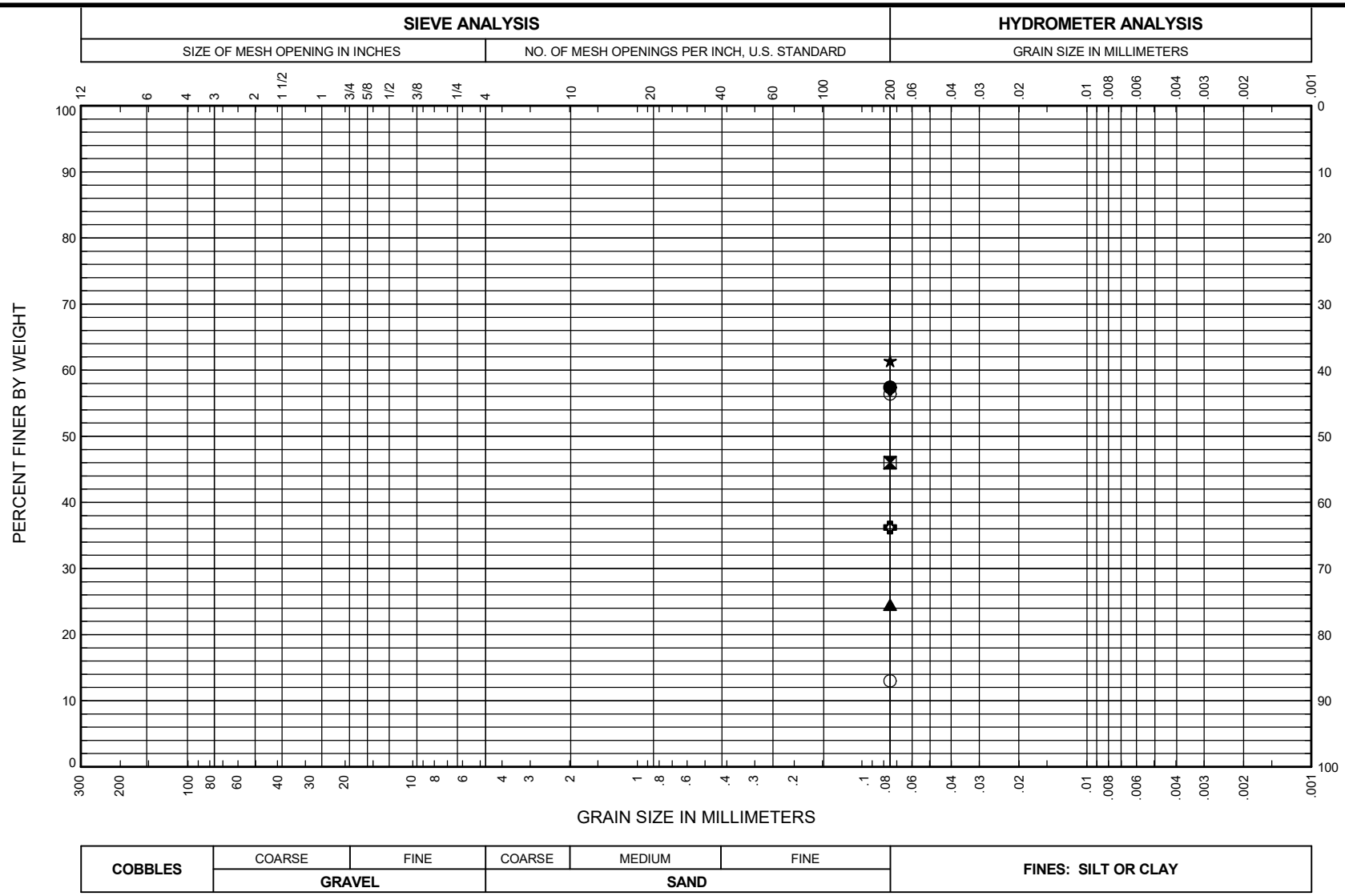

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-33, N23	100.0	*ML*	*Sandy SILT*	-	-	57	44	
⊠ B-33, N24	105.0	*SM*	*Silty SAND*	-	-	46	39	
▲ B-33, N25	110.0	*SM*	*Silty SAND*	-	-	25	39	
★ B-33, N26	115.0	*ML*	*Sandy SILT*	-	-	61	41	
⊙ B-33, N27	120.0	*ML*	*Sandy SILT*	-	-	56	38	
✿ B-33, N29	129.0	*SM*	*Silty SAND*	-	-	36	34	
○ B-33, N30	135.0	*SM*	*Silty SAND*	-	-	13	31	

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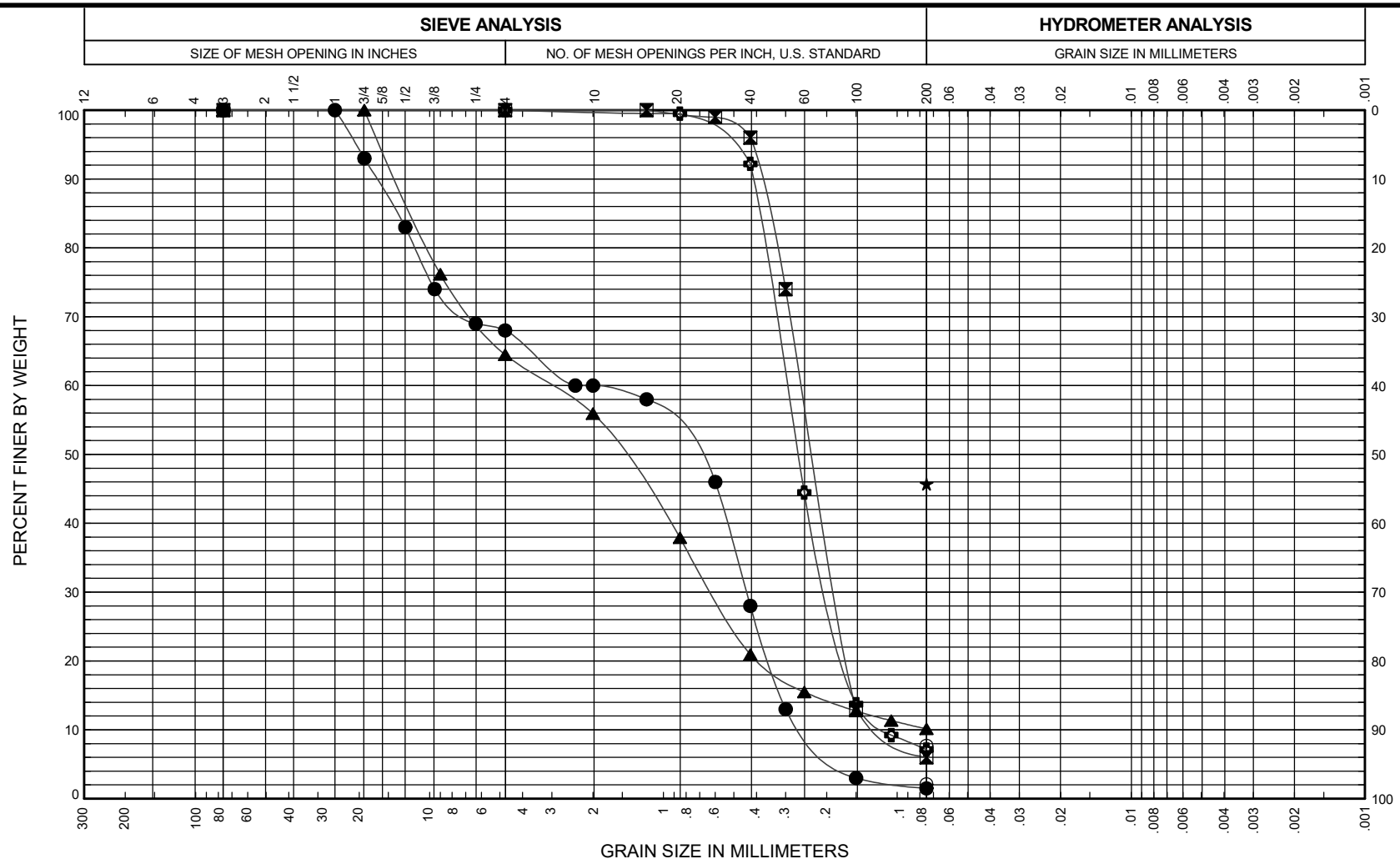
FIG. E8

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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* *Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-02, N2	16.0	*SP*	*Gravelly SAND with trace silt*	32	67	2		
⊠ B-02, N6	36.5	*SP-SM*	*SAND with some silt*	0	94	6		
▲ B-07, N10*	55.0	*SP-SM*	*Gravelly SAND with some silt*	36	54	10	15	
★ B-09, N7	25.4	*SM*	*Silty SAND*	-	-	46	43	
⊙ B-11, N13	39.0	*SP-SM*	*SAND with some silt and trace gravel*	-	-	8	31	
✿ B-11, N15	52.5	*SP-SM*	*SAND with some silt*	0	93	7	34	
○ B-12A, N3	10.0	*SP*	*SAND with trace silt and gravel*	-	-	2	28	

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FIG. E9
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FIG. E9

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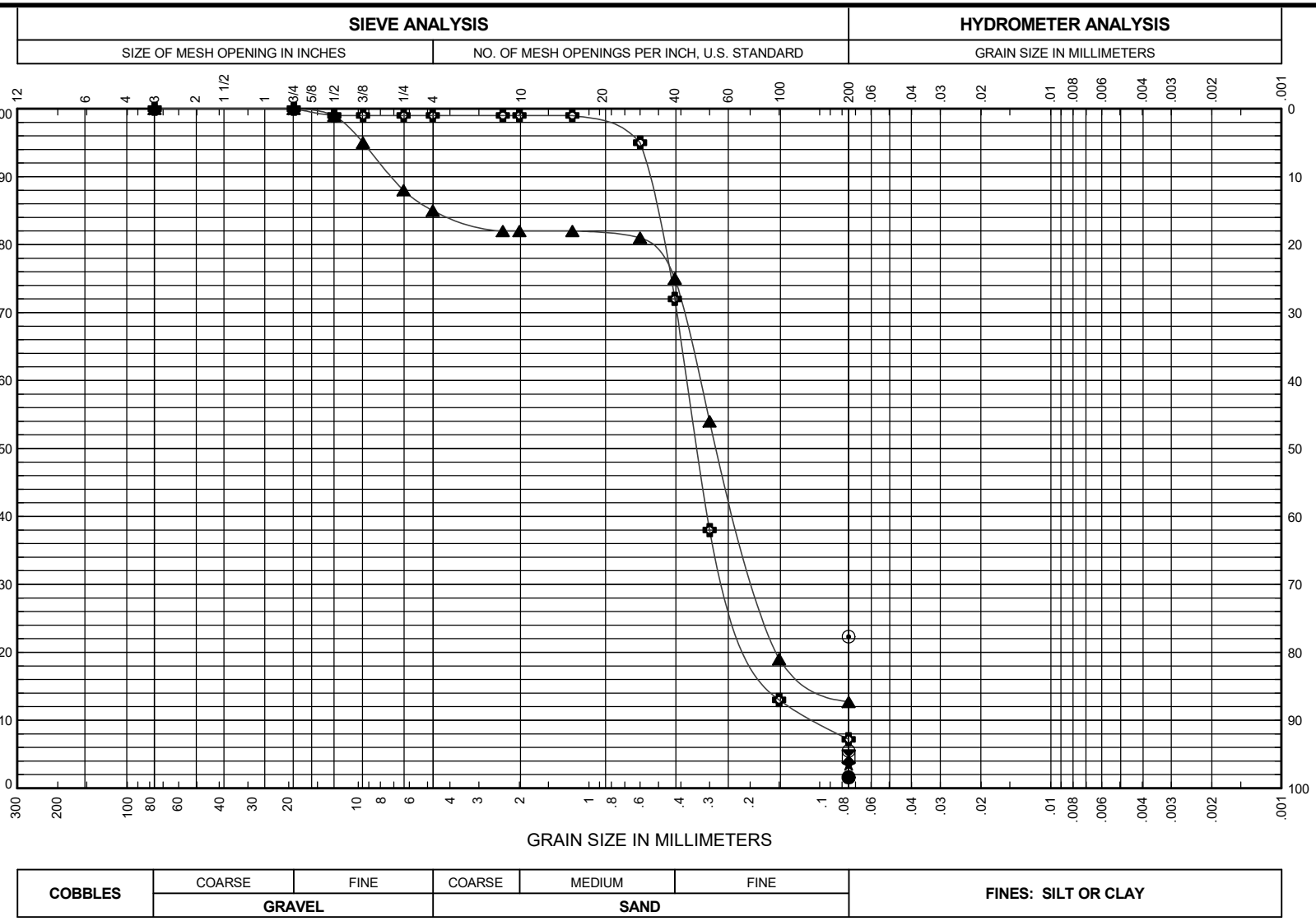

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-12A, N8	25.0	*SP*	*SAND with trace silt*	-	-	2	38	
⊠ B-12A, N12	45.0	*SP*	*SAND with trace silt*	-	-	5	38	
▲ B-13, N4	10.0	*SM*	*Silty SAND with some gravel*	15	72	13	36	
★ B-13, N6	15.0	*SP*	*SAND with trace silt*	-	-	4	30	
⊙ B-13, N11	35.0	*SM*	*Silty SAND*	-	-	22	39	
✿ B-13, N12	40.0	*SP-SM*	*SAND with some silt*	1	92	7	28	
○ B-13, N14	50.0	*SP-SM*	*SAND with some silt*	-	-	6	31	

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FIG. E9

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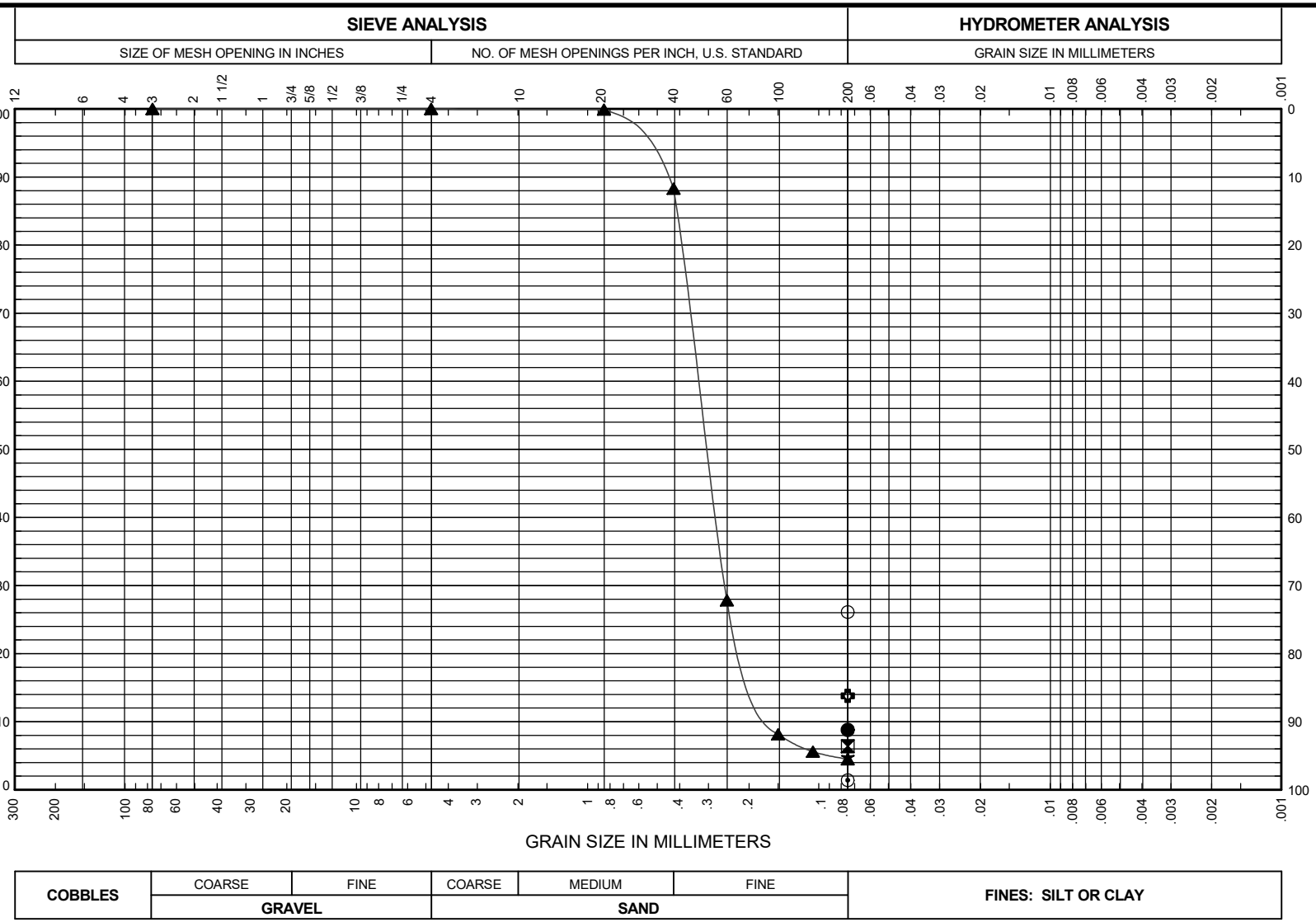

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-14, N15	65.0	*SP-SM*	*SAND with some silt*	-	-	9	41	
⊠ B-14, N16	70.0	*SP-SM*	*SAND with some silt*	-	-	6	41	
▲ B-14, N18	90.0	*SP*	*SAND with trace silt*	0	96	4	45	
★ B-14, N20	110.0	*SP*	*SAND with trace silt*	-	-	5	45	
⊙ B-14, N21	120.0	*SP*	*SAND with trace silt*	-	-	1	37	
✿ B-15, N32	140.0	*SM*	*Silty SAND*	-	-	14	36	
○ B-15, N33	145.0	*SM*	*Silty SAND*	-	-	26	35	

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FIG. E9

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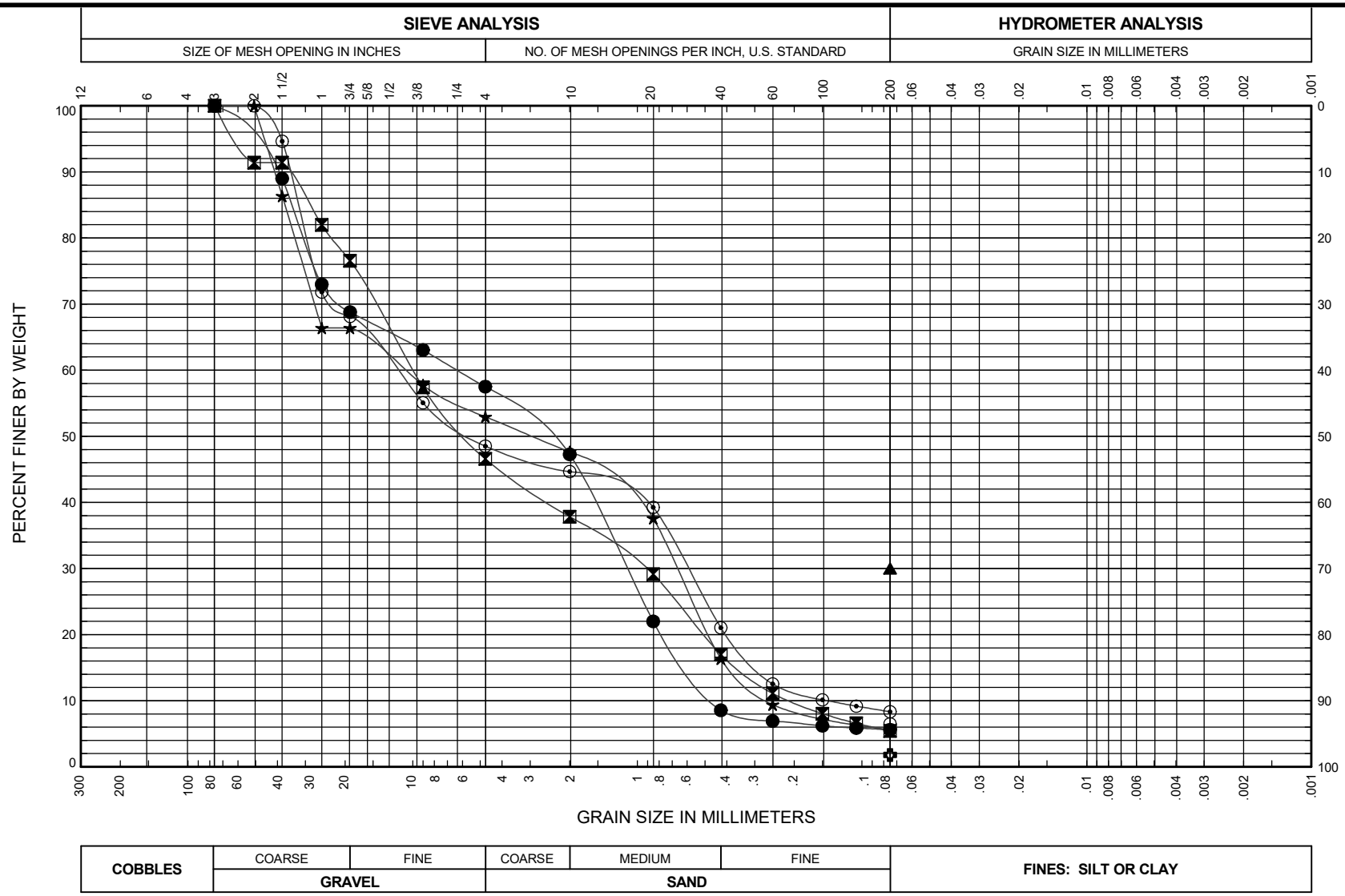

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** Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-22, S4a	50.0	*SP-SM*	*Gravelly SAND with some silt*	42	52	6		
⊠ B-24, S2*	10.0	*GP-GM*	*Sandy GRAVEL with some silt*	53	41	5		
▲ B-24, S6b	42.0	*SM*	*Silty SAND*	-	-	30		
★ B-25, S3*	14.0	*SP-SM*	*Gravelly SAND with some silt*	47	47	6		
⊙ B-26, S4c*	33.0	*GP-GM*	*Sandy GRAVEL with some silt*	51	40	8		
✿ B-27, N3	10.5	*SP*	*Gravelly SAND with trace silt*	-	-	2	19	
○ B-27, N6	18.6	*SP-SM*	*SAND with some silt and gravel*	-	-	7	26	

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GRAIN SIZE DISTRIBUTION
SAND ALLUVIUM

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FIG. E9
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FIG. E9

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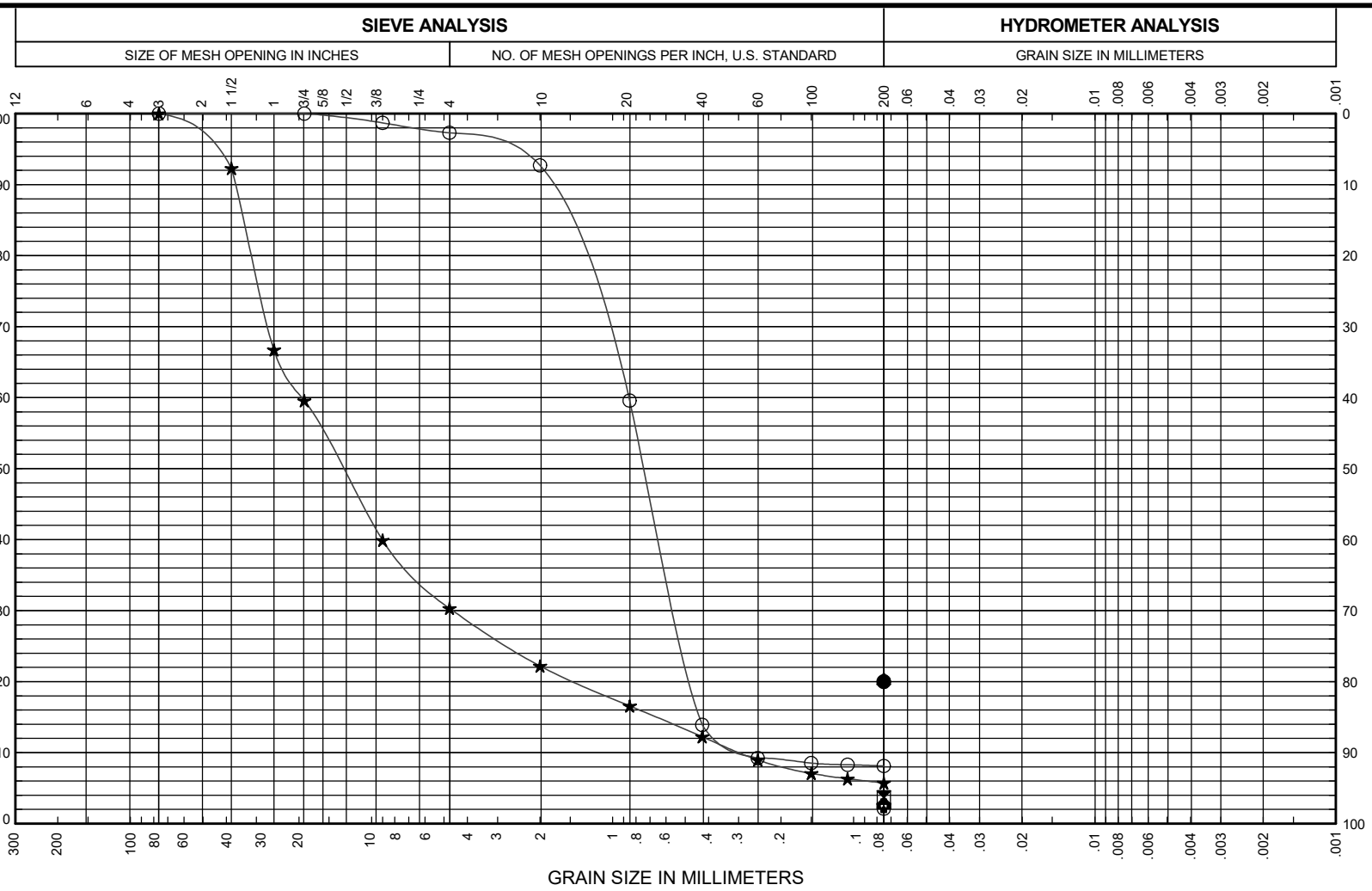

NOTES:
1) Sieve analyses were performed in general accordance with ASTM D6913, sieve with hydrometer analyses were performed in general accordance with ASTM D422, and amount finer than #200 sieve analyses were performed in general accordance with ASTM D1140 unless otherwise noted in the report.
2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-27, N14	55.7	*SM*	*Silty SAND with trace gravel*	-	-	20	36	
⊠ B-28, S1b	8.5	*SP*	*SAND with trace silt and gravel*	-	-	4		
▲ B-28, S2d	29.7	*SM*	*Silty SAND*	-	-	20		
★ B-28, S3b	47.5	*GP-GM*	*GRAVEL with some silt and sand*	70	25	6		
⊙ B-29, S2	25.0	*SP*	*SAND with trace silt and gravel*	-	-	2		
✿ B-29, S3	40.0	*SP*	*SAND with trace silt and gravel*	-	-	3		
○ B-30, S3a	44.0	*SP-SM*	*SAND with some silt*	3	89	8		

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Portland, Oregon

GRAIN SIZE DISTRIBUTION
SAND ALLUVIUM

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FIG. E9
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FIG. E9

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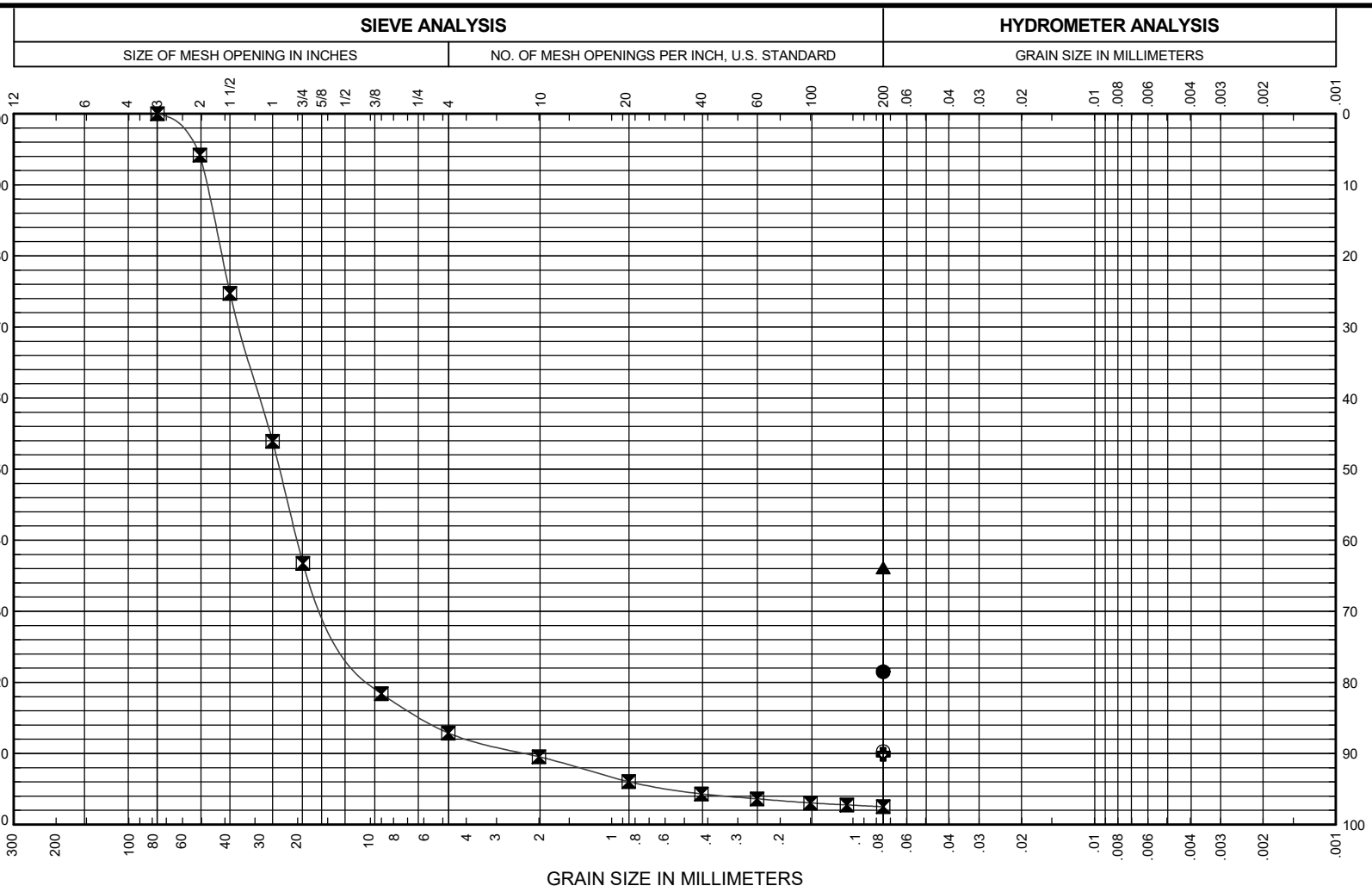

NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-31, S3a	30.7	*SM*	*Silty SAND*	-	-	22		
⊠ B-31, S4b	55.0	*GP*	*GRAVEL with trace silt and sand*	87	10	3		
▲ B-32, N30	150.0	*SM*	*Silty SAND*	-	-	36	36	
★ B-33, N31	140.0	*SM*	*Gravelly silty SAND*	-	-	22	33	
⊙ B-33, N35	165.0	*SP-SM*	*SAND with some silt and gravel*	-	-	10	24	
✿ B-33, N37	175.0	*SP-SM*	*SAND with some silt and gravel*	-	-	10	13	

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GRAIN SIZE DISTRIBUTION
SAND ALLUVIUM

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FIG. E9
Sheet 6 of 6

FIG. E9

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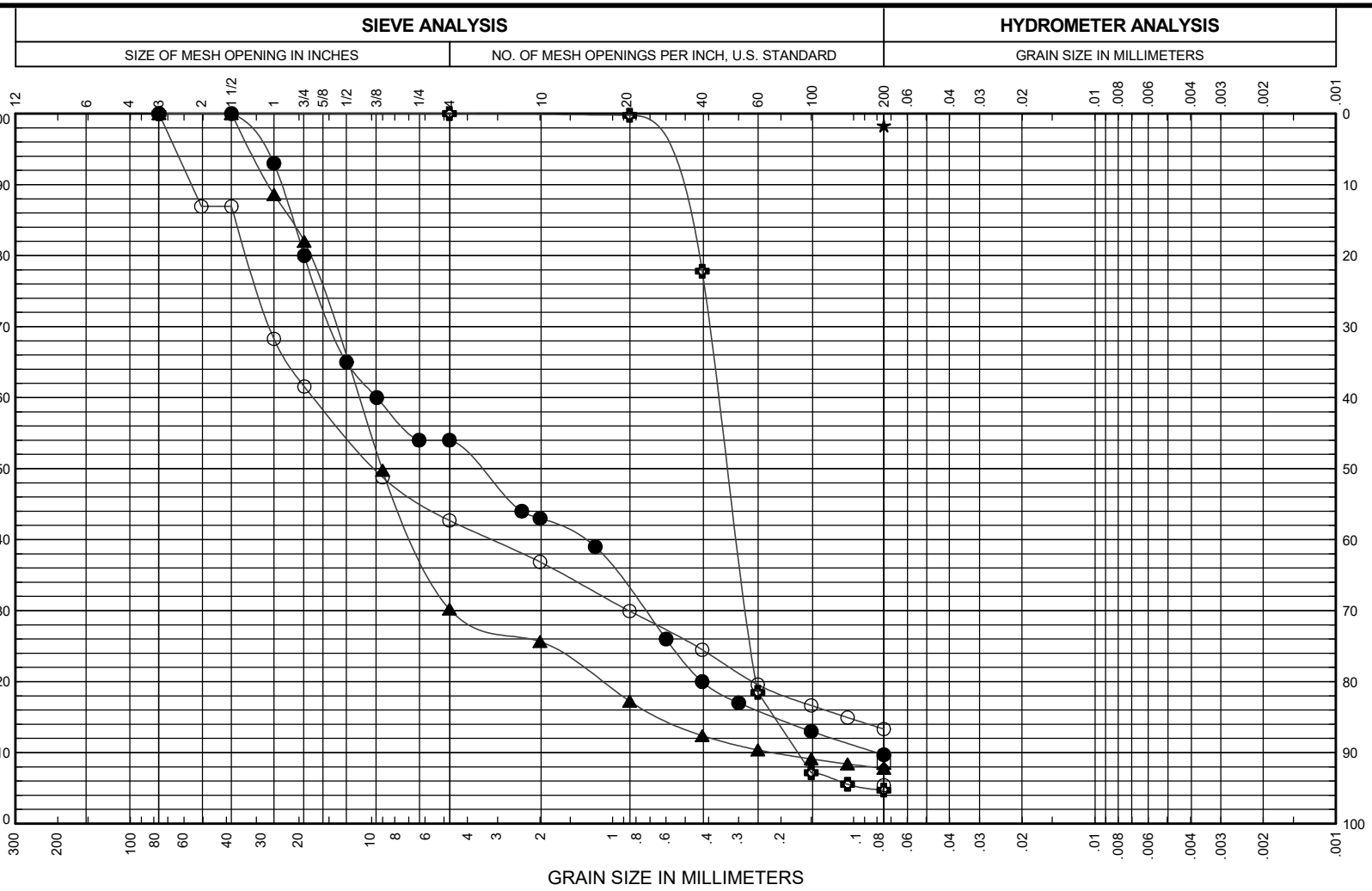

NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.
* *Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-01, N10	50.0	*GP-GM*	*Sandy GRAVEL with some silt*	46	44	10		
⊠ B-06, N9	60.0	*SP-SM*	*SAND with some silt*	-	-	9	26	
▲ B-08, N7*	40.0	*GP-GM*	*GRAVEL with some silt and sand*	70	22	8	10	
★ B-08, N9	50.0	*MH*	*Clayey SILT*	-	-	98	42	
⊙ B-13, N20	80.0	*GP-GM*	*GRAVEL with some silt and sand*	-	-	5	11	
✿ B-14, N22	128.6	*SP*	*SAND with trace silt (tested material not representative; see drill log)*	0	95	5	35	
○ B-22, S3a	30.0	*GM*	*Silty GRAVEL with some sand*	57	29	13		

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GRAIN SIZE DISTRIBUTION
GRAVEL ALLUVIUM

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FIG. E10
Sheet 1 of 2

FIG. E10

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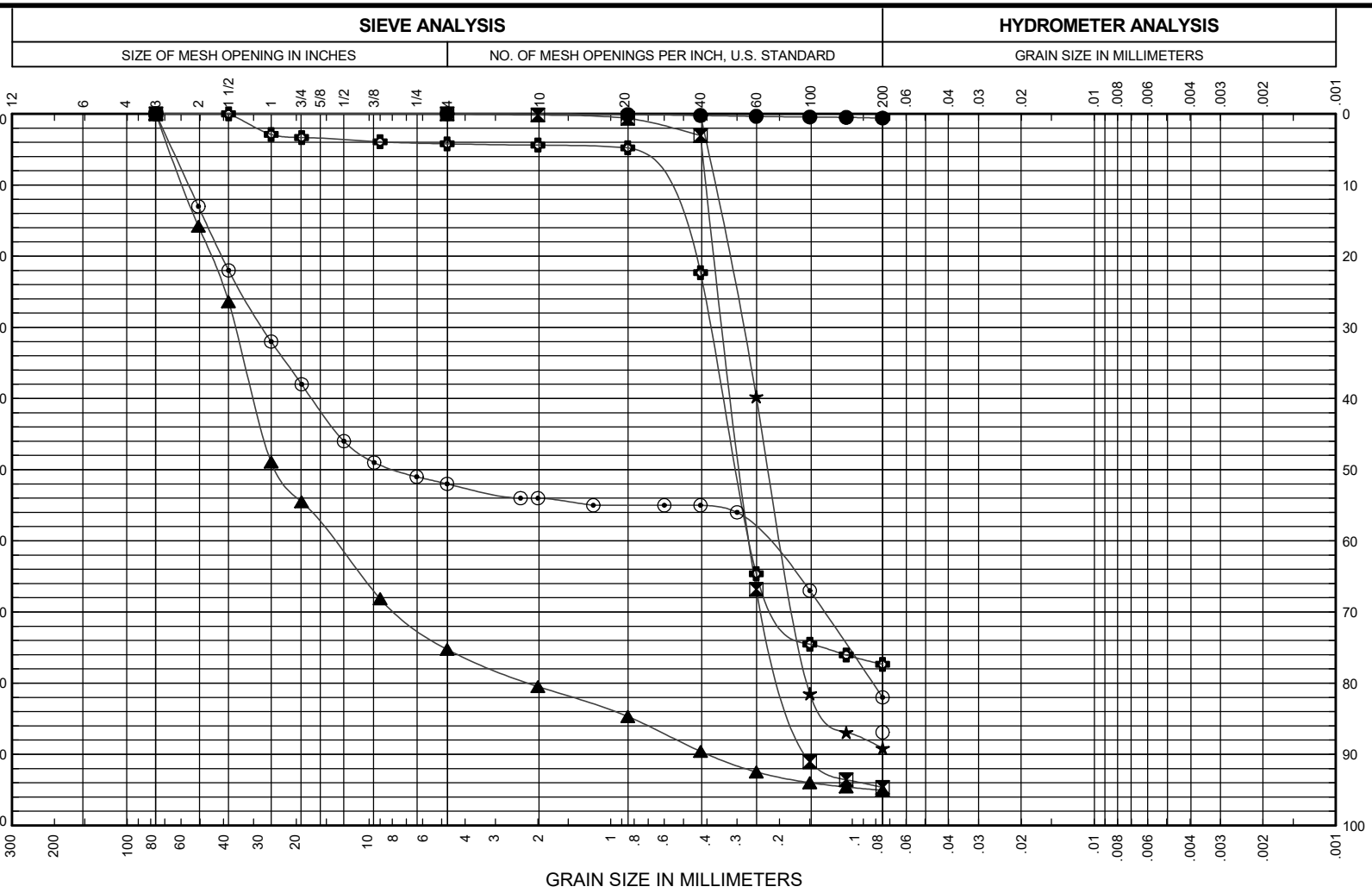

NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-22, S3b	44.0	*ML*	*SILT*	0	1	99		
⊠ B-22, S4d	63.0	*SP-SM*	*SAND with some silt*	0	95	5		
▲ B-23, S3c	32.5	*GP-GM*	*GRAVEL with some silt and sand*	75	20	5		
★ B-23, S5b	63.0	*SP-SM*	*SAND with some silt*	0	89	11		
⊙ B-25, S6a	44.0	*GM*	*Sandy silty GRAVEL*	52	30	18		
✿ B-30, S2b	26.0	*SM*	*Silty SAND*	4	73	23		
○ B-32, N31	155.0	*GM*	*Silty GRAVEL with some sand*	-	-	13	15	

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GRAIN SIZE DISTRIBUTION
GRAVEL ALLUVIUM

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FIG. E10
Sheet 2 of 2

FIG. E10

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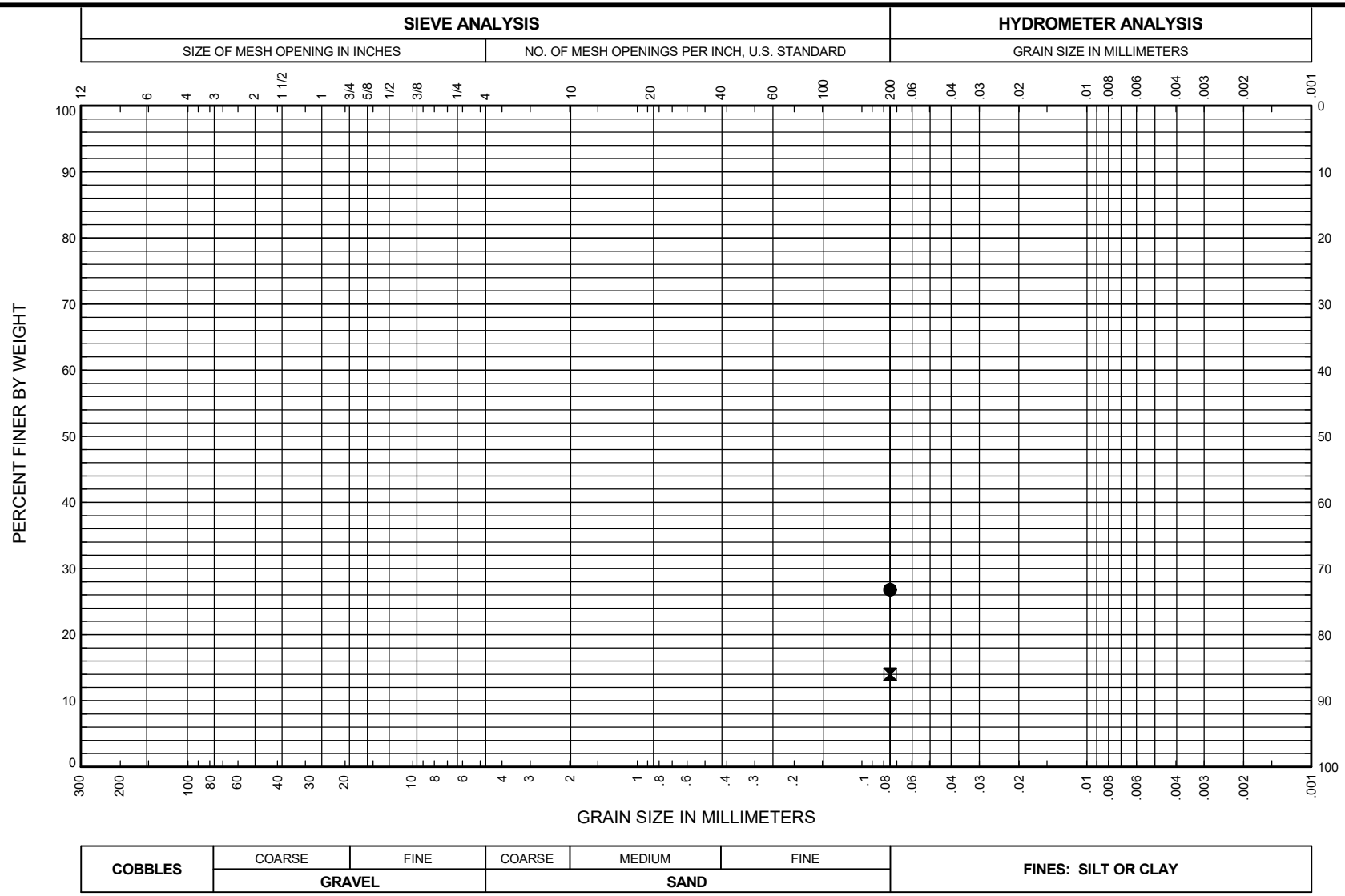

NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.
** Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-20, N4	25.0	*SM*	*Silty SAND*	-	-	27	23	
⊠ B-20, N5*	30.0	*SM*	*Silty SAND with trace gravel*	-	-	14	19	

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GRAIN SIZE DISTRIBUTION
CATASTROPHIC FLOOD DEPOSITS - CHANNEL FACIES

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FIG. E11

FIG. E11

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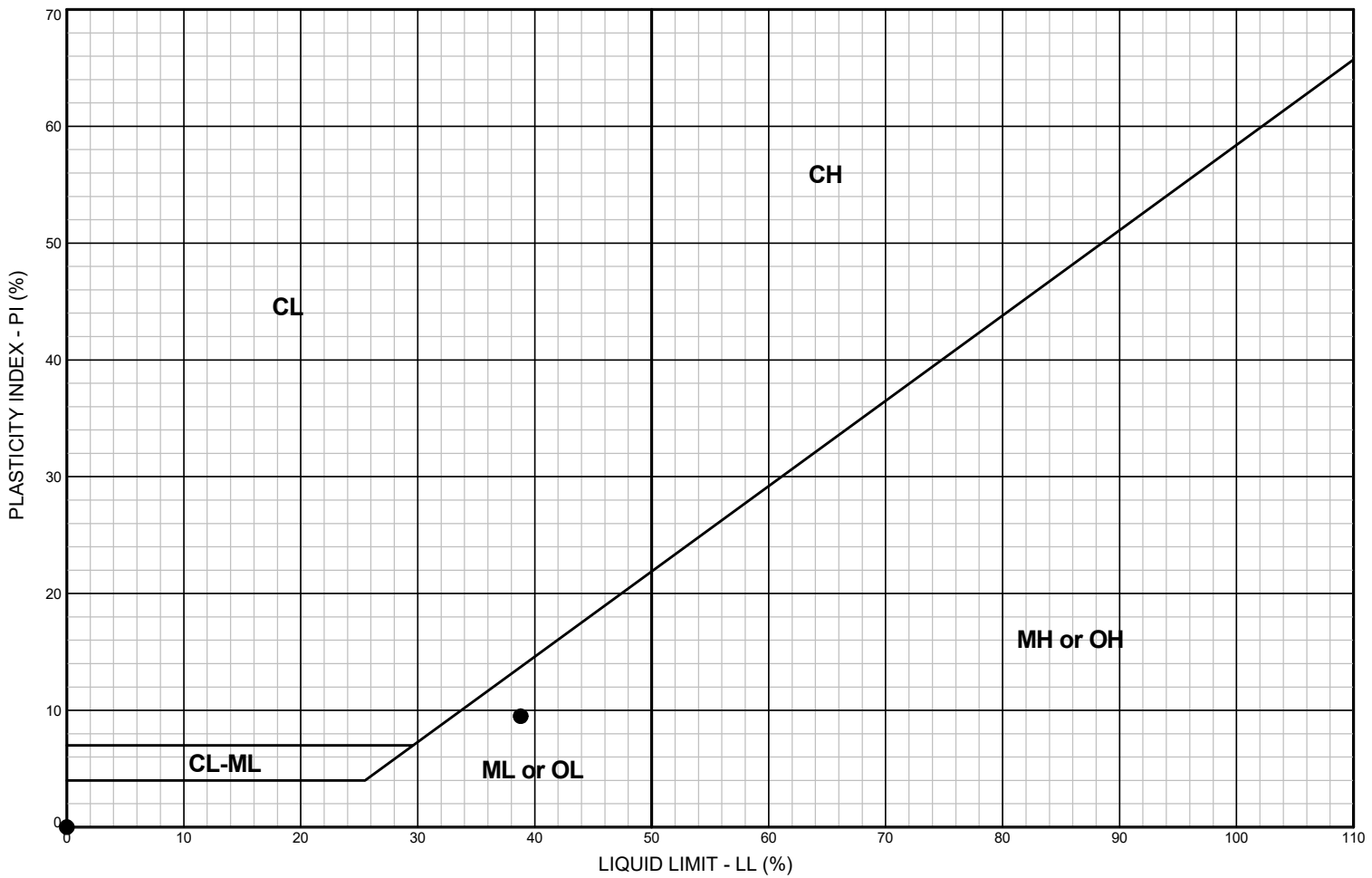

NOTES

1) Atterberg limits tests were performed in general accordance with ASTM D4318 unless otherwise noted in the report.

2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

3) Plasticity adjectives used in sample descriptions correspond to plasticity index as follows:
- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-20, N1	10.0	*ML*	*SILT with trace sand*	39	29	10	41	
B-20, N2	15.0	*ML*	*SILT with some sand*	NP	NP	NP	39	

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ATTERBERG LIMITS RESULTS
CATASTROPHIC FLOOD DEPOSITS
- FINE-GRAINED FACIES

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FIG. E12

FIG. E12

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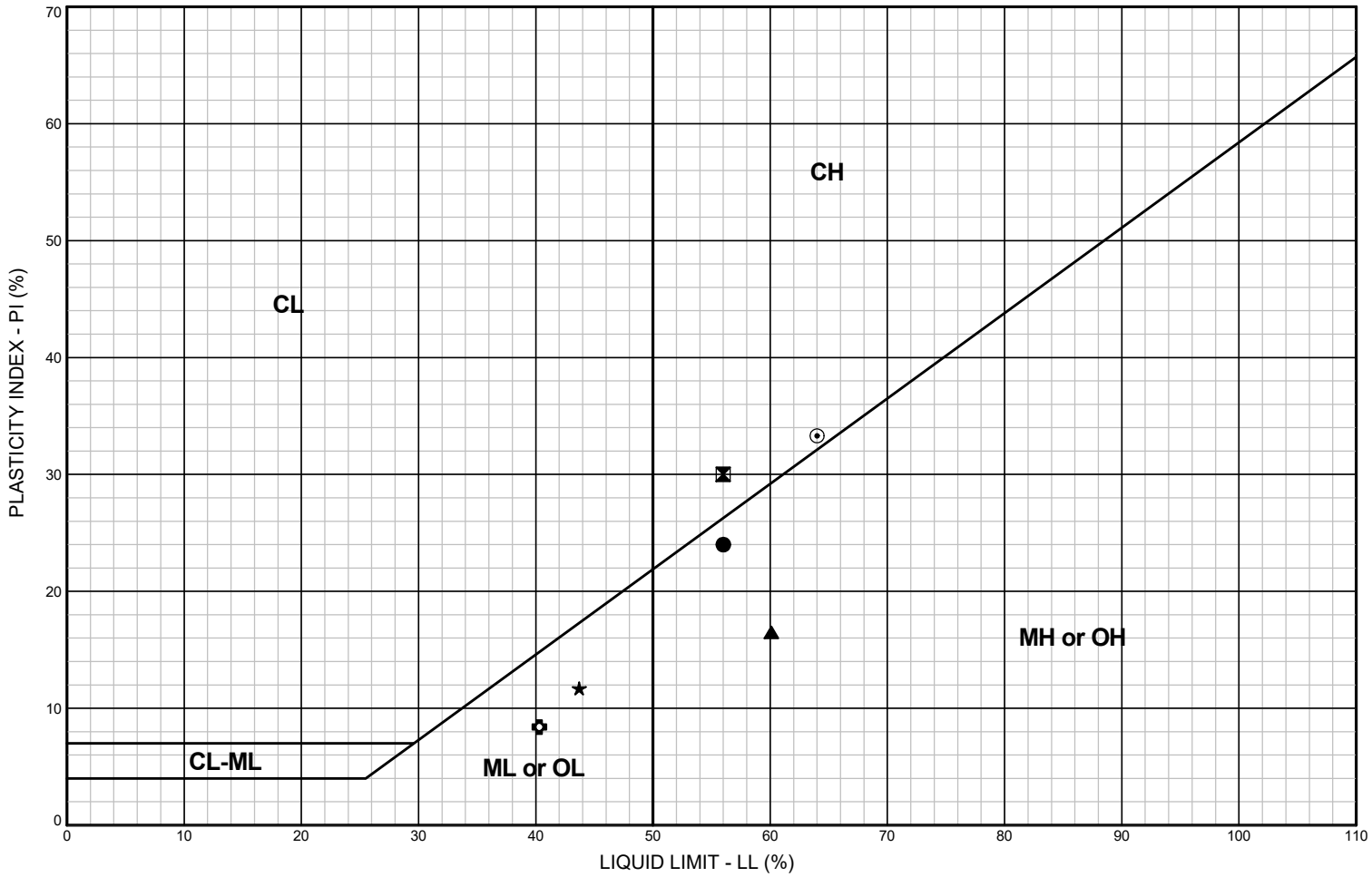

NOTES

1) Atterberg limits tests were performed in general accordance with ASTM D4318 unless otherwise noted in the report.

2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

3) Plasticity adjectives used in sample descriptions correspond to plasticity index as follows:
- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-01, N18	90.0	*MH*	*Clayey SILT*	56	32	24		
⊠ B-02, N14	77.0	*CH*	*CLAY with some sand*	56	26	30		76.3
▲ B-27, N19	79.4	*MH*	*Clayey SILT with trace sand*	60	44	16	36	
★ B-27, N20	84.5	*ML*	*SILT with some sand*	44	32	12	40	
⊙ B-30, S4d	72.0	*CH*	*CLAY*	64	31	33		
✿ B-30, S5a	85.0	*ML*	*SILT with trace sand*	40	32	8		

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ATTERBERG LIMITS RESULTS
UPPER TROUTDALE FORMATION

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FIG. E13

FIG. E13

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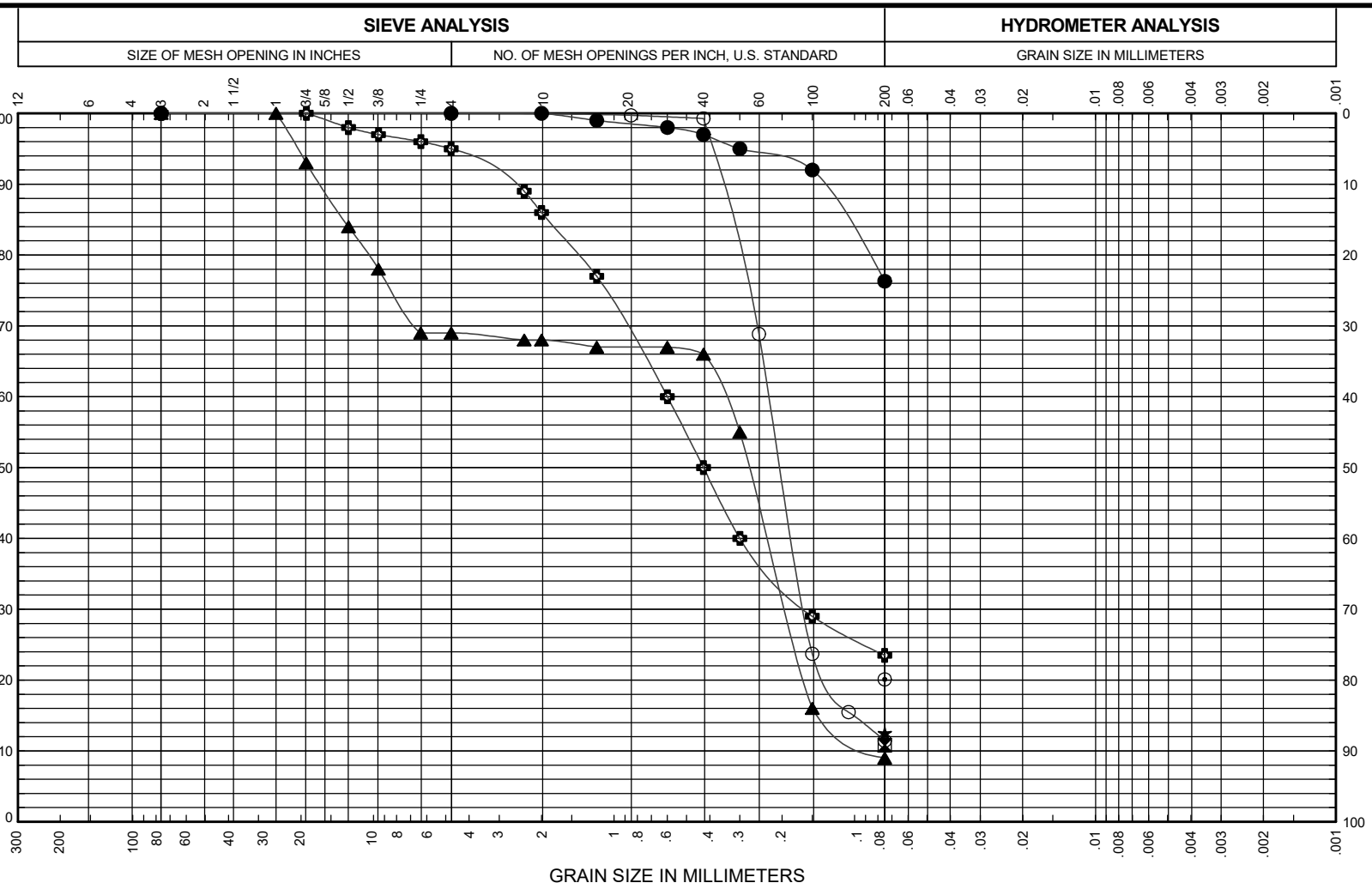

NOTES:
1) Sieve analyses were performed in general accordance with ASTM D6913, sieve with hydrometer analyses were performed in general accordance with ASTM D422, and amount finer than #200 sieve analyses were performed in general accordance with ASTM D1140 unless otherwise noted in the report.
2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-02, N14	77.0	*CH*	*CLAY with some sand*	0	24	76		
⊠ B-04, N13	60.0	*SP-SM*	*SAND with some silt and trace gravel*	-	-	11	23	
▲ B-05, N10	50.0	*SP-SM*	*Gravelly SAND with some silt*	31	60	9	25	
★ B-05, N12	60.0	*SM*	*Silty SAND*	-	-	13	23	
⊙ B-08, N15	80.0	*SM*	*Silty SAND*	-	-	20	28	
✿ B-10, N15	61.3	*SM*	*Silty SAND with trace gravel*	5	72	24	36	
○ B-21, N11	55.0	*SP-SM*	*SAND with some silt*	0	89	11	25	

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GRAIN SIZE DISTRIBUTION
UPPER TROUTDALE FORMATION

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FIG. E14
Sheet 1 of 3

FIG. E14

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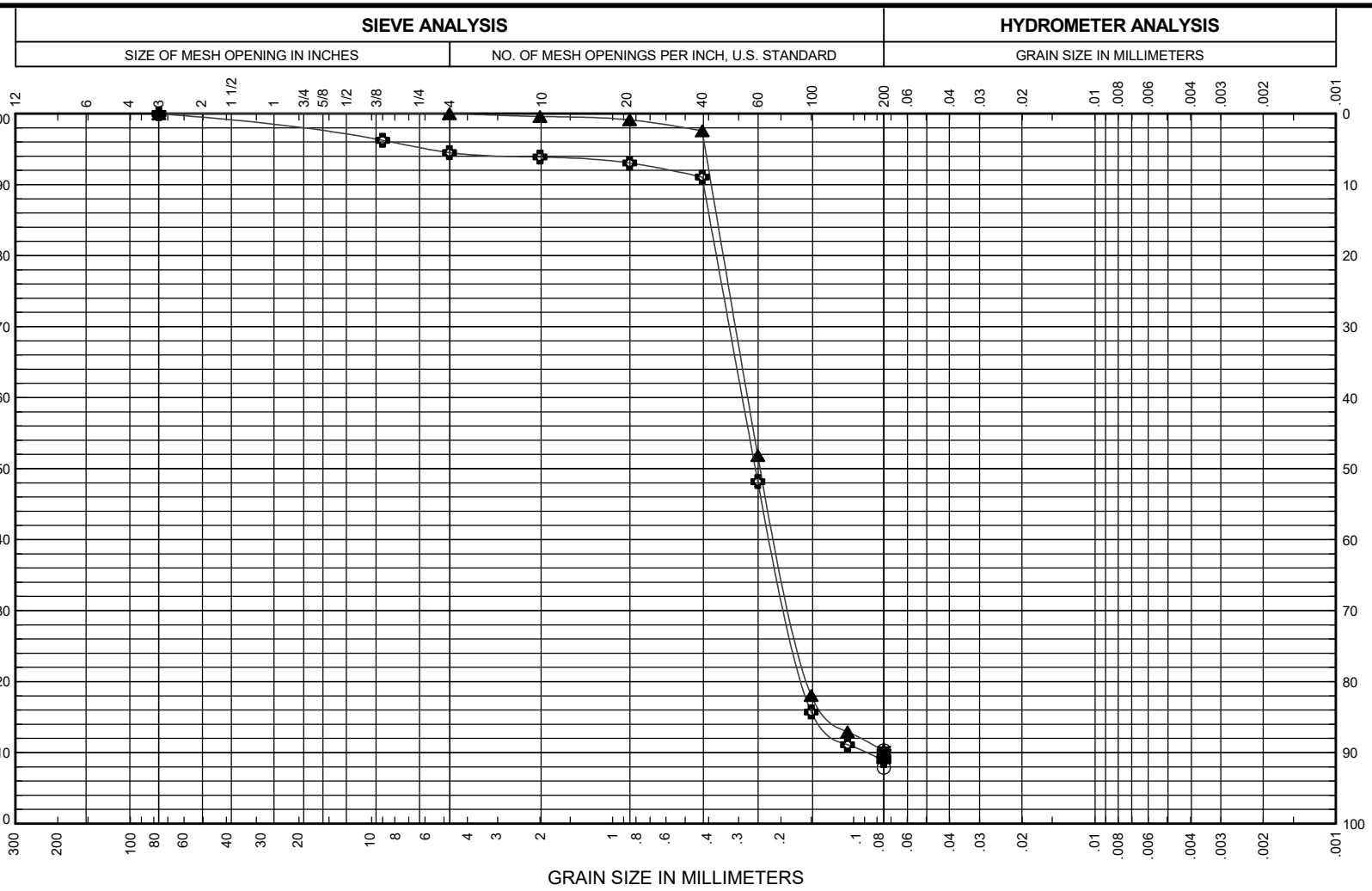

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-21, N12	60.0	*SP-SM*	*SAND with some silt*	-	-	9	22	
⊠ B-21, N13	65.0	*SP-SM*	*SAND with some silt and trace gravel*	-	-	10	19	
▲ B-21, N14	70.0	*SP-SM*	*SAND with some silt*	0	90	10	23	
★ B-21, N15	75.0	*SP-SM*	*SAND with some silt*	-	-	11	24	
⊙ B-21, N16	80.0	*SP-SM*	*SAND with some silt*	-	-	10	25	
✿ B-21, N17	85.0	*SP-SM*	*SAND with some silt and trace gravel*	5	86	9	22	
○ B-21, N18	90.0	*SP-SM*	*SAND with some silt and trace gravel*	-	-	8	22	

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GRAIN SIZE DISTRIBUTION
UPPER TROUTDALE FORMATION

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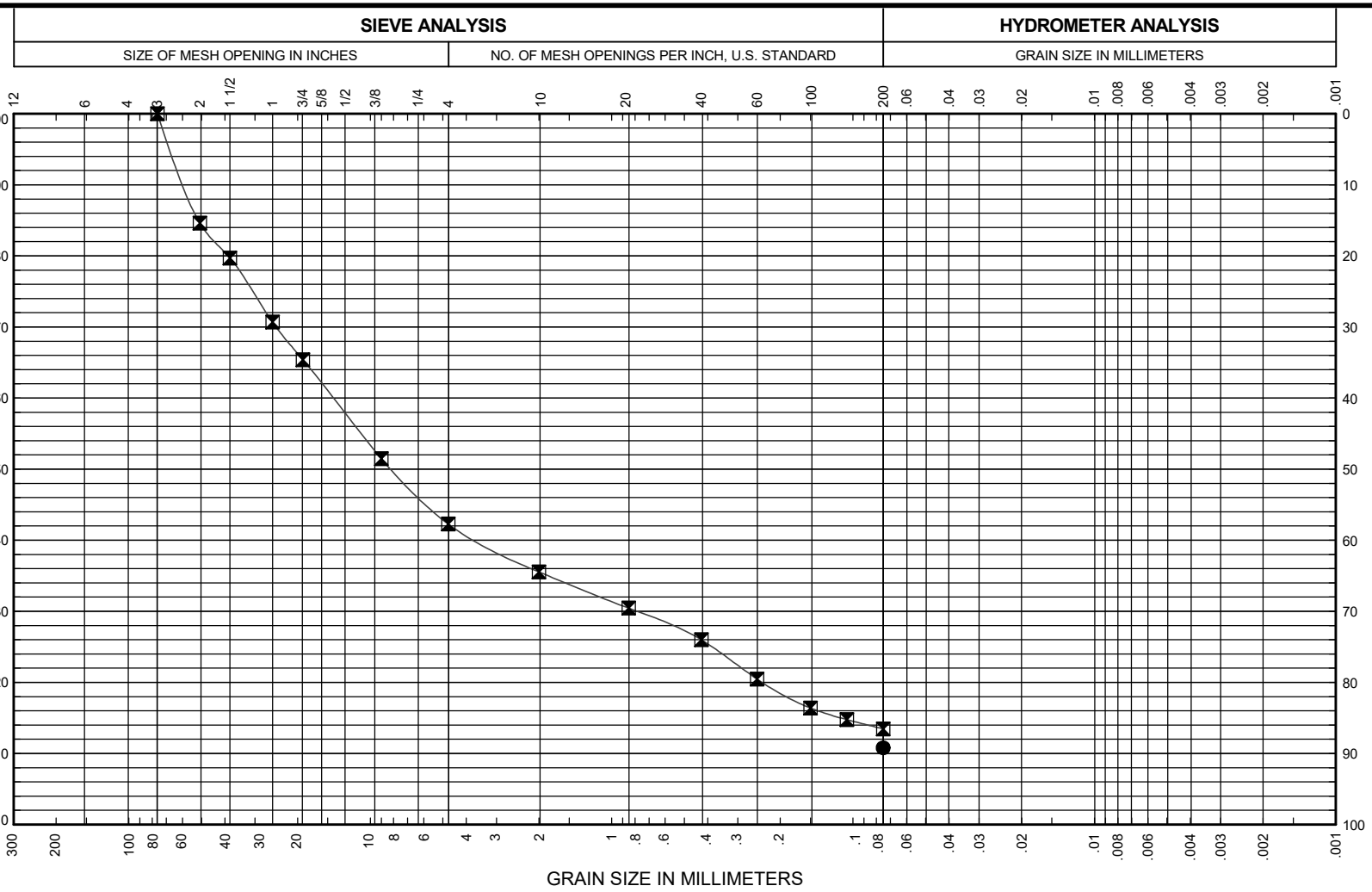
FIG. E14
Sheet 2 of 3

FIG. E14

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-21, N19	95.0	*SP-SM*	*SAND with some silt and trace gravel*	-	-	11	25	
⊠ B-30, S5c	91.0	*GC*	*Clayey GRAVEL with some sand*	58	29	13		

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GRAIN SIZE DISTRIBUTION
UPPER TROUTDALE FORMATION

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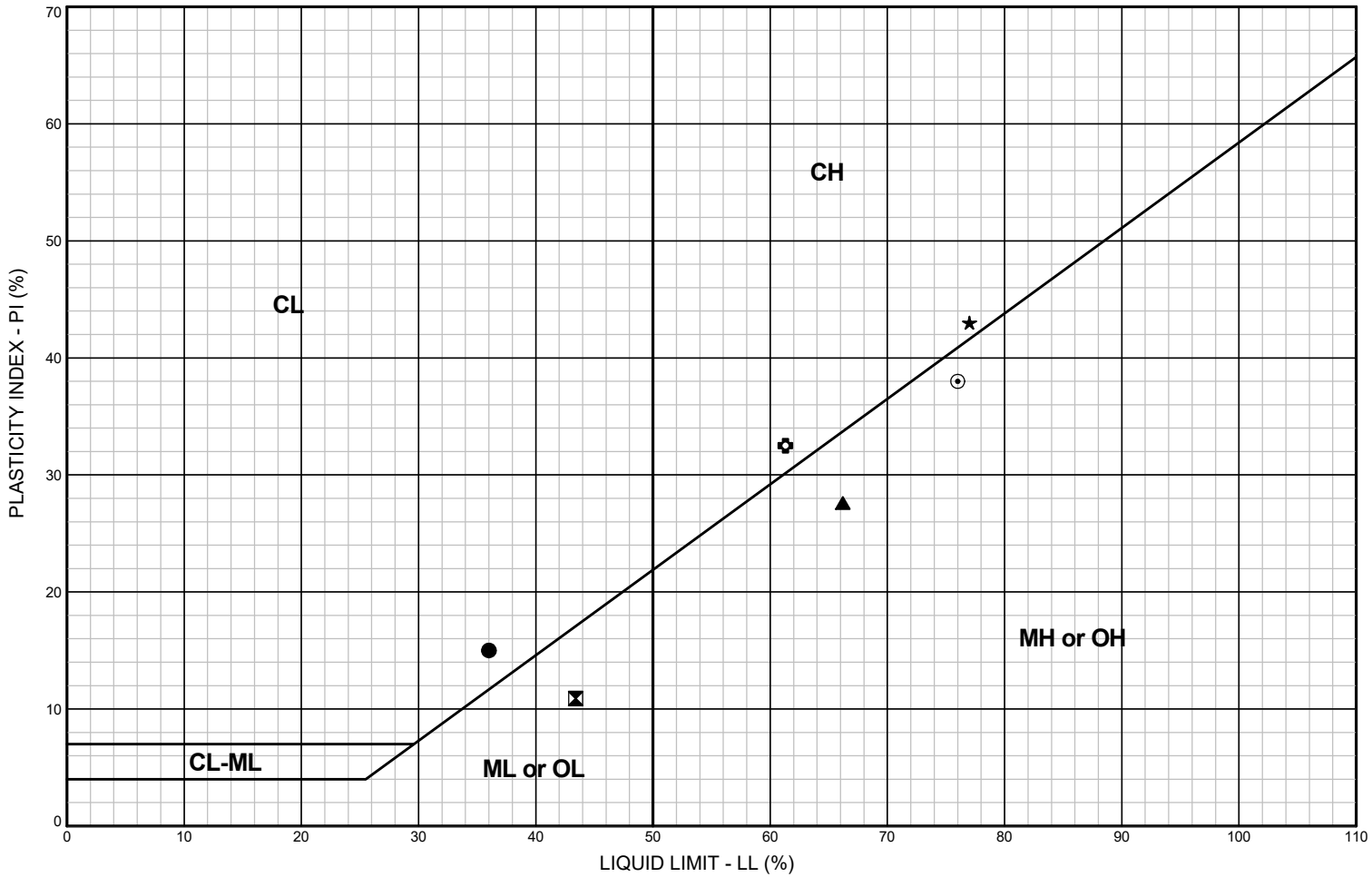
FIG. E14
Sheet 3 of 3

FIG. E14

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



NOTES

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3) Plasticity adjectives used in sample descriptions correspond to plasticity index as follows:
- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-04, N16	75.0	*CL*	*Silty CLAY with trace sand*	36	21	15	30	
⊠ B-08, N24	150.0	*SM*	*Silty SAND*	43	33	10	36	
▲ B-22, S6b	92.0	*MH*	*Clayey SILT*	66	39	27		95.7
★ B-24, S19a	120.0	*CH*	*CLAY with trace sand*	77	34	43		
⊙ B-26, S17b	140.5	*MH*	*Clayey SILT with trace sand*	76	38	38		
✿ B-29, S9b	138.0	*CH*	*CLAY with trace sand*	61	29	32		

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ATTERBERG LIMITS RESULTS
LOWER TROUTDALE FORMATION

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FIG. E15

FIG. E15

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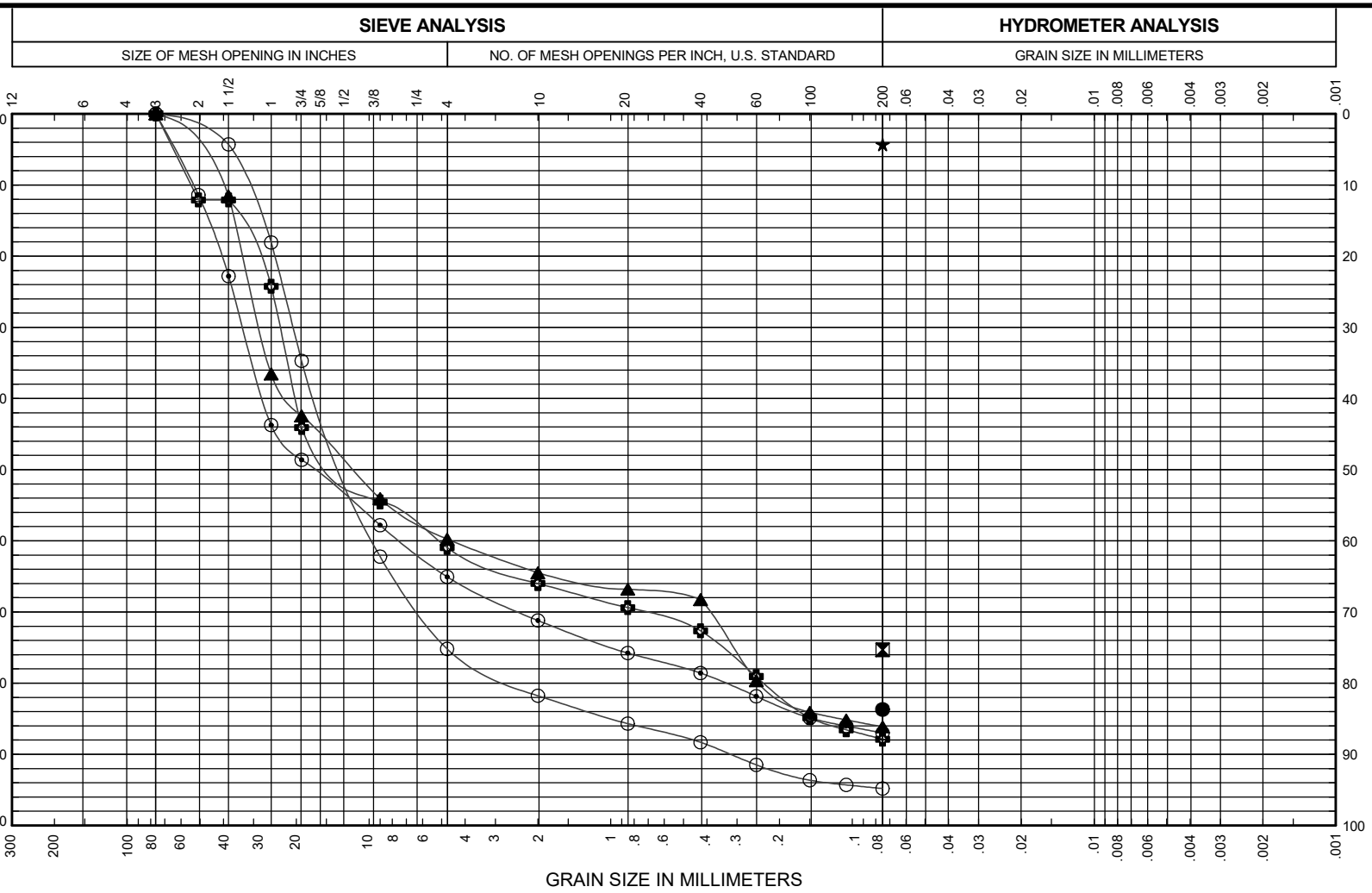

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-10, N21	94.3	*SM*	*Silty SAND with some gravel*	-	-	16	23	
⊠ B-19, N17a	80.0	*SM*	*Silty SAND*	-	-	25	31	
▲ B-22, S6a	90.0	*GM*	*Silty GRAVEL with some sand*	60	26	14		
★ B-22, S6b	92.0	*MH*	*Clayey SILT*	-	-	96		
⊙ B-22, S7	100.0	*GC*	*Clayey GRAVEL with some sand*	65	22	13		
✿ B-22, S9b	116.0	*GM*	*Silty GRAVEL with some sand*	61	27	12		
○ B-22, S11a	130.0	*GP-GM*	*Sandy GRAVEL with some silt*	75	20	5		

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GRAIN SIZE DISTRIBUTION
LOWER TROUTDALE FORMATION

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FIG. E16
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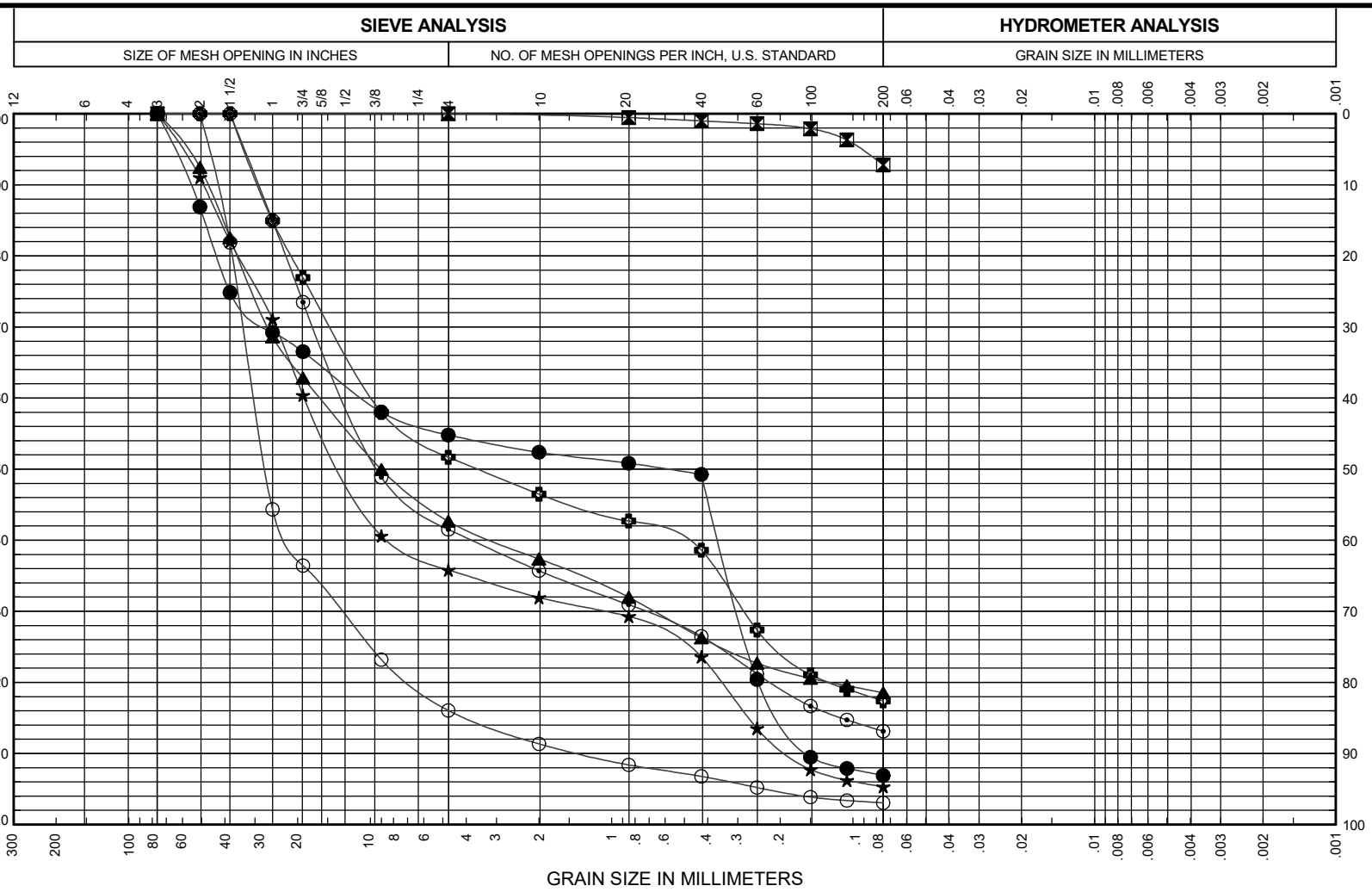
FIG. E16

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.
** Sample specimen weight did not meet required minimum mass for ASTM test method.*

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-23, S6b	82.0	*SP-SM*	*Gravelly SAND with some silt*	45	48	7		
⊠ B-23, S7a	90.1	*ML*	*SILT with trace sand*	0	7	93		
▲ B-23, S7c	94.0	*GM*	*Silty GRAVEL with some sand*	57	24	19		
★ B-23, S9a	117.0	*GP-GM*	*Sandy GRAVEL with some silt*	64	30	5		
⊙ B-24, S10*	75.0	*GM*	*Silty GRAVEL with some sand*	58	28	13		
✿ B-24, S13*	90.0	*GM*	*Sandy silty GRAVEL*	48	34	17		
○ B-24, S17b*	113.0	*GP*	*GRAVEL with trace silt and sand*	84	13	3		

Earthquake Ready Burnside Bridge
Portland, Oregon

GRAIN SIZE DISTRIBUTION
LOWER TROUTDALE FORMATION

April 2022 102636-009

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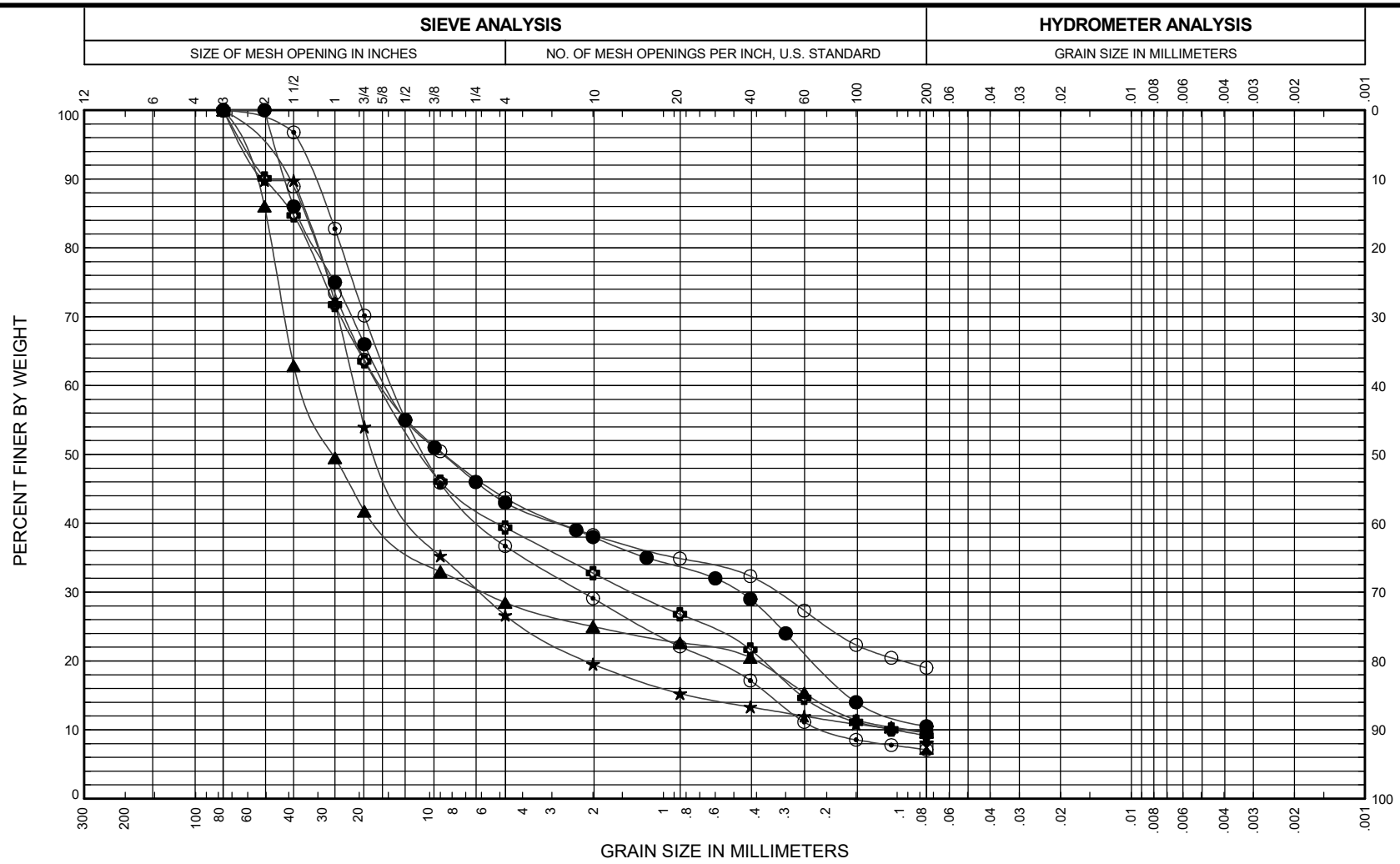
FIG. E16
Sheet 2 of 4

FIG. E16



NOTES:
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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.
** Sample specimen weight did not meet required minimum mass for ASTM test method.*

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-25, S11	84.0	*GP-GM*	*Sandy GRAVEL with some silt*	57	33	11		
⊠ B-26, S9a	78.0	*GP-GM*	*Sandy GRAVEL with some silt*	-	-	7		
▲ B-26, S15*	128.0	*GP-GC*	*GRAVEL with some clay and sand*	72	19	10		
★ B-28, S5a	84.0	*GP-GM*	*GRAVEL with some silt and sand*	73	17	10		
⊙ B-28, S7c	123.0	*GW-GM*	*GRAVEL with some silt and sand*	63	30	7		
✿ B-29, S4d	76.0	*GW-GM*	*Sandy GRAVEL with some silt*	61	30	9		
○ B-29, S8c	129.0	*GM*	*Silty GRAVEL with some sand*	56	25	19		

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GRAIN SIZE DISTRIBUTION
LOWER TROUTDALE FORMATION

April 2022 102636-009

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FIG. E16
Sheet 3 of 4

FIG. E16

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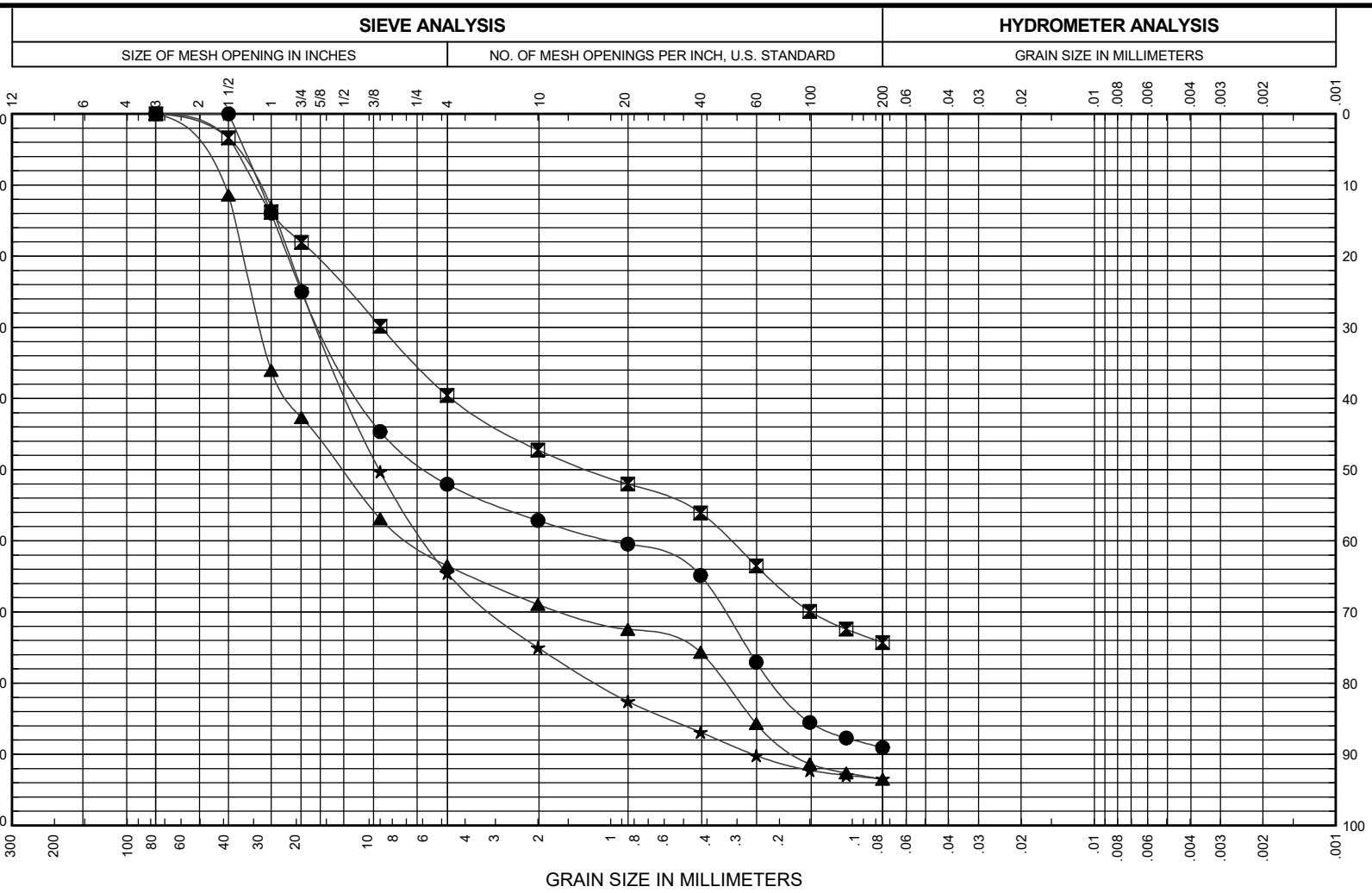

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2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-30, S7a	106.0	*GP-GC*	*Sandy GRAVEL with some clay*	52	37	11		
⊠ B-31, S5	70.1	*GC*	*Sandy clayey GRAVEL*	40	35	26		
▲ B-31, S7	101.8	*GP-GM*	*Sandy GRAVEL with some silt*	63	30	7		
★ B-31, S9b	128.0	*GW-GC*	*GRAVEL with some clay and sand*	65	29	7		

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GRAIN SIZE DISTRIBUTION
LOWER TROUTDALE FORMATION

April 2022 102636-009

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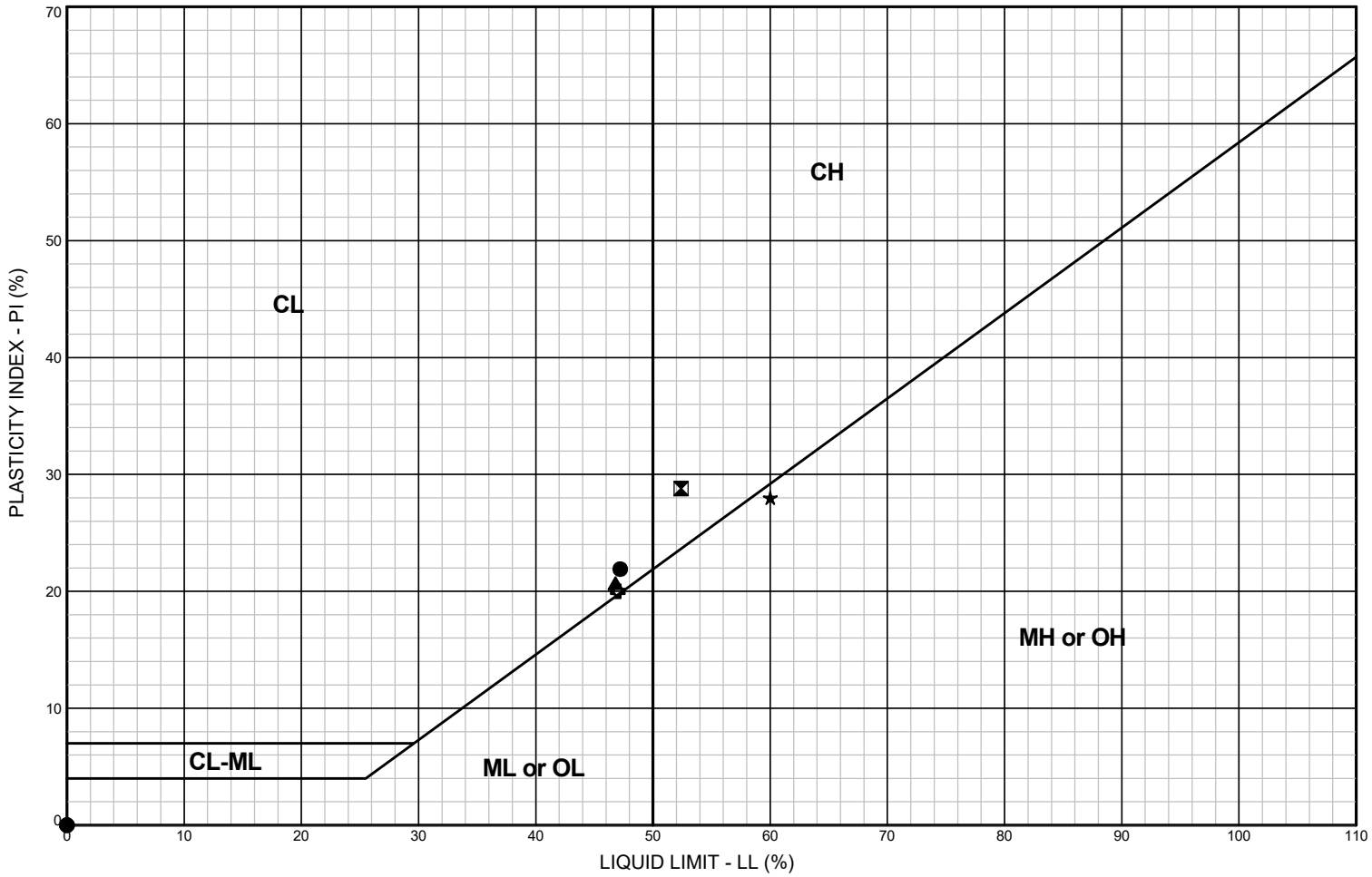
FIG. E16
Sheet 4 of 4

FIG. E16

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



NOTES

1) Atterberg limits tests were performed in general accordance with ASTM D4318 unless otherwise noted in the report.

2) Group Name and Group Symbol are in accordance with ASTM D2488 and are refined in accordance with ASTM D2487 where appropriate laboratory tests are performed.

3) Plasticity adjectives used in sample descriptions correspond to plasticity index as follows:
- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-09, N23	116.3	*CL*	*Silty CLAY with trace sand*	47	25	22	30	
⊠ B-09, N25	127.2	*CH*	*CLAY with trace sand*	52	24	28	33	
▲ B-09, N26	131.2	*CL*	*Silty CLAY with trace sand*	47	26	21	31	
★ B-10, N25	123.0	*MH*	*Sandy clayey SILT*	60	32	28	42	70.4
B-10, N27b	144.0	*SM*	*Silty SAND*	NP	NP	NP	42	38.1
✿ B-25, S13	104.0	*CL*	*Sandy silty CLAY*	47	27	20		
B-25, S16b	138.5	*SP-SM*	*SAND with some silt*	NP	NP	NP		

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ATTERBERG LIMITS RESULTS
SANDY RIVER MUDSTONE

April 2022 102636-009

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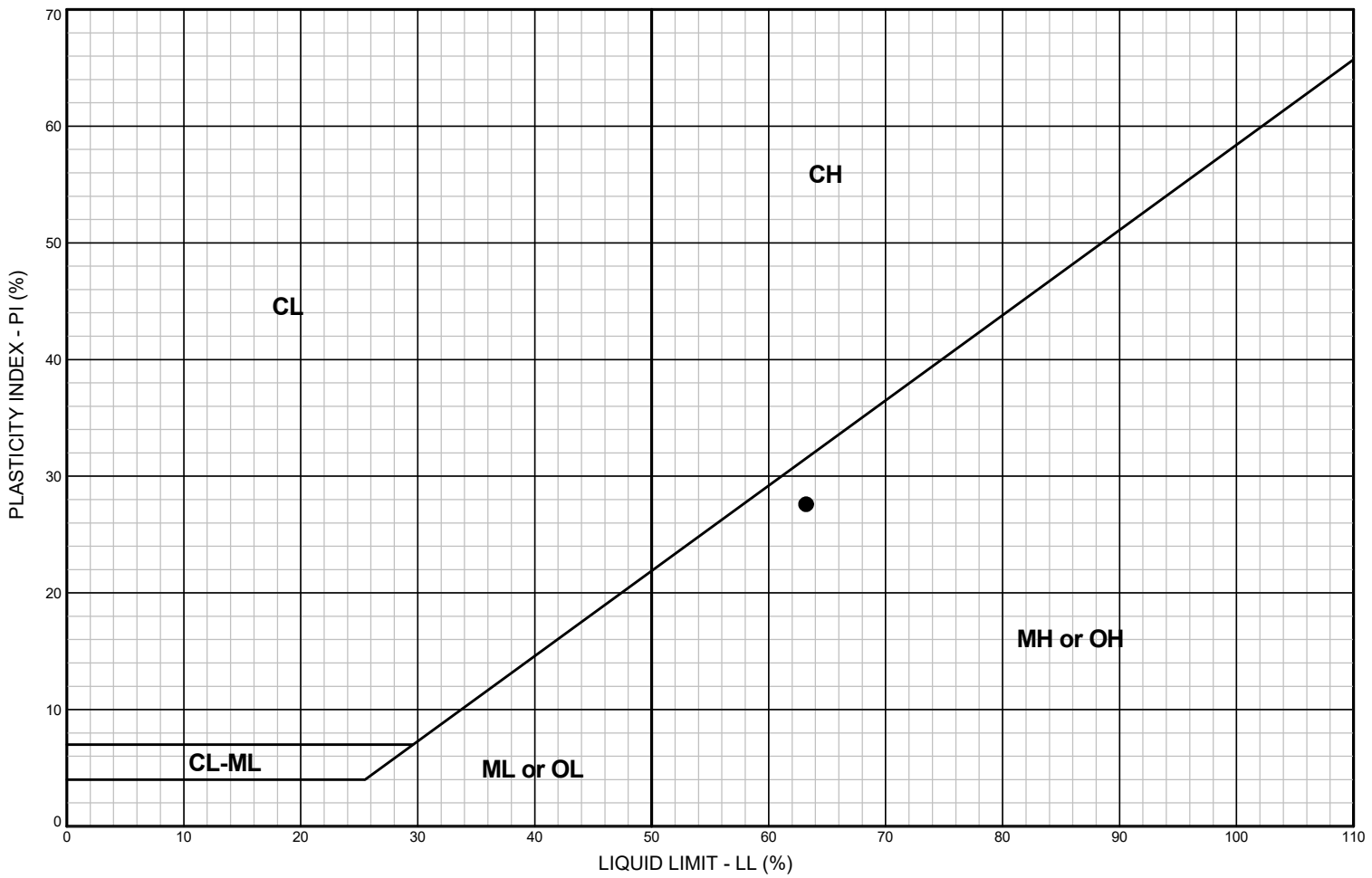
FIG. E17
Sheet 1 of 2

FIG. E17

ATT_UNIT_COMPLETE 102636.GPJ SHAN_WIL.GDT 4/12/22



NOTES

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3) Plasticity adjectives used in sample descriptions correspond to plasticity index as follows:
- Nonplastic (NP) (< 3%)
- Low Plasticity (3 to 15%)
- Medium Plasticity (15 to 30%)
- High Plasticity (> 30%)

BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	LL %	PL %	PI %[3]	NAT. W.C. %	FINES %
● B-27, N27	148.6	*MH*	*Clayey SILT with trace sand*	63	36	27	45	

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ATTERBERG LIMITS RESULTS
SANDY RIVER MUDSTONE

April 2022 102636-009

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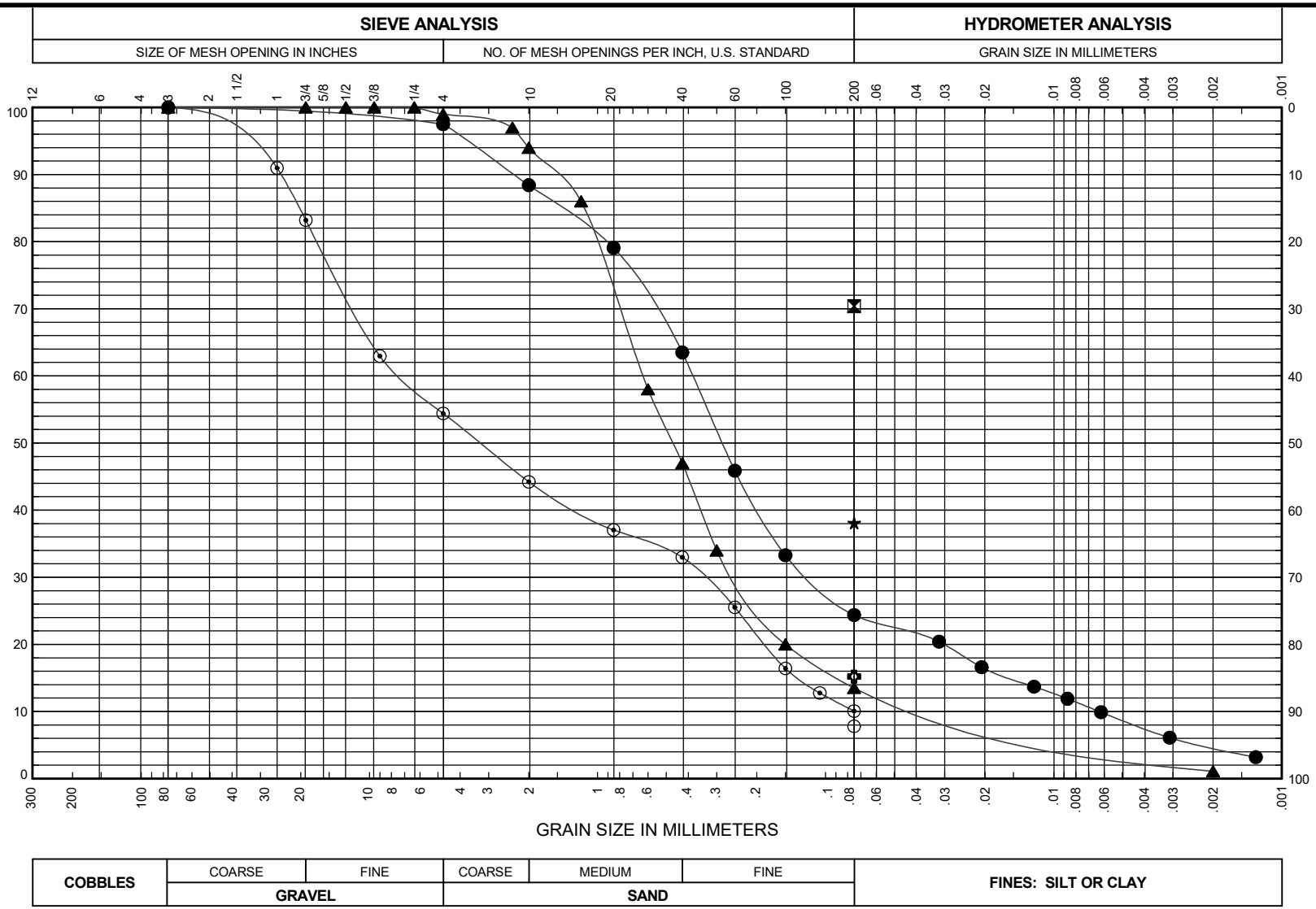
FIG. E17
Sheet 2 of 2

FIG. E17

ATT_UNIT_COMPLETE 102636.GPJ SHAN_WIL.GDT 4/12/22



NOTES:
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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-09, N27	139.6	*SM*	*Silty SAND*	3	73	24	29	
⊠ B-10, N25	123.0	*MH*	*Sandy clayey SILT*	-	-	70	42	
▲ B-10, N26	133.5	*SM*	*Silty SAND*	1	86	14	24	
★ B-10, N27b	144.0	*SM*	*Silty SAND*	-	-	38	42	
⊙ B-11, N33	170.0	*GP-GM*	*Sandy GRAVEL with some silt*	46	44	10	25	
✿ B-24, S21	140.0	*SM*	*Silty SAND*	-	-	15		
○ B-25, S17a	144.0	*SP-SM*	*SAND with some silt*	-	-	8		

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GRAIN SIZE DISTRIBUTION
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April 2022 102636-009

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FIG. E18
Sheet 1 of 3

FIG. E18

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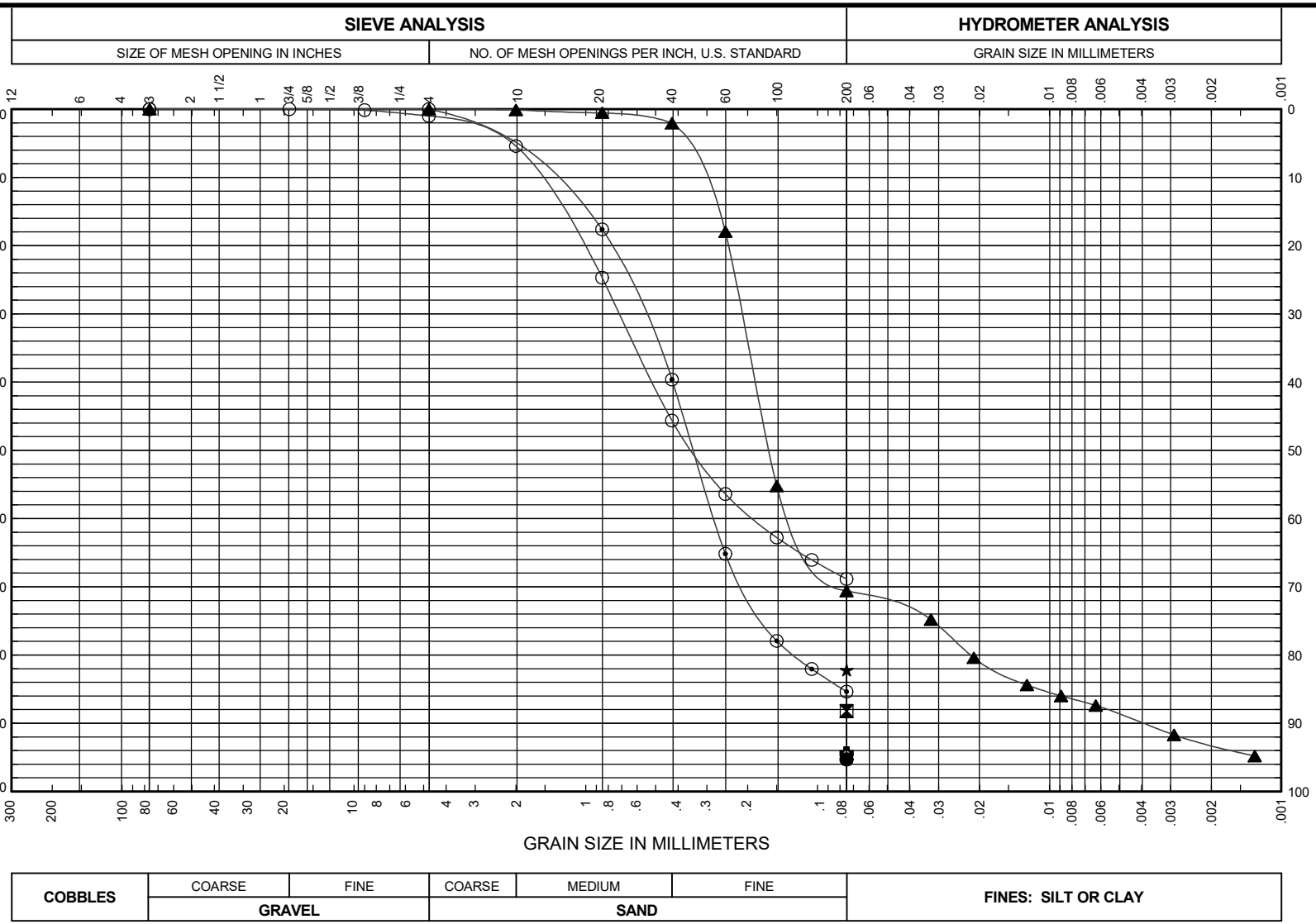

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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-25, S19	159.0	*SP*	*SAND with trace silt*	-	-	5		
⊠ B-27, N24	111.2	*SM*	*Silty SAND*	-	-	12	28	
▲ B-27, N25	121.1	*SC*	*Clayey SAND*	0	71	29	34	
★ B-27, N26	138.1	*SM*	*Silty SAND*	-	-	18	30	
⊙ B-27, N28	160.3	*SM*	*Silty SAND*	0	85	15	27	
✿ B-29, S10b	152.0	*SP-SM*	*SAND with some silt*	-	-	6		
○ B-30, S8c	127.0	*SC*	*Clayey SAND*	1	68	31		

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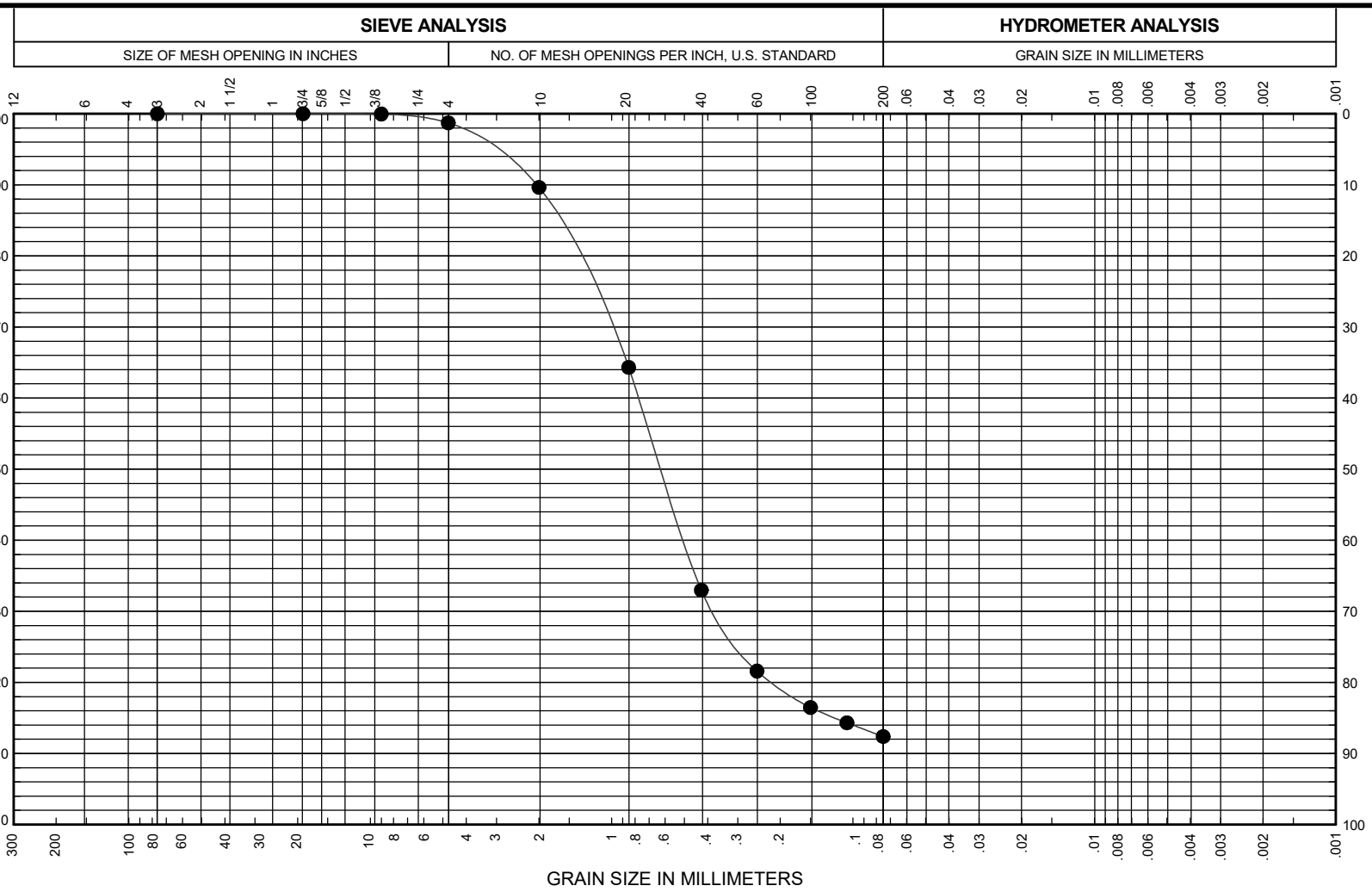
FIG. E18
Sheet 2 of 3

FIG. E18

GSA UNIT COMPLETE 102636.GPJ SHAN WIL.GDT 4/12/22



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BORING AND SAMPLE NO.	DEPTH (feet)	GROUP SYMBOL[2]	GROUP NAME[2]	GRAVEL %	SAND %	FINES %	NAT. W.C. %	DRY DENSITY PCF
● B-30, S10	146.0	*SM*	*Silty SAND*	1	86	12		

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GRAIN SIZE DISTRIBUTION
SANDY RIVER MUDSTONE

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FIG. E18
Sheet 3 of 3

FIG. E18

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TECHNICAL REPORT

Report To:	Ms. Aimee Holmes, P.E., C.E.G. Shannon & Wilson, Inc. 3990 S.W. Collins Way, Suite 203 Lake Oswego, Oregon 97035	**Date:** **Lab No.:**	11/28/16 16-304
Project:	Laboratory Testing – 24-1-04065-001	**Project No.:**	2966.1.1

Report of: Atterberg Limits and sieve analysis

Sample Identification

NTI completed Atterberg limits and sieve analysis testing on samples delivered to our laboratory on November 17, 2016. Testing was performed in accordance with the standards indicated. Our laboratory test results are summarized on the following table and attached page.

Laboratory Testing

Atterberg Limits (ASTM D4318)			
Sample ID	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**
B-1 N-7 @ 35 – 36.5 ft.	37	29	8
B-1 N-18 @ 90 – 91.5 ft.	56	32	24
B-2 N-14 @ 77 – 78.5 ft.	56	26	30
B-3 N-5 @ 25 – 26.5 ft.	33	27	6
B-3 N-14 @ 70 – 71.5 ft.	37	28	9
B-3 N-17 @ 85 – 86.5 ft.	42	34	8
B-3 N-20 @ 100 – 101.5 ft.	40	31	9
B-3 N-24 @ 120 – 121.5 ft.	36	32	4

Copies: Laboratory Test Results

Copies: Addressee

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Project:	Laboratory Testing – 24-1-04065-001	**Project No.:**	2966.1.1

Laboratory Testing

Sieve Analysis of Aggregate (ASTM C117/C136)				
Sieve Size	**B-1 N-7 @ 35 – 36.5 ft. Percent Passing**	**B-1 N-10 @ 50 – 51.5 ft. Percent Passing**	**B-2 N-2 @ 16 – 17.5 ft. Percent Passing**	**B-2 N-6 @ 36.5 – 38 ft. Percent Passing**
1 ½"	--	100	--	--
1"	--	93	100	--
¾"	--	80	93	--
½"	--	65	83	--
⅜"	--	60	74	--
¼"	--	54	69	--
#4	--	54	68	--
#8	--	44	60	--
#10	--	43	60	--
#16	--	39	58	100
#30	100	26	46	99
#40	99	20	28	96
#50	97	17	13	74
#100	88	13	3	13
#200	67.4	9.7	1.5	6.0

Sieve Analysis of Aggregate (ASTM C117/C136)				
Sieve Size	**B-2 N-12 @ 67.1 – 68.6 ft. Percent Passing**	**B-2 N-14 @ 77 – 78.5 ft. Percent Passing**	**B-3 N-2 @ 10 – 11.5 ft. Percent Passing**	**B-3 N-5 @ 25 – 26.5 ft. Percent Passing**
¾"	--	--	100	--
½"	--	--	90	--
⅜"	100	--	90	--
¼"	99	--	84	--
#4	99	--	84	--
#8	99	--	82	--
#10	99	100	81	--
#16	99	99	81	--
#30	99	98	75	100
#40	99	97	64	99
#50	98	95	40	98
#100	90	92	12	78
#200	65.9	76.3	7.4	42.9

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Project:	Laboratory Testing – 24-1-04065-001	**Project No.:**	2966.1.1

Laboratory Testing

Sieve Analysis of Aggregate (ASTM C117/C136)			
Sieve Size	**B-3 N-6 @ 32 – 33.5 ft. Percent Passing**	**B-3 N-14 @ 70 – 71.5 ft. Percent Passing**	**B-3 N-17 @ 85 – 86.5 ft. Percent Passing**
#30	--	--	100
#40	100	100	99
#50	99	96	98
#100	76	77	93
#200	42.7	57.1	77.3

Sieve Analysis of Aggregate (ASTM C117/C136)			
Sieve Size	**B-3 N-20 @ 100 – 101.5 ft. Percent Passing**	**B-3 N-23 @ 115 – 116.5 ft. Percent Passing**	**B-3 N-24 @ 120 – 121.5 ft. Percent Passing**
#30	--	100	--
#40	100	99	100
#50	99	82	99
#100	88	29	91
#200	72.7	17.0	68.0

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TECHNICAL REPORT

Report To:	Ms. Veronica Biesiada Shannon & Wilson, Inc. 3990 SW Collins Way, Suite 203 Lake Oswego, Oregon 97035	**Date:** **Lab No.:**	08/31/2021 21-356
Project:	EQRB (102636)	**Project No.:**	3638.1.1

Report of: Moisture content, amount of material finer than 75µm (No. 200 wash), liquid limit, plastic limit, and plasticity index, particle size analysis, and particle size analysis with hydrometer testing of soil

Sample Identification

As requested, NTI provided a moisture content, amount of material finer than 75µm (No. 200 wash), liquid limit, plastic limit, and plasticity index, particle size analysis and particle size analysis with hydrometer testing of soil on samples delivered to our laboratory by a Shannon and Wilson representative on August 12, 2021. Testing was performed in accordance with the standards indicated. Our laboratory test results are summarized on the following table.

Laboratory Testing

Moisture Content of Soil (ASTM D2216 & AASHTO T265)			
Sample ID	**Moisture Content (%)**	**Sample ID**	**Moisture Content (%)**
B-10 N11 @ 42.5 – 44.0 Ft.	38.1	B-13 N3 @ 7.5 – 9.0 Ft.	53.7
B-10 N12 @ 47.5 – 49.0 Ft.	36.7	B-13 N4 @ 10.0 – 11.5 Ft.	36.3
B-10 N15 @ 61.3 – 62.8 Ft.	36.2	B-13 N6 @ 15.0 – 16.5 Ft.	30.0
B-10 N21 @ 94.3 – 95.1 Ft.	23.3	B-13 N11 @ 35.0 – 36.5 Ft.	39.0
B-10 N25 @ 123.0 – 124.5 Ft.	41.8	B-13 N12 @ 40.0 – 41.5 Ft.	28.0
B-10 N26 @ 133.5 – 135.0 Ft.	24.1	B-13 N14 @ 50.0 – 51.5 Ft.	30.6
B-10 N27B @ 144.0 – 145.0 Ft.	41.7	B-13 N20 @ 80.0 – 81.5 Ft.	11.2

Attachments: Laboratory Test Results

Copies: (1) Addressee

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TECHNICAL REPORT

Report To:	Ms. Veronica Biesiada Shannon & Wilson, Inc. 3990 SW Collins Way, Suite 203 Lake Oswego, Oregon 97035	**Date:** **Lab No.:**	08/31/2021 21-356
Project:	EQRB (102636)	**Project No.:**	3638.1.1

Laboratory Testing

Amount of Material Finer than the No. 200 Sieve (ASTM D1140)	
Sample ID	**Percent Passing the No. 200 Sieve**
B-10 N12 @ 47.5 – 49.0 Ft.	63.7
B-10 N21 @ 94.3 – 95.1 Ft.	16.3
B-10 N25 @ 123.0 – 124.5 Ft.	70.4
B-10 N27B @ 144.0 – 145.0 Ft.	38.1
B-13 N3 @ 7.5 – 9.0 Ft.	50.8
B-13 N6 @ 15.0 – 16.5 Ft.	3.5
B-13 N11 @ 35.0 – 36.5 Ft.	22.3
B-13 N14 @ 50.0 – 51.5 Ft.	5.5
B-13 N20 @ 80.0 – 81.5 Ft.	5.4

Atterberg Limits (ASTM D4318 & AASHTO T89/T90)			
Sample ID	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**
B-10 N12 @ 47.5 – 49.0 Ft.	35	27	8
B-10 N25 @ 123.0 – 124.5 Ft.	60	32	28
B-10 N27B @ 144.0 – 145.0 Ft.	NP	NP	NP

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TECHNICAL REPORT

Report To:	Ms. Veronica Biesiada Shannon & Wilson, Inc. 3990 SW Collins Way, Suite 203 Lake Oswego, Oregon 97035	**Date:** **Lab No.:**	08/31/2021 21-356
Project:	EQRB (102636)	**Project No.:**	3638.1.1

Laboratory Testing

Particle Size Analysis & Material Finer than the No. 200 Sieve by Washing (ASTM D1140, D6913)			
Sieve Size	B-10 N15 @ 61.3 – 62.8 Ft. **Percent Passing**	B-13 N4 @ 10.0 – 11.5 Ft. **Percent Passing**	B-13 N12 @ 40.0 – 41.5 Ft. **Percent Passing**
¾”	100	100	100
½”	98	99	99
⅜”	97	95	99
¼”	96	88	99
#4	95	85	99
#8	89	82	99
#10	86	82	99
#16	77	82	99
#30	60	81	95
#40	50	75	72
#50	40	54	38
#100	29	19	13
#200	23.5	12.7	7.2

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TECHNICAL REPORT

Report To:	Ms. Veronica Biesiada Shannon & Wilson, Inc. 3990 SW Collins Way, Suite 203 Lake Oswego, Oregon 97035	**Date:** **Lab No.:**	08/31/2021 21-356
Project:	EQRB (102636)	**Project No.:**	3638.1.1

Laboratory Testing

Particle Size Analysis of Soil (ASTM D422 & D6913)	
Sieve Size	B-10 N11 @ 42.5 – 44.0 Ft. **Percent Passing**
#40	100
#50	98
#100	83
#200	53.4

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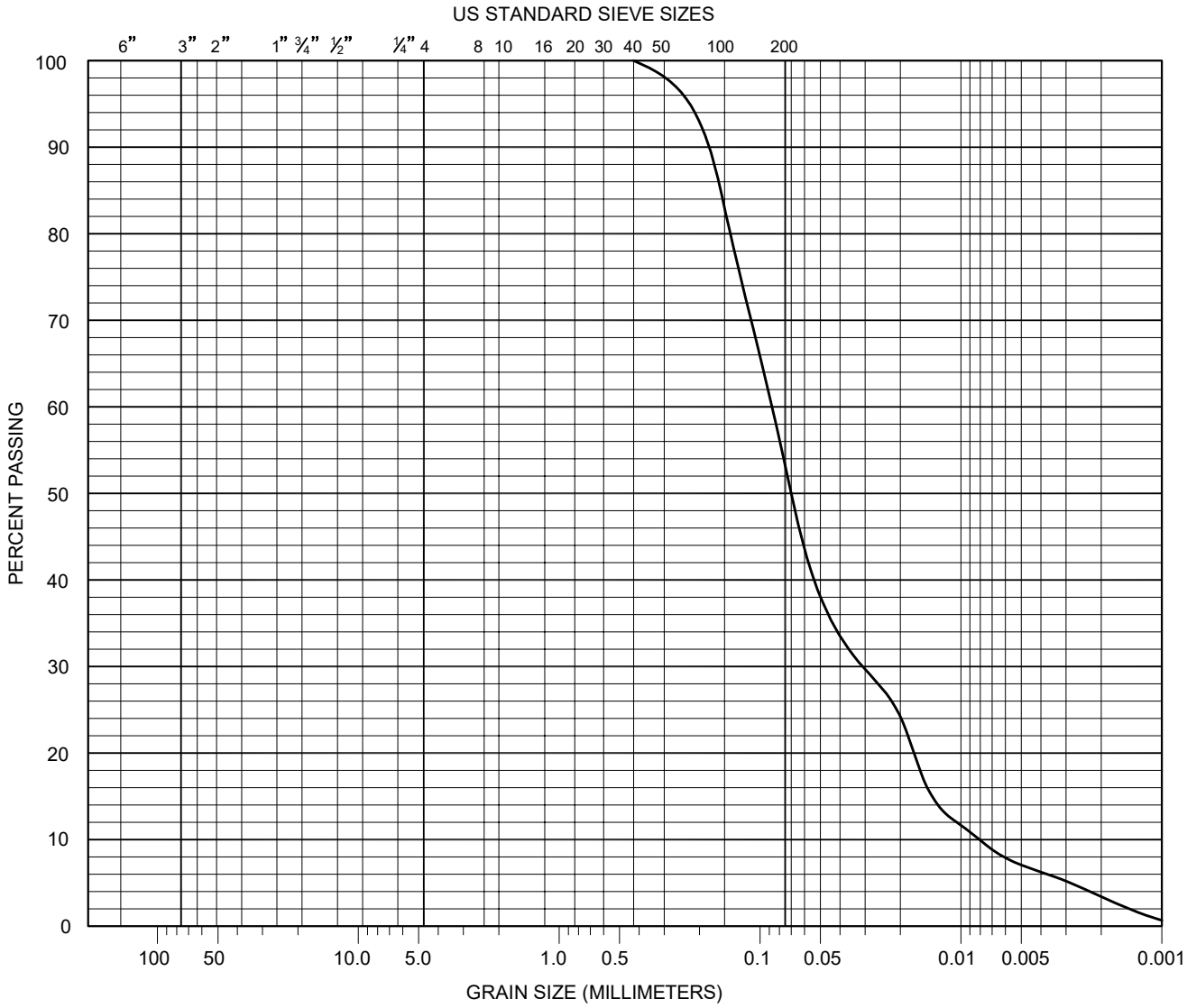
Attachment 2



COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	SAMPLE IDENTIFICATION	FIELD MOISTURE (%)	% PASSING NO. 200 SIEVE	% PASSING 2 µ	ASTM D2487
———	B10 N11 @ 42.5 - 44.0 FT	38.1	53.4	3.0	- - -

GRADATION TEST RESULTS - ASTM D422

PROJECT NO. 3638.1.1	SHANNON AND WILSON EQRB (102636)	LAB NO. 21-356

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TECHNICAL REPORT

Report To:	Ms. Veronica Biesiada Shannon & Wilson, Inc. 3990 SW Collins Way, Suite 203 Lake Oswego, Oregon 97035	**Date:** **Lab No.:**	08/31/2021 21-356
Project:	EQRB (102636)	**Project No.:**	3638.1.1

Laboratory Testing

Particle Size Analysis of Soil (ASTM D422 & D6913)	
Sieve Size	B-10 N26 @ 133.5 – 135.0 Ft. **Percent Passing**
¼"	100
#4	99
#8	97
#10	94
#16	86
#30	58
#40	47
#50	34
#100	20
#200	13.5

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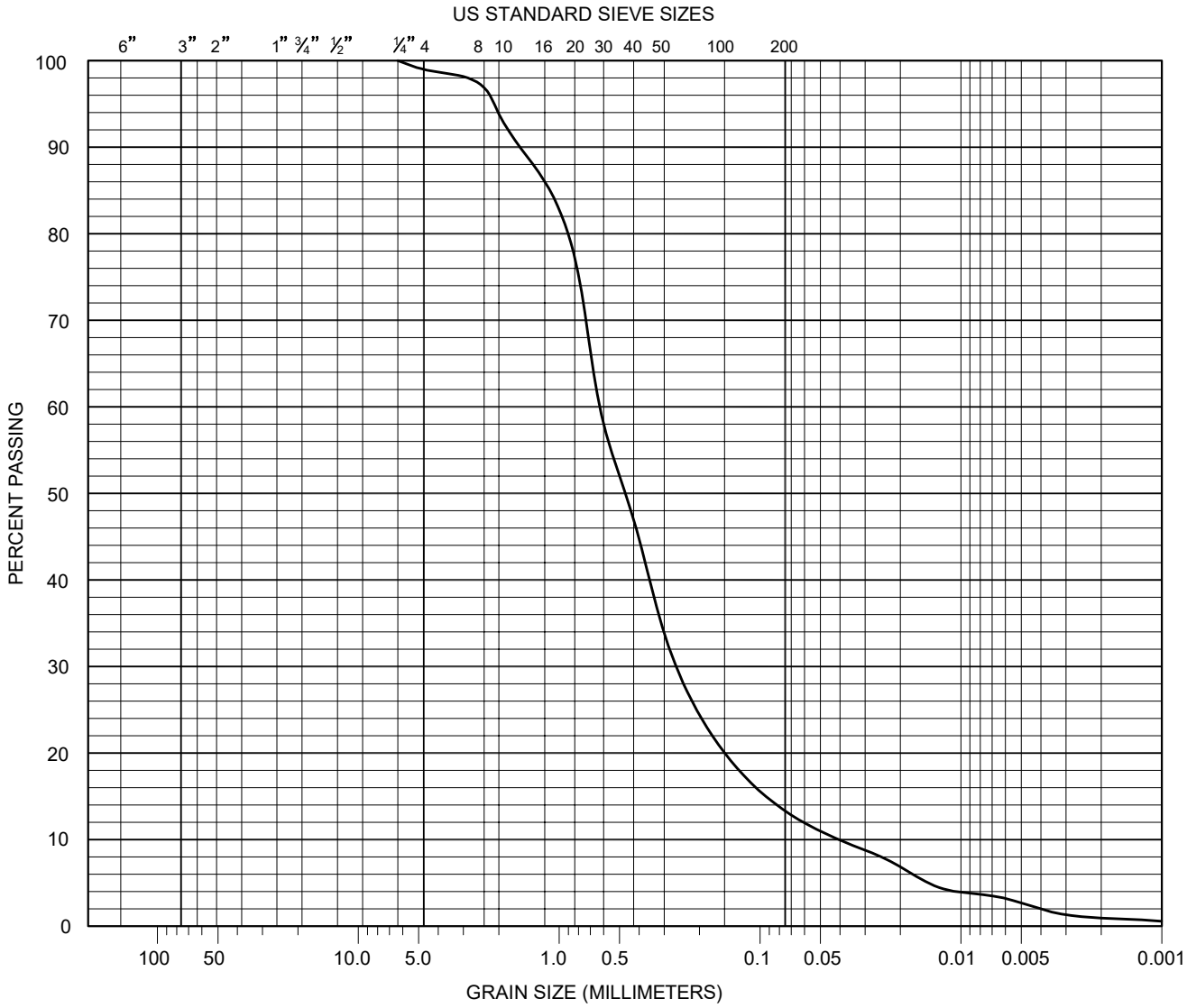
Attachment 2



COBBLES	GRAVEL		SAND			SILT AND CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

SYMBOL	SAMPLE IDENTIFICATION	FIELD MOISTURE (%)	% PASSING NO. 200 SIEVE	% PASSING 2 µ	ASTM D2487
———	B10 N26 @ 133.5 - 135.0 FT	24.1	13.5	1.1	- - -

GRADATION TEST RESULTS - ASTM D422

PROJECT NO. 3638.1.1	SHANNON AND WILSON EQRB (102636)	LAB NO. 21-356

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TECHNICAL REPORT

Report To:	Ms. Veronica Biesiada Shannon & Wilson, Inc. 3990 SW Collins Way, Suite 203 Lake Oswego, Oregon 97035	**Date:** **Lab No.:**	11/22/2021 21-471
Project:	Burnside Bridge Prog. 7 (102636)	**Project No.:**	3638.1.1

Report of: Moisture density, moisture content, liquid limit, plastic limit, and plasticity index, and amount of material finer than 75µm (No. 200 wash).

Sample Identification

NTI completed moisture density, moisture content, liquid limit, plastic limit, plasticity index, sieve analysis, and amount of material finer than 75µm (No. 200 wash) of soil samples delivered to our laboratory on November 5, 2021. Testing was performed in accordance with the standards indicated. Our laboratory test results are summarized on the following table and pages.

Laboratory Testing

Moisture Content of Soil and Density (ASTM D2216 & ASTM D7623)		
Sample ID	**Moisture Content (%)**	**Dry Density (pcf)**
B-17 U-1 @ 23.0 – 25.0 Ft.	48.2	72.8
B-17 U-2 @ 40.0 – 42.0 Ft.	41.3	79.4
B-17 U-3 @ 80.0 – 82.0 Ft.	38.8	79.9
B-17 U-4 @ 101.5 – 103.5 Ft.	36.5	78.2
B-18 U-2 @ 38.0 – 40.0 Ft.	102.7	40.2
B-33 U-5 @ 127.0 – 129.0 Ft.	29.2	94.9

Attachments: Laboratory Test Results

Copies: (1) Addressee

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 REVIEWED BY: Michael A. Ginsbach

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TECHNICAL REPORT

Report To: Ms. Veronica Biesiada
Shannon & Wilson, Inc.
3990 SW Collins Way, Suite 203
Lake Oswego, Oregon 97035

Date: 11/22/2021

Lab No.: 21-471

Project: Burnside Bridge Prog. 7 (102636)

Project No.: 3638.1.1

Atterberg Limits (ASTM D4318)			
Sample ID	**Liquid Limit**	**Plastic Limit**	**Plasticity Index**
B-4 N-6 @ 25.0 – 26.5 Ft.	39	27	12
B-4 N-16 @ 75.0 – 76.5 Ft.	36	21	15
B-5 N-3 @ 15.0 – 16.5 Ft.	38	26	12
B-17 U-1 @ 23.0 – 25.0 Ft.	49	32	17
B-24 C-5 @ 33.0 – 35.0 Ft.	34	26	8
B-24 C-7 @ 50.0 – 60.0 Ft.	32	22	10
B-24 C-19 @ 120.0 – 128.0 Ft.	77	34	43
B-25 C-6 @ 44.0 – 51.0 Ft.	29	19	10
B-25 C-13 @ 104.0 – 114.0 Ft.	47	27	20
B-25 C-16 @ 138.5 – 144.0 Ft.	NP	NP	NP
B-26 C-17 @ 140.5 – 148.0 Ft.	76	38	38

Amount of Material Finer than the No. 200 Sieve (ASTM D1140)	
Sample ID	**Percent Passing the No. 200 Sieve**
B-4 N-7 @ 32.0 – 33.5 Ft.	48.2
B-4 N-8 @ 35.0 – 36.5 Ft.	60.7
B-4 N-13 @ 60.0 – 61.5 Ft.	10.8
B-5 N-4 @ 20.0 – 21.5 Ft.	74.6
B-5 N-5 @ 25.0 – 26.5 Ft.	81.8
B-5 N-12 @ 60.0 – 61.5 Ft.	12.5
B-24 C-7 @ 50.0 – 60.0 Ft.	23.7

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Date: 11/22/2021

Lab No.: 21-471

Project: Burnside Bridge Prog. 7 (102636)

Project No.: 3638.1.1

Sieve Analysis & Material Finer than the No. 200 Sieve by Washing (ASTM C136/C117 & AASHTO T27/T11)

Sieve Size	B-5, N-10 @ 50.0-51.4 Ft. Percent Passing	B-17, U-1 @ 23.0-25.0 Ft. Percent Passing	B-17, U-2 @ 40.0-42.0 Ft. Percent Passing
2”	-	-	-
1 ½”	-	-	-
1”	100	-	-
¾”	93	-	-
½”	84	-	-
⅜”	78	-	100
¼”	69	-	99
#4	69	-	98
#8	68	-	95
#10	68	-	93
#16	67	100	90
#30	67	99	84
#40	66	99	81
#50	55	97	78
#100	16	94	64
#200	8.8	77.7	21.3

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Project No.: 3638.1.1

Sieve Analysis & Material Finer than the No. 200 Sieve by Washing (ASTM C136/C117 & AASHTO T27/T11)

Sieve Size	B-17, U-3 @ 80.0-82.0 Ft. Percent Passing	B-17, U-4 @ 101.5-103.5 Ft. Percent Passing	B-18, U-2 @ 38.0-40.0 Ft. Percent Passing
½"	-	-	100
⅜"	-	-	99
¼"	-	-	98
#4	-	-	98
#8	-	-	96
#10	-	-	95
#16	-	-	94
#30	-	-	90
#40	100	-	89
#50	98	100	86
#100	88	81	81
#200	72.7	39.7	71.5

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Project: Burnside Bridge Prog. 7 (102636)

Project No.: 3638.1.1

Sieve Analysis & Material Finer than the No. 200 Sieve by Washing (ASTM C136/C117 & AASHTO T27/T11)			
Sieve Size	**B-24, C-5 @ 33.0-35.0 Ft. Percent Passing**	**B-25, C-6 @ 44.0-51.0 Ft. Percent Passing**	**B-25, C-11 @ 84.0-94.0 Ft. Percent Passing**
3”	-	100	-
2”	-	87	100
1 ½”	-	78	86
1”	-	68	75
¾”	-	62	66
½”	-	54	55
⅜”	-	51	51
¼”	-	49	46
#4	-	48	43
#8	-	46	39
#10	-	46	38
#16	-	45	35
#30	100	45	32
#40	99	45	29
#50	96	44	24
#100	78	33	14
#200	40.9	18.0	10.5

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Date: 11/22/2021

Lab No.: 21-471

Project: Burnside Bridge Prog. 7 (102636)

Project No.: 3638.1.1

Sieve Analysis & Material Finer than the No. 200 Sieve by Washing (ASTM C136/C117 & AASHTO T27/T11)		
Sieve Size	**B-26, C-8 @ 70.5-78.0 Ft. Percent Passing**	**B-33, U-5 @ 127.0-129.0 Ft. Percent Passing**
3”	100	-
2”	89	-
1 ½”	83	-
1”	75	-
¾”	68	-
½”	59	-
⅜”	54	-
¼”	48	-
#4	44	-
#8	36	-
#10	35	-
#16	30	100
#30	26	97
#40	24	88
#50	22	62
#100	18	31
#200	14.4	22.9

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Oregon State University
College of Engineering

Armin W. Stuedlein, PhD, P.E. (WA)
Professor

T. Matthew Evans, PhD
Professor

School of Civil and
Construction Engineering
101 Kearney Hall
Corvallis, Oregon 97331
P 541-737-4934

10 January 2022

Sam Sideras, PhD, P.E.
Shannon & Wilson, Inc.
3990 SW Collins Way #100
Lake Oswego, OR 97035

cc: Risheng Park Piao, P.E., G.E.

SUBJECT: Cyclic Testing Data Report
Earthquake Ready Burnside Bridge Project
Multnomah County
Portland, OR

This data report provides a brief summary of laboratory tests conducted on intact thin-walled tube samples from boreholes advanced by Shannon & Wilson in support of design of the Earthquake Ready Burnside Bridge project under the auspices of Multnomah County. Laboratory tests were conducted as specified in the fully-executed subcontract agreement dated 18 August 2021.

SCOPE OF WORK

Laboratory tests on intact samples consisted of compressibility, bender element tests, monotonic direct simple shear, cyclic direct simple shear, post-cyclic monotonic direct simple shear tests, and post-cyclic reconsolidation tests. Index properties were measured on cuttings derived from tube samples. The suite of index tests requisitioned by Shannon & Wilson included the determination of moisture content (ASTM D2216-19), grain size distribution (ASTM D7928-17 and ASTM D6913-17), and Atterberg limits (ASTM D4318-17) testing. Preconsolidation stresses and compressibility of specimens prepared from tube samples were evaluated using one-dimensional constant rate of strain (CRS) consolidation tests (ASTM D4186-12). The cyclic response of specimens prepared from intact tube samples was evaluated using stress-controlled, undrained (constant volume), cyclic direct simple shear tests (CDSS; ASTM D 8296-19) followed by post-cyclic monotonic and monotonic undrained (constant volume) direct simple shear tests (DSS; ASTM D6528-17). Note that CRS, DSS, and CDSS tests were conducted without back-pressure saturation, which represents a modification from the corresponding ASTM standard; this practice is supported by work by Landon et al. (2018) and represents our laboratory standard of practice (e.g., Jana and Stuedlein 2021). Interpreted in conjunction with index tests, the CDSS and post-cyclic DSS test results can facilitate assessments of liquefaction and cyclic softening susceptibility and triggering, calculations of seismic and post-seismic global stability, and calculations of post-seismic settlement. Specifically:

- The cyclic shearing resistance of the soil when subjected to loading representative of the magnitude of earthquake loading (shear stress amplitude, number of equivalent cycles);

- The potential for significant excess pore pressure generation in the soil, useful for the determination of liquefaction triggering and post-shaking global stability; and,

- The in-shaking and post-shaking strength and compressibility of the soil for use in global stability and settlement evaluations for bridge approach fills, abutments, and other retaining walls.

THIN-WALLED TUBE SAMPLES PROVIDED AND SPECIMEN PREPARATION

A Shannon and Wilson, Inc., representative provided tube samples for laboratory testing over several visits to the OSU Geotechnical Laboratory in August and September 2021. The tube samples were subsequently sealed with plastic wrap and stored vertically in a climate chamber until selection for specimen preparation. Tube samples were prepared for sample extraction by cutting the tubes into two or three segments to minimize disturbance during extraction. A four-point pipe cutter was used to cut tubes to minimize ovaling of the tube during tube cutting. The portions of tubes with soil samples that were cut but not extracted were re-sealed and stored vertically in a climate chamber until extraction. The portion of the tube that was selected for extraction was then placed vertically into the extraction frame and the sample extracted using uniform displacement from the bottom and in the same relative direction of the tube during sampling to prevent sample disturbance due to shear reversal along the tube periphery. Specimens were then cut from the tube and placed into their receiving apparatus (e.g., oedometer cell, direct simple shear cell) to minimize moisture loss due to evaporation. Soil cuttings were used to determine the natural moisture content and index properties. Specimens that exhibited noticeable disturbance were rejected and new specimens prepared.

LABORATORY TEST PROGRAM

The testing program consisted of:

- Four strain-controlled, monotonic DSS tests were conducted on specimens prepared from thin-walled tube samples. Refer to Figures 1, 26, 37, and 40 for the shear stress-shear strain curves corresponding to these tests;

- Nine constant-rate-of-strain consolidation tests on specimens prepared from thin-walled tube samples. Refer to Figures 2, 3, 8, 10, 14, 21, 27, 34, and 35 for the corresponding one-dimensional vertical effective stress-axial strain consolidation curves;

- Seventeen stress-controlled, cyclic direct simple shear tests on specimens prepared from thin-walled tube samples. Selected specimens were subjected to a static shear stress bias, indicated using a non-zero α in figure captions. Refer to Figures 4, 6, 9, 11, 12, 15, 17, 19, 22, 24, 28, 30, 31, 32, 36, 38, and 39 for the shear stress-shear strain hysteresis and effective stress paths corresponding to these CDSS tests;

- Ten post-cyclic, strain-controlled, monotonic DSS and post-cyclic reconsolidation tests were performed on selected CDSS specimens; refer to Figures 5, 7, 13, 16, 18, 20, 23, 25, 29, and 33 for the results of these post-cyclic tests;

- Three bender element-based shear wave velocity tests were performed on cyclic direct simple shear test specimens following consolidation to the specified vertical effective stress and prior to cyclic shear. These specimens were prepared from thin-walled tube sample U2 from Borehole B-32, sample U2 from Borehole B-16, and sample U1 from Borehole B-15. Refer to Figure 41 for a summary of these results; and,

- Twelve determinations of natural water content, twelve Atterberg limits and four grain size distributions determined using hydrometer tests. Refer to Table 1 and Figure 42 for a summary of these index test and grain size distribution results.

The list of figures on Pages 5 and 6 summarize the tests conducted and corresponding figure numbers.

INFORMATION REGARDING CYCLIC DIRECT SIMPLE SHEAR AND POST-CYCLIC TESTS

The cyclic resistance of specimens prepared from thin-walled tube samples was evaluated using stress-controlled CDSS tests. The normal (vertical) consolidation stresses, σ'_{vc}, applied to specimens for CDSS tests were provided by Shannon & Wilson. Following consolidation, specimens were loaded at constant volume (undrained) with sinusoidal wave forms of 0.1 Hz frequency. This rate of loading is sufficiently slow to allow a more-or-less uniform excess pore pressure distribution throughout the specimen, but sufficiently fast to prevent significant shear-induced creep from affecting cyclic response. Each specimen was cyclically loaded until 5% shear strain, or to a specified number of cycles, per Shannon & Wilson's directive. Cyclic shearing was applied using cyclic stress ratios ($CSR = \tau/\sigma'_{vc}$, where τ is applied shear stress) and static shear stress biases, if any, as specified by Shannon and Wilson.

Under the constant volume condition, loss of normal stress, σ_v, directly corresponds to the generation of excess pore pressure. The excess pore pressure is commonly evaluated in terms of the excess pore pressure ratio, defined as:

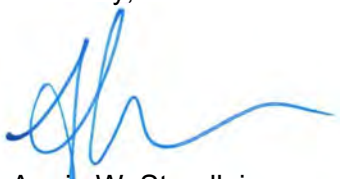
$$r_u = 1 - \frac{\sigma_v}{\sigma'_{vc}}$$

which may be used to interpret the results of the CDSS tests. After completion of the CDSS tests, specimens selected by Shannon & Wilson were returned to a zero-shear condition, and a strain-controlled monotonic DSS test or reconsolidation test immediately conducted. Post-cyclic, monotonic DSS tests were performed using a shear strain rate of 5% per hour. Excess pore pressures generated during cyclic testing are not allowed to dissipate; accordingly, these test results are intended to provide an analogous post-earthquake shearing resistance.

LIMITATIONS

In accordance with the subcontract agreement, specimens derived from thin-walled tube samples were tested but no interpretation of the test data was made, owing to the need for the Engineer of Record to use judgment in the selection of preferred interpretation protocols. This data report has been prepared from tube samples provided to OSU by Shannon & Wilson, Inc., and represents conditions specific to the boreholes and elevations corresponding to the samples retrieved.

Sincerely,



Armin W. Stuedlein



T. Matthew Evans

TABLE 1 – SUMMARY OF ATTERBERG LIMITS AND NATURAL WATER CONTENT

Test No.	Borehole	Sample	Liquid Limit, LL	Plastic Limit, PL	Plastic Index, PI	Natural Water Content, W_n (%)
1	B-17	U1				50
3	B-17	U1	34.3	24.8	9.5	
4	B-18	U2				51
6	B-18	U2	45.2	38.5	6.8	
7	B-17	U4				46
9	B-17	U4	Non-plastic			
14	B-17	U2				45
16	B-17	U2	35.7	26.3	9.4	
18	B-17	U3				39
20	B-17	U3	Non-plastic			
24	B-33	U3				43
26	B-33	U3	Non-plastic			
27	B-33	U1				49
30	B-33	U1	Non-plastic			
31	B-33	U2				44
34	B-33	U2	36.3	30.2	6.1	
38	B-16	U2				40
41	B-16	U2	Non-plastic			
45	B-32	U2				37
47	B-32	U2	Non-plastic			
48	B-15	U1				42
51	B-15	U1	36.3	30.4	5.9	
54	B-15	U3				36
57	B-15	U3	Non-plastic			

REFERENCES

Landon, M. E., C. Marchetti, and D. J. DeGroot. 2018. “Constant rate of strain consolidation testing of saturated cohesive soils without back pressure saturation.” Geotech. Test. J. 41 (2): 20170030.

Jana, A., and Stuedlein, A.W. 2021 “Monotonic, Cyclic, and Postcyclic Responses of an Alluvial Plastic Silt Deposit.” Journal of Geotechnical and Geoenvironmental Engineering 147, no. 3: 04020174.

LIST OF FIGURES

Figure 1: Monotonic Direct Simple Shear Test for B-17 U-1 (Test 2)

Figure 2: Constant-Rate-of-Strain Consolidation Test Result for B-18 U2 (Test 5)

Figure 3: Constant-Rate-of-Strain Consolidation Test Result for B-17 U4 (Test 8)

Figure 4: Cyclic Direct Simple Shear Test Result for B-17 U1 (Test 10)

Figure 5: Post-Cyclic Monotonic Direct Simple Shear Test for B-17 U1 (Test 11)

Figure 6: Cyclic Direct Simple Shear Test Result for B-18 U2 (Test 12)

Figure 7: Post-Cyclic Monotonic Direct Simple Shear Test for B-18 U2 (Test 13)

Figure 8: Constant-Rate-of-Strain Consolidation Test Result for B-17 U2 (Test 15)

Figure 9: Cyclic Direct Simple Shear Test Result for B-17 U1 (Test 17)

Figure 10: Constant-Rate-of-Strain Consolidation Test Result for B-17 U3 (Test 19)

Figure 11: Cyclic Direct Simple Shear Test Result for B-17 U1 (Test 21)

Figure 12: Cyclic Direct Simple Shear Test Result for B-17 U2 (Test 22)

Figure 13: Post-Cyclic Monotonic Direct Simple Shear Test for B-17 U2 (Test 23)

Figure 14: Constant-Rate-of-Strain Consolidation Test Result for B-33 U3 (Test 25)

Figure 15: Cyclic Direct Simple Shear Test Result for B-33 U1 (Test 28)

Figure 16: Post-Cyclic Monotonic Direct Simple Shear Test for B-33 U1 (Test 29)

Figure 17: Cyclic Direct Simple Shear Test Result for B-33 U2 (Test 32)

Figure 18: Post-Cyclic Monotonic Direct Simple Shear Test for B-33 U2 (Test 33)

Figure 19: Cyclic Direct Simple Shear Test Result for B-17 U3 (Test 35)

Figure 20: Post-Cyclic Monotonic Direct Simple Shear Test for B-17 U3 (Test 36)

Figure 21: Constant-Rate-of-Strain Consolidation Test Result for B-17 U1 (Test 37)

Figure 22: Cyclic Direct Simple Shear Test Result for B-16 U2 (Test 39)

Figure 23: Post-Cyclic Monotonic Direct Simple Shear Test for B-16 U2 (Test 40)

Figure 24: Cyclic Direct Simple Shear Test Result for B-33 U3 (Test 42)

Figure 25: Post-Cyclic Monotonic Direct Simple Shear Test for B-33 U3 (Test 43)

Figure 26: Monotonic Direct Simple Shear Test for B-33 U3 (Test 44)

Figure 27: Constant-Rate-of-Strain Consolidation Test Result for B-32 U2 (Test 46)

Figure 28: Cyclic Direct Simple Shear Test Result for B-15 U1 (Test 49)

Figure 29: Post-Cyclic Reconsolidation Test for B-15 U1 (Test 50)

Figure 30: Cyclic Direct Simple Shear Test Result for B-32 U2 (Test 52)

Figure 31: Cyclic Direct Simple Shear Test Result for B-15 U1 (Test 53)

Figure 32: Cyclic Direct Simple Shear Test Result for B-15 U3 (Test 55)

Figure 33: Post-Cyclic Reconsolidation Test for B-15 U3 (Test 56)

Figure 34: Constant-Rate-of-Strain Consolidation Test Result for B-15 U1 (Test 61)

Figure 35: Constant-Rate-of-Strain Consolidation Test Result for B-15 U3 (Test 62)

Figure 36: Cyclic Direct Simple Shear Test Result for B-15 U1 (Test 63)

Figure 37: Monotonic Direct Simple Shear Test for B-32 U2 (Test 64)

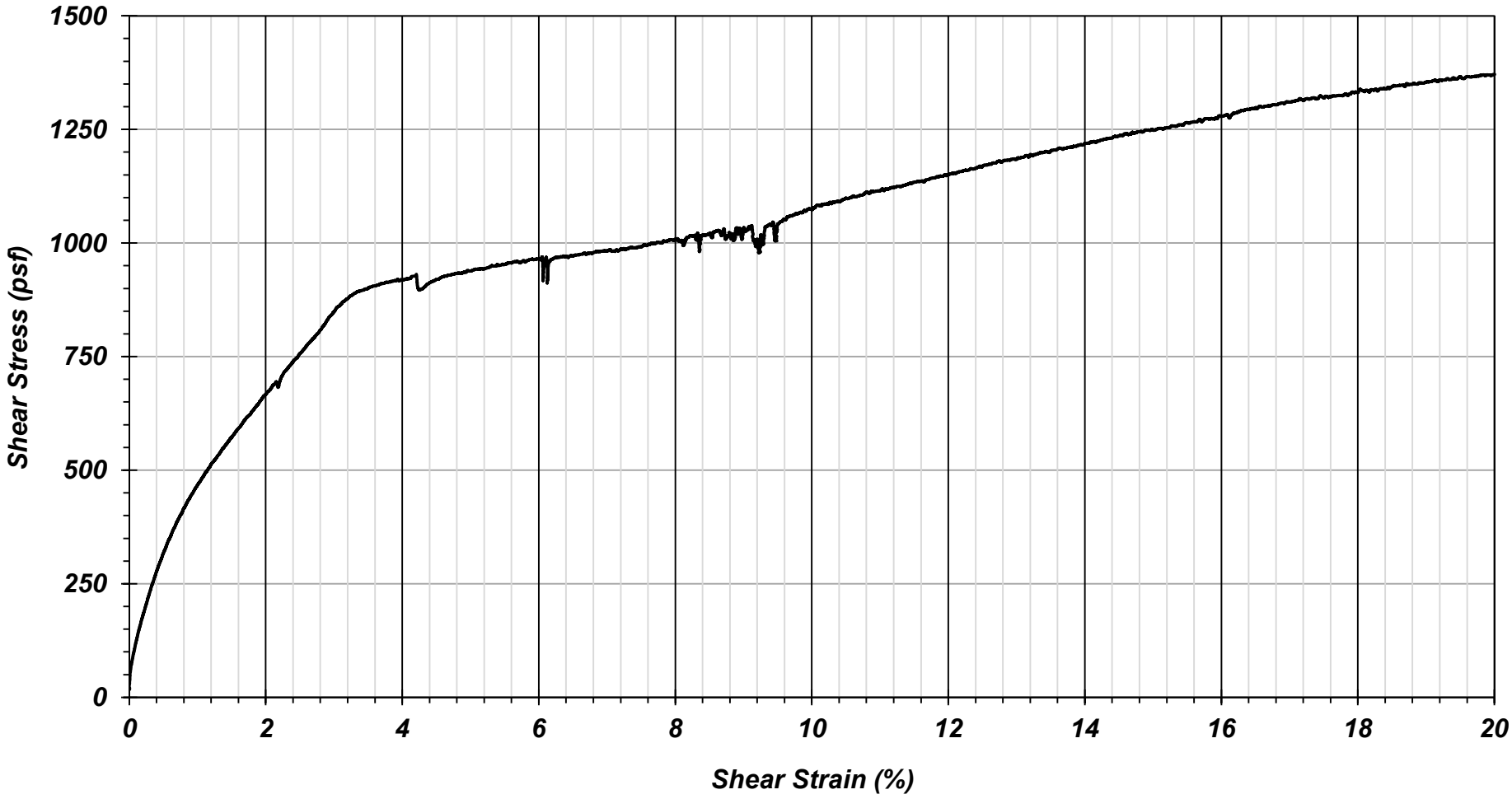
Figure 38: Cyclic Direct Simple Shear Test Result for B-32 U2 (Test 66)

Figure 39: Cyclic Direct Simple Shear Test Result for B-16 U2 (Test 68)

Figure 40: Monotonic Direct Simple Shear Test Result for B-15 U1 (Test 70)

Figure 41: Bender Element Test Results (Tests 65, 67, 69)

Figure 42: Grain Size Distributions (Tests 72 – 75)



Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)
B-17-U1	23-25	5

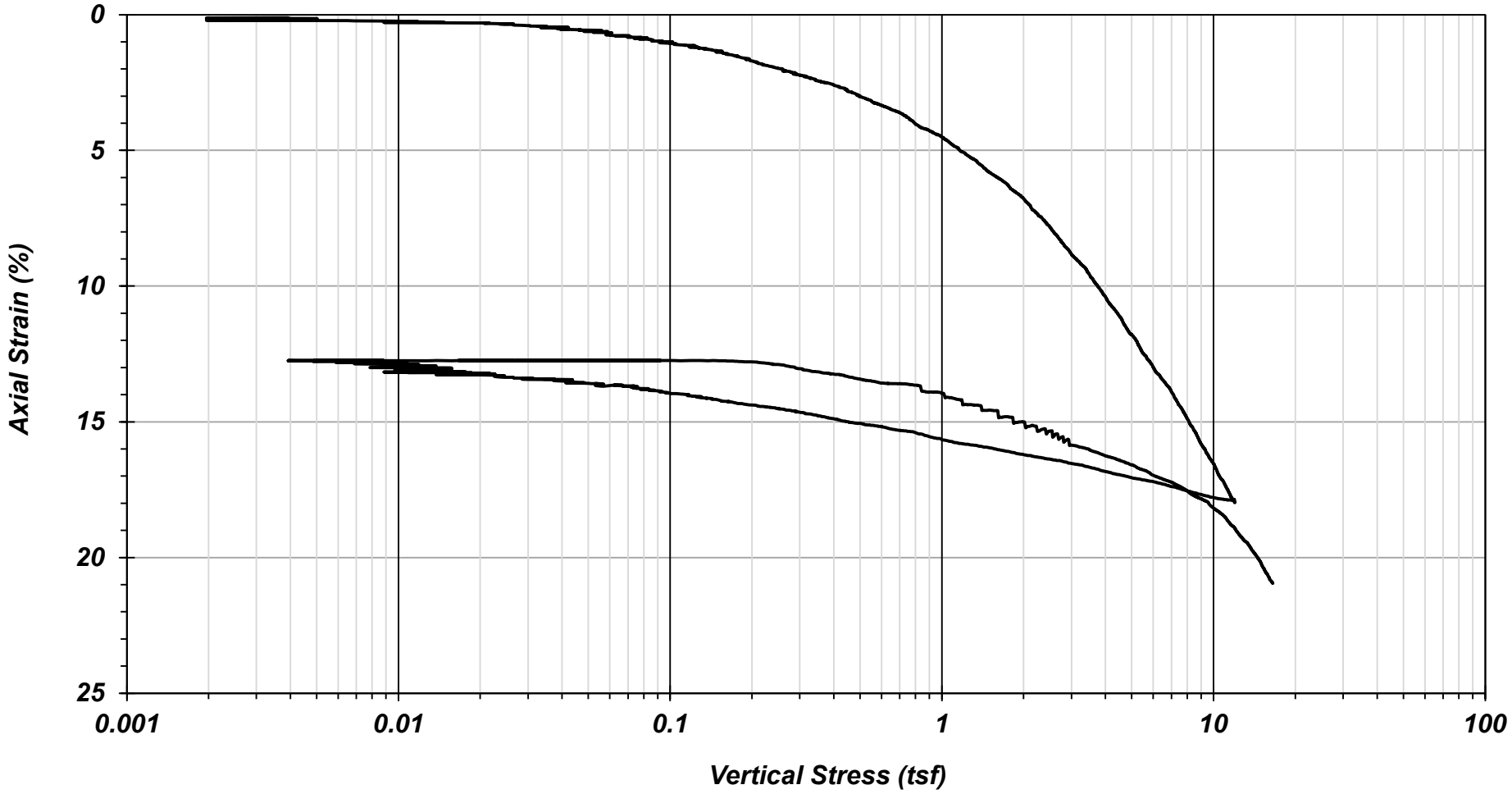
Vertical (Normal) Effective Consolidation Stress
2300 psf

Earthquake Ready Burnside Bridge Project, Portland OR

Monotonic Direct Simple Shear Results

Oregon State University

FIG. 1



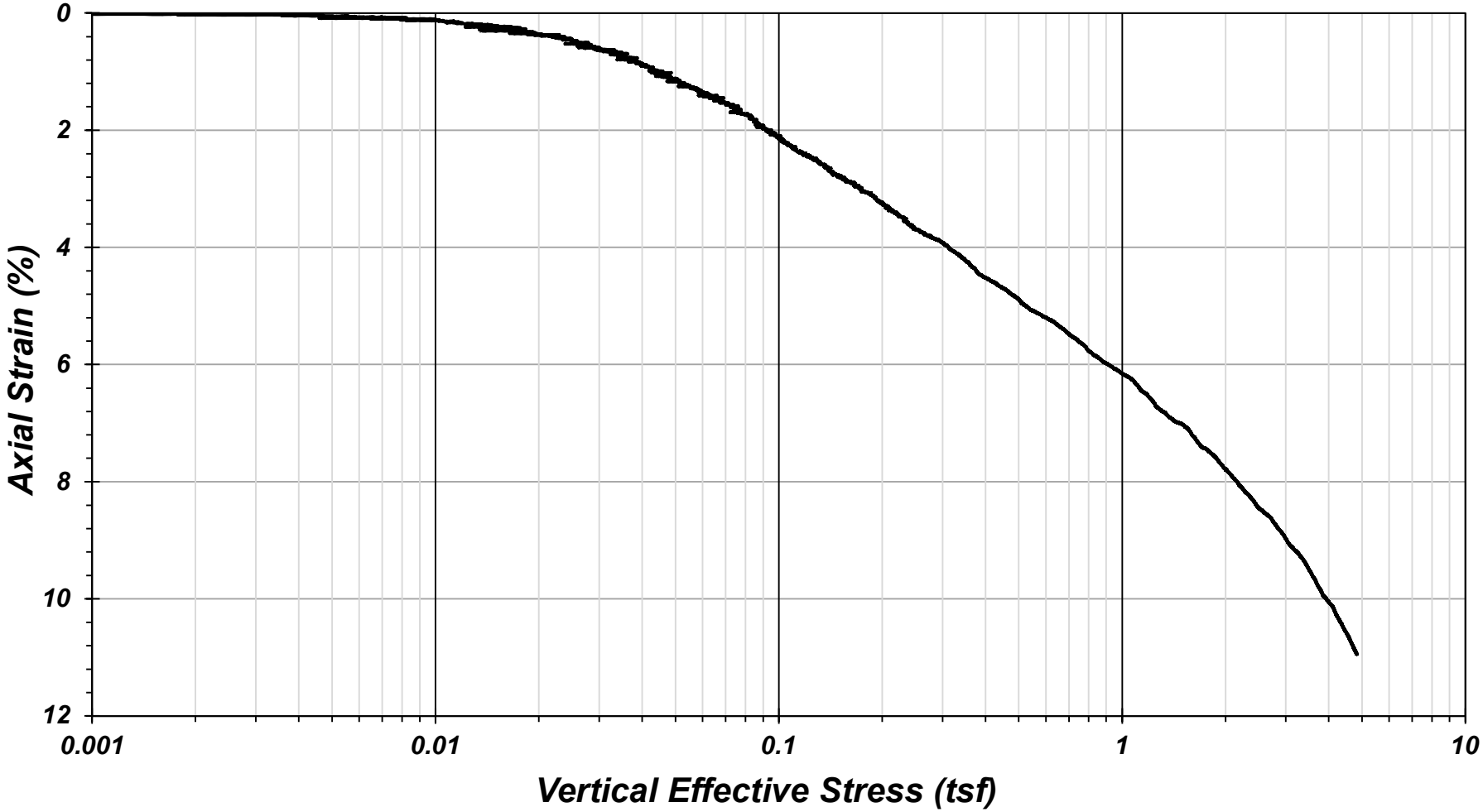
1-D Consolidation Test (CRS)			
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)	Initial Water Content w (%)
B-18-U2	38-40	1	51

Earthquake Ready Burnside Bridge Project, Portland, OR

1-D Constant Rate-of-Strain Consolidation Test

Oregon State University

FIG. 2



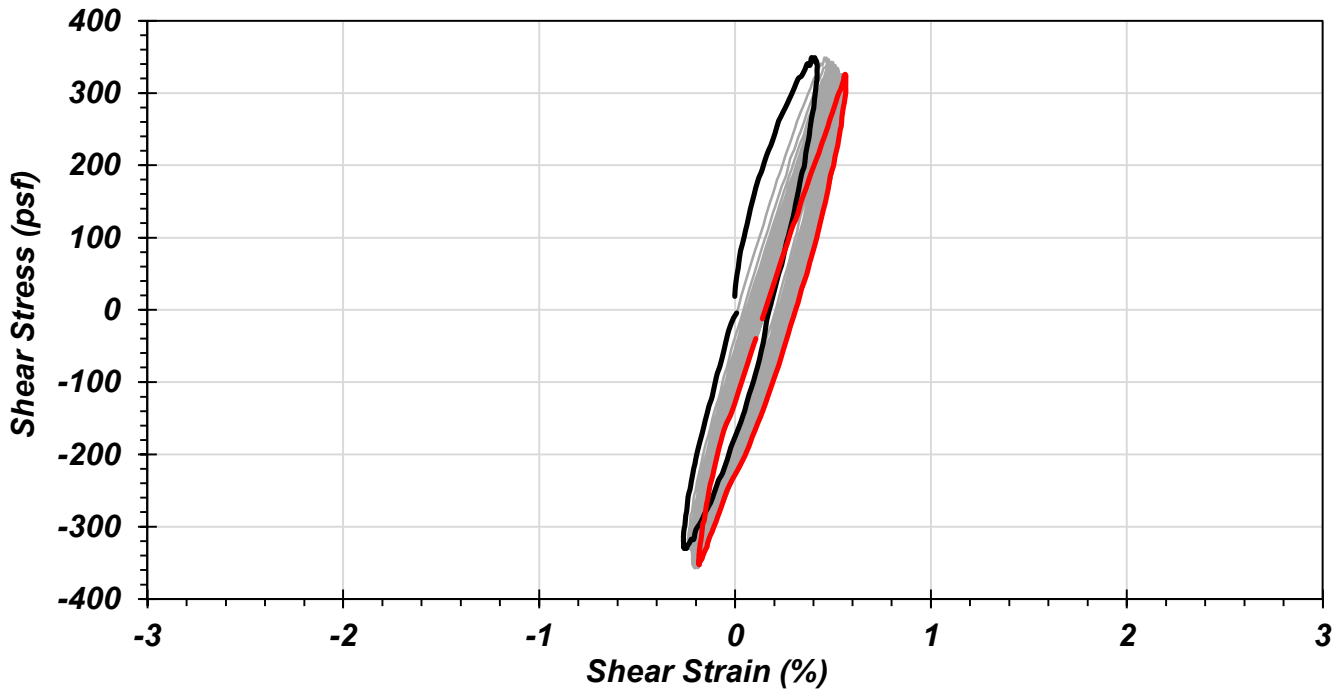
1-D Consolidation Test (CRS)			
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)	Initial Water Content, w (%)
B-17 U4	101.5-103.5	1	46

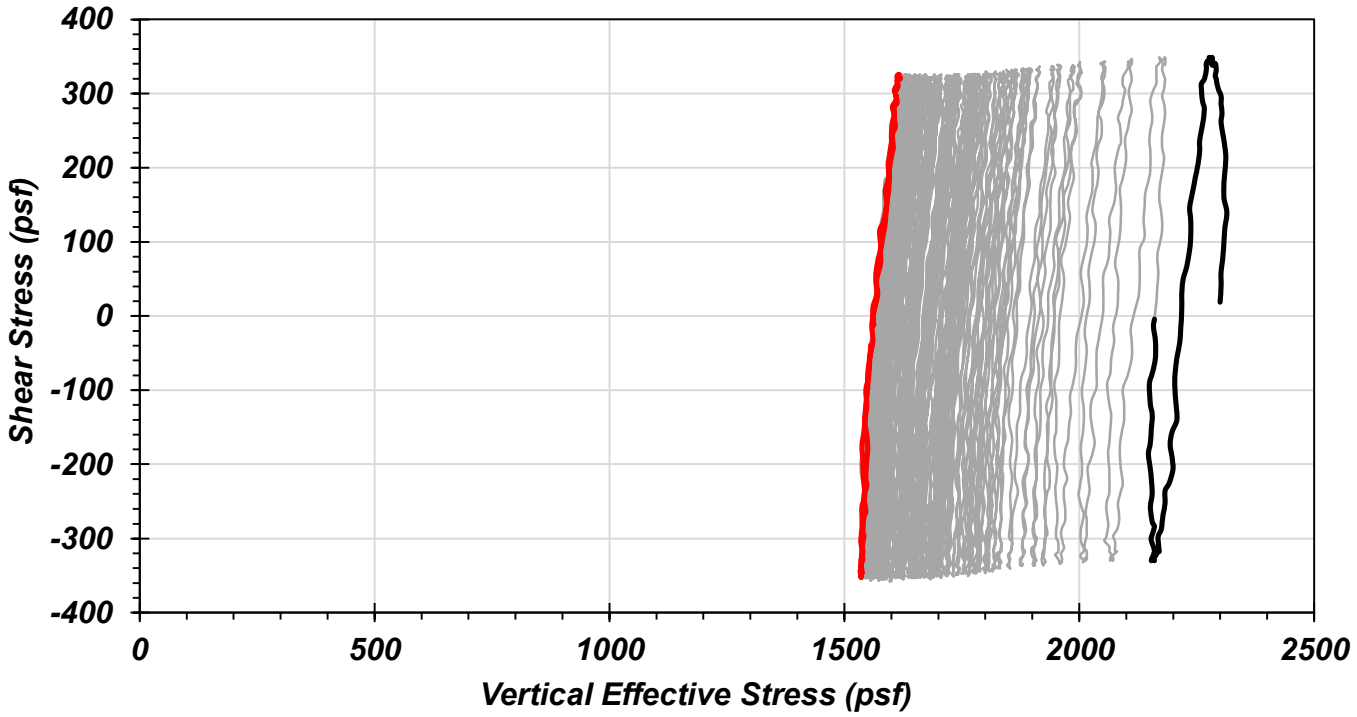
Earthquake-Ready Burnside Bridge Project, Portland, OR

1-D Constant Rate of Strain Consolidation Test

Oregon State University

FIG. 3





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-17 U1	80-82	0.15	100

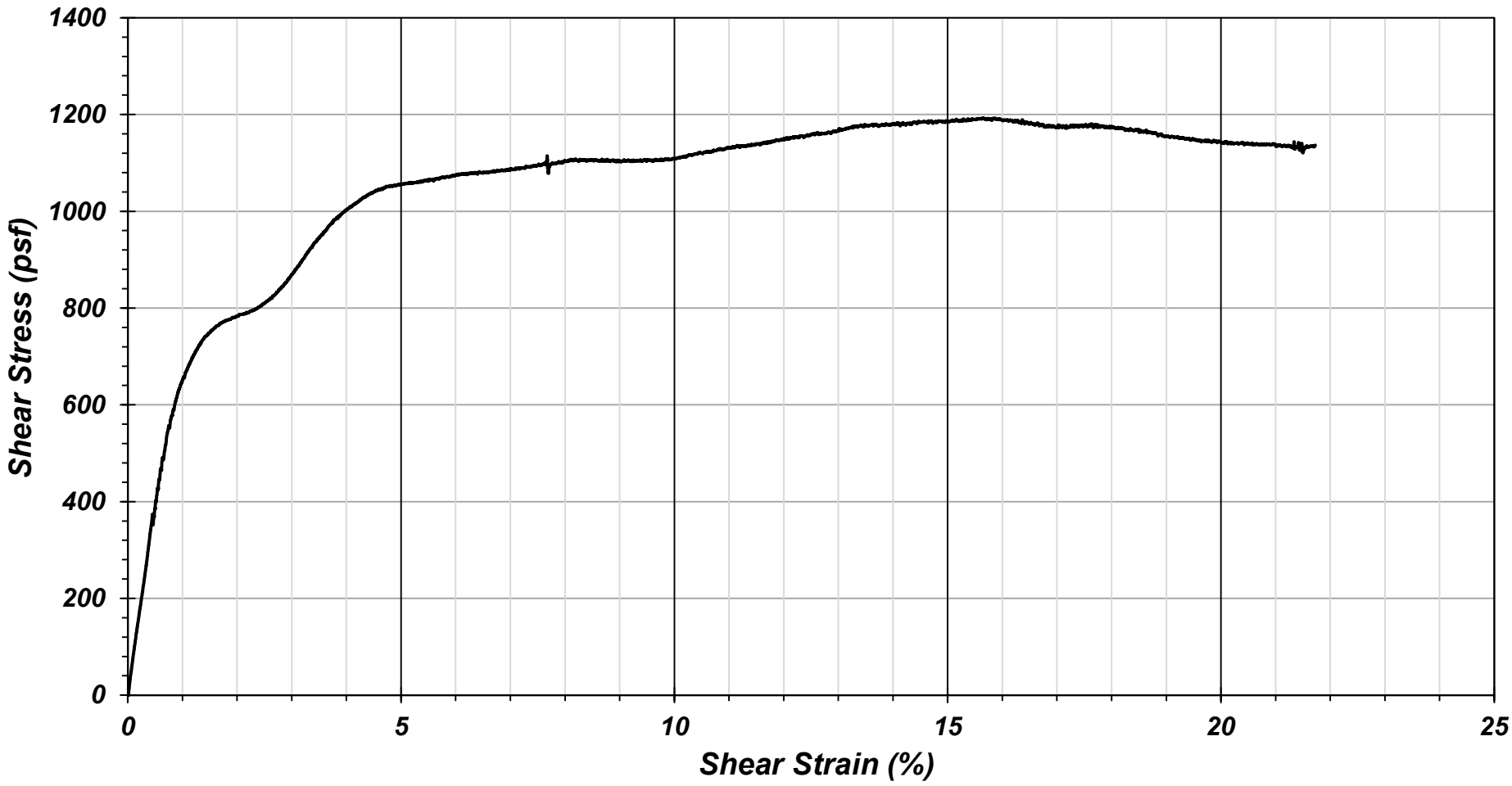
Vertical (Normal) Effective Consolidation Stress
2300 psf

Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 4



Post-Cyclic Monotonic Stage		
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)
B-17 U1	80-82	5

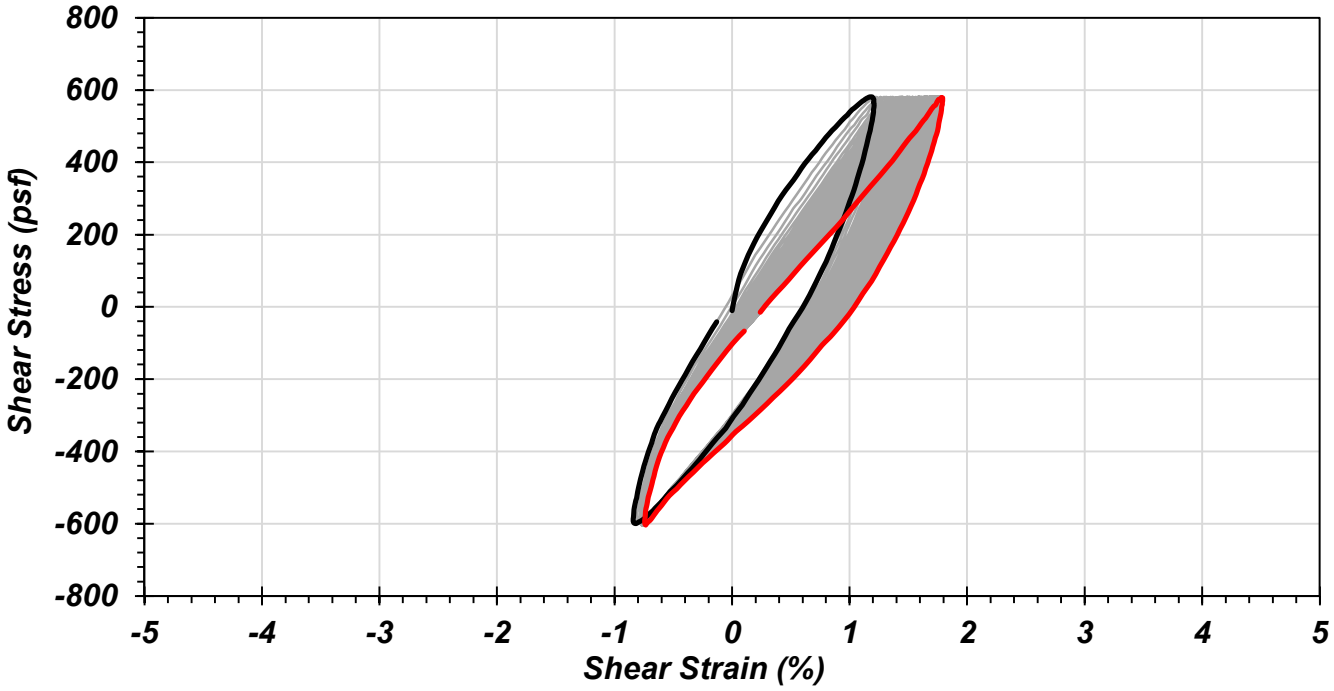
Cyclic Stage	
CSR	Number of Cycles
0.15	100

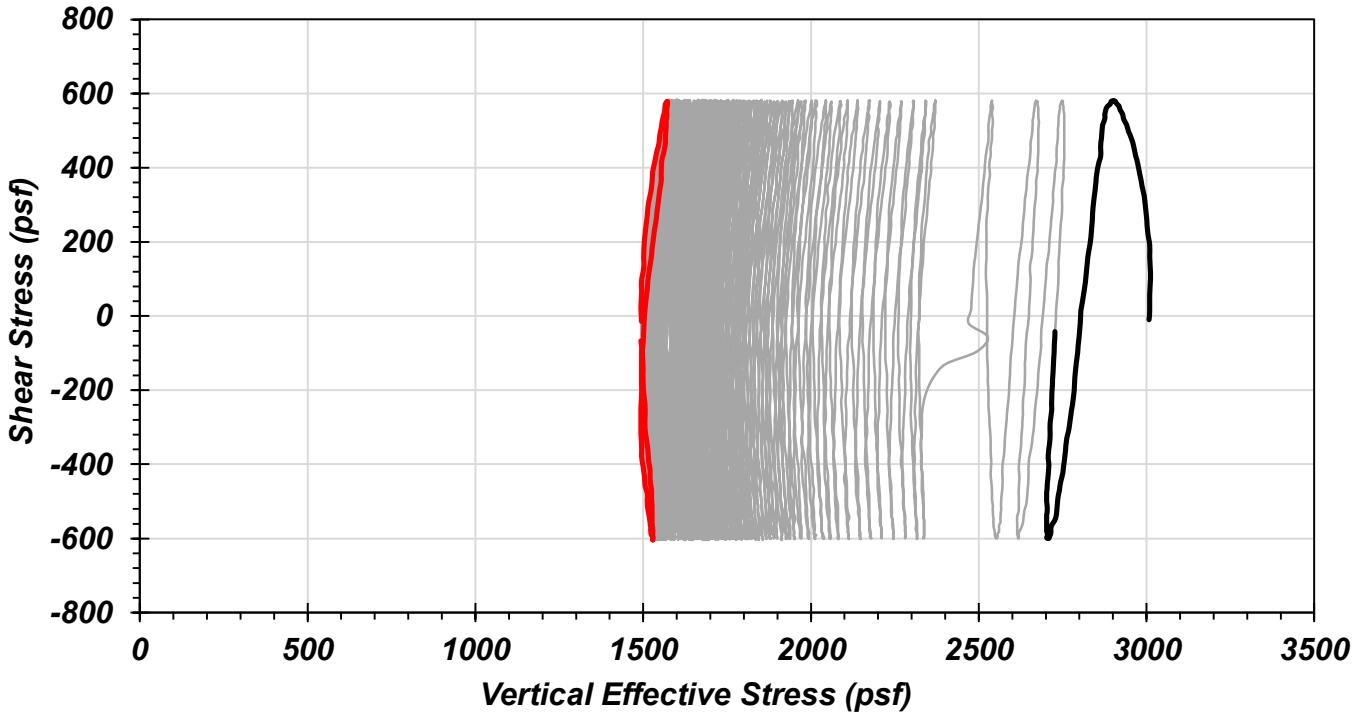
Earthquake-Ready Burnside Bridge Project, Portland, OR

Post-Cyclic Monotonic Direct Simple Shear Test Results

Oregon State University

FIG. 5





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-18 U2	38-40	0.2	100

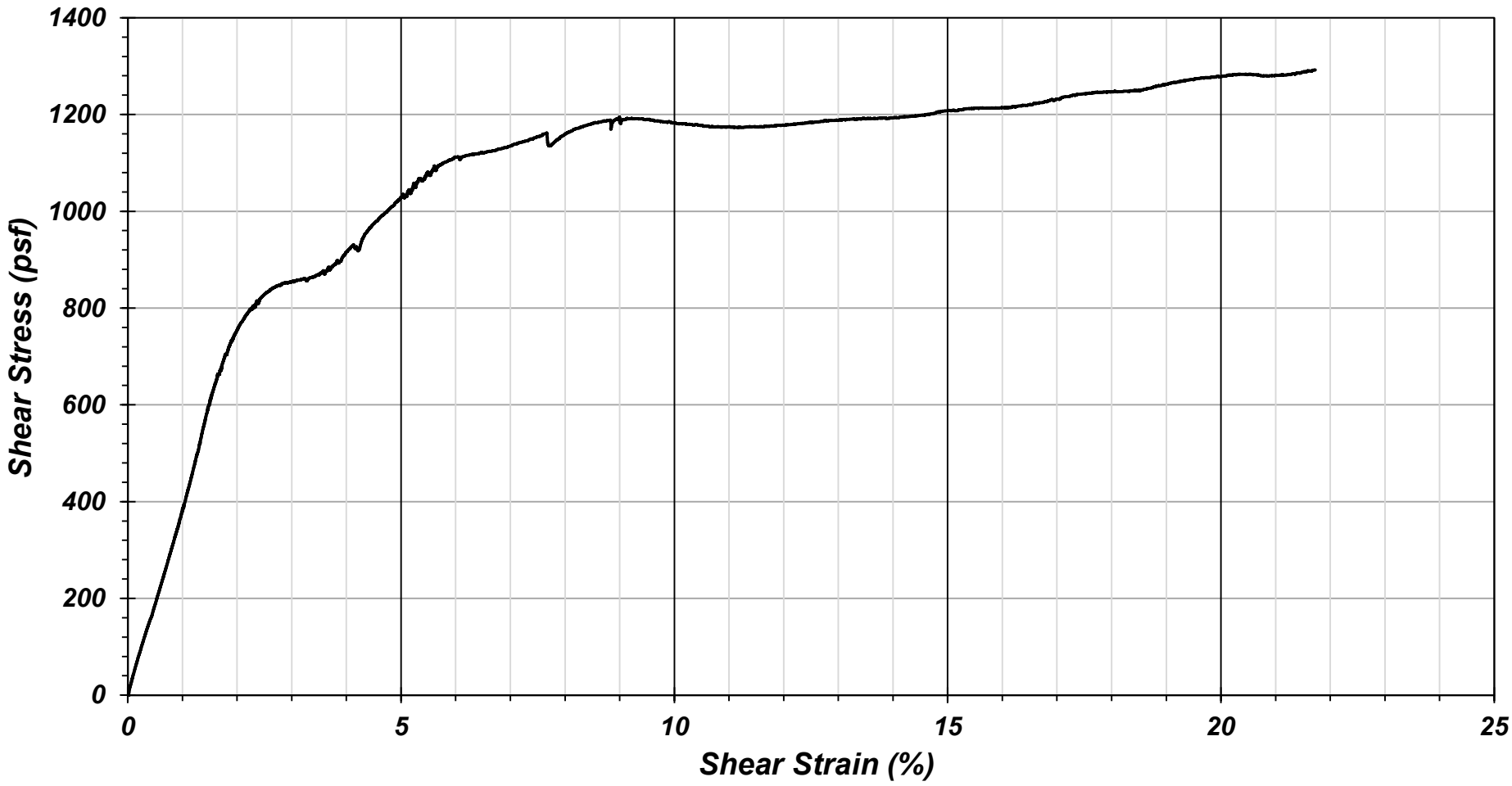
Vertical (Normal) Effective Consolidation Stress
3000 psf

Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 6



Post-Cyclic Monotonic Stage		
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)
B-18 U2	38-40	5

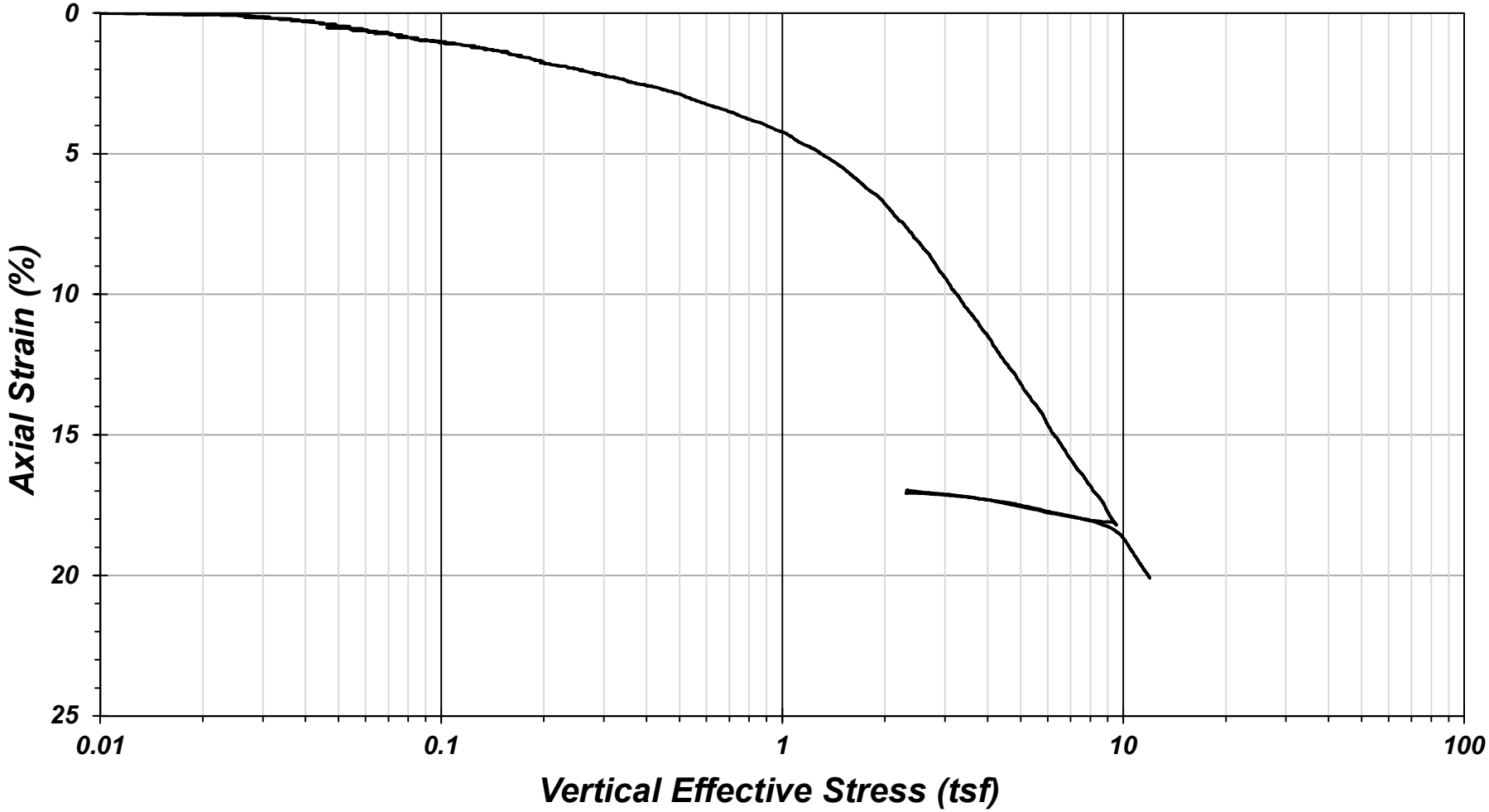
Cyclic Stage	
CSR	Number of Cycles
0.2	100

Earthquake-Ready Burnside Bridge Project, Portland, OR

Post-Cyclic Monotonic Direct Simple Shear Test Results

Oregon State University

FIG. 7



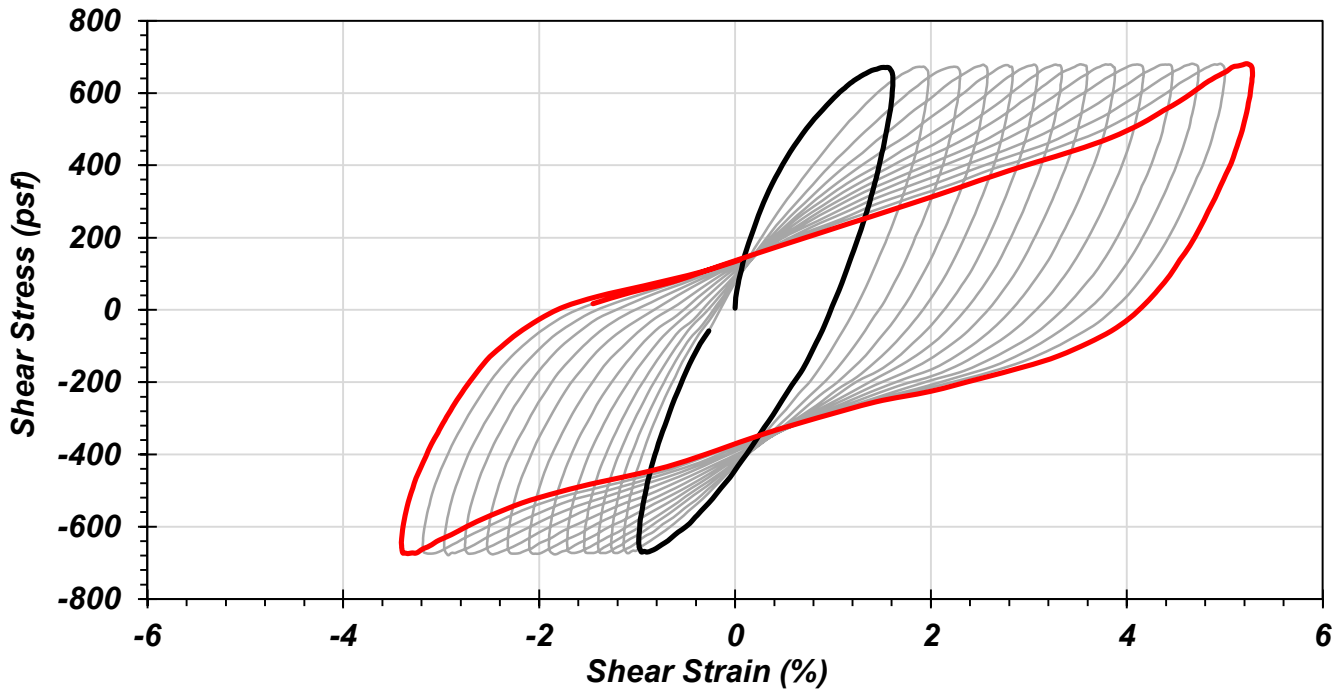
1-D Consolidation Test (CRS)			
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)	Initial Water Content, w (%)
B-17 U2	40-42	1	45

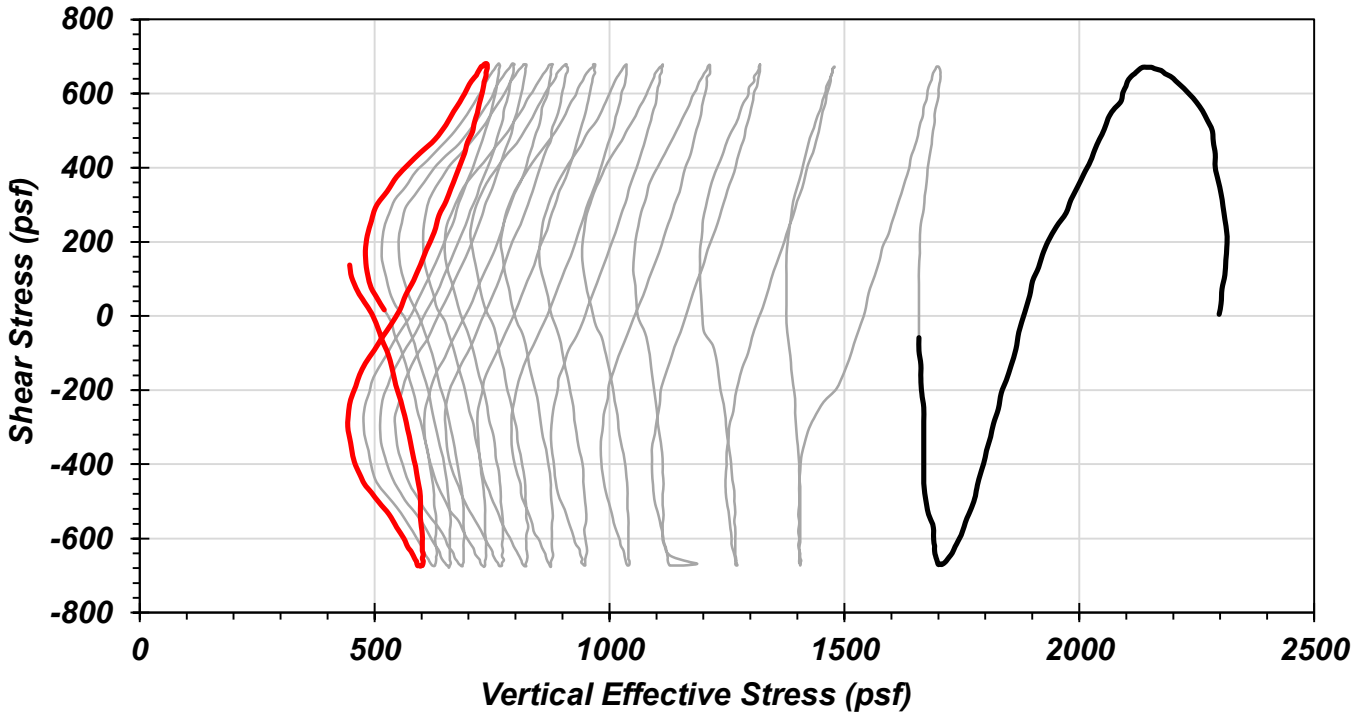
Earthquake-Ready Burnside Bridge Project, Portland, OR

1-D Constant Rate of Strain Consolidation Test

Oregon State University

FIG. 8





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-17 U1	80-82	0.3	14

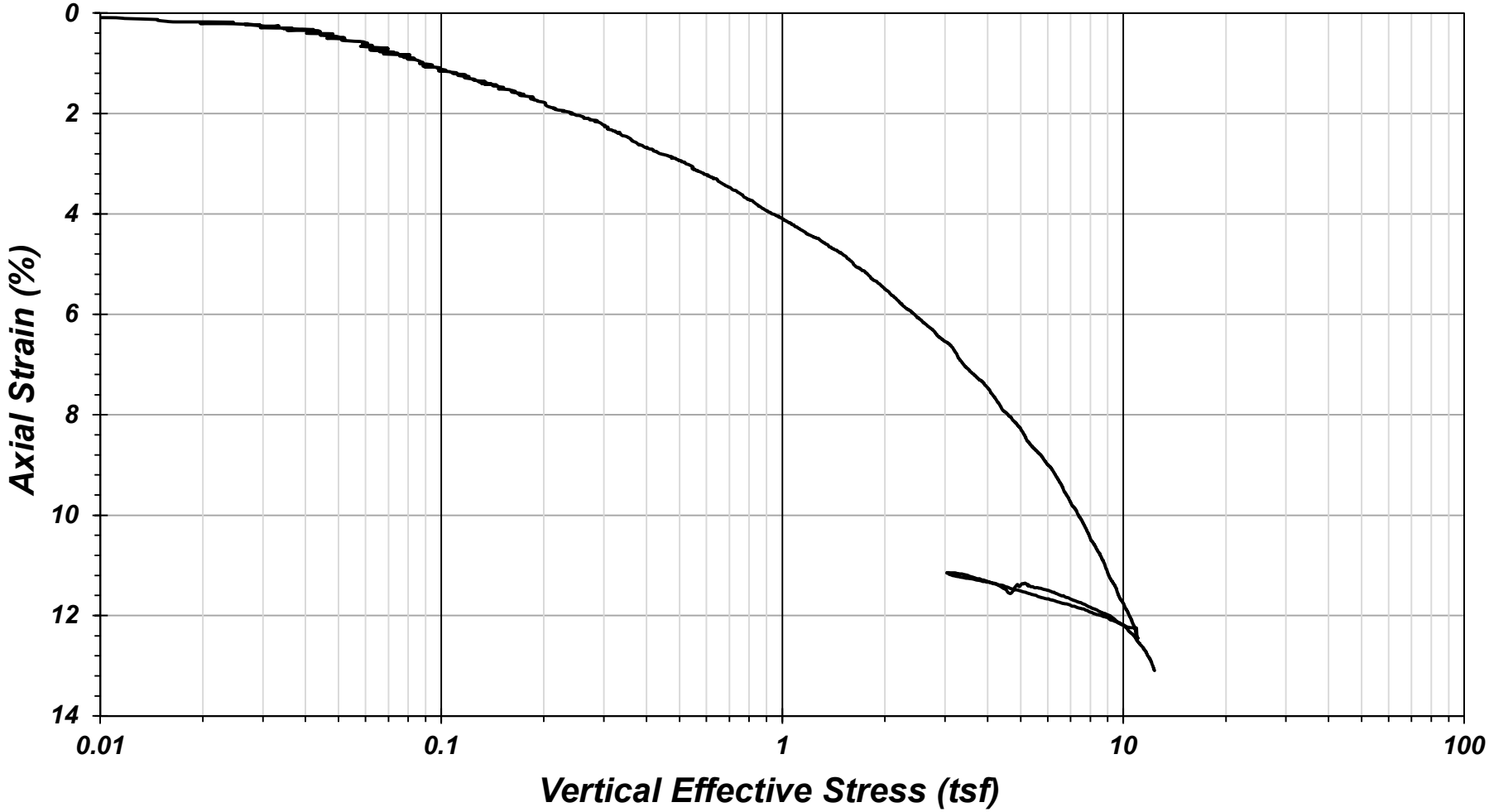
Vertical (Normal) Effective Consolidation Stress
2300 psf

Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 9



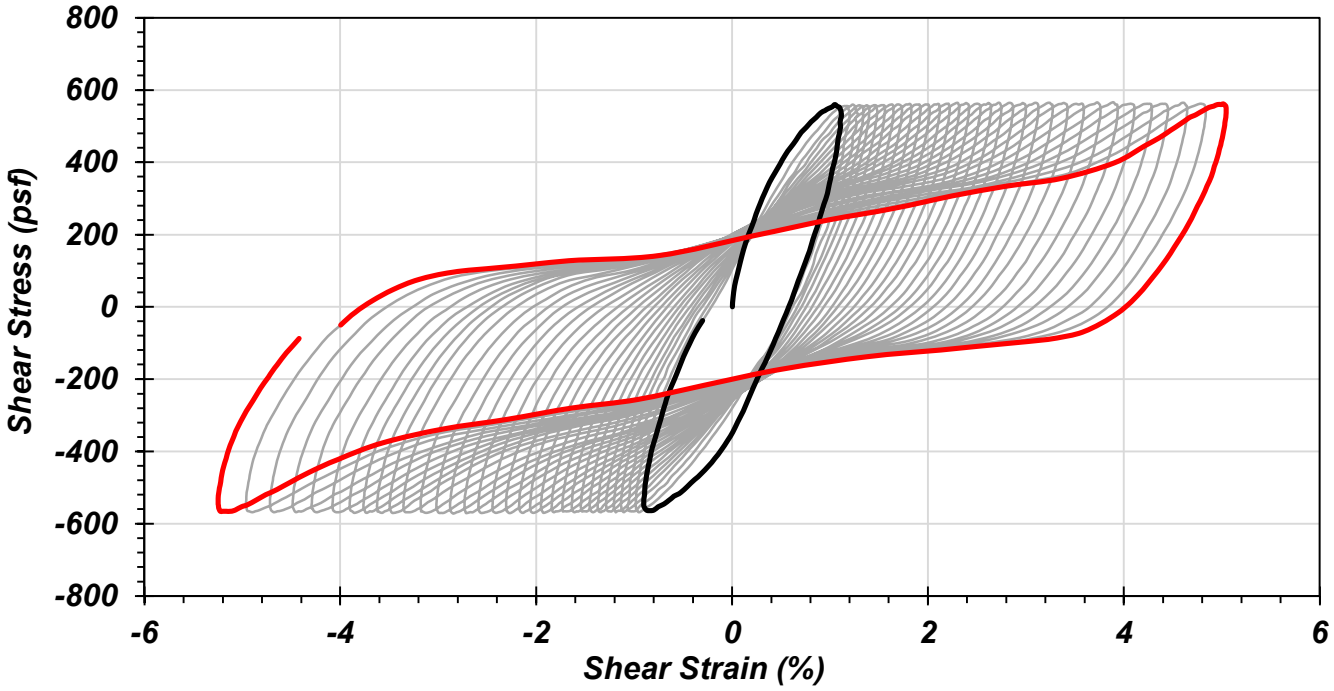
1-D Consolidation Test (CRS)			
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)	Initial Water Content, w (%)
B-17 U3	80-82	1	39

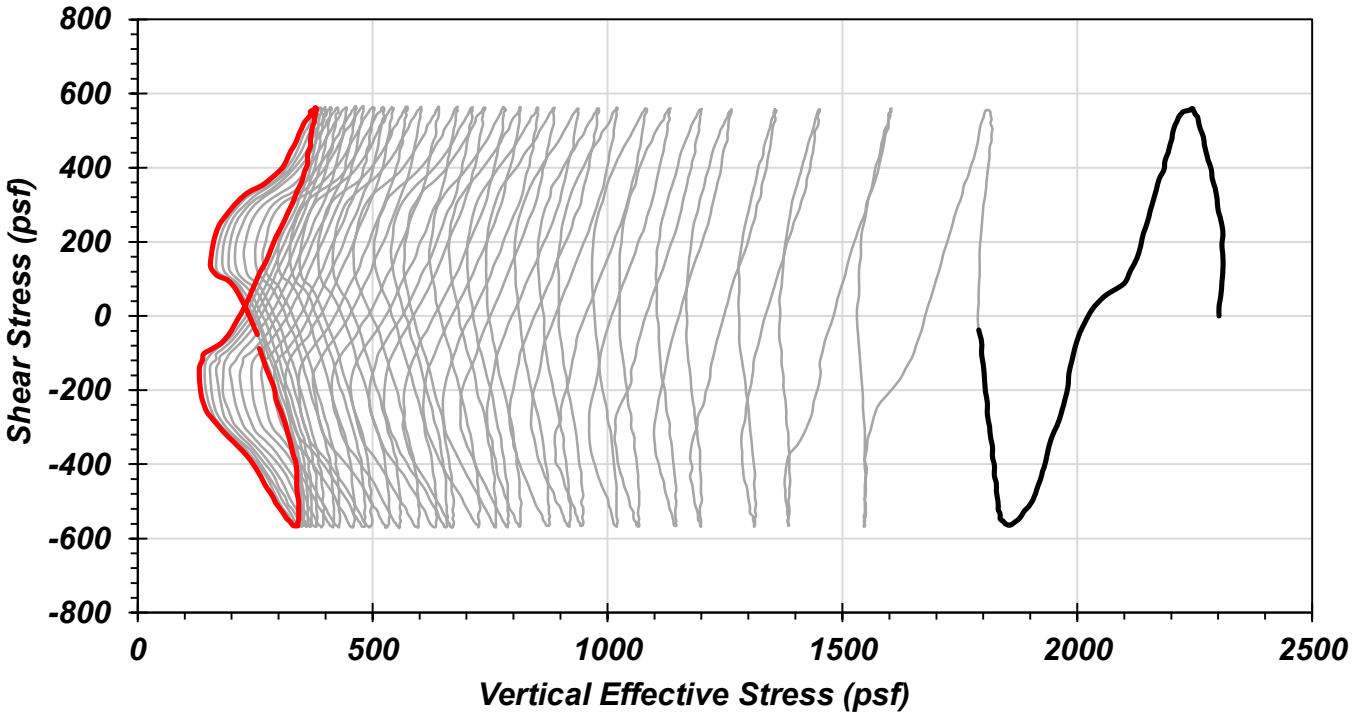
Earthquake-Ready Burnside Bridge Project, Portland, OR

1-D Constant Rate of Strain Consolidation Test

Oregon State University

FIG. 10





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-17 U1	23-25	0.25	33

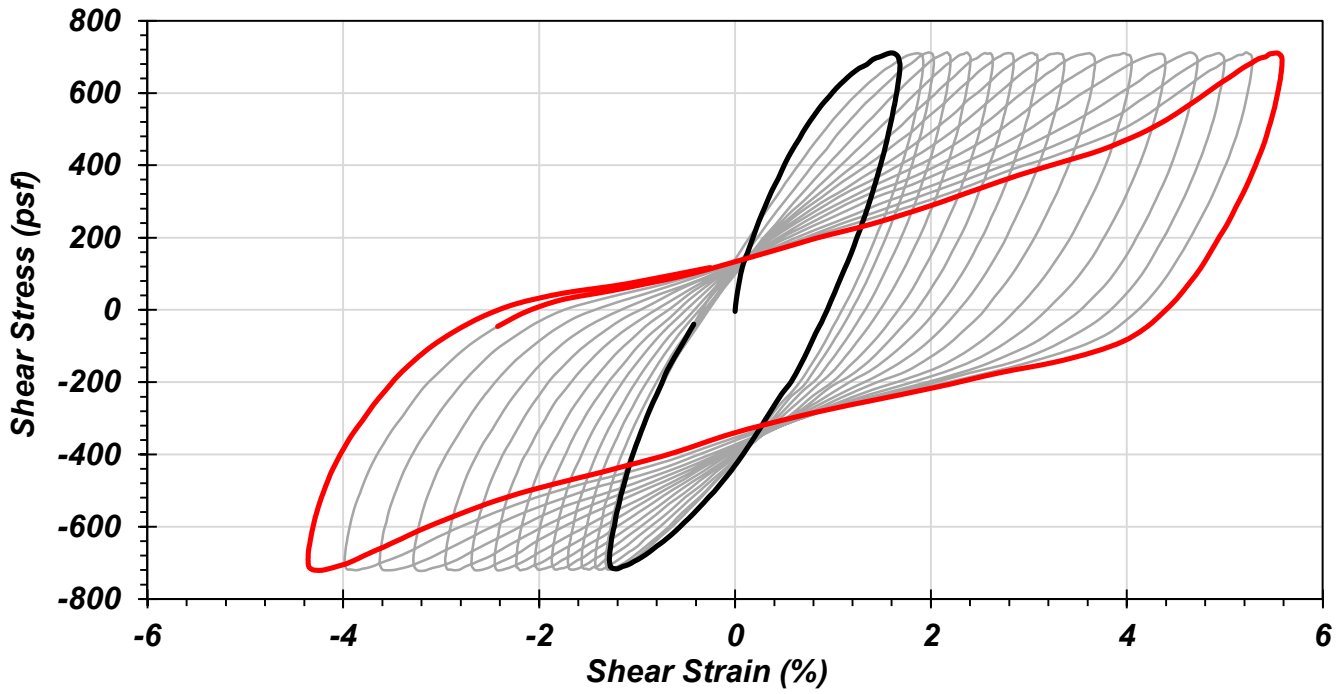
Vertical (Normal) Effective Consolidation Stress
2300 psf

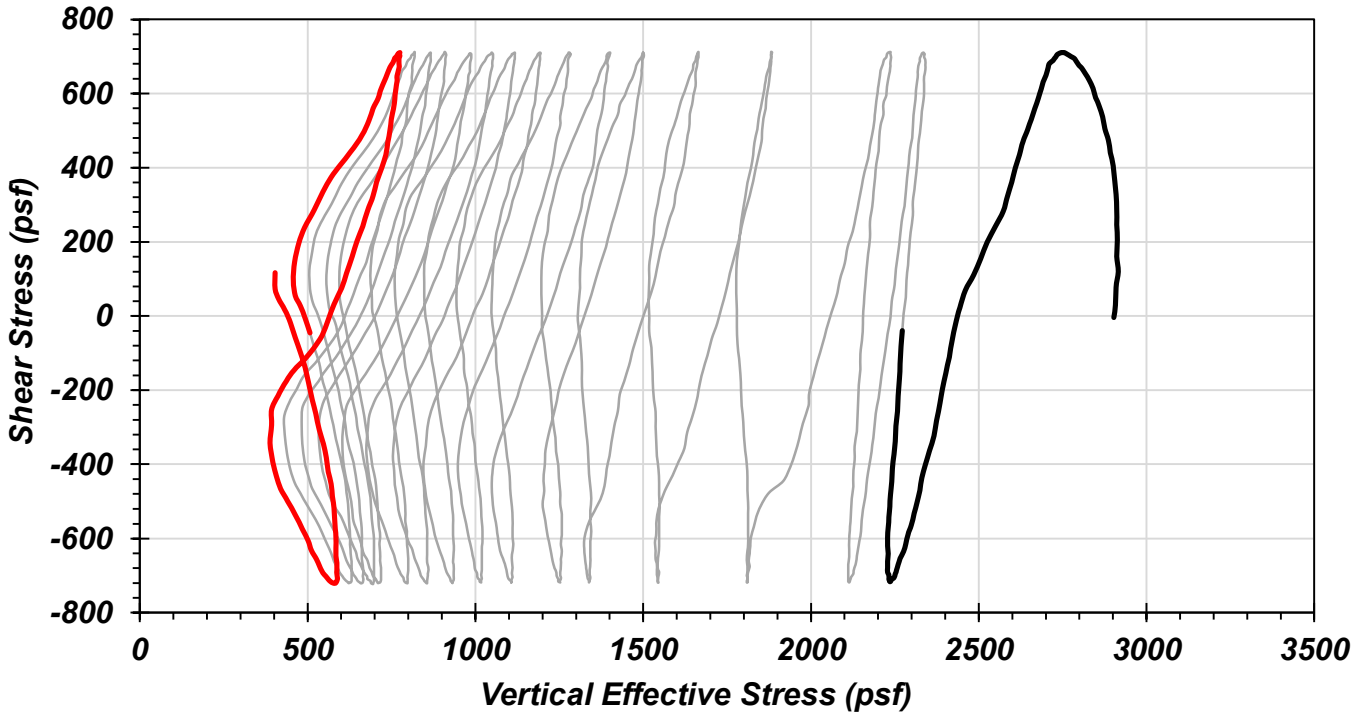
Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 11





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-17 U2	40-42	0.25	16

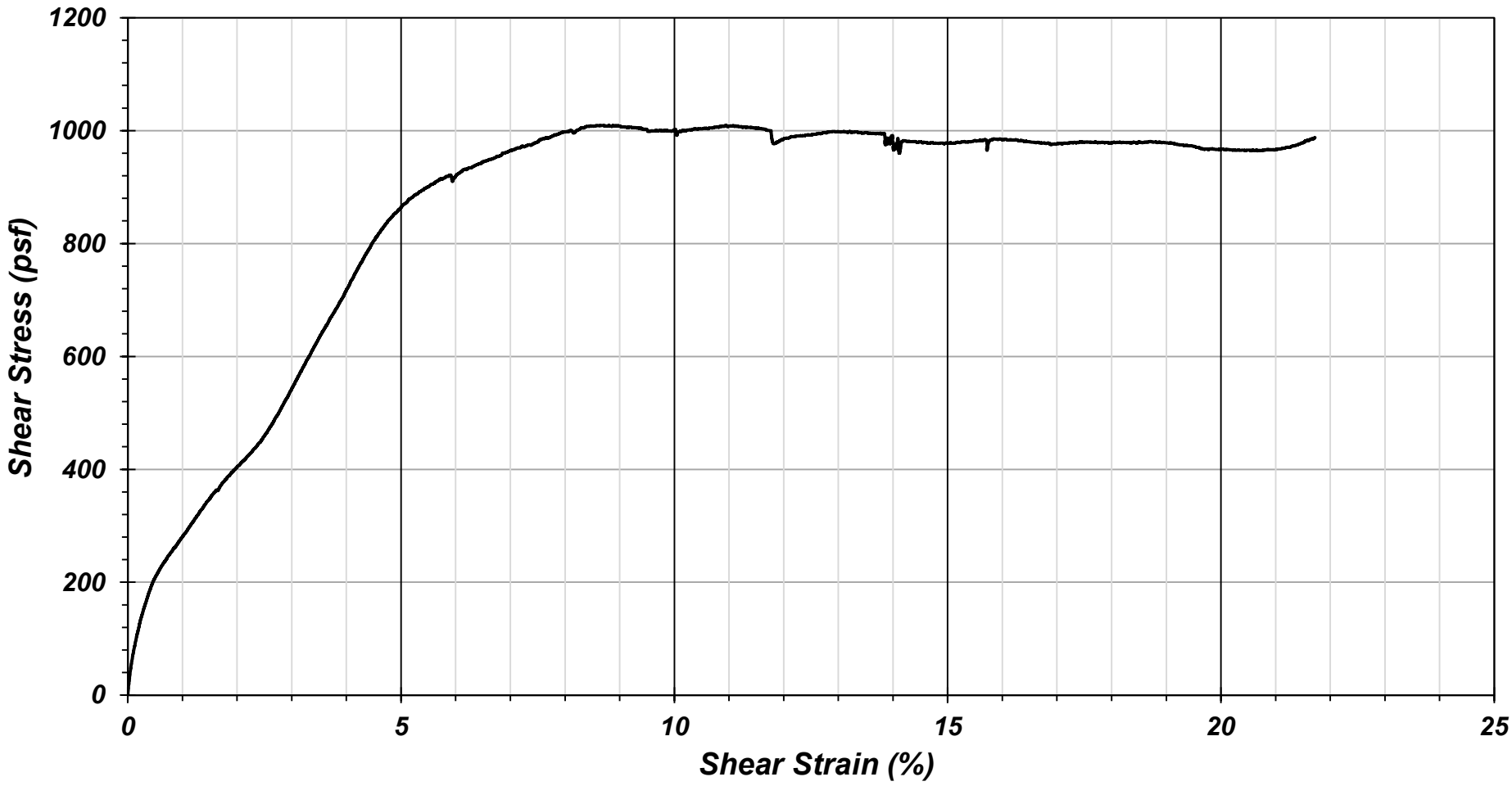
Vertical (Normal) Effective Consolidation Stress
2900 psf

Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 12



Post-Cyclic Monotonic Stage		
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)
B-17 U2	40-42	5

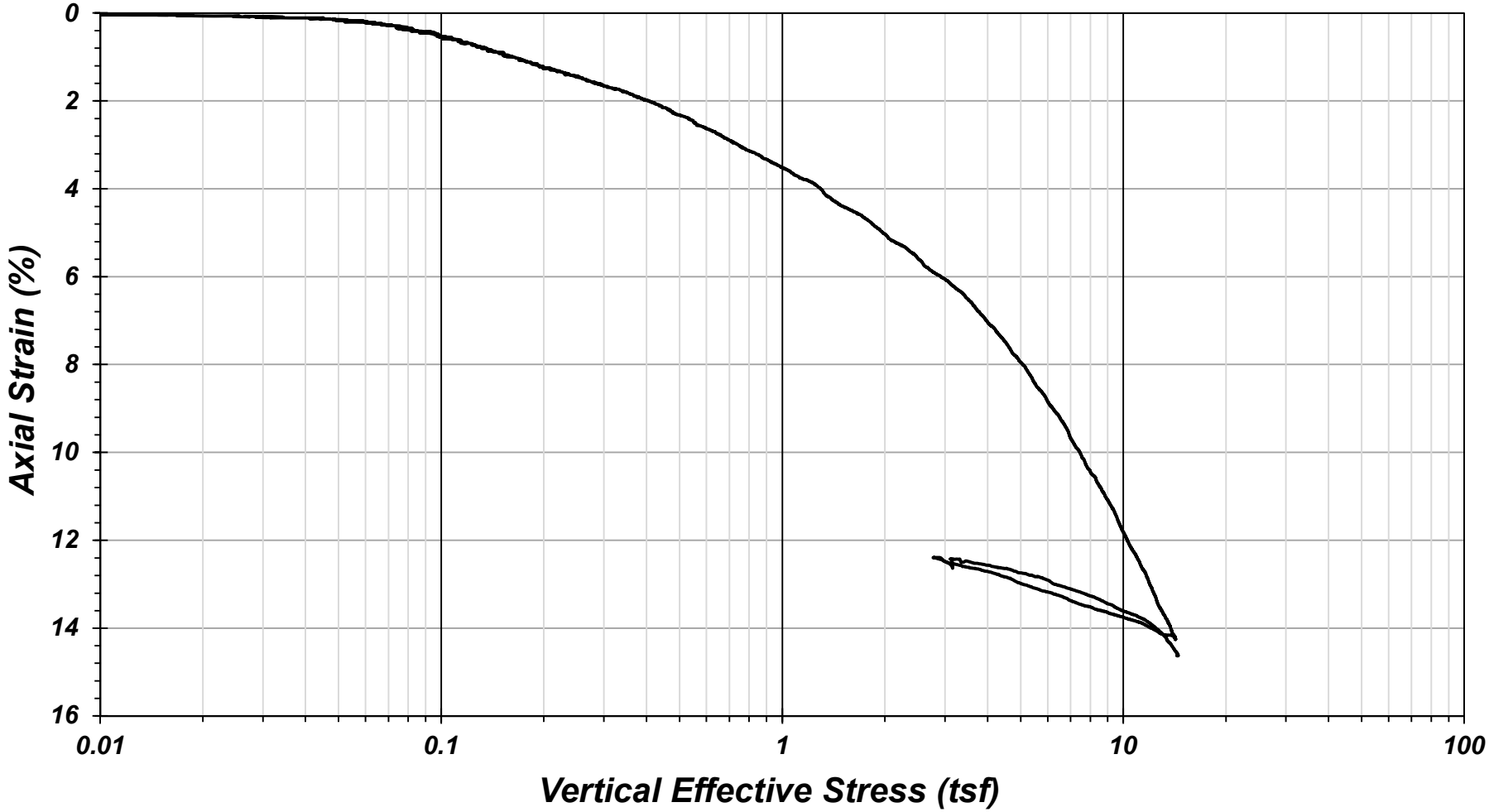
Cyclic Stage	
CSR	Number of Cycles
0.25	16

Earthquake-Ready Burnside Bridge Project, Portland, OR

Post-Cyclic Monotonic Direct Simple Shear Test Results

Oregon State University

FIG. 13



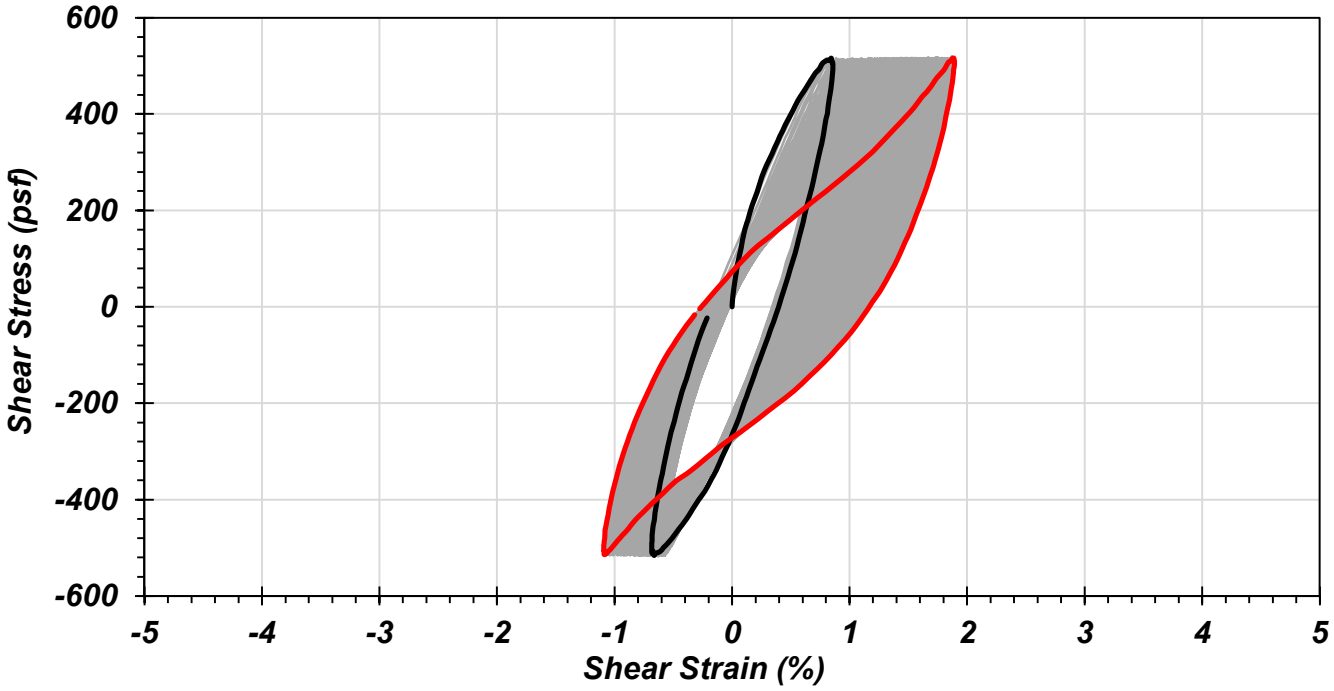
1-D Consolidation Test (CRS)			
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)	Initial Water Content, w (%)
B-33 U3	63-65	1	43

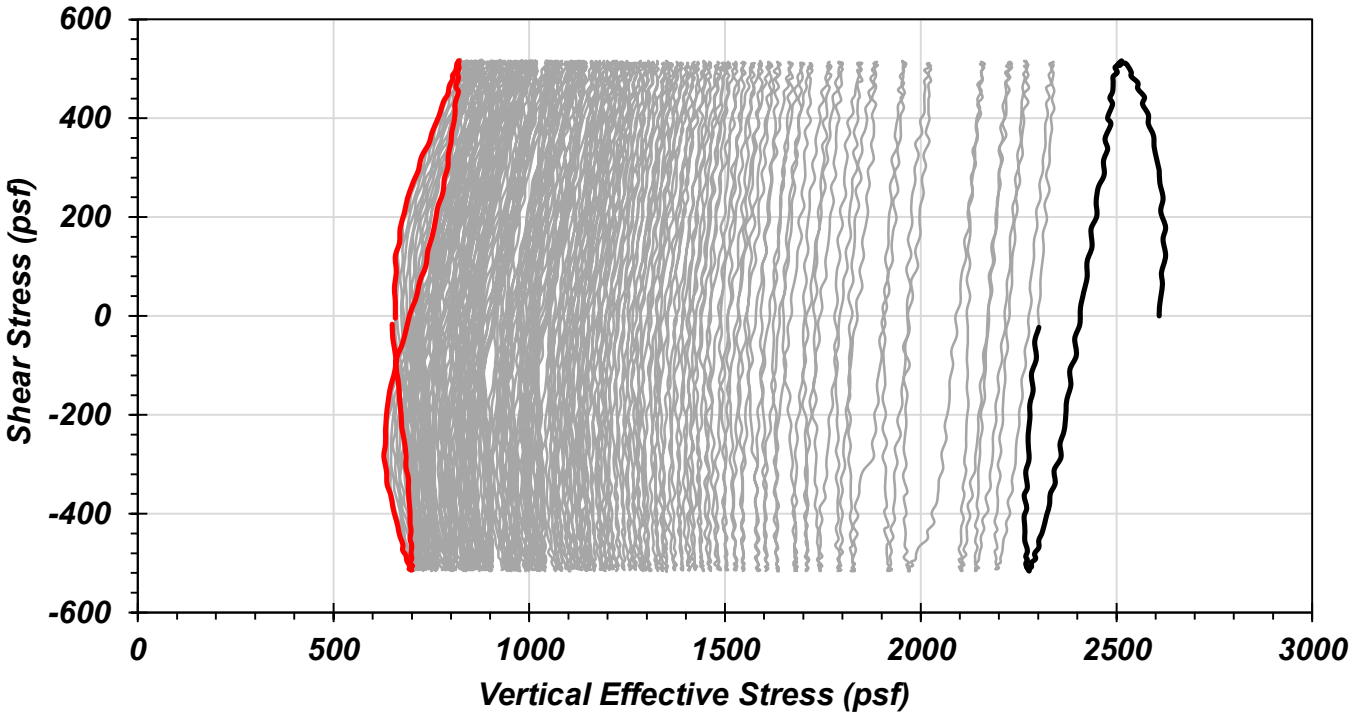
Earthquake-Ready Burnside Bridge Project, Portland, OR

1-D Constant Rate of Strain Consolidation Test

Oregon State University

FIG. 14





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-33 U1	33-35	0.2	100

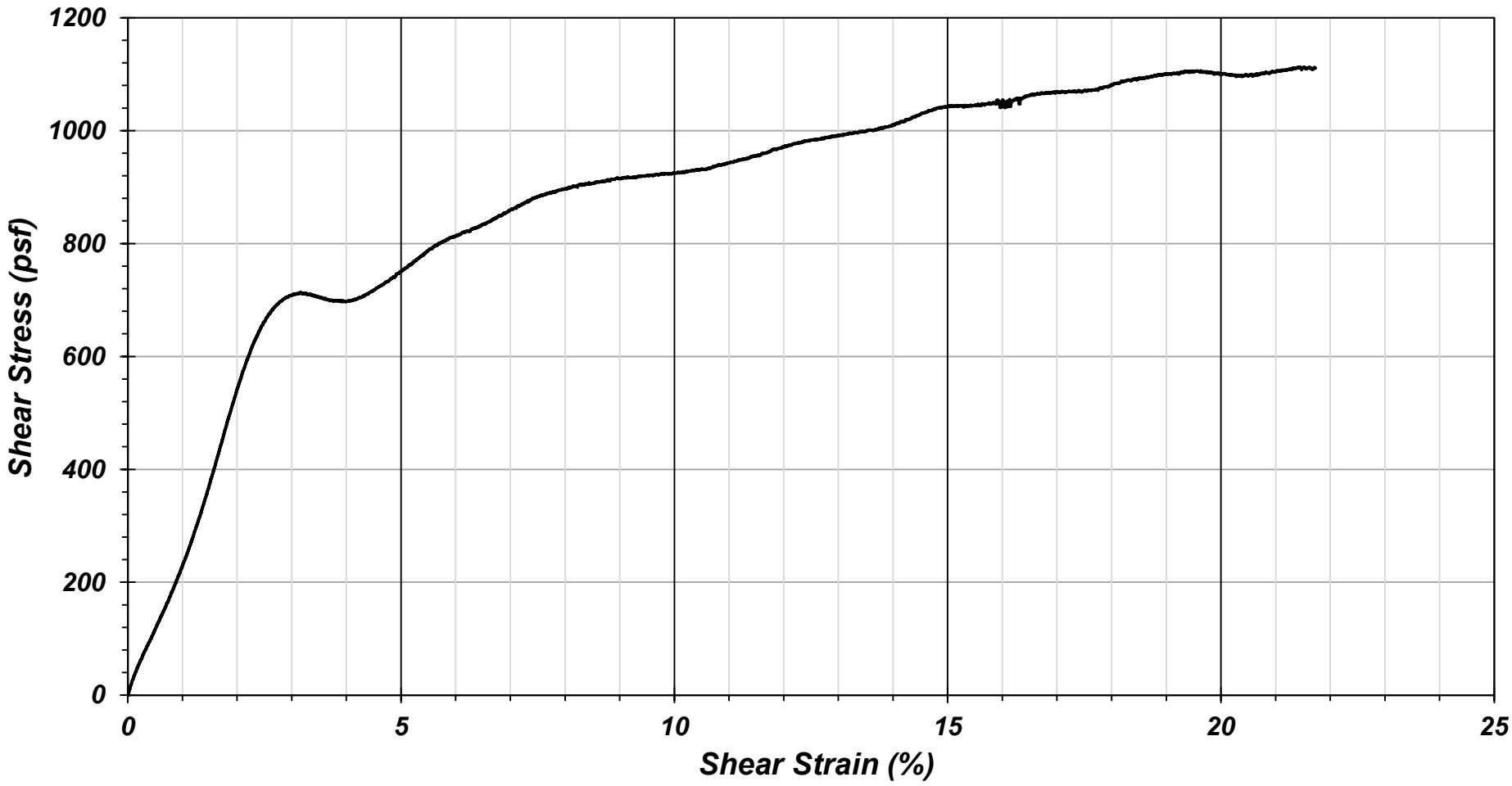
Vertical (Normal) Effective Consolidation Stress
2600 psf

Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 15



Post-Cyclic Monotonic Stage		
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)
B-33 U1	33-35	5

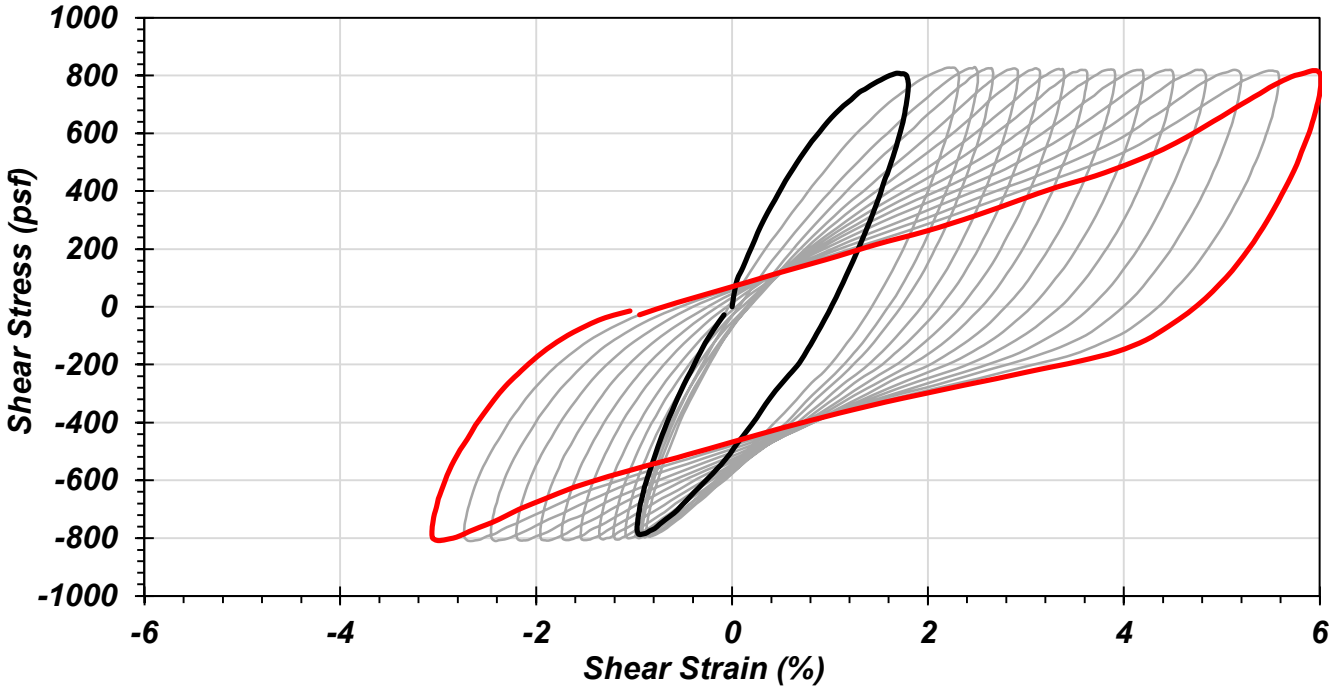
Cyclic Stage	
CSR	Number of Cycles
0.2	100

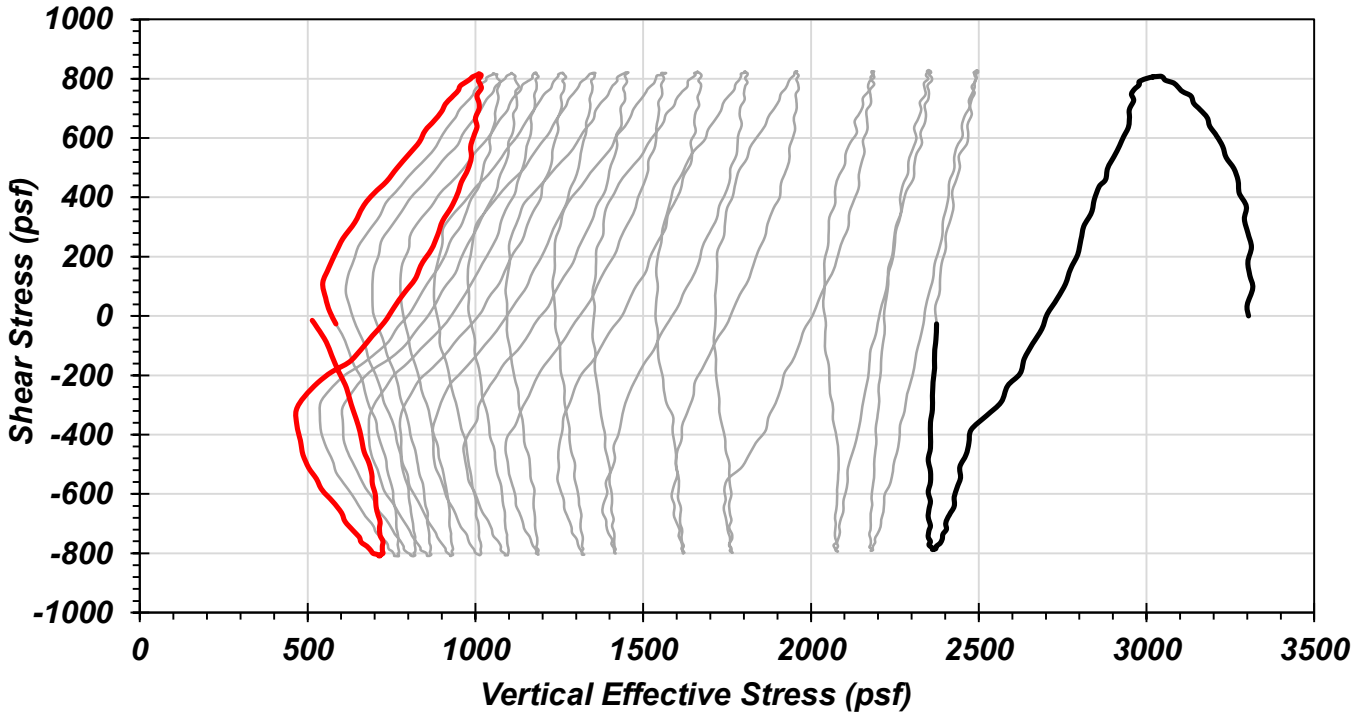
Earthquake-Ready Burnside Bridge Project, Portland, OR

Post-Cyclic Monotonic Direct Simple Shear Test Results

Oregon State University

FIG. 16





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-33 U2	48-50	0.25	15

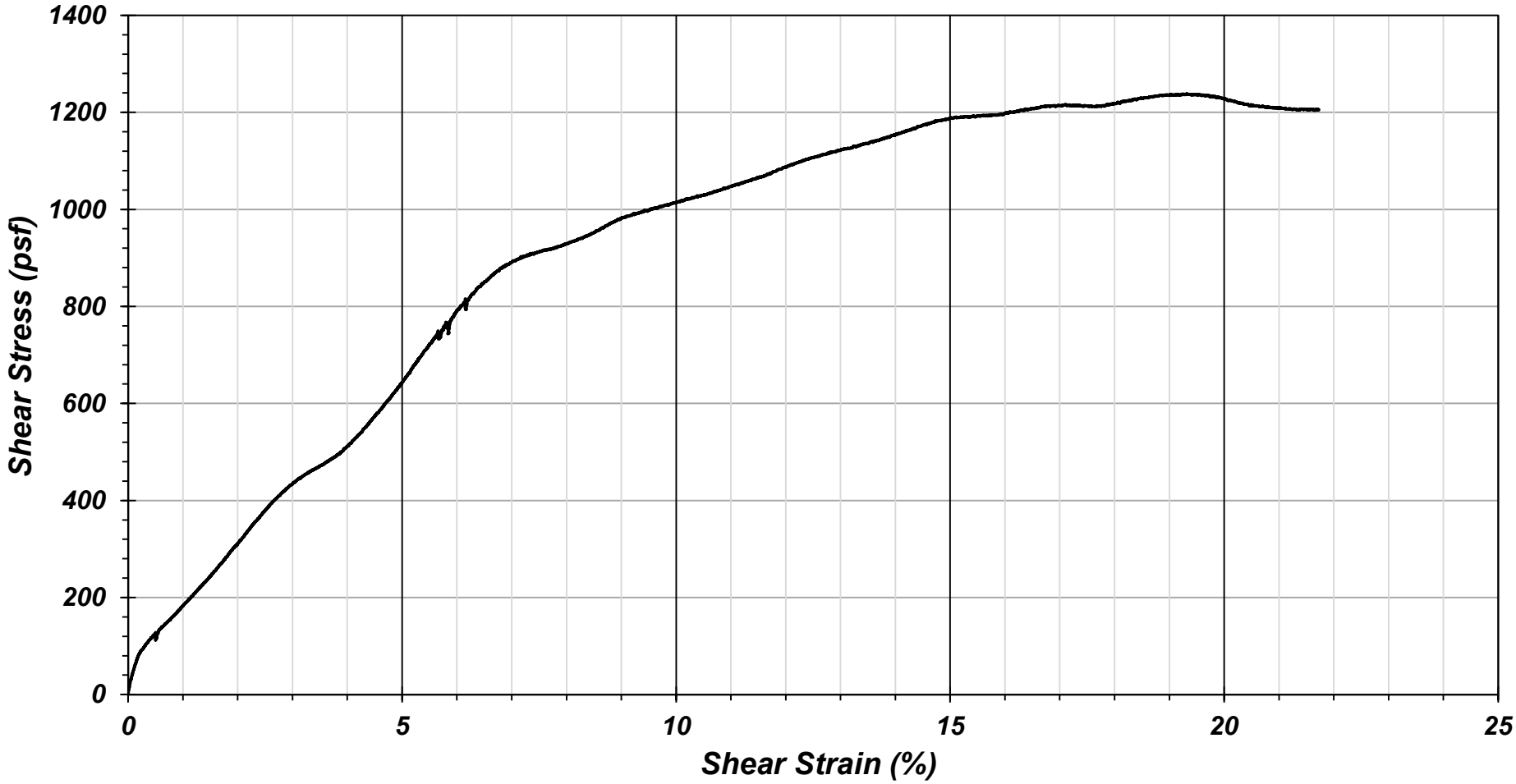
Vertical (Normal) Effective Consolidation Stress
3300 psf

Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 17



Post-Cyclic Monotonic Stage		
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)
B-33 U2	48-50	5

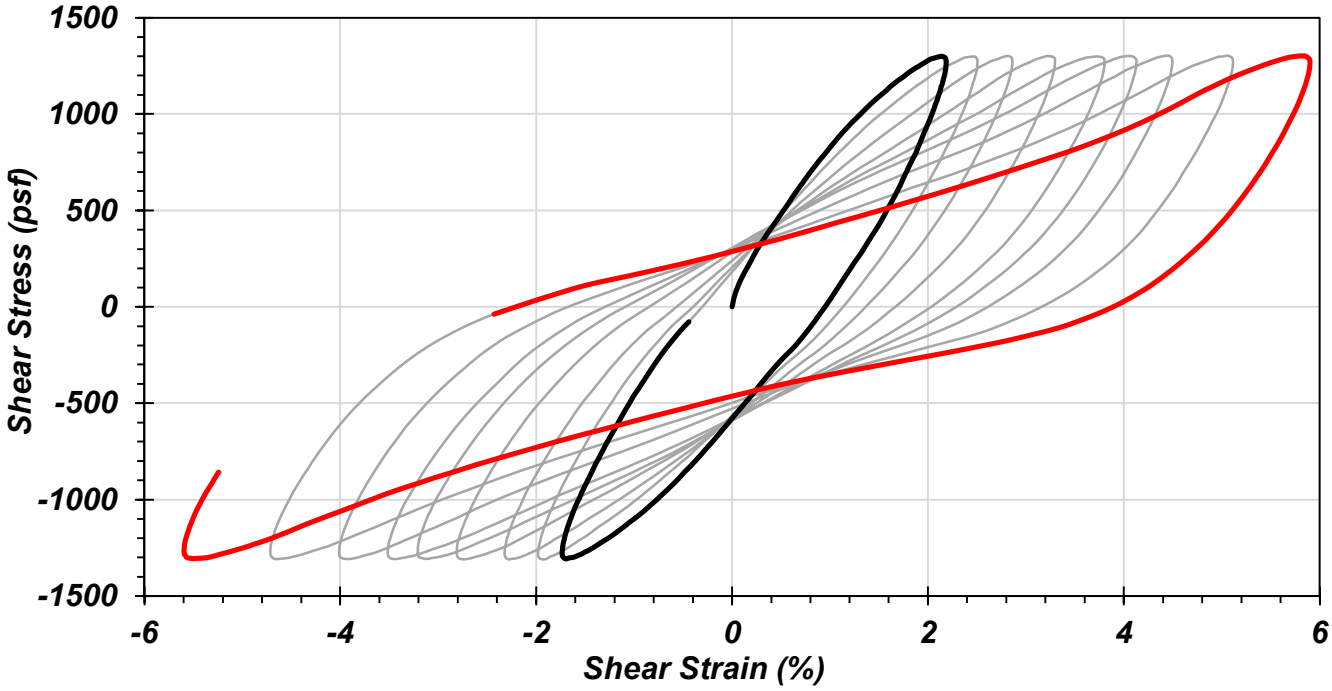
Cyclic Stage	
CSR	Number of Cycles
0.25	15

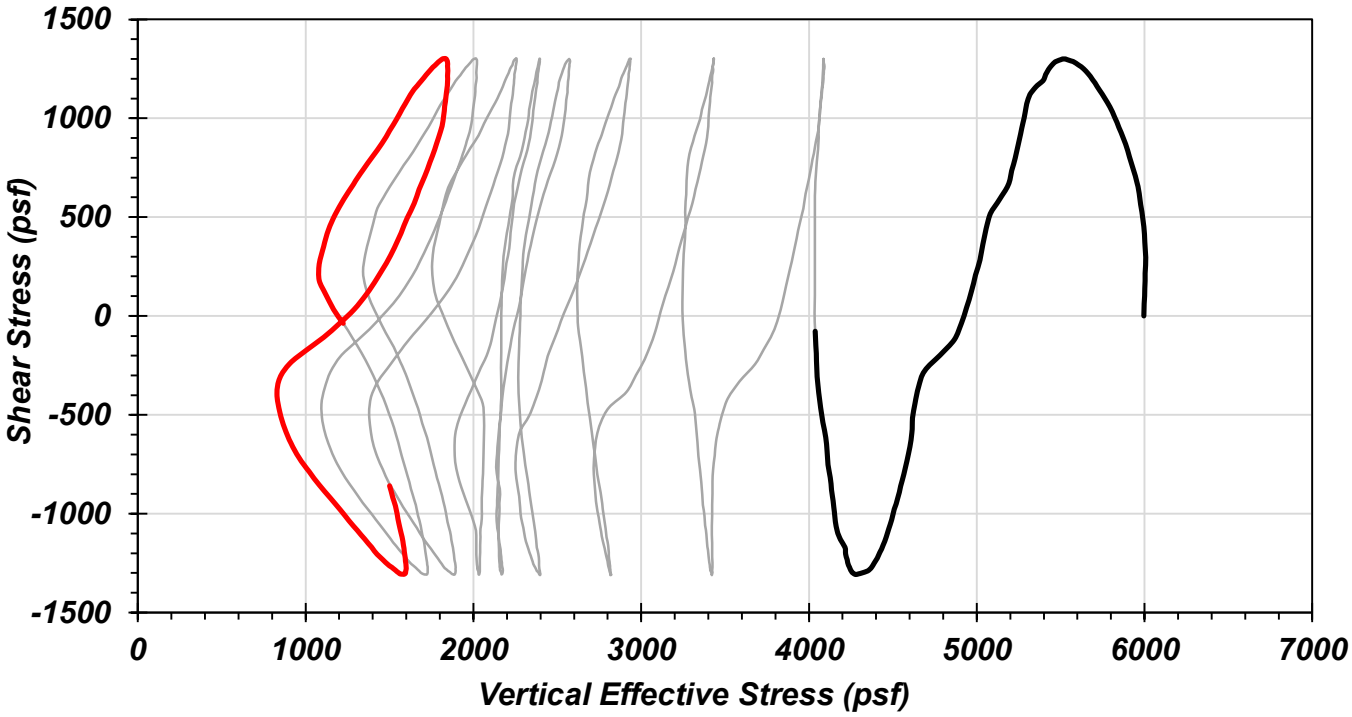
Earthquake-Ready Burnside Bridge Project, Portland, OR

Post-Cyclic Monotonic Direct Simple Shear Test Results

Oregon State University

FIG. 18





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-17 U3	80-82	0.22	9

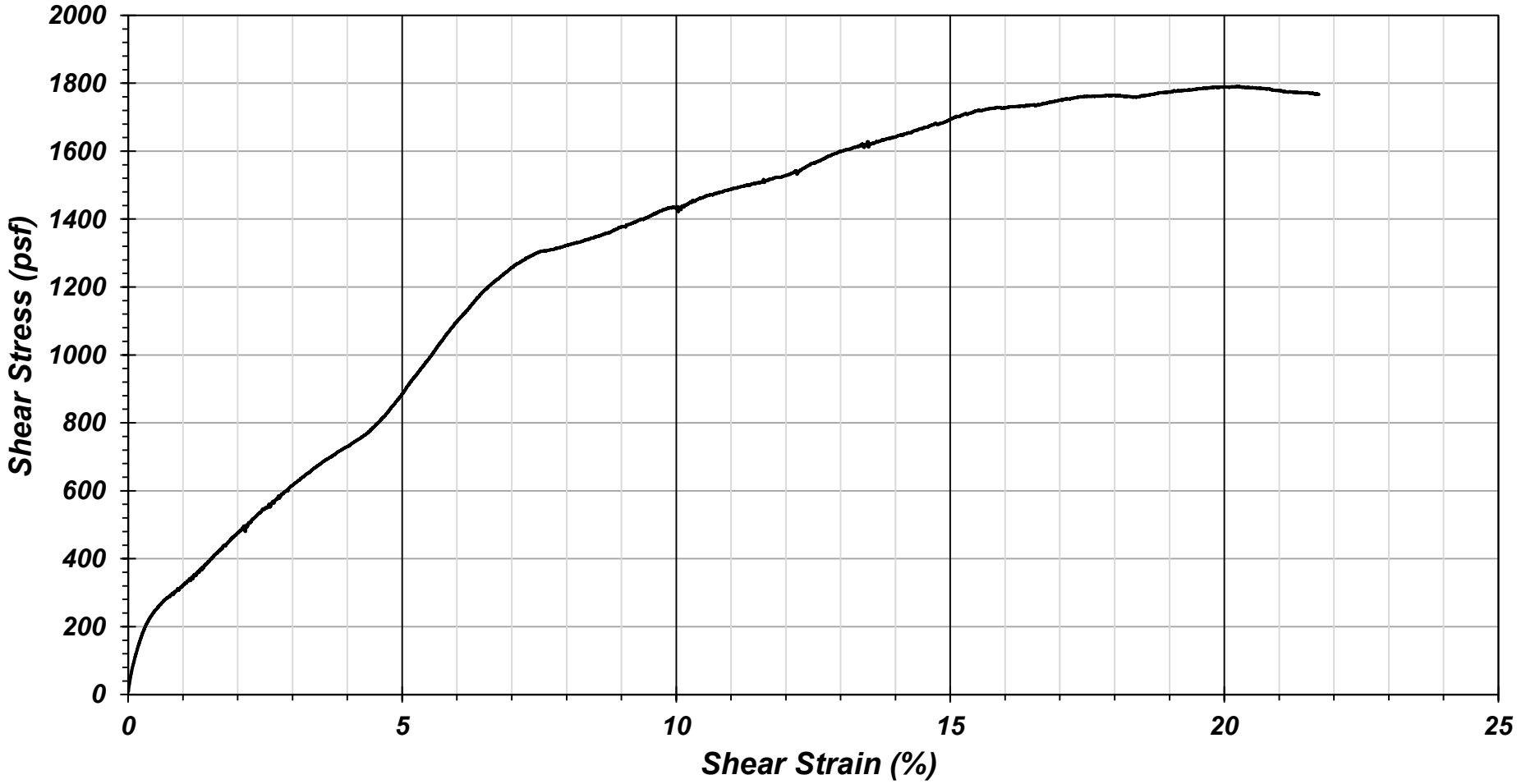
Vertical (Normal) Effective Consolidation Stress
6000 psf

Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 19



Post-Cyclic Monotonic Stage		
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)
B-17 U3	80-82	5

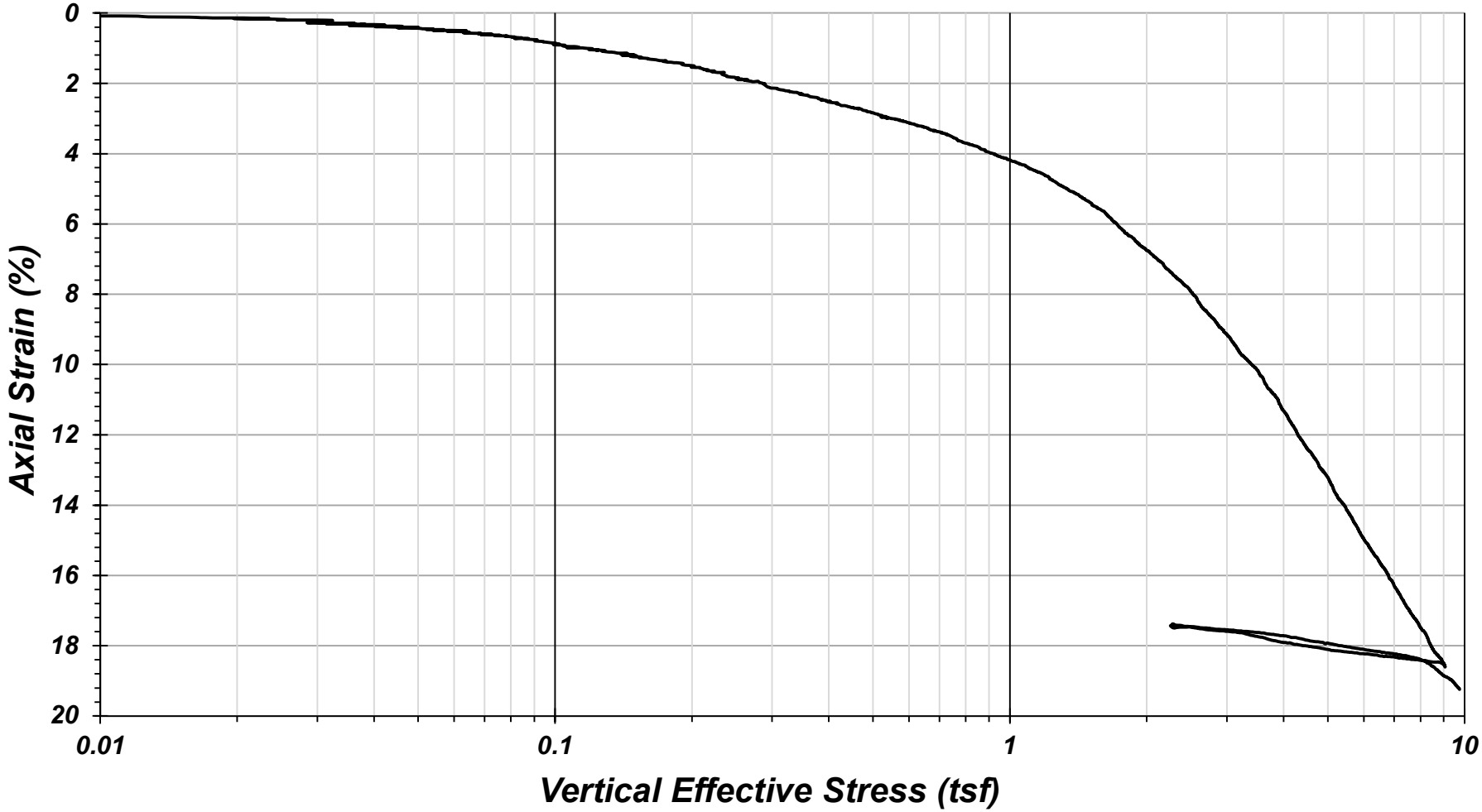
Cyclic Stage	
CSR	Number of Cycles
0.22	9

Earthquake-Ready Burnside Bridge Project, Portland, OR

Post-Cyclic Monotonic Direct Simple Shear Test Results

Oregon State University

FIG. 20



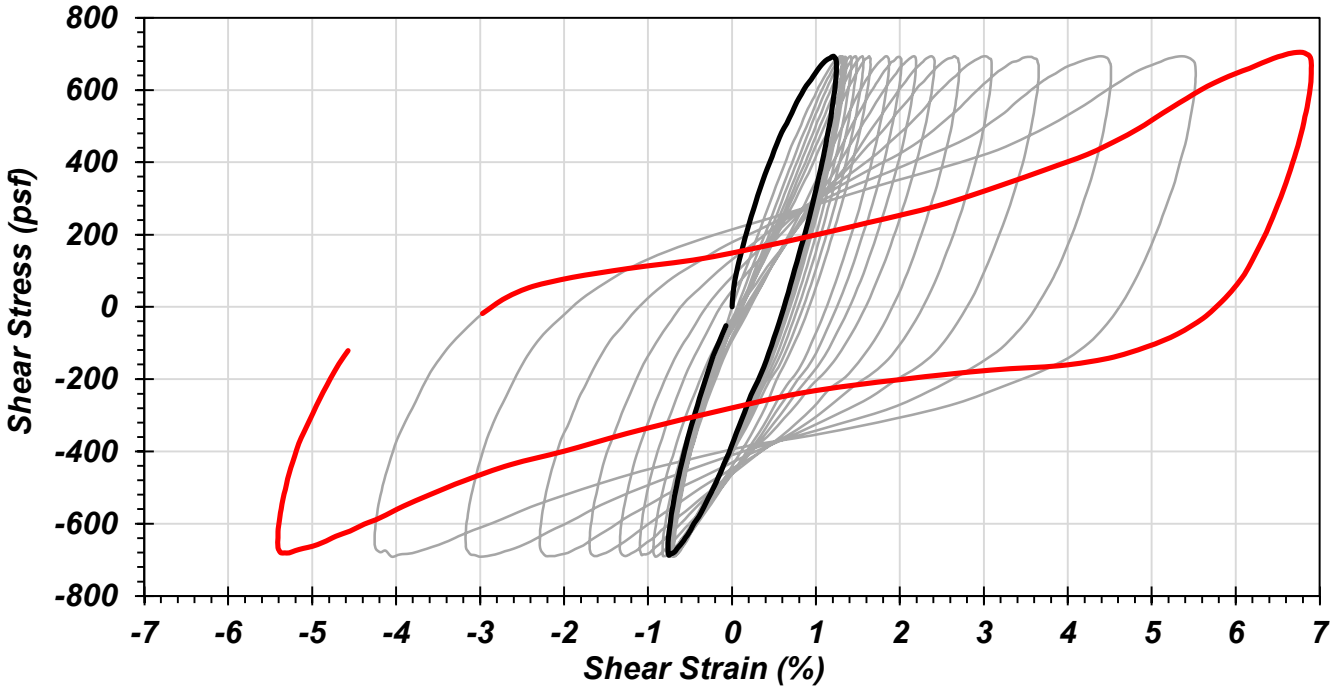
1-D Consolidation Test (CRS)			
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)	Initial Water Content, w (%)
B-17 U1	23-25	1	N/A

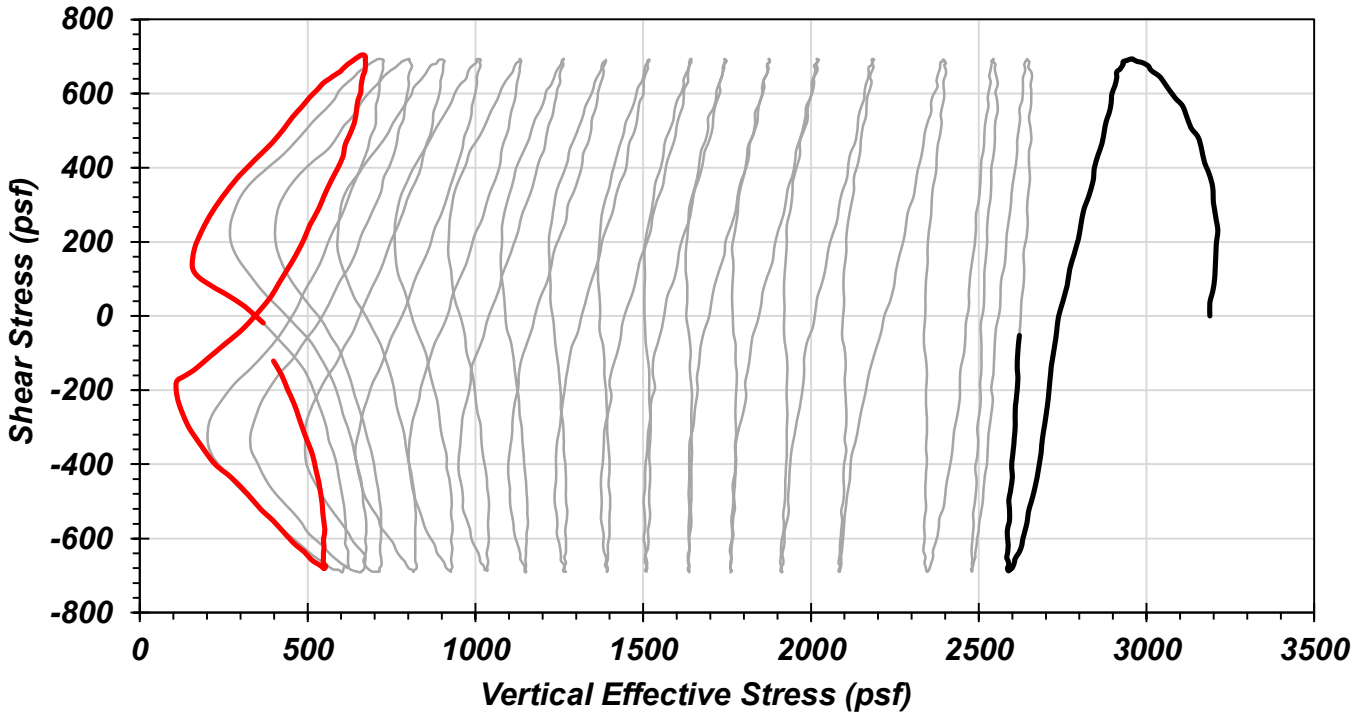
Earthquake-Ready Burnside Bridge Project, Portland, OR

1-D Constant Rate of Strain Consolidation Test

Oregon State University

FIG. 21





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-16 U2	35-37	0.22	18

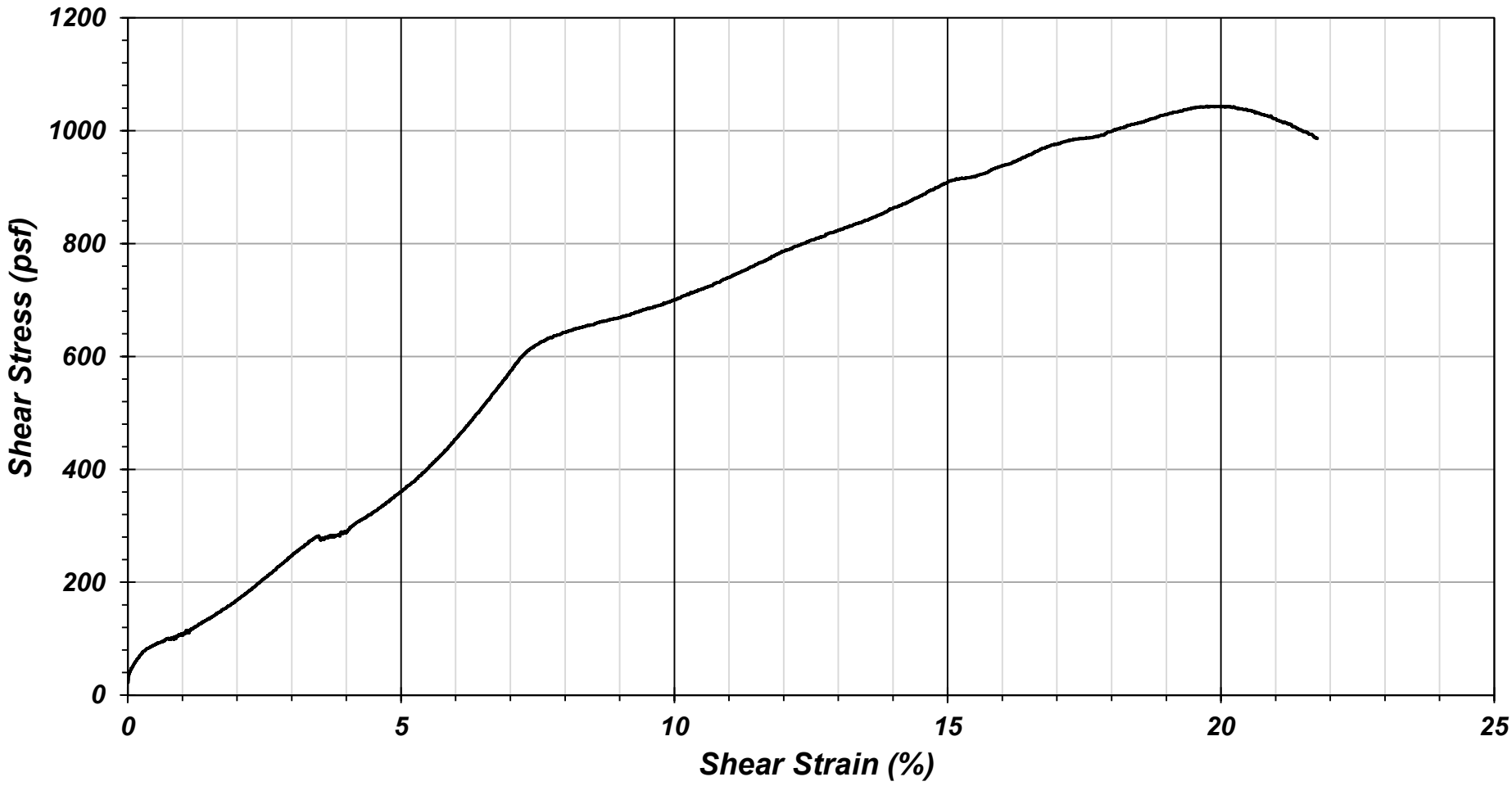
Vertical (Normal) Effective Consolidation Stress
3200 psf

Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 22



Post-Cyclic Monotonic Stage		
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)
B-16 U2	35-37	5

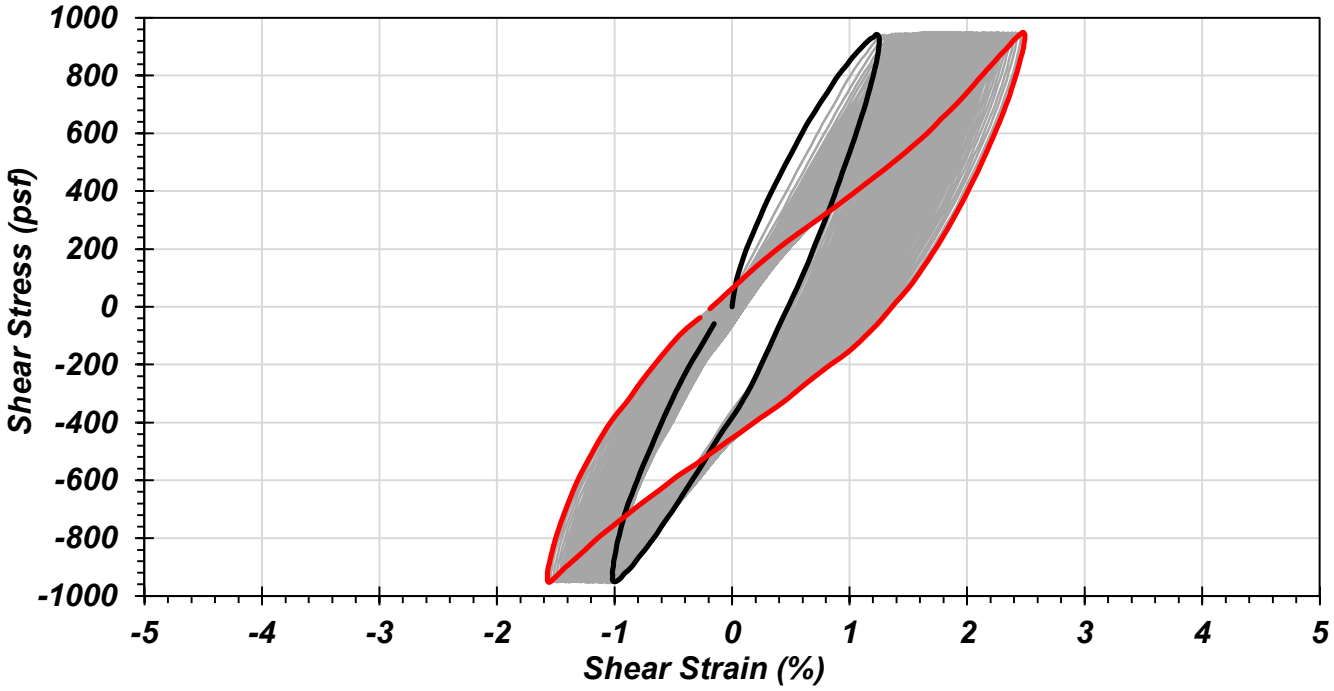
Cyclic Stage	
CSR	Number of Cycles
0.22	18

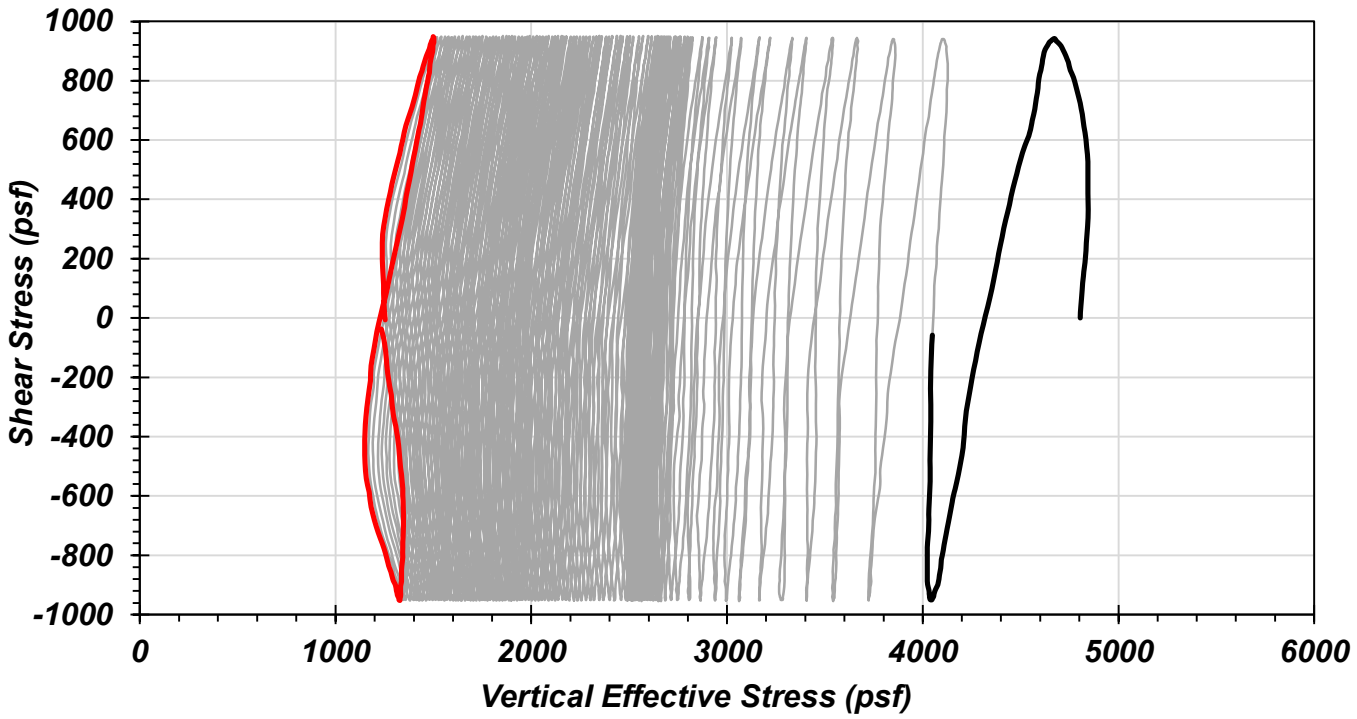
Earthquake-Ready Burnside Bridge Project, Portland, OR

Post-Cyclic Monotonic Direct Simple Shear Test Results

Oregon State University

FIG. 23





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-33 U3	63-65	0.2	100

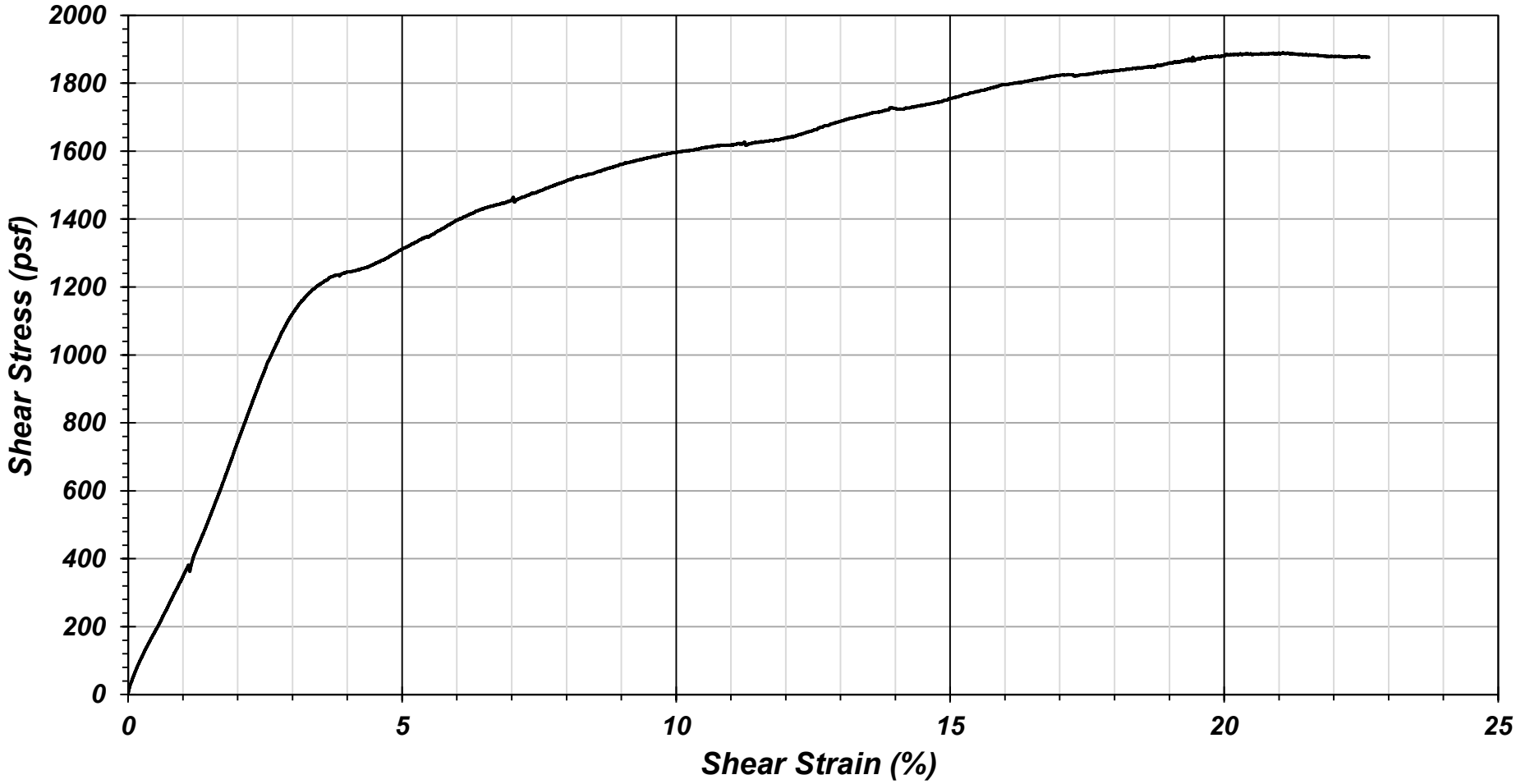
Vertical (Normal) Effective Consolidation Stress
4800 psf

Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 24



Post-Cyclic Monotonic Stage		
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)
B-33 U3	63-65	5

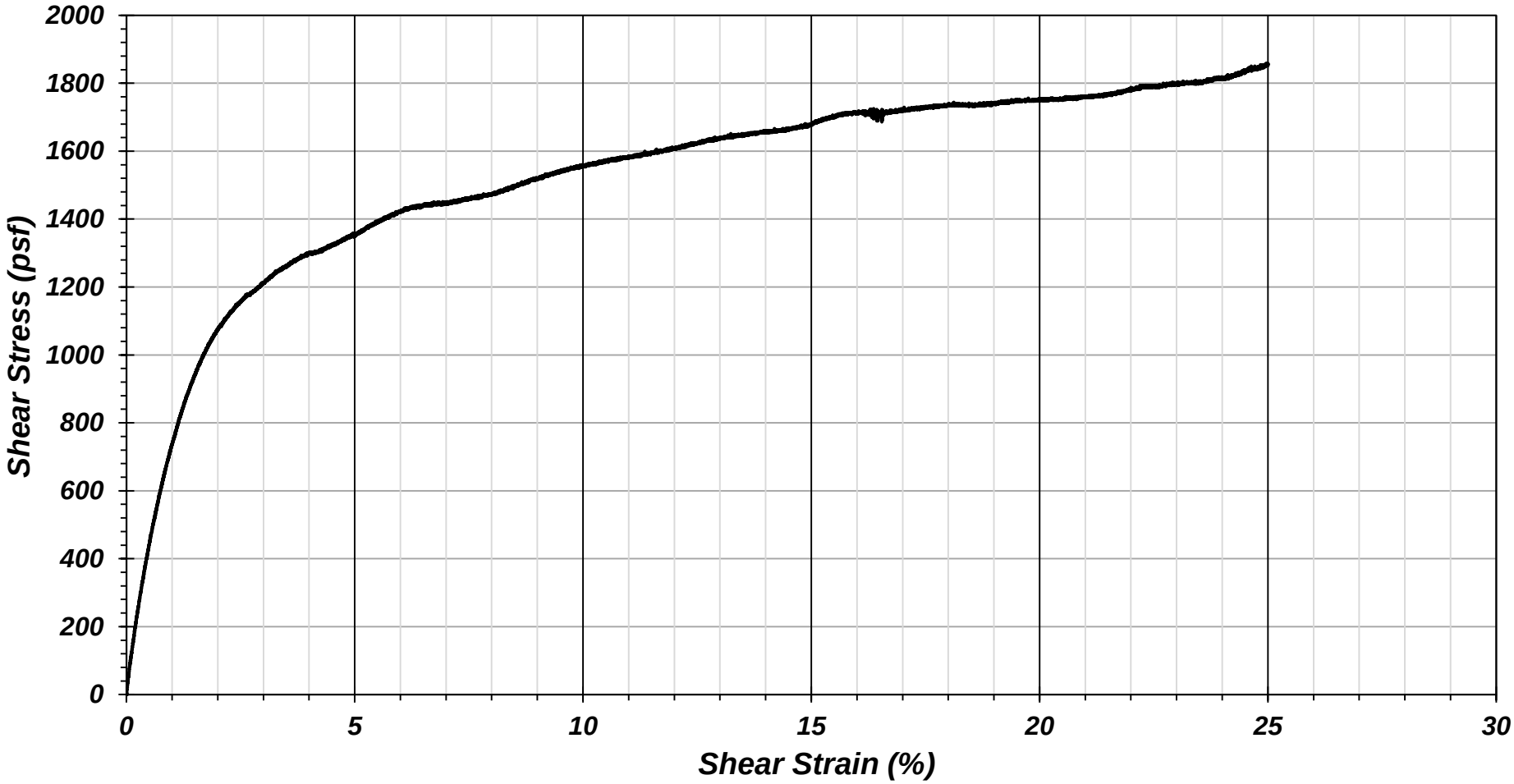
Cyclic Stage	
CSR	Number of Cycles
0.2	100

Earthquake-Ready Burnside Bridge Project, Portland, OR

Post-Cyclic Monotonic Direct Simple Shear Test Results

Oregon State University

FIG. 25



Monotonic Test		
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)
B-33 U3	63-65	5

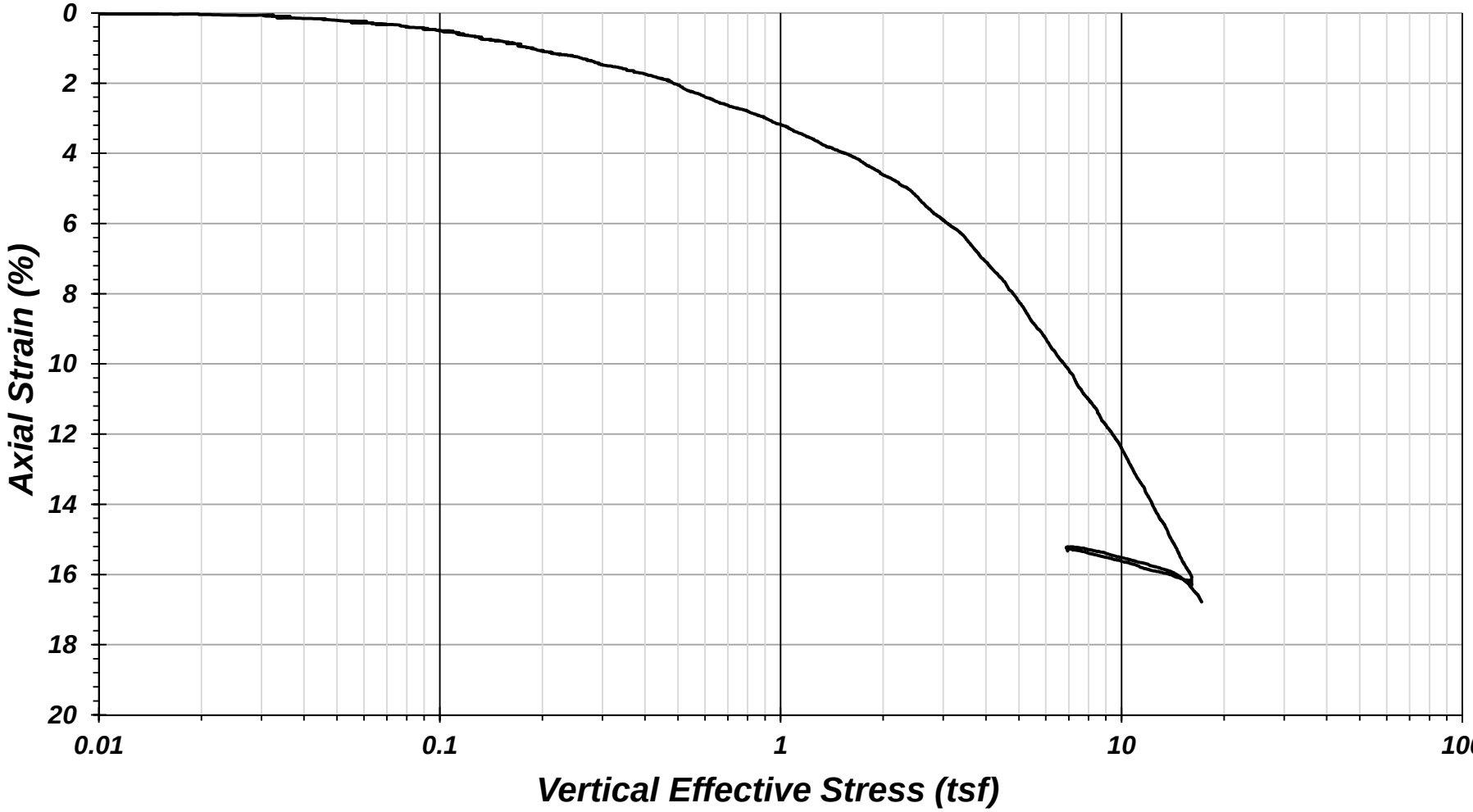
Vertical (Normal) Effective Consolidation Stress
4800 psf

Earthquake-Ready Burnside Bridge Project, Portland, OR

Monotonic Direct Simple Shear Test Results

Oregon State University

FIG. 26



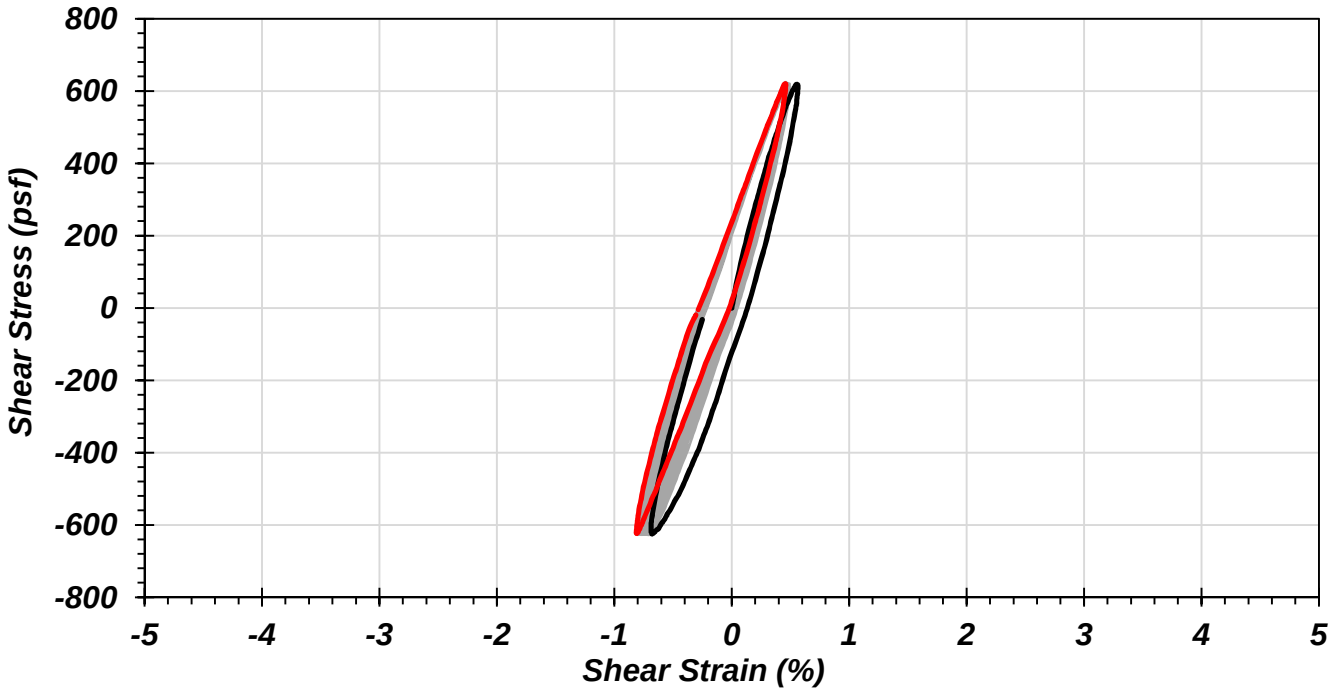
1-D Consolidation Test (CRS)			
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)	Initial Water Content, w (%)
B-32 U2	63-65	1	N/A

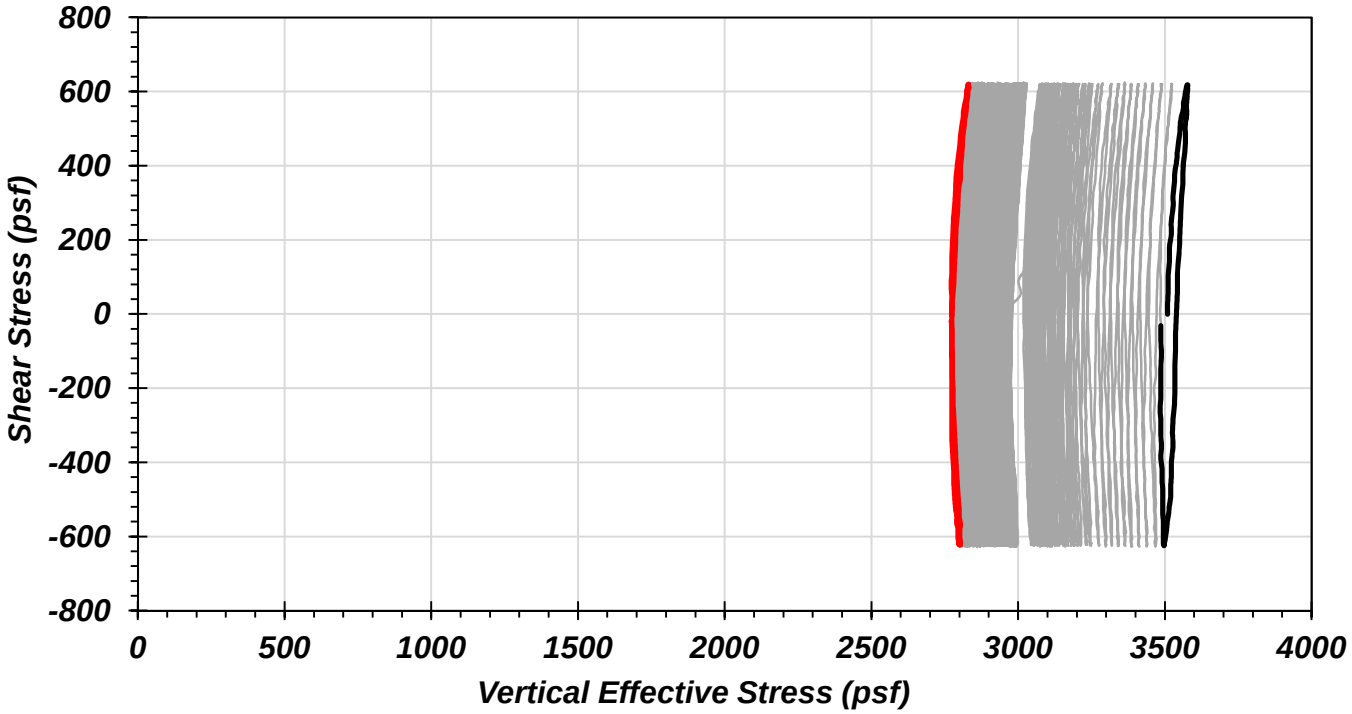
Earthquake-Ready Burnside Bridge Project, Portland, OR

1-D Constant Rate of Strain (CRS) Consolidation Test

Oregon State University

FIG. 27





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-15 U1	38-40	0.18	100

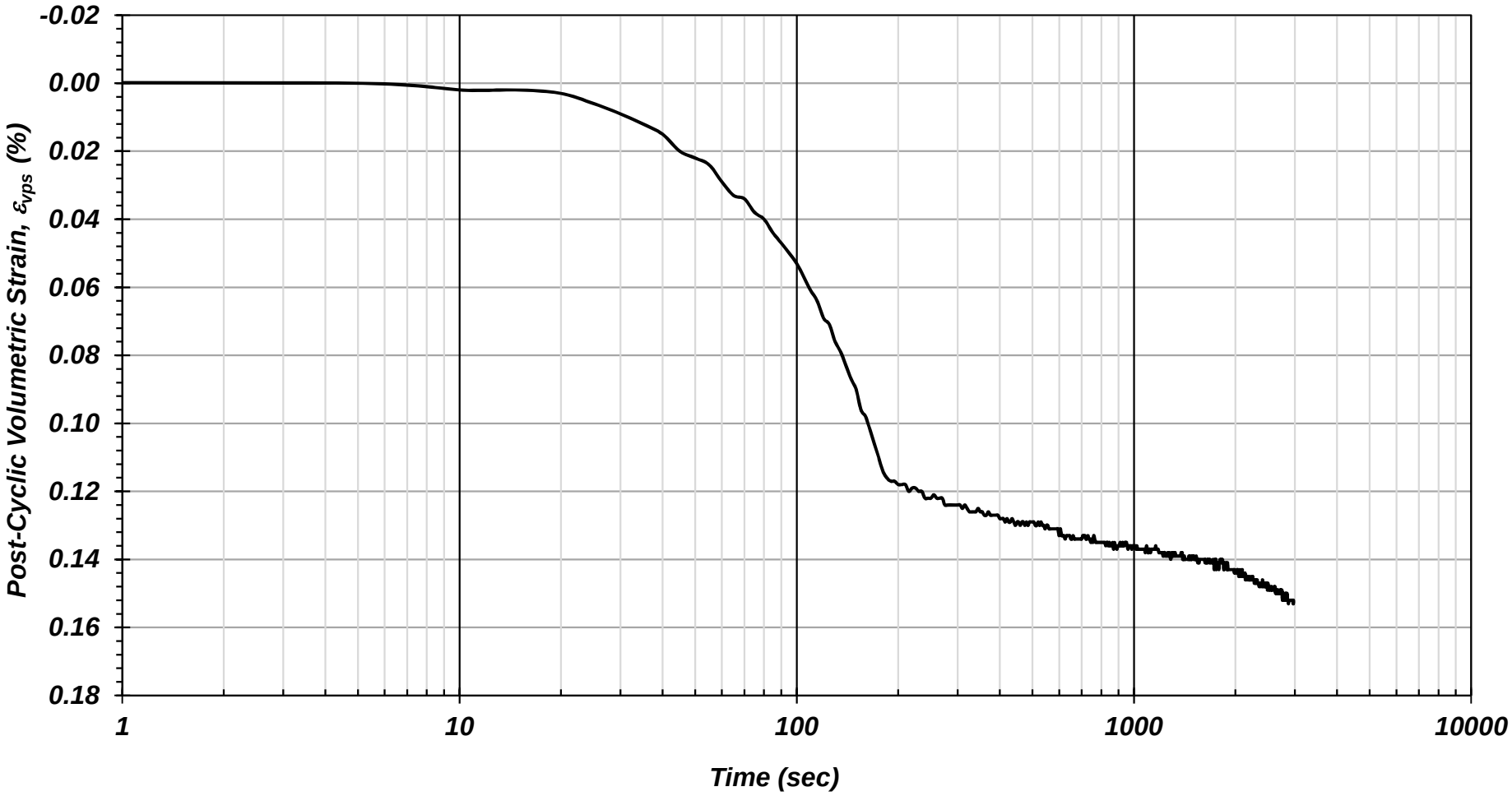
Vertical (Normal) Effective Consolidation Stress
3500 psf (with OCR = 1.63)

Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 28



Post-Cyclic Reconsolidation Stage	
Boring and Sample No.	Depth (ft)
B-15 U1	38-40

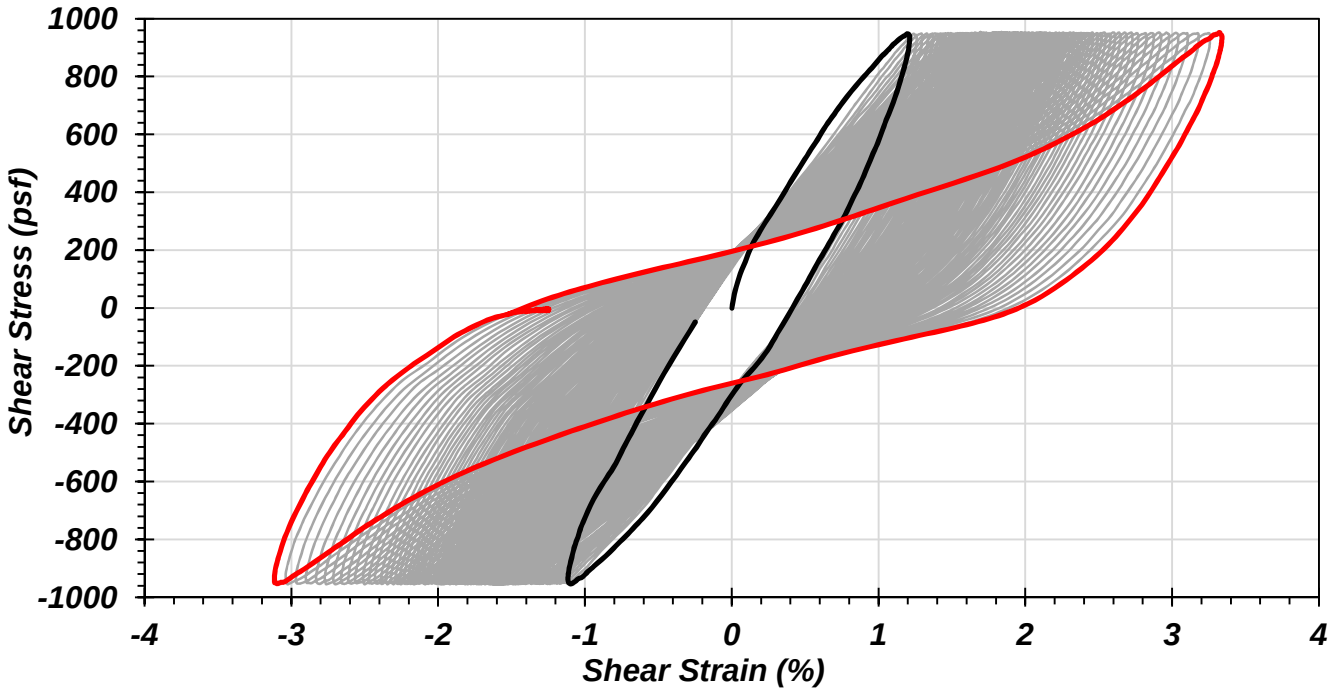
Cyclic Stage	
CSR	Number of Cycles
0.18	100

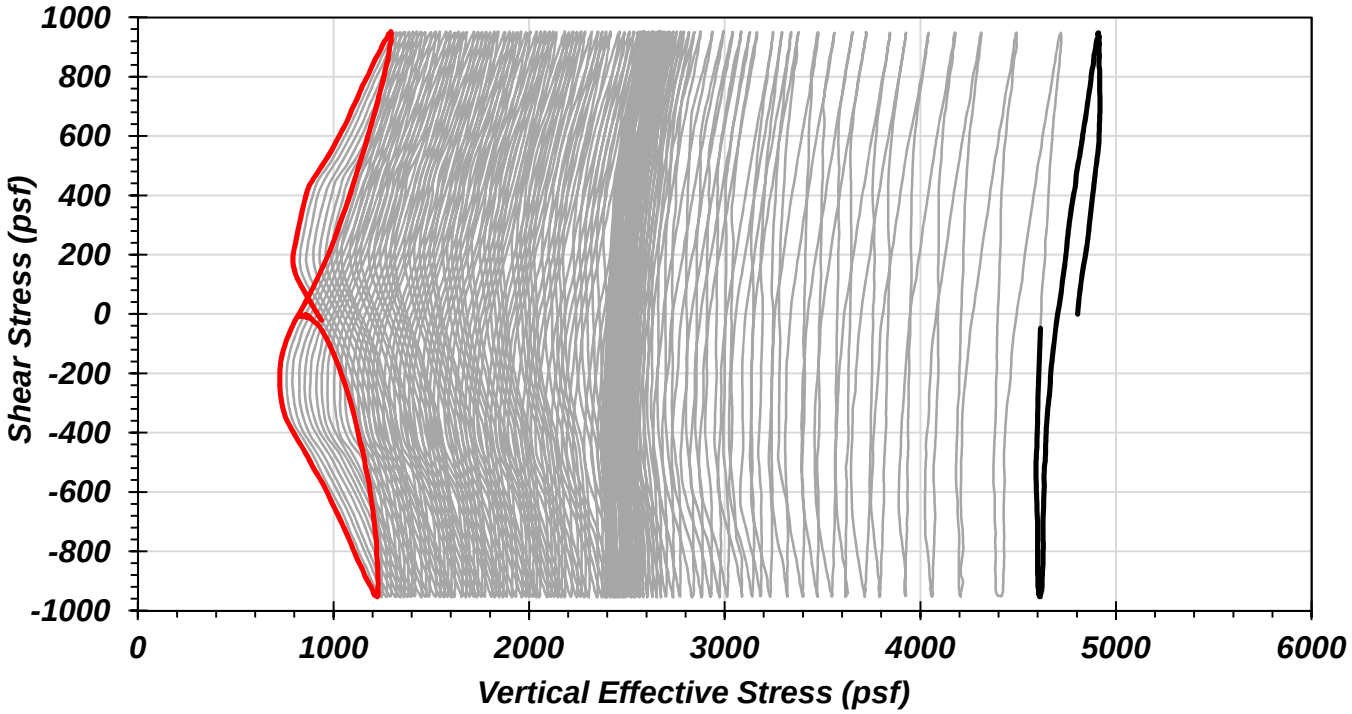
Earthquake-Ready Burnside Bridge Project, Portland, OR

Post-Cyclic Reconsolidation Results

Oregon State University

FIG. 29





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-32 U2	63-65	0.2	100

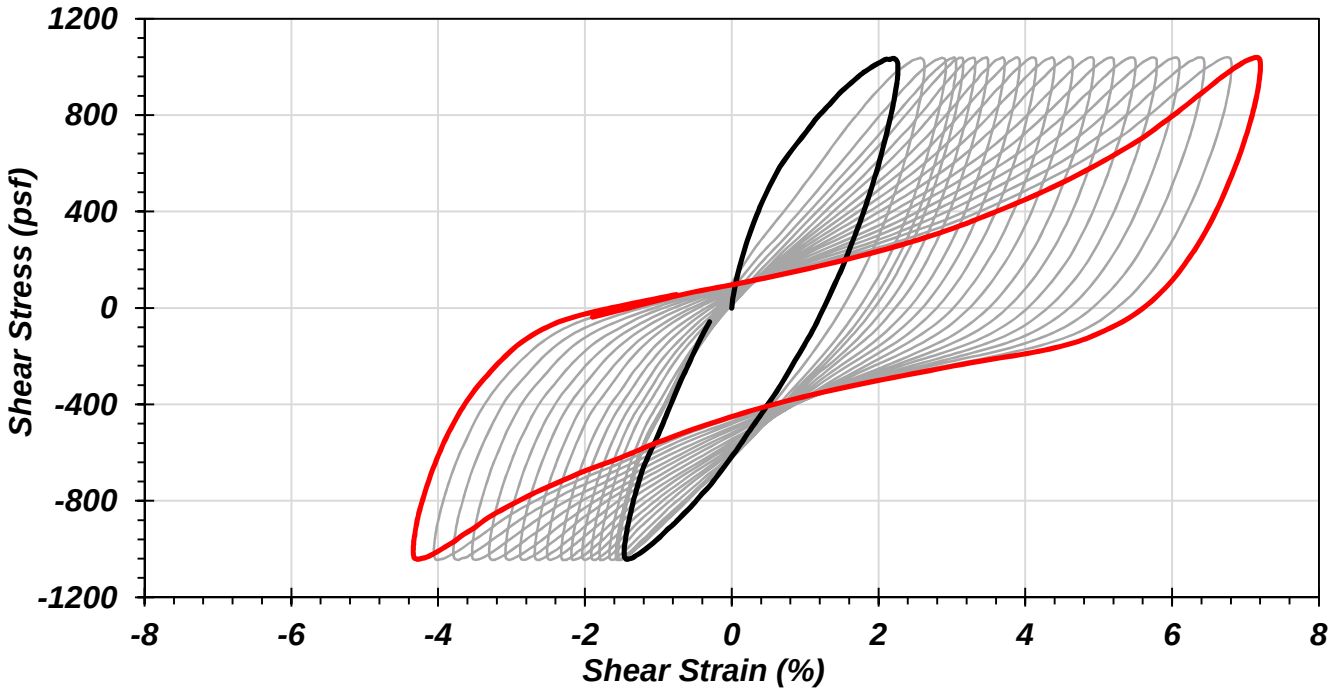
Vertical (Normal) Effective Consolidation Stress
4800 psf (with OCR = 1.46)

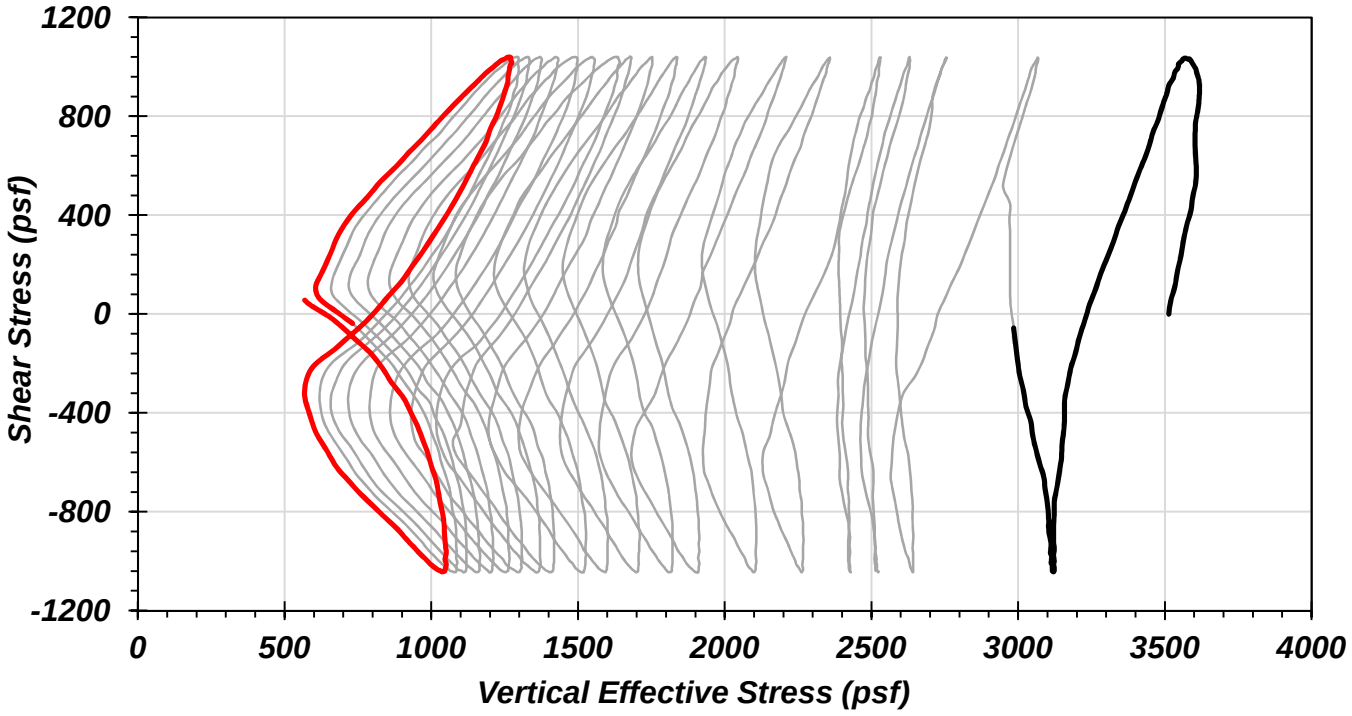
Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 30





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-15 U1	38-40	0.3	20

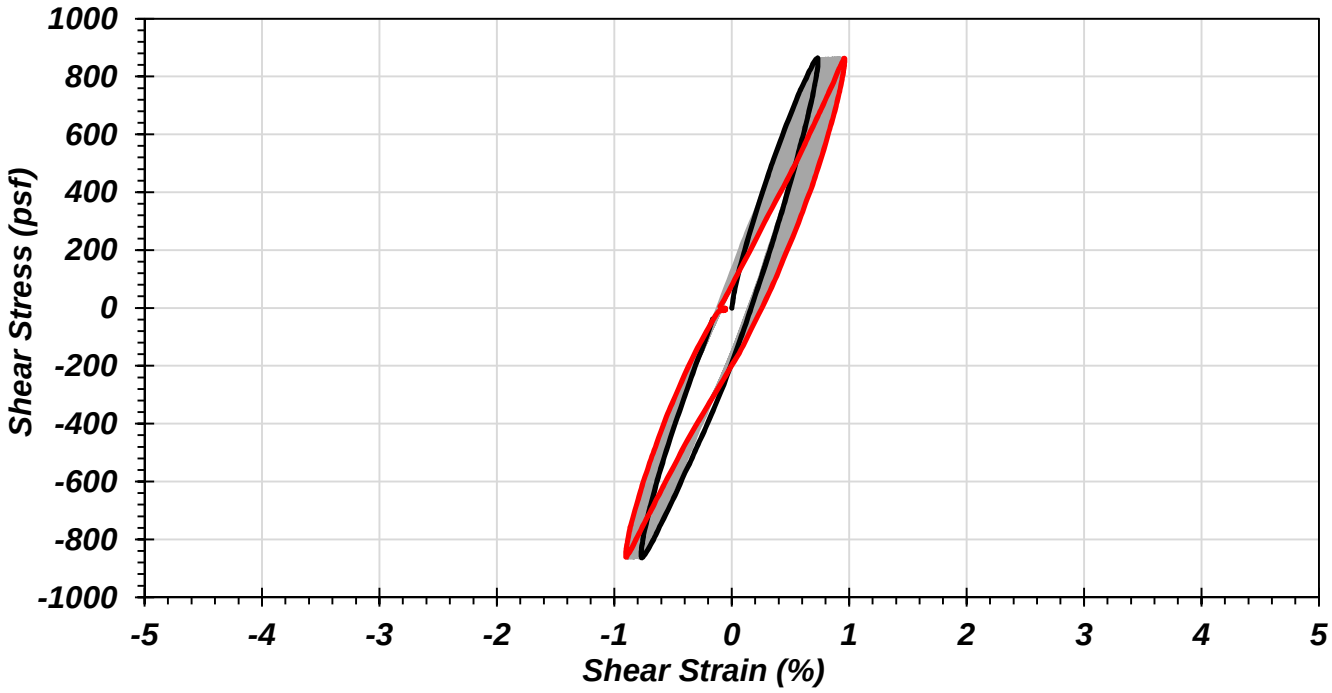
Vertical (Normal) Effective Consolidation Stress
3500 psf (with OCR = 1.63)

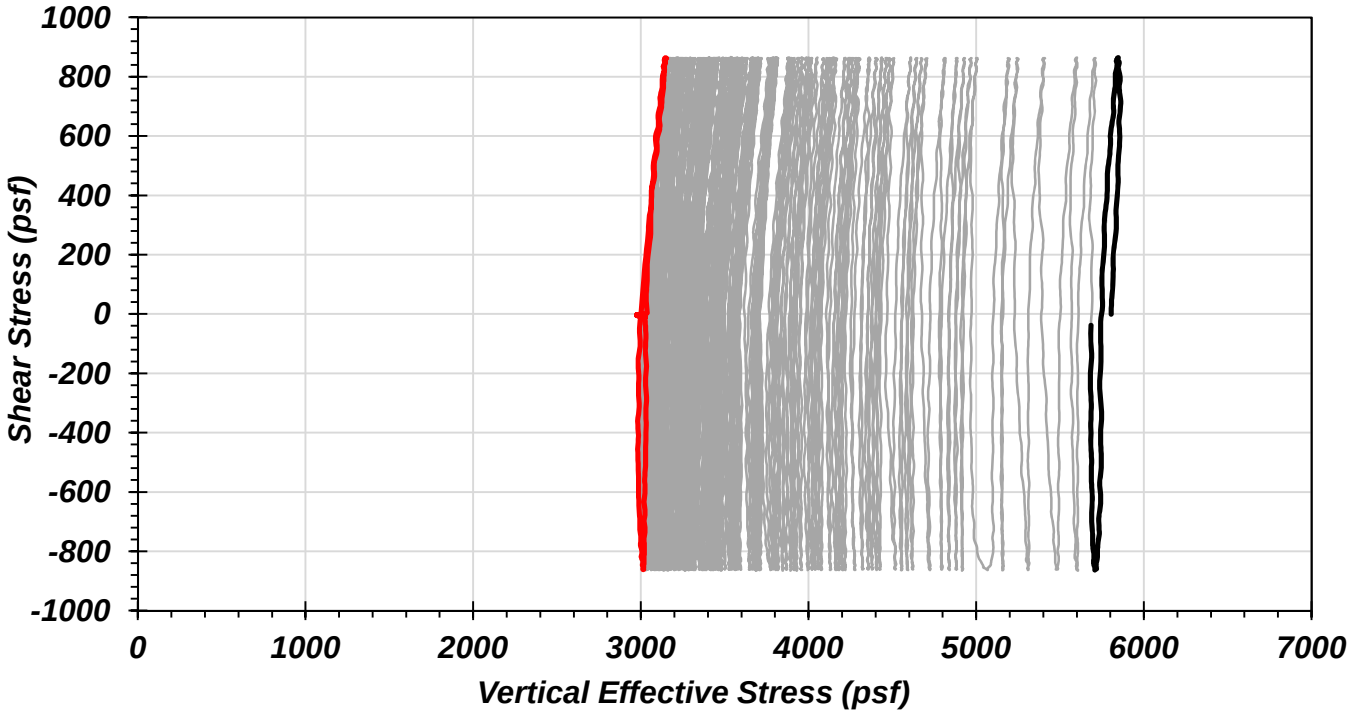
Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 31





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-15 U3	83-85	0.15	100

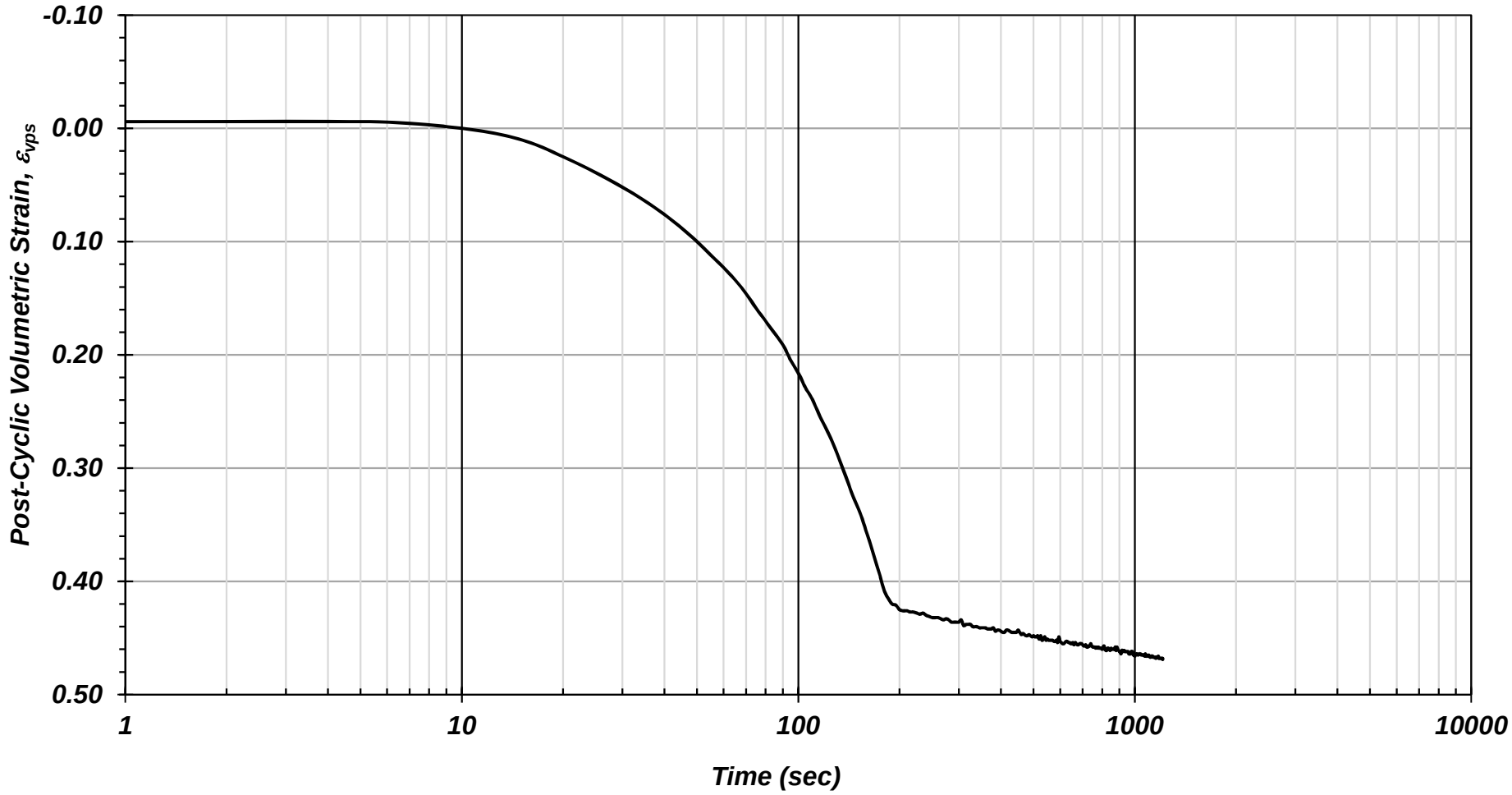
Vertical (Normal) Effective Consolidation Stress
5800 psf (with OCR = 1.29)

Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 32



Post-Cyclic Reconsolidation Stage	
Boring and Sample No.	Depth (ft)
B-15 U3	83-85

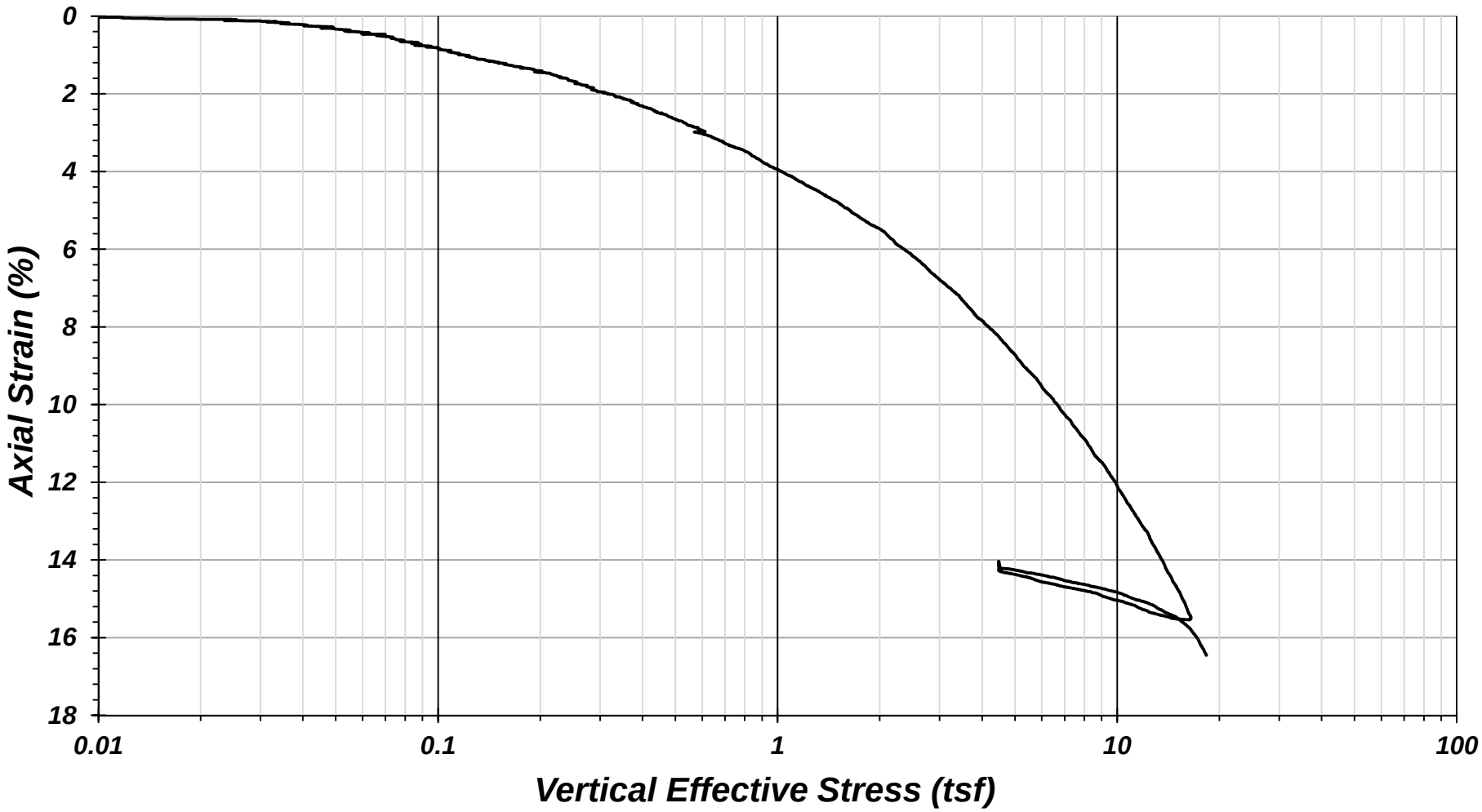
Cyclic Stage	
CSR	Number of Cycles
0.15	100

Earthquake-Ready Burnside Bridge Project, Portland, OR

Post-Cyclic Reconsolidation Test Results

Oregon State University

FIG. 33



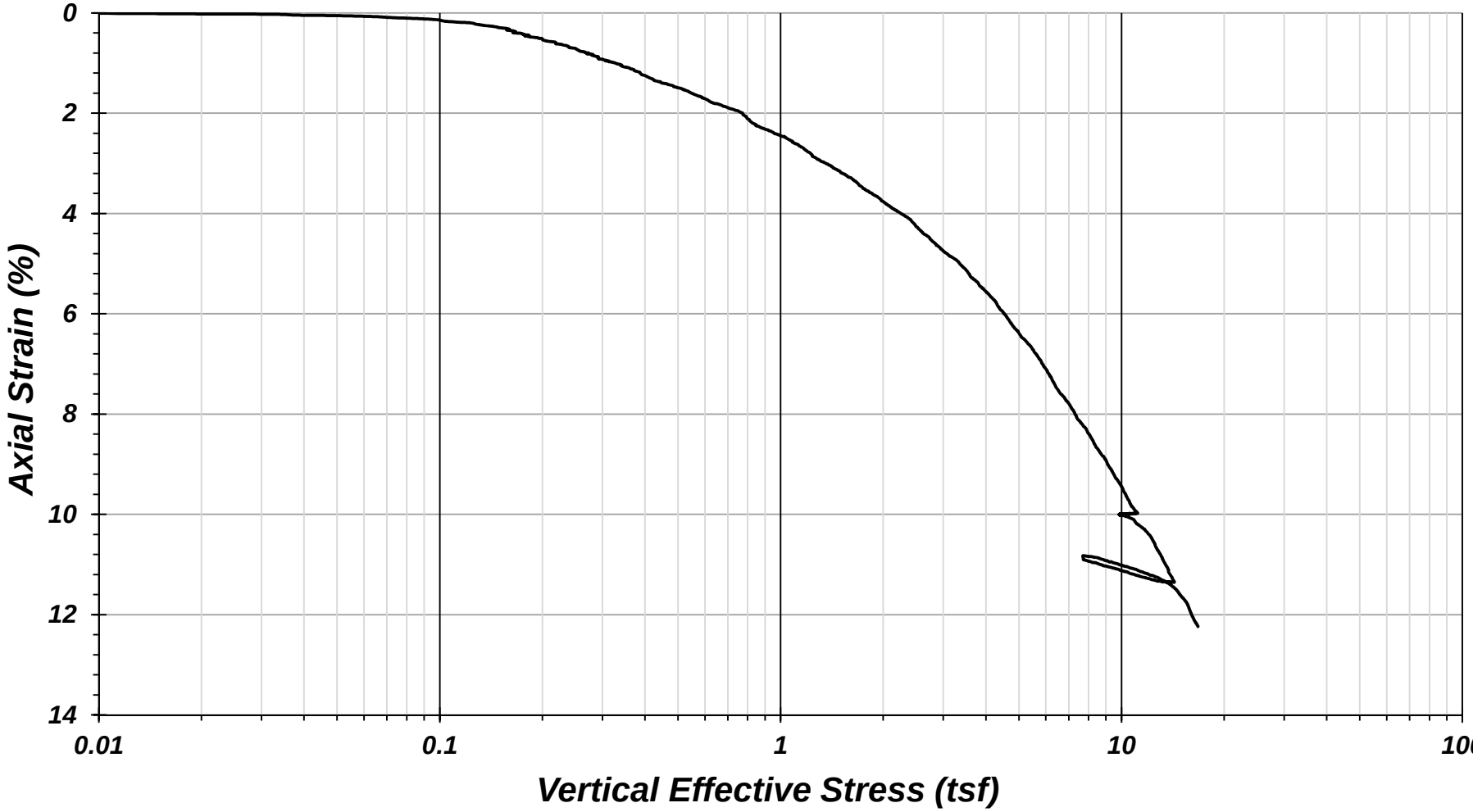
1-D Consolidation Test (CRS)			
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)	Initial Water Content, w (%)
B-15 U1	38-40	1	N/A

Earthquake-Ready Burnside Bridge Project, Portland, OR

1-D Constant Rate of Strain (CRS) Consolidation Test

Oregon State University

FIG. 34



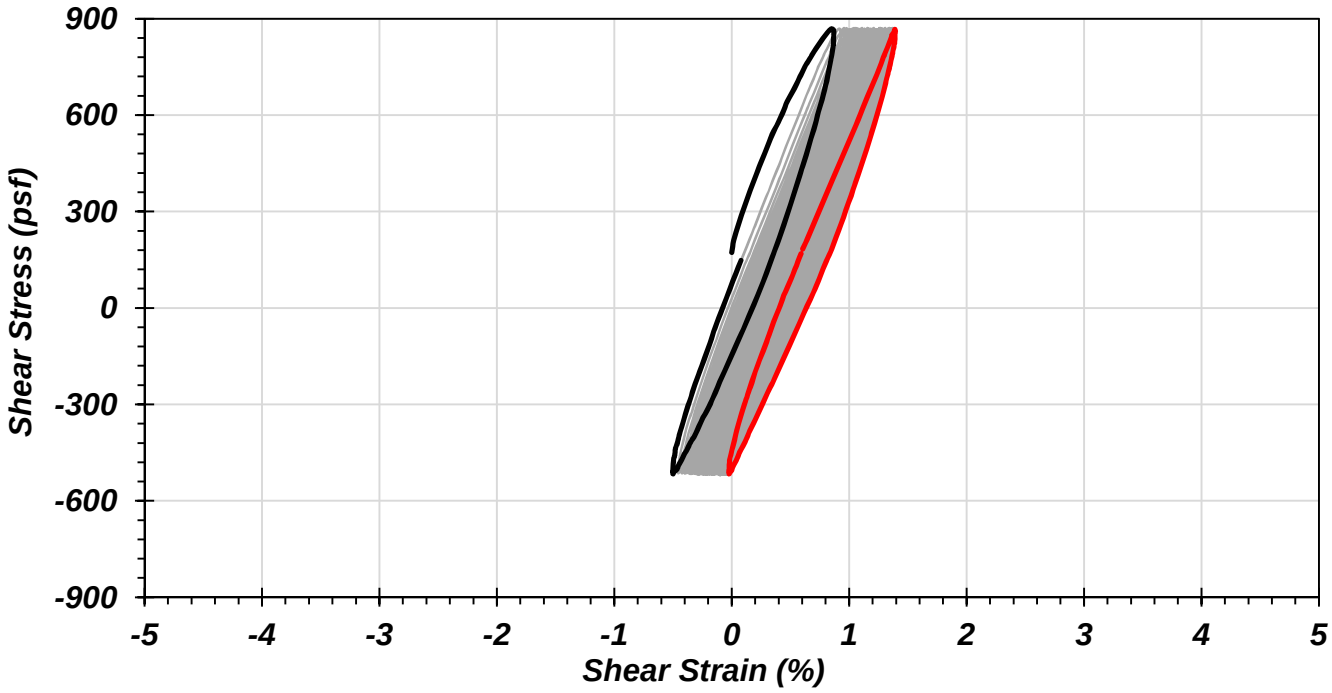
1-D Consolidation Test (CRS)			
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)	Initial Water Content, w (%)
B-15 U3	83-85	1	N/A

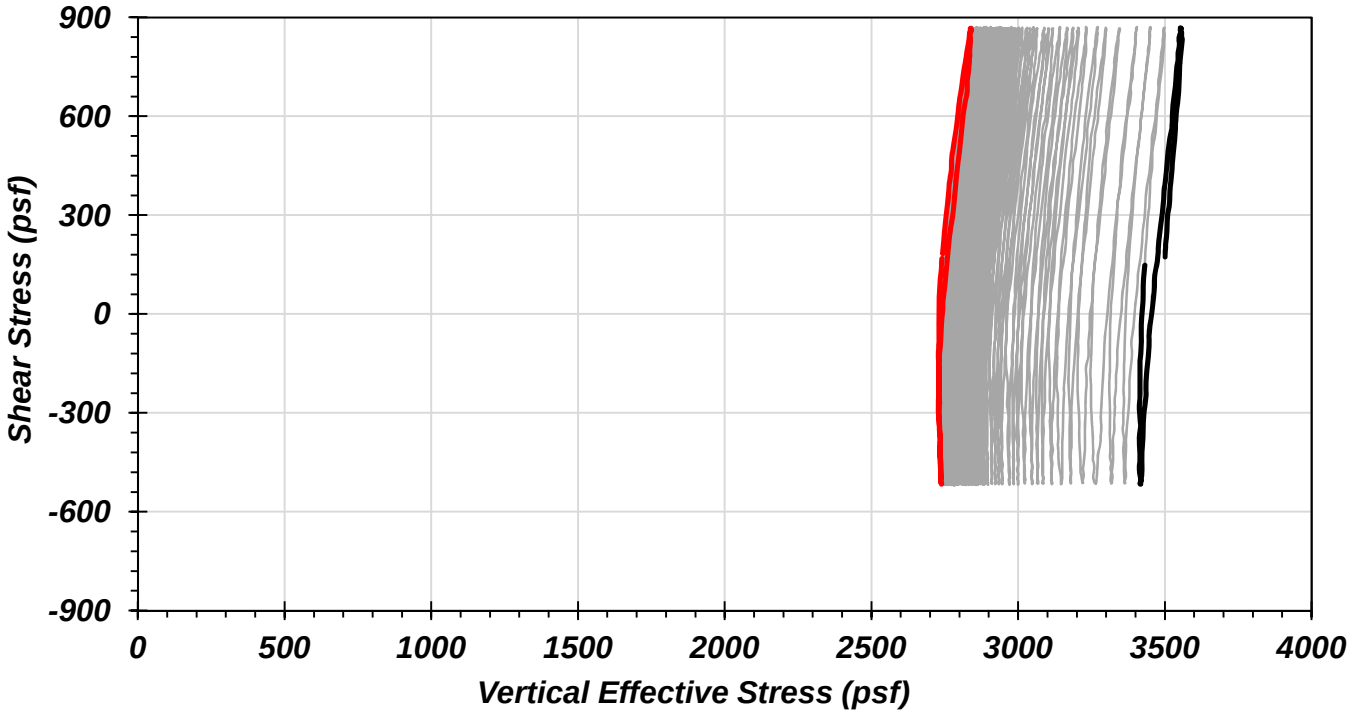
Earthquake-Ready Burnside Bridge Project, Portland, OR

1-D Constant Rate of Strain (CRS) Consolidation Test

Oregon State University

FIG. 35





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-15 U1	38-40	0.2	100

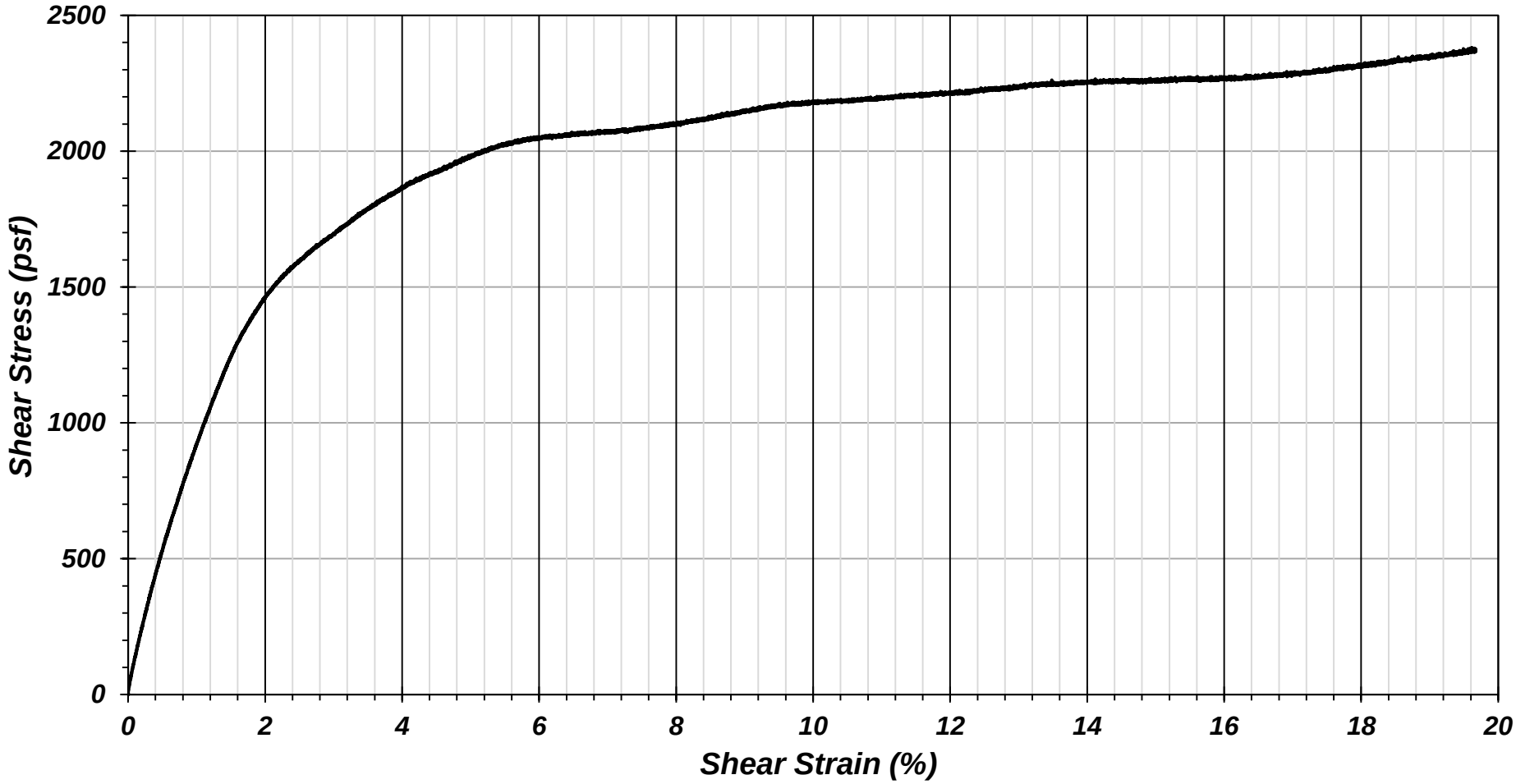
Vertical (Normal) Effective Consolidation Stress
3500 psf (with OCR = 1.63, α = 0.05)

Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 36



Monotonic Test		
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)
B-32 U2	63-65	5

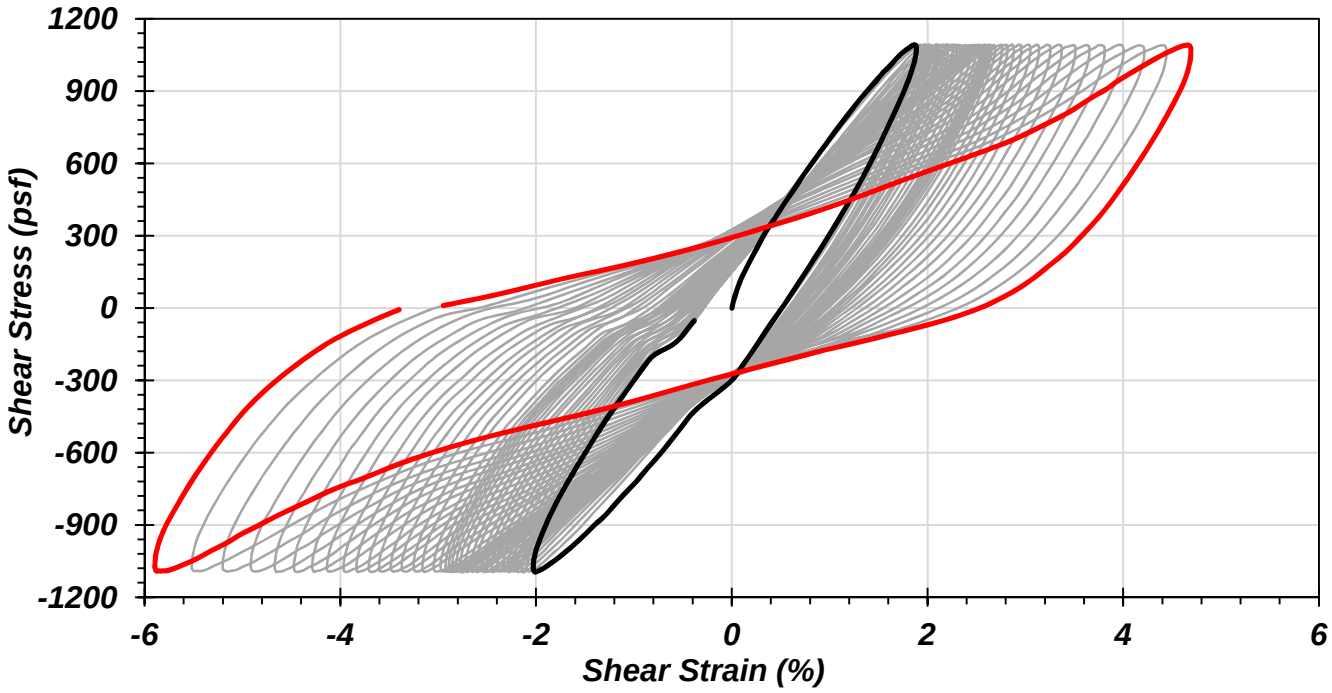
Vertical (Normal) Effective Consolidation Stress
4800 psf (with OCR = 1.46)

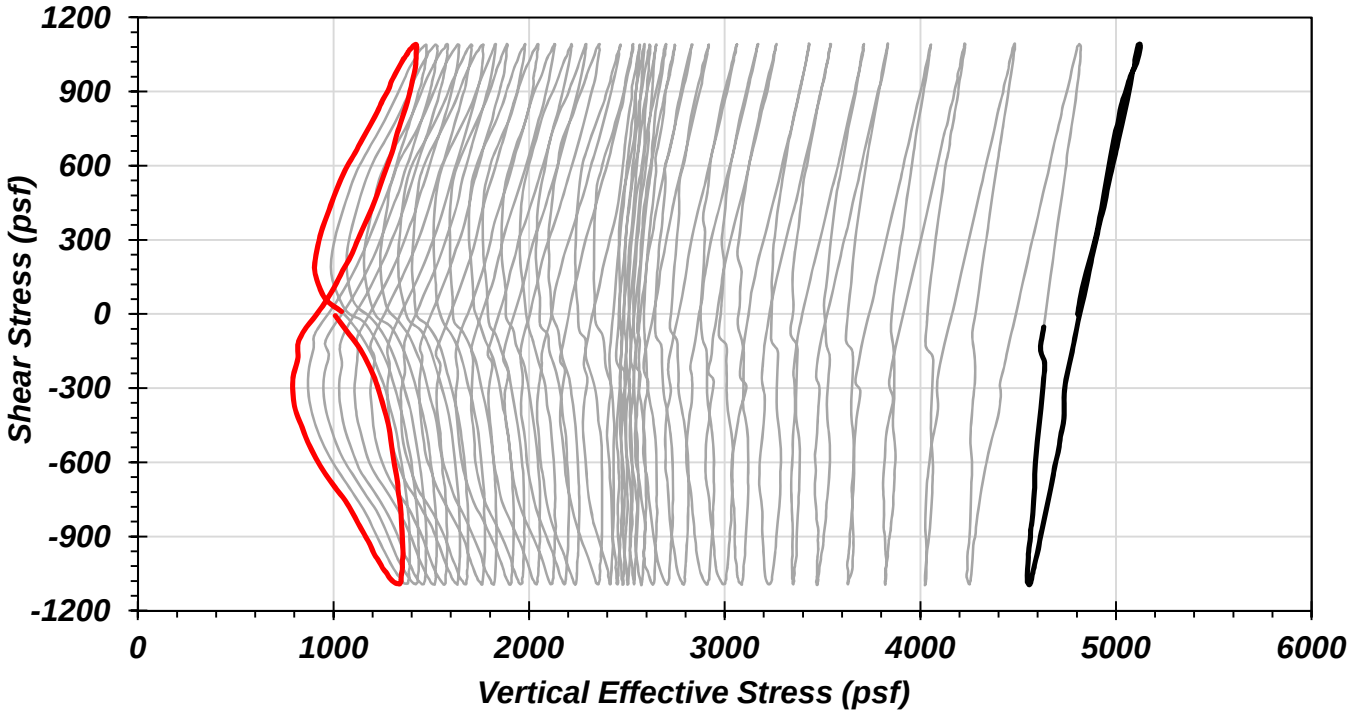
Earthquake-Ready Burnside Bridge Project, Portland, OR

Monotonic Direct Simple Shear Test Results

Oregon State University

FIG. 37





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-32 U2	63-65	0.23	37

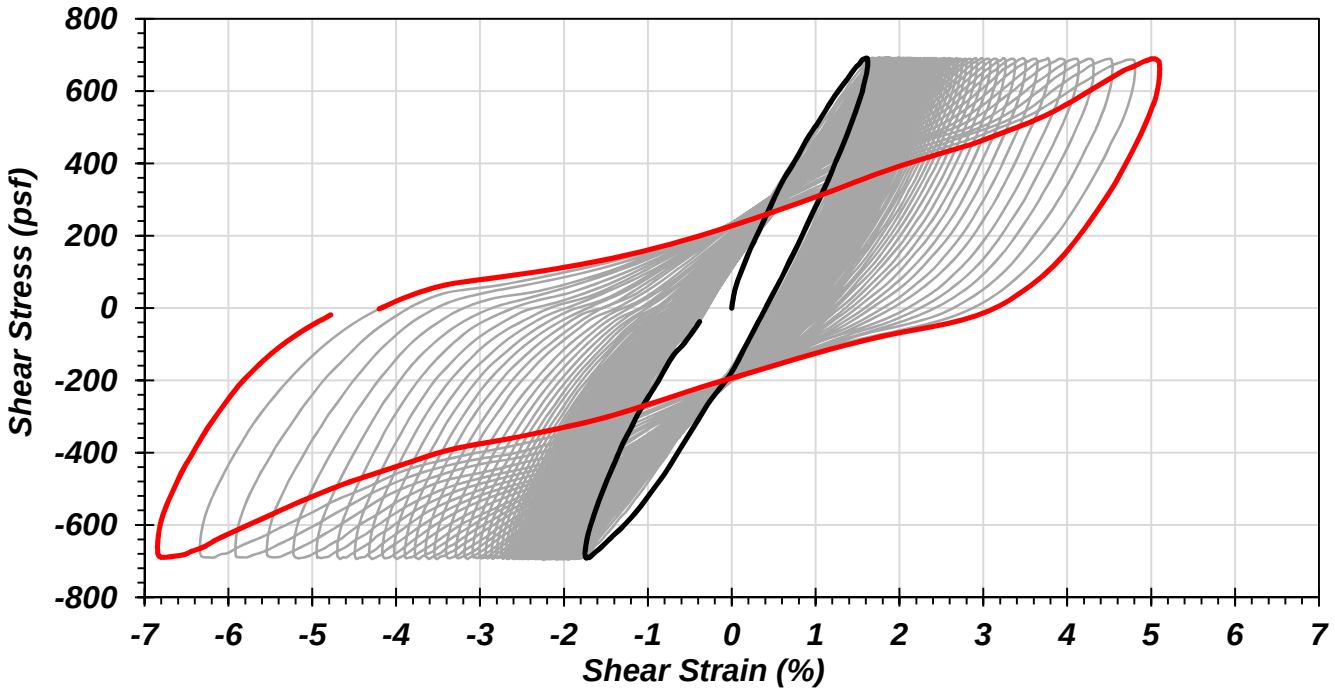
Vertical (Normal) Effective Consolidation Stress
4800 psf (with OCR = 1.46)

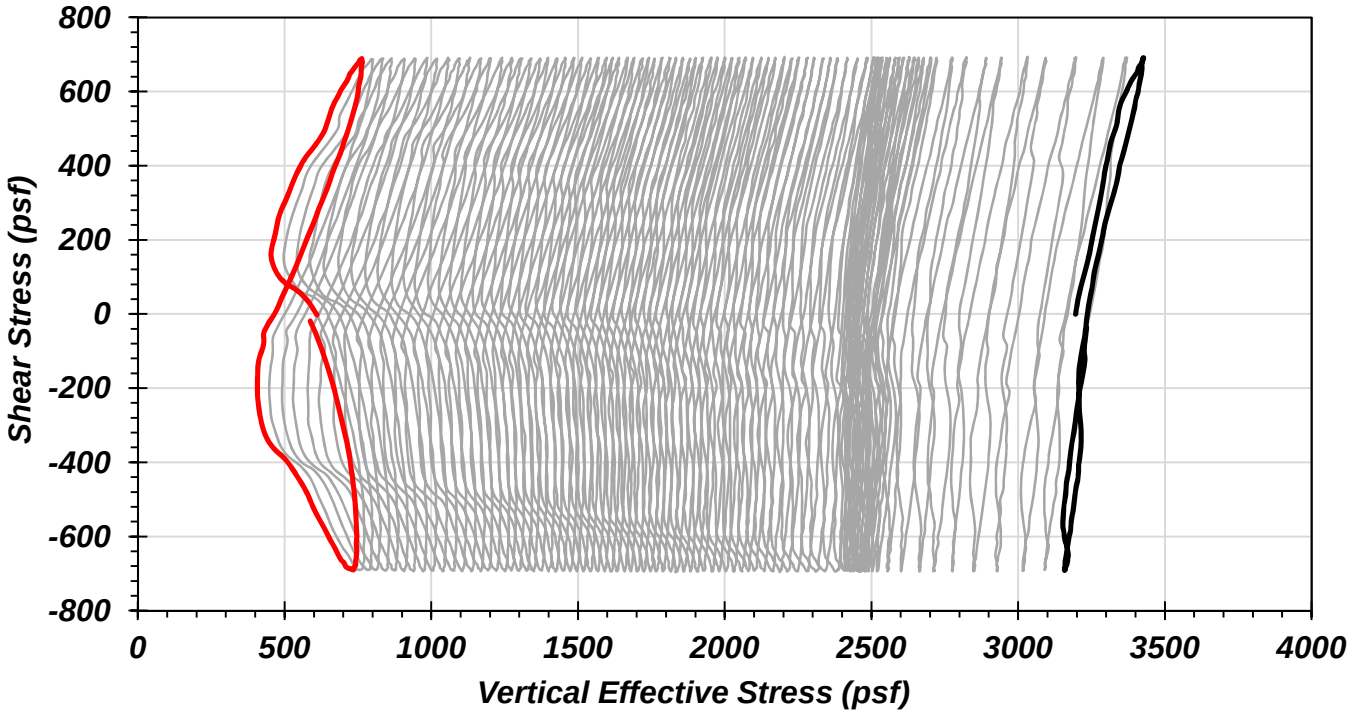
Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 38





Boring and Sample No.	Depth (ft)	CSR	Number of Cycles
B-16 U2	35-37	0.22	86

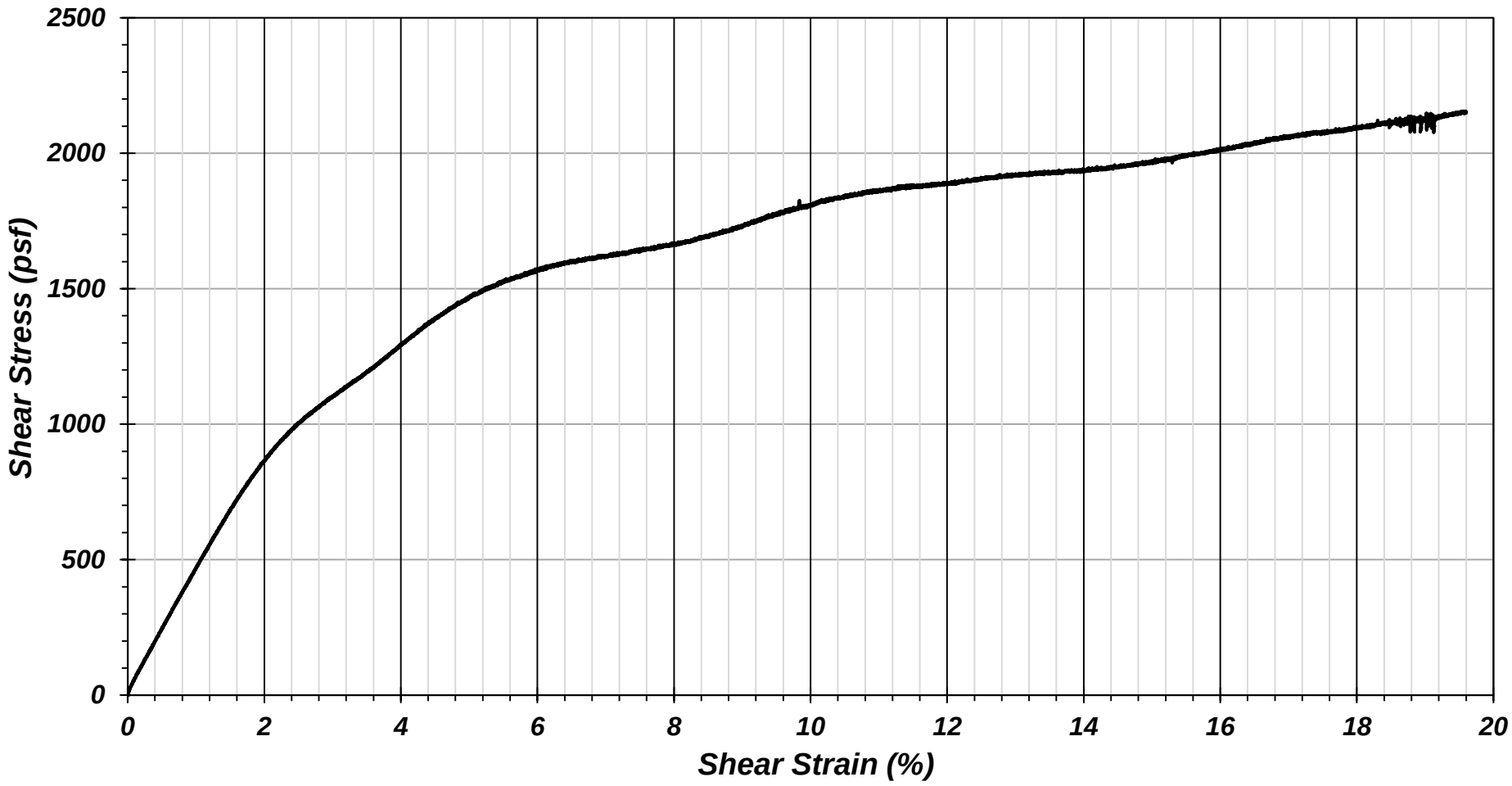
Vertical (Normal) Effective Consolidation Stress
3200 psf (with OCR = 1.75)

Earthquake-Ready Burnside Bridge Project, Portland, OR

Cyclic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 39



Monotonic Test		
Boring and Sample No.	Depth (ft)	Strain Rate (%/hr)
B-15 U1	38-40	5

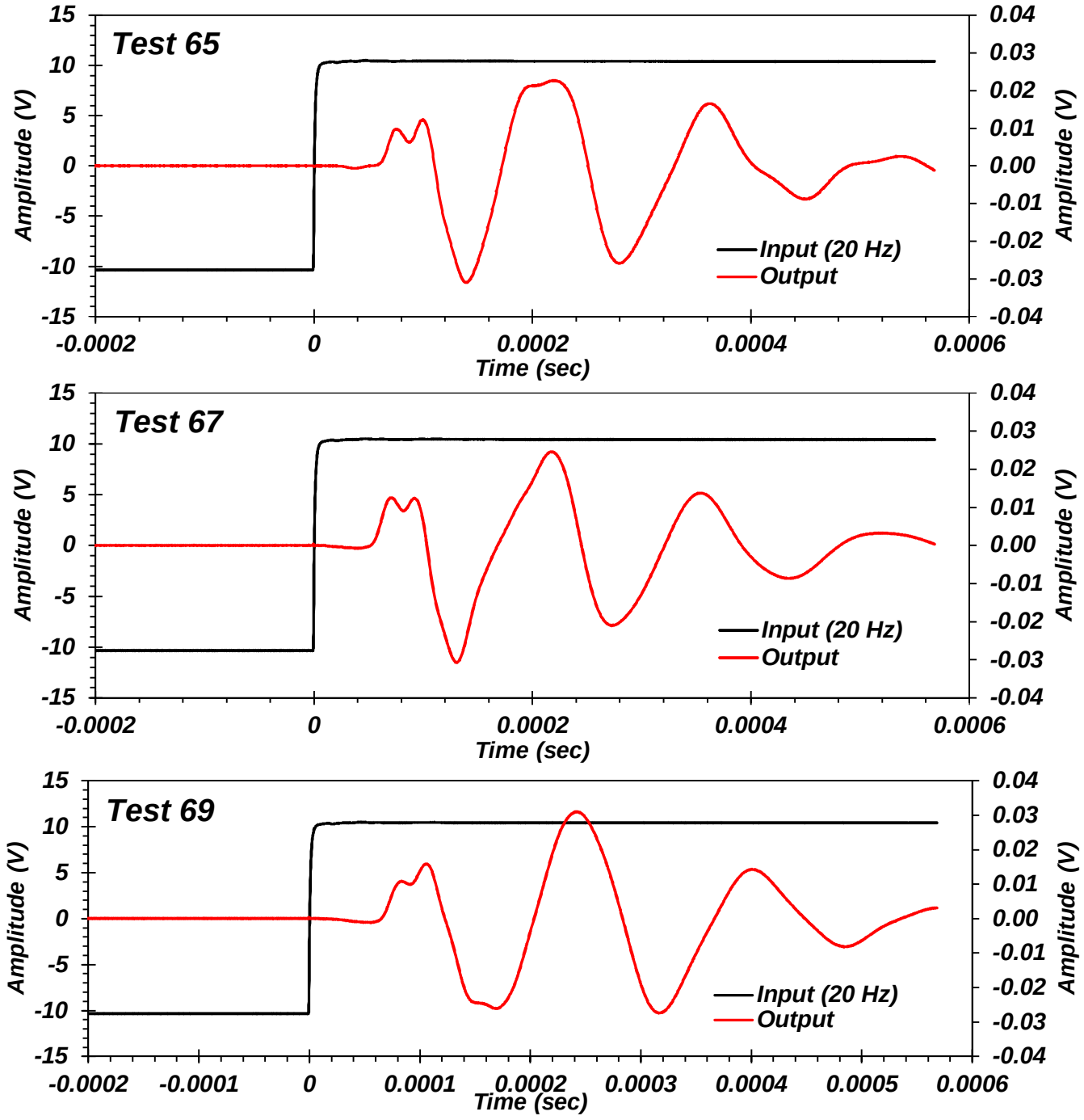
Vertical (Normal) Effective Consolidation Stress
3500 psf (with OCR = 1.63)

Earthquake-Ready Burnside Bridge Project, Portland, OR

Monotonic Direct Simple Shear (DSS) Test

Oregon State University

FIG. 40



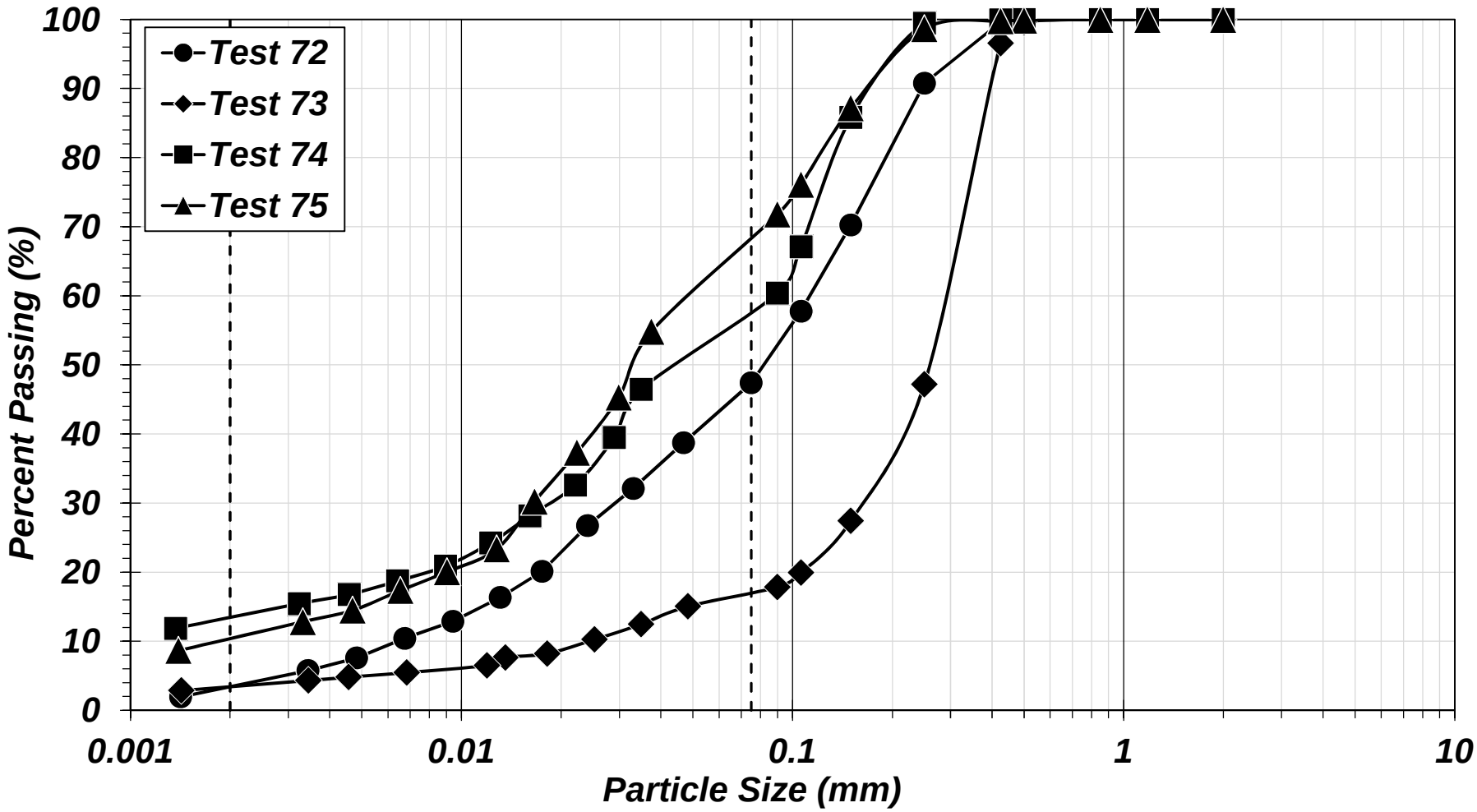
Tube-Sample	Test No.	Delay Time (sec)	Specimen height (mm)	Tip-to-tip Bender Element Distance (mm)	V_s (m/s)
B-32 U2	65	0.0000523	16.55	10.70	204.7
B-16 U2	67	0.0000529	15.05	9.20	173.9
B-15 U1	69	0.0000663	16.33	10.48	157.9

Earthquake-Ready Burnside Bridge Project, Portland, OR

Bender Element Test

Oregon State University

FIG. 41



Boring and Sample No.	Depth (ft)	Test No.
B-15 U1	38 - 40	72
B-15 U3	83 - 85	73
B-32 U2	63 - 65	74
B-16 U2	35 - 37	75

Earthquake-Ready Burnside Bridge Project, Portland OR

Grain Size Distribution

Oregon State University

FIG. 42

GeoTesting EXPRESS

Client:	Shannon & Wilson, Inc.				Attachment 5
Project:	Burnside Bridge				
Location:	Portland, OR			Project No:	GTX-314610
Boring ID:	---	Sample Type:	---	Tested By:	amp
Sample ID:	---	Test Date:	11/23/21	Checked By:	bfs
Depth :	---	Test Id:	641419		

pH of Soil by ASTM D4972

Boring ID	Sample ID	Depth	Visual Description	pH of Soil in Distilled Water	pH of Soil in Calcium Chloride
B-5	N3	15-16.5'	Moist, dark brown silt	6.4	5.6
B-6	N1	11-12.5'	Moist, brown silt	6.4	6.0
B-7	N1	11.12.5'	Moist, brown silt	6.5	6.3
B-8	N1	15-16.5'	Moist, dark brown sandy silt	5.7	5.4
B-12	N2 & N3	15-22.3'	Moist, brown sandy silt	5.6	4.8
B-16	N4	10-11.5'	Moist, brown silt	6.8	6.6
B-19	N4	17.5-19'	Moist, dark grayish brown sandy silt	6.9	5.9
B-27	N2	7.9-9.4	Moist, dark brown sandy silt	4.8	4.2
B-32	N4	20-21.5'	Moist, dark brown silt	7.0	6.5
B-33	N7	22.5-24'	Moist, brown silt	6.8	6.4

Notes: Sample Preparation: screened through #10 sieve

Method A, pH meter used

Attachment 5

Client:	Shannon Wilson, inc
Project:	Burnside Bridge
Location:	Portland, OR
GTX#:	314610
Test Date:	AMP
Tested By:	
Checked By:	

Laboratory Measurement of Soil Resistivity Using the Wenner Four-Electrode Method by ASTM G57 (Laboratory Measurement)

Boring ID	Sample ID	Depth, ft.	Sample Description	Electrical Resistivity, ohm-cm	Electrical Conductivity, $(ohm\text{-}cm)^{-1}$
B-5	N-3	15-16.5	Moist, dark brown silt	3,926	2.55E-04
B-6	N-1	11-12.5	Moist, brown silt	2,479	4.03E-04
B-7	N1	11-12.5	Moist, brown silt	2,169	4.61E-04
B-8	N1	15-16.5	Moist, dark brown sandy silt	4,442	2.25E-04
B-12	N2 & N3	15-22.3	Moist, brown sandy silt	8,574	1.17E-04
B-16	N4	10-11.5	Moist, brown silt	1,240	8.07E-04
B-19	N4	17.5-19	Moist, dark grayish brown sandy silt	19,628	5.09E-05
B-27	N2	7.9-9.4	Moist, dark brown sandy silt	5,578	1.79E-04
B-32	N4	20-21.5	Moist, dark brown silt	3,306	3.03E-04
B-33	N-7	22.5-24	Moist, brown silt	3,822	2.62E-04

Notes: Test Equipment: Nilsson Model 400 Soil Resistance Meter, MC Miller Soil Box
Water added to sample to create a thick slurry prior to testing (saturated condition).
Electrical Conductivity is calculated as inverse of Electrical Resistivity (per ASTM G57)
Test conducted in standard laboratory atmosphere: 68-73 F

Attachment 5



PO Box 572455 / Salt Lake City UT 84157-2455 / USA
TEL +1 801 262 2448 · FAX +1 801 262 9870 · www.TEi-TS.com

GEOTESTING EXPRESS INCORPORATED
125 NAGOG PARK
ACTON MA 01720-3451
USA

Analysis No.	TS-A2109950
Report Date	18 November 2021
Date Sampled	15 November 2021
Date Received	16 November 2021
Where Sampled	Acton, MA USA
Sampled By	Client

This is to attest that we have examined: Soil: Project: Burnside Bridge; Site Location: Portland, OR; Job Number: GTX-314610

When examined to the applicable requirements of:

ASTM D 512-12*	“Standard Test Methods for Chloride Ion in Water” Method B
ASTM D 516-16	“Standard Test Method for Sulfate Ion in Water”
ASTM G 200-20	“Standard Test Method for Measurement of Oxidation-Reduction Potential (ORP) of Soil”

Results:

ASTM D 512 - Chloride Method B

Sample		Results		Detection Limit
		ppm (mg/kg)	%[1]	
B-5		20.	0.0020	10.
N3	- -			
B-6		21.	0.0021	
N-	- -			
B-7		23.	0.0023	
N1	- -			
B-8		17.	0.0017	
N1	- -			
B-12		10.	0.0010	
N2 & N3	- -			
B-16		21.	0.0021	
N4	- -			

NOTE: [1]Percent by weight after drying and prepared as per the Standard. *Withdrawn 2021 without Replacement

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ASTM D 512 - Chloride Method B

Sample		Results		Detection Limit
		ppm (mg/kg)	%[1]	
B-19		10.	0.0010	10.
N4	- -			
B-27		10.	0.0010	
N2	- -			
B-32		20.	0.0020	
N4	- -			
B-33		17.	0.0017	
N7	- -			

NOTE: [1]Percent by weight after drying and prepared as per the Standard. *Withdrawn 2021 without Replacement

ASTM D 516 – Sulfates (Soluble)

Sample		Results		Detection Limit
		ppm (mg/kg)	%[1]	
B-5		< 10.	< 0.0010	10.
N3	- -			
B-6		< 10.	< 0.0010	
N-	- -			
B-7		< 10.	< 0.0010	
N1	- -			
B-8		< 10.	< 0.0010	
N1	- -			
B-12		< 10.	< 0.0010	
N2 & N3	- -			
B-16		< 10.	< 0.0010	
N4	- -			

NOTE: [1]Percent by weight after drying and prepared as per the Standard.

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ASTM D 516 – Sulfates (Soluble)

Sample		Results		Detection Limit
		ppm (mg/kg)	%[1]	
B-19		< 10.	< 0.0010	10.
N4	- -			
B-27		< 10.	< 0.0010	
N2	- -			
B-32		< 10.	< 0.0010	
N4	- -			
B-33		12.	0.0012	
N7	- -			

NOTE: [1]Percent by weight after drying and prepared as per the Standard.

ASTM G 200 - Oxidation-Reduction Potential (ORP)

Sample		Results	Detection Limit
B-5		258.1 @ 20.0 ºC	0.1 mV
N3	- -		
B-6		252.4 @ 20.3 ºC	
N-	- -		
B-7		238.1 @ 20.4 ºC	
N1	- -		
B-8		272.1 @ 20.3 ºC	
N1	- -		
B-12		121.7 @ 20.6 ºC	
N2 & N3	- -		
B-16		111.2 @ 21.0 ºC	
N4	- -		

Sample prepared as per the Standard.

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ASTM G 200 - Oxidation-Reduction Potential (ORP)

Sample		Results	Detection Limit
B-19		192.4 @ 21.3 ºC	0.1 mV
N4	- -		
B-27		290.7 @ 21.7 ºC	
N2	- -		
B-32		195.6 @ 21.5 ºC	
N4	- -		
B-33		181.5 @ 21.7 ºC	
N7	- -		

Sample prepared as per the Standard.

END OF ANALYSIS

USEPA Laboratory ID UT00930

Merrill Gee P.E. – Engineer in Charge

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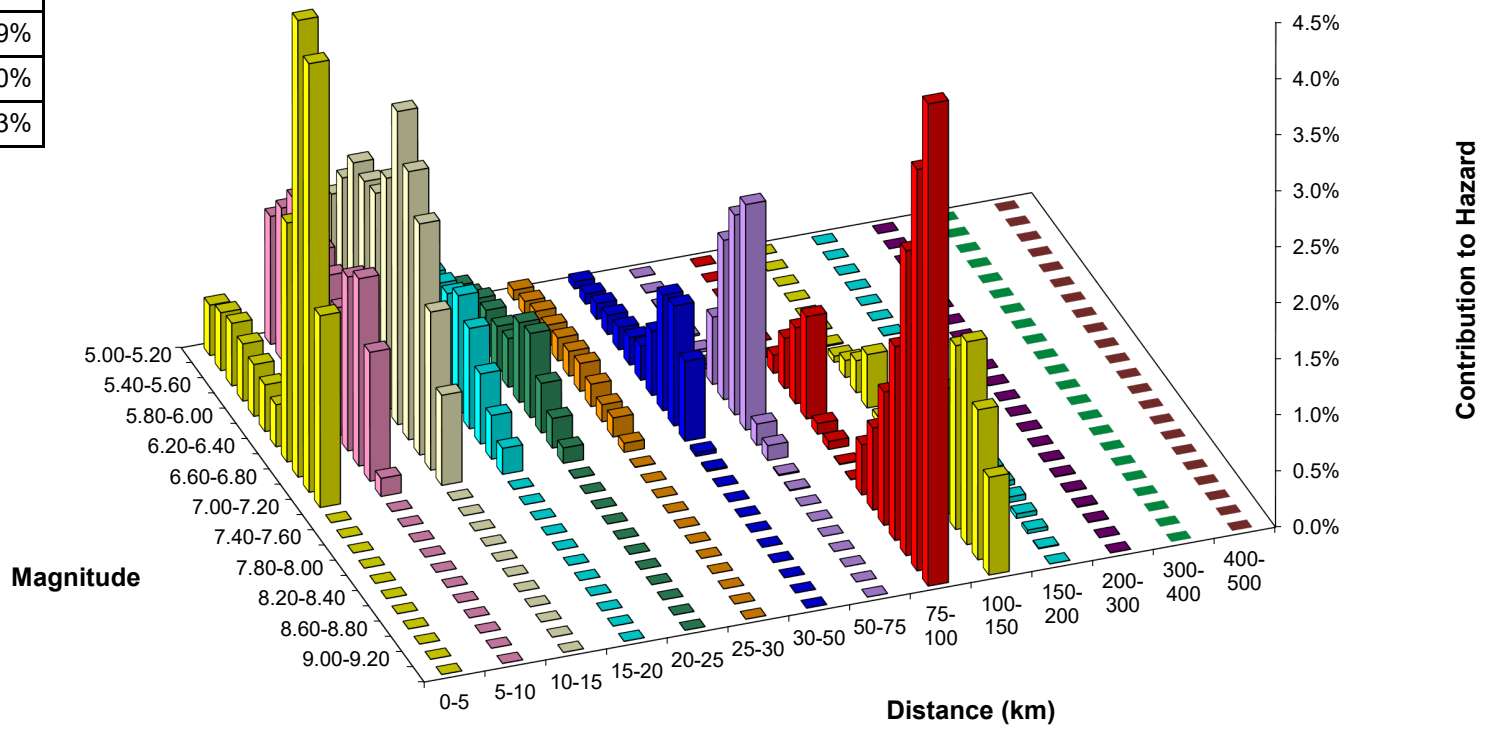
APPENDIX F: PROBABILISTIC SEISMIC HAZARD ANALYSIS DEAGGREGATION

Appendix F

Probabilistic Seismic Hazard Analysis Deaggregation Figures

Mean Mw	6.9
Mean Rrup (km)	39
Mean ε_0	0.56

Hazard Contribution	
Crustal Faults	24.8%
Crustal Background	39.9%
CSZ Interface	25.0%
CSZ Intraslab	10.3%



NOTES

1. Hazard data correspond to Site Class B/C Boundary VS30 of 760 meters per second.

2. Mw = moment magnitude
   Rrup = source-to-site rupture distance
   ε_0 = epsilon zero, a measure of the ground motion variation from the mean
   km = kilometers
   CSZ = Cascadia subduction zone
   VS30 = time-averaged shear wave velocity for 30 meters of soil below soil profile base

FIG. F-1

Earthquake Ready Burnside Bridge
Portland, Oregon

1,000-YEAR HAZARD DEAGGREGATION
PEAK GROUND ACCELERATION

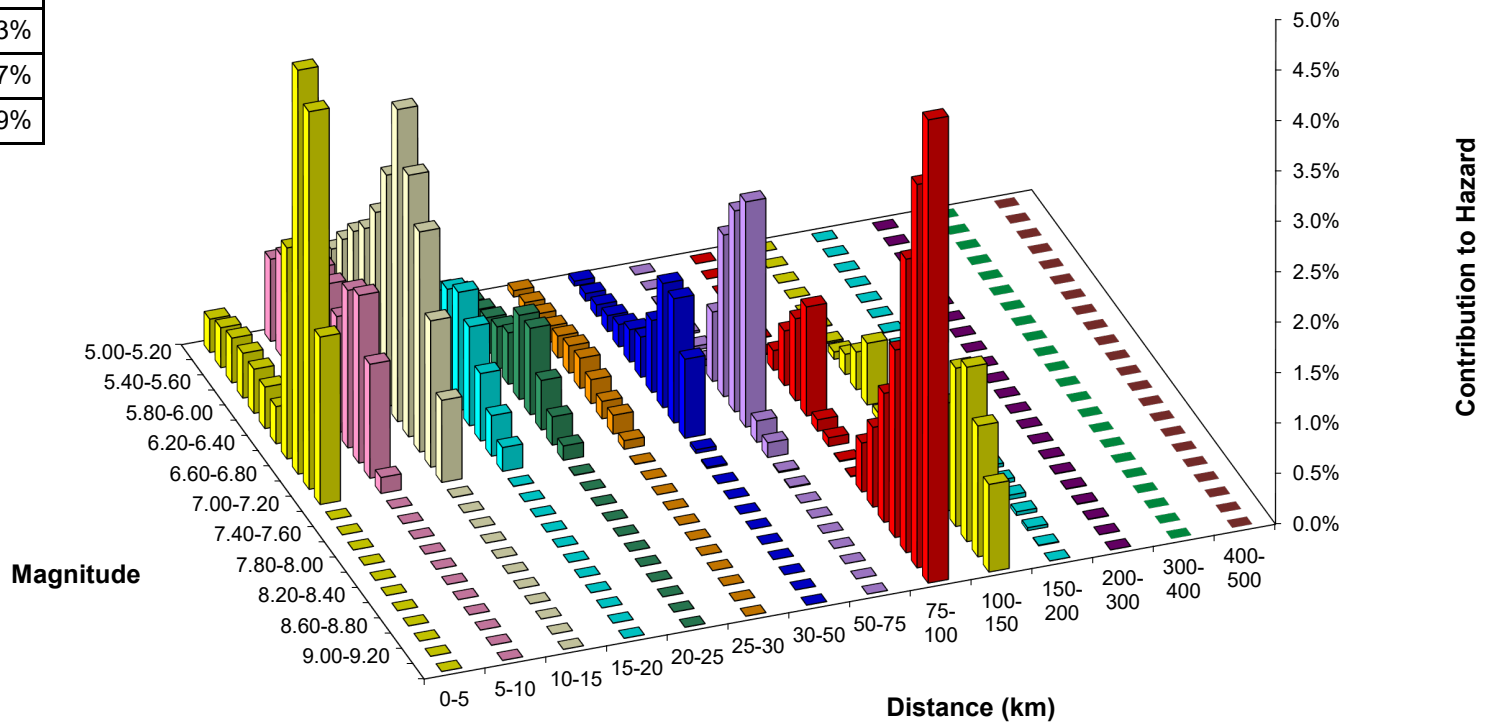
April 2022 102636-009

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. F-1

Mean Mw	7.0
Mean Rrup (km)	40
Mean ε_0	0.61

Hazard Contribution	
Crustal Faults	26.1%
Crustal Background	37.3%
CSZ Interface	24.7%
CSZ Intraslab	11.9%



NOTES

1. Hazard data correspond to Site Class B/C Boundary VS30 of 760 meters per second.

2. Mw = moment magnitude
   Rrup = source-to-site rupture distance
   ε_0 = epsilon zero, a measure of the ground motion variation from the mean
   km = kilometers
   CSZ = Cascadia subduction zone
   VS30 = time-averaged shear wave velocity for 30 meters of soil below soil profile base

FIG. F-2

Earthquake Ready Burnside Bridge
Portland, Oregon

1,000-YEAR HAZARD DEAGGREGATION
0.25 SECOND PERIOD

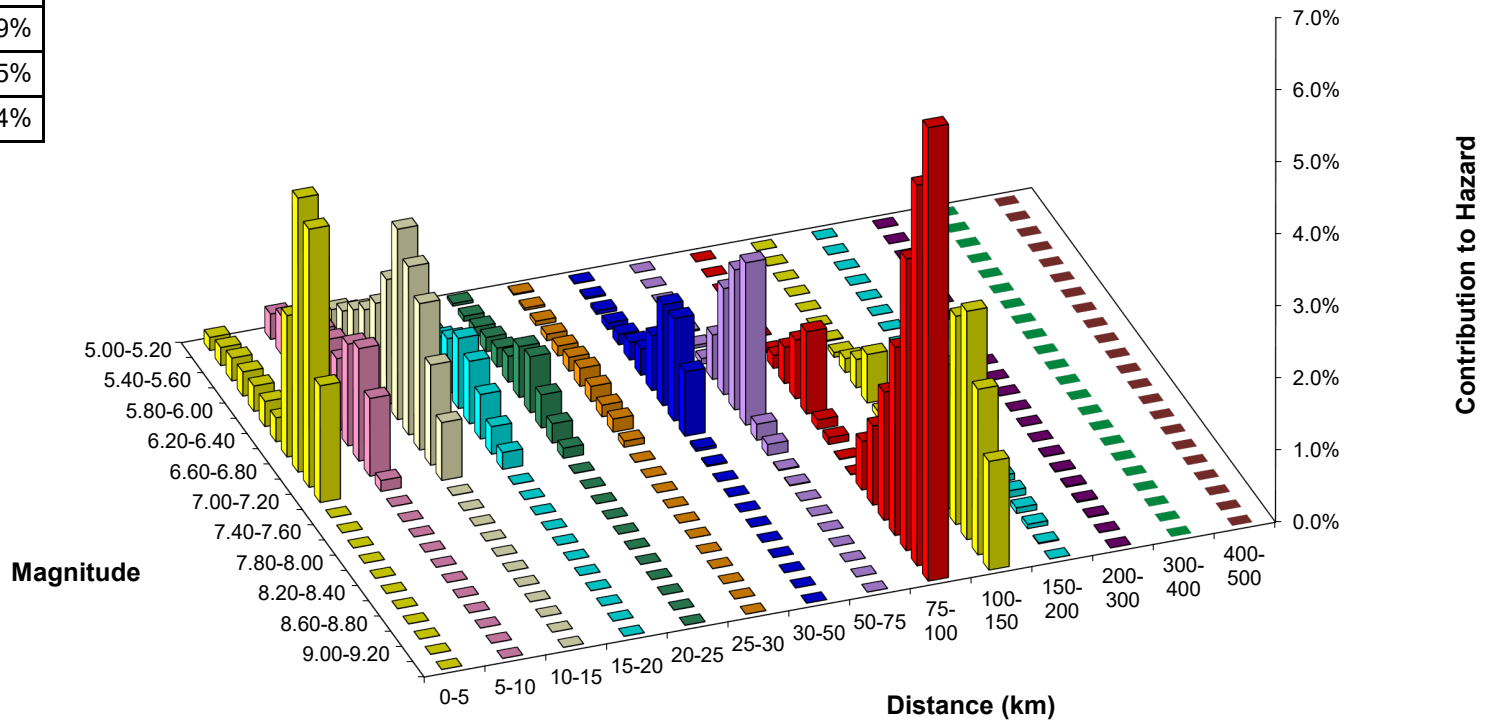
April 2022 102636-009

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. F-2

Mean Mw	7.4
Mean Rrup (km)	52
Mean ε_0	0.65

Hazard Contribution	
Crustal Faults	25.2%
Crustal Background	26.9%
CSZ Interface	36.5%
CSZ Intraslab	11.4%



NOTES

1. Hazard data correspond to Site Class B/C Boundary VS30 of 760 meters per second.

2. Mw = moment magnitude
   Rrup = source-to-site rupture distance
   ε_0 = epsilon zero, a measure of the ground motion variation from the mean
   km = kilometers
   CSZ = Cascadia subduction zone
   VS30 = time-averaged shear wave velocity for 30 meters of soil below soil profile base

FIG. F-3

Earthquake Ready Burnside Bridge
Portland, Oregon

1,000-YEAR HAZARD DEAGGREGATION
0.5 SECOND PERIOD

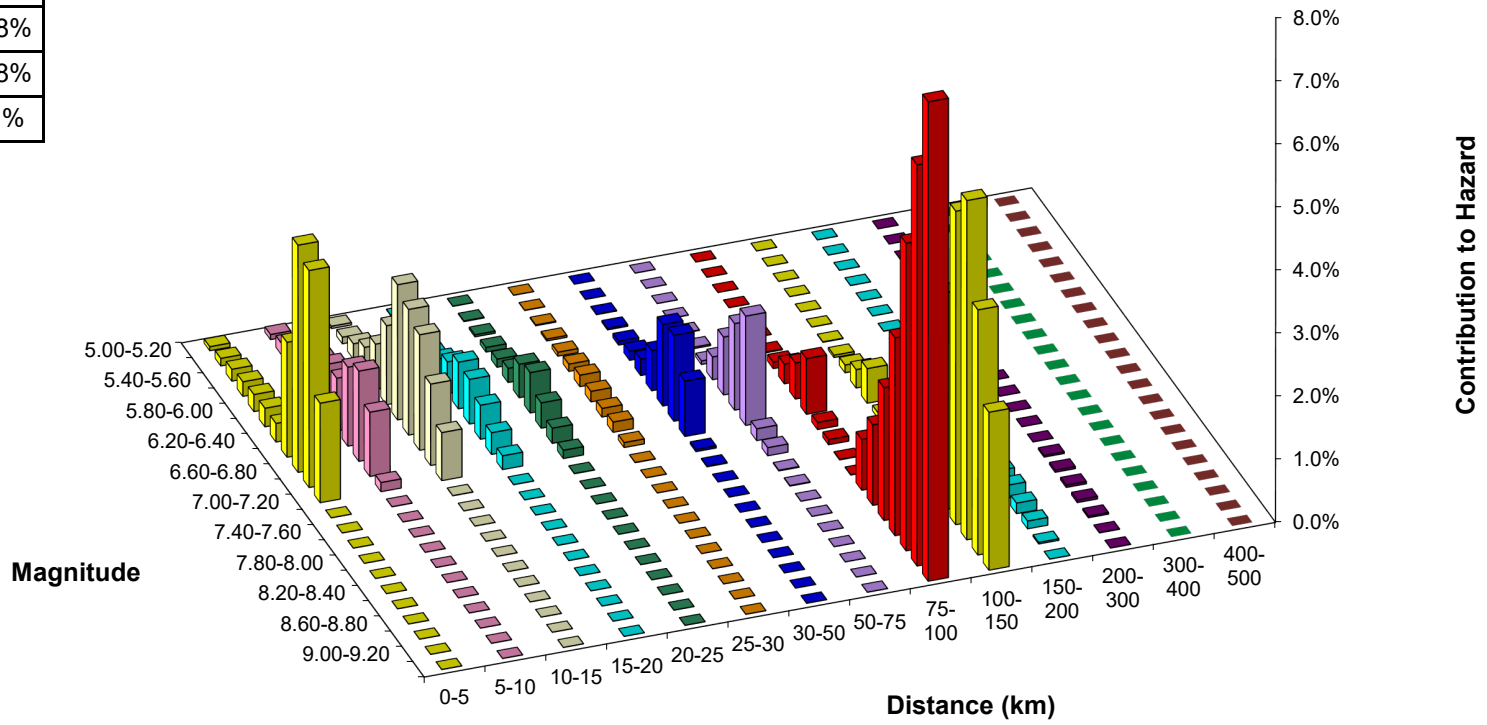
April 2022 102636-009

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. F-3

Mean Mw	7.7
Mean Rrup (km)	66
Mean ε_0	0.65

Hazard Contribution	
Crustal Faults	23.3%
Crustal Background	17.8%
CSZ Interface	50.8%
CSZ Intraslab	8.1%



NOTES

1. Hazard data correspond to Site Class B/C Boundary VS30 of 760 meters per second.

2. Mw = moment magnitude
   Rrup = source-to-site rupture distance
   ε_0 = epsilon zero, a measure of the ground motion variation from the mean
   km = kilometers
   CSZ = Cascadia subduction zone
   VS30 = time-averaged shear wave velocity for 30 meters of soil below soil profile base

FIG. F-4

Earthquake Ready Burnside Bridge
Portland, Oregon

1,000-YEAR HAZARD DEAGGREGATION
1.0 SECOND PERIOD

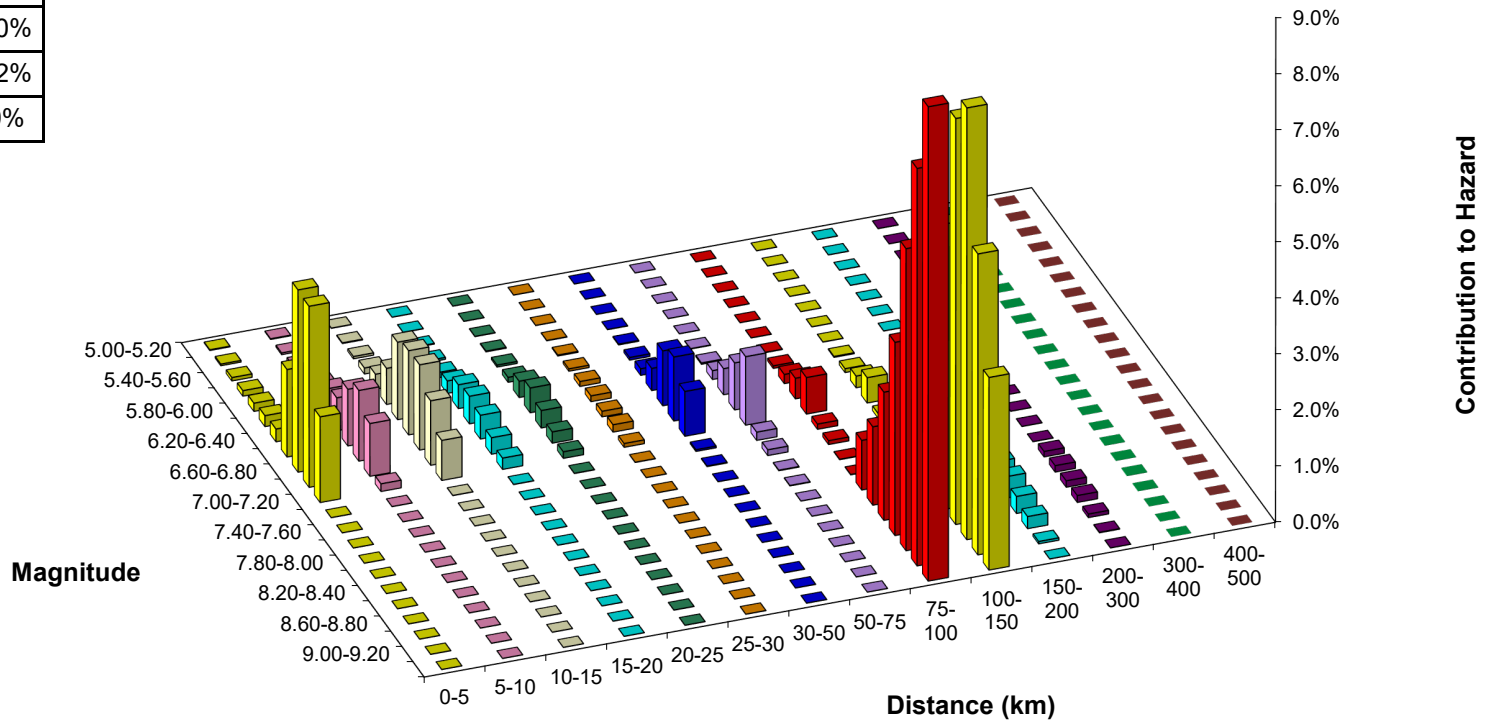
April 2022 102636-009

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. F-4

Mean Mw	8.1
Mean Rrup (km)	80
Mean ε_0	0.62

Hazard Contribution	
Crustal Faults	18.9%
Crustal Background	10.0%
CSZ Interface	66.2%
CSZ Intraslab	4.9%



NOTES

1. Hazard data correspond to Site Class B/C Boundary VS30 of 760 meters per second.

2. Mw = moment magnitude
   Rrup = source-to-site rupture distance
   ε_0 = epsilon zero, a measure of the ground motion variation from the mean
   km = kilometers
   CSZ = Cascadia subduction zone
   VS30 = time-averaged shear wave velocity for 30 meters of soil below soil profile base

FIG. F-5

Earthquake Ready Burnside Bridge
Portland, Oregon

1,000-YEAR HAZARD DEAGGREGATION
2.0 SECOND PERIOD

April 2022 102636-009

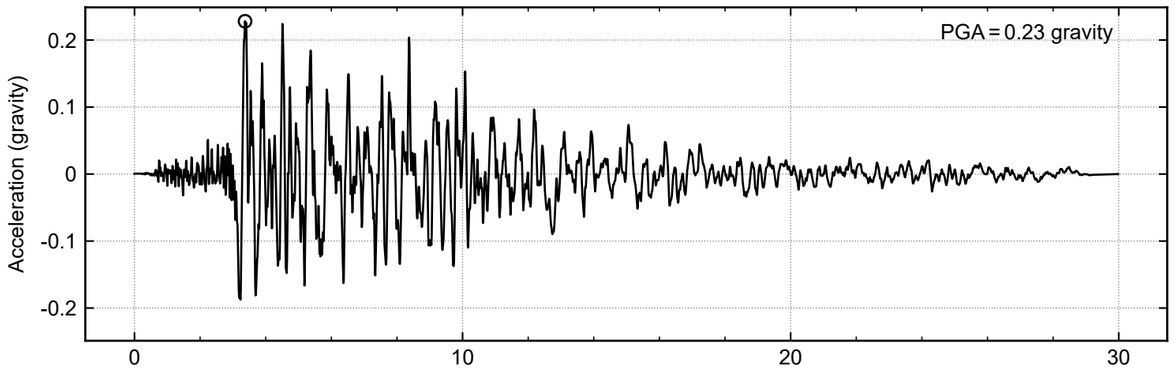
SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

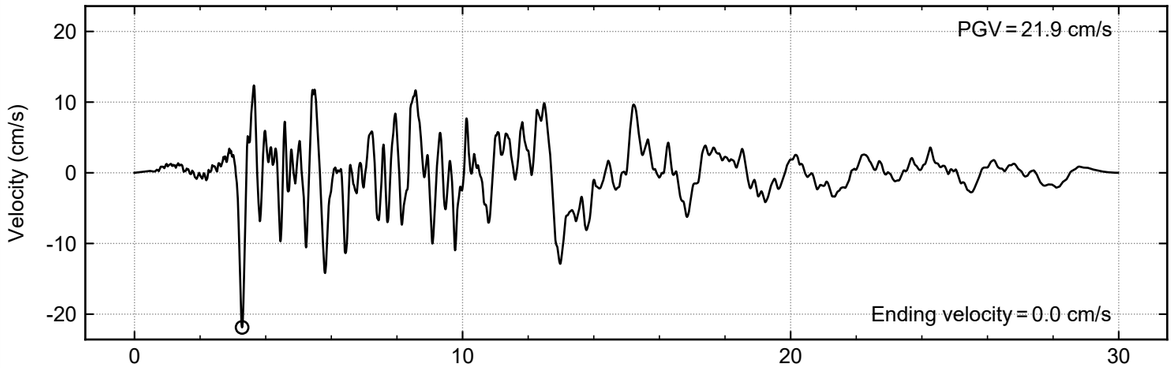
FIG. F-5

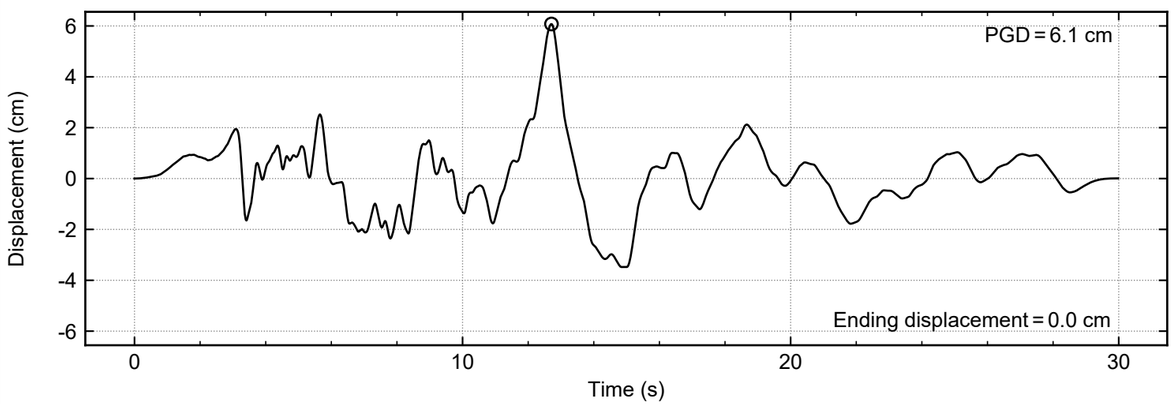
APPENDIX G: INPUT TIME HISTORY PLOTS

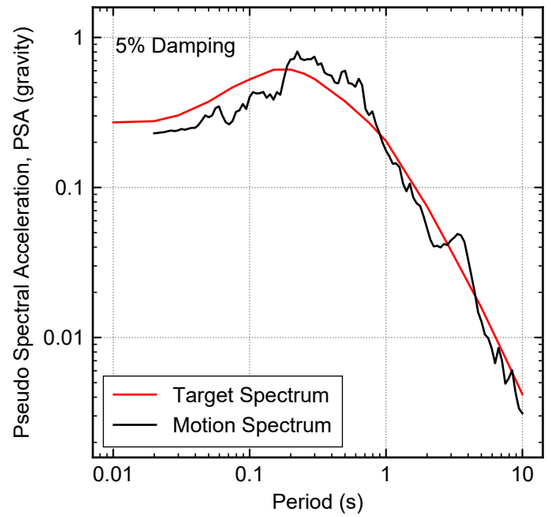
Appendix G

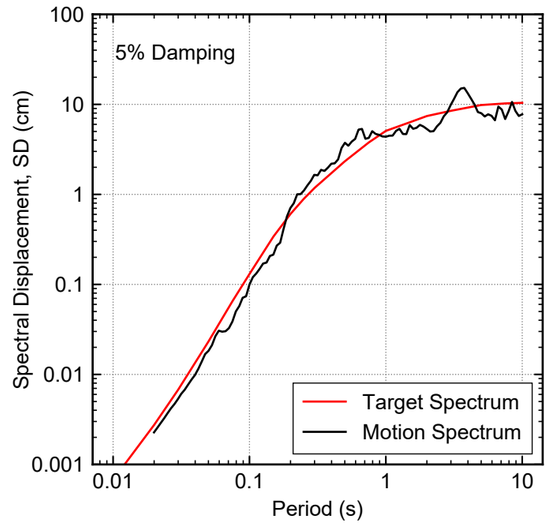
Input Time History Plots

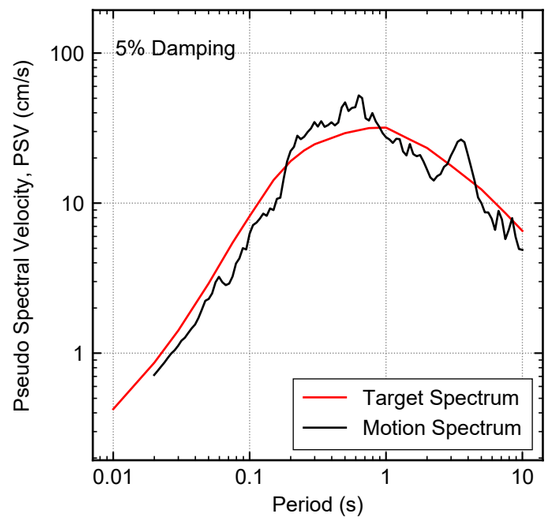


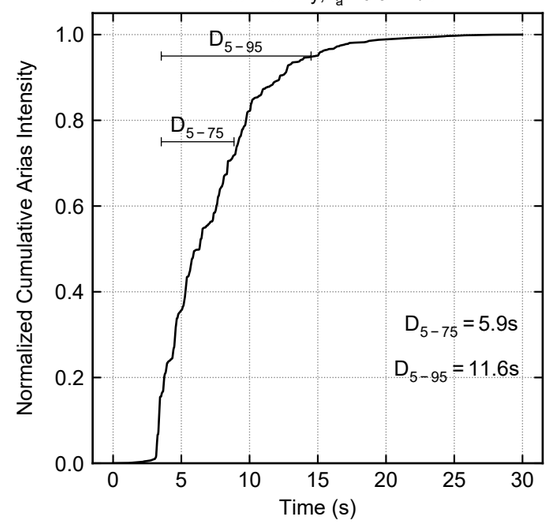












Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 2.043 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

NORTHRIDGE 1994
BURBANK-HOWARD RD., 60°
SCALED TIME HISTORY
1,000-YEAR CRUSTAL

November 2021 102636-007

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. G-1

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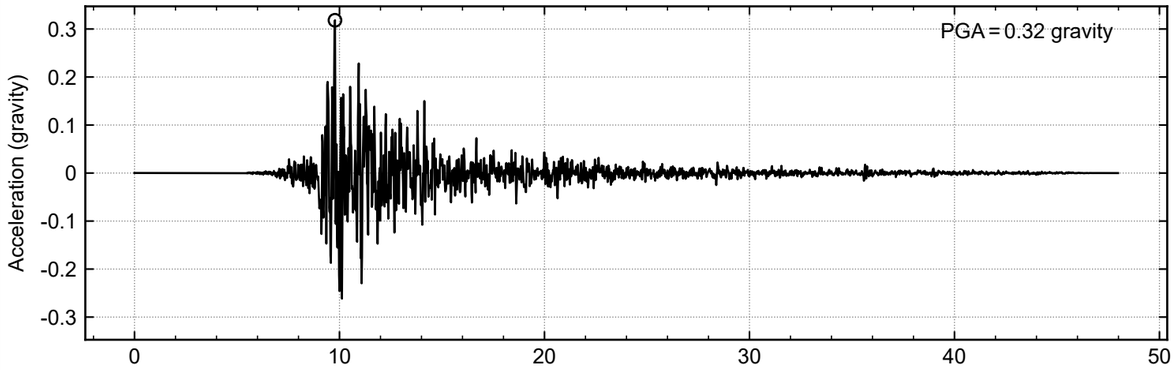

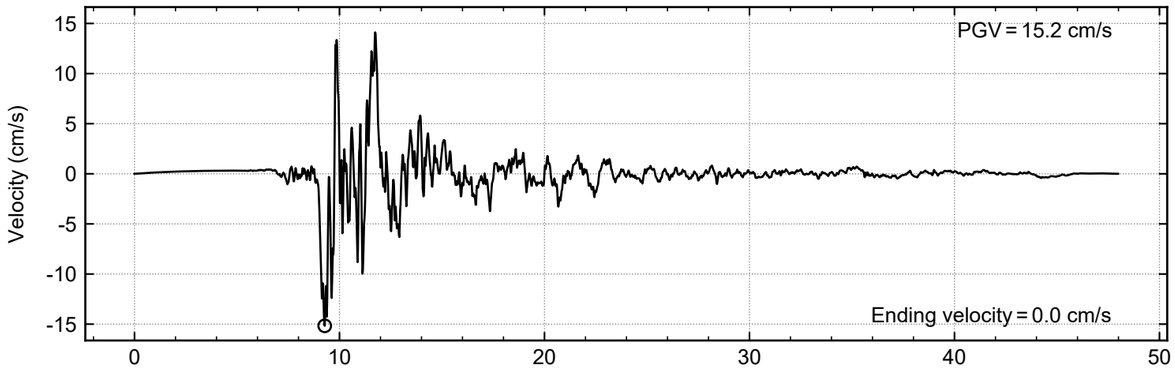

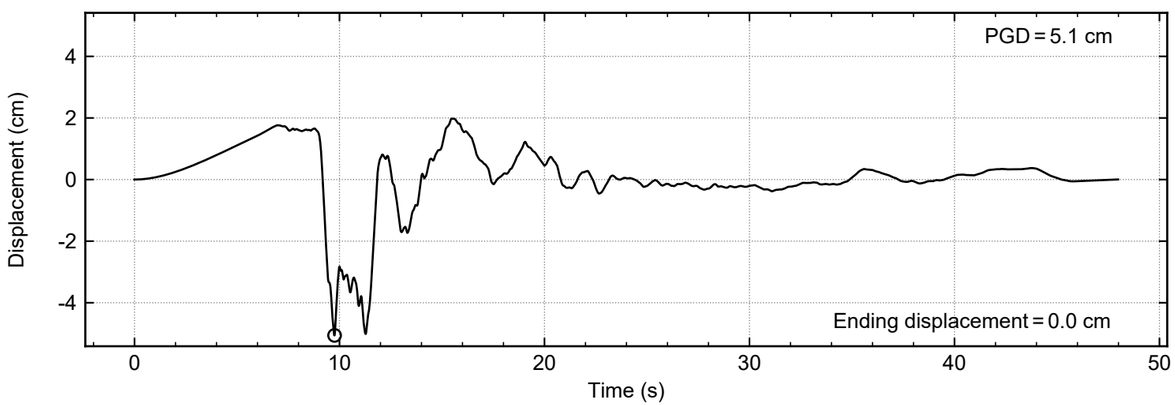

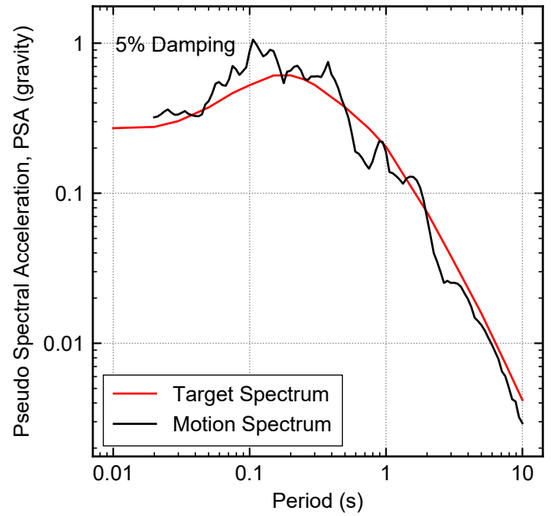

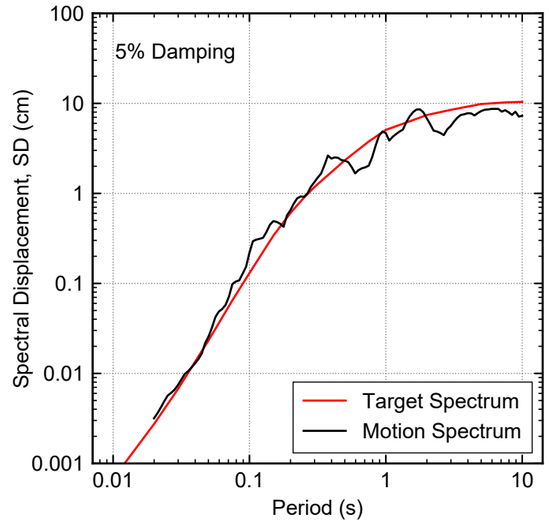

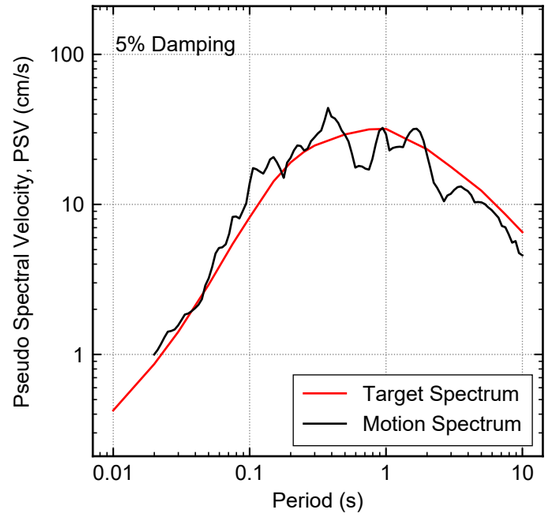

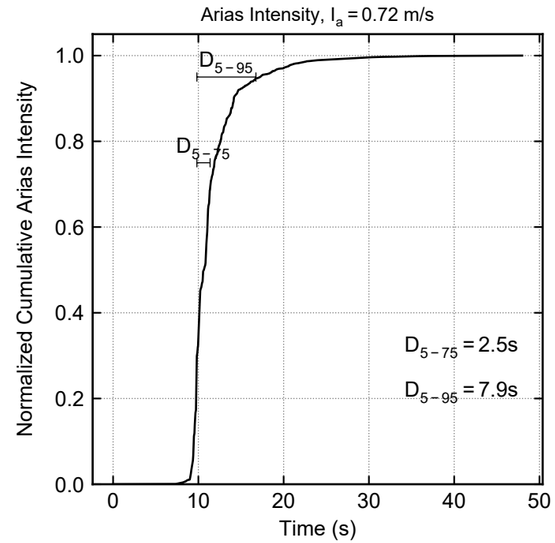

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 2.143 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

CHRISTCHURCH, NEW ZEALAND 2011
MQZ, E
SCALED TIME HISTORY
1,000-YEAR CRUSTAL

November 2021 102636-007

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. G-2

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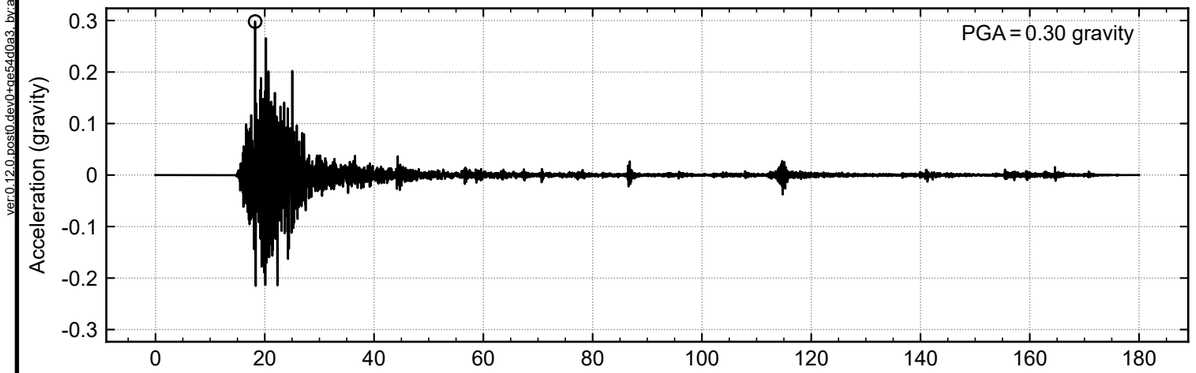

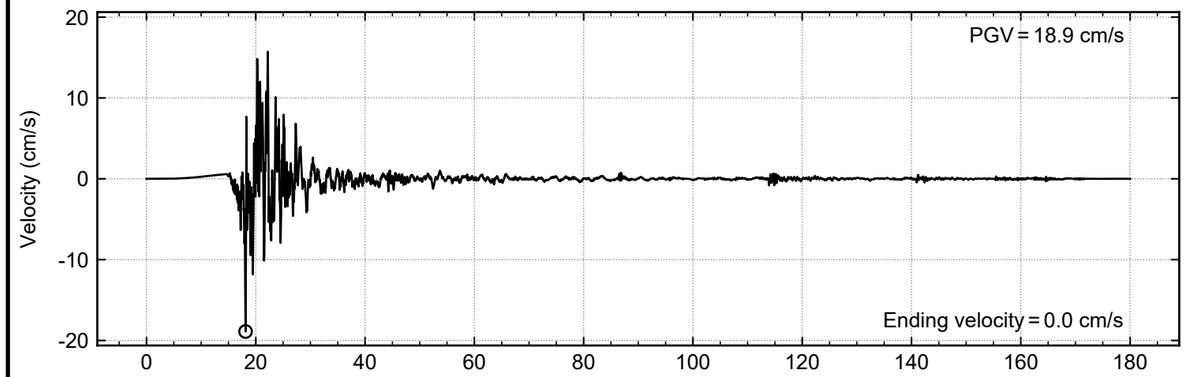

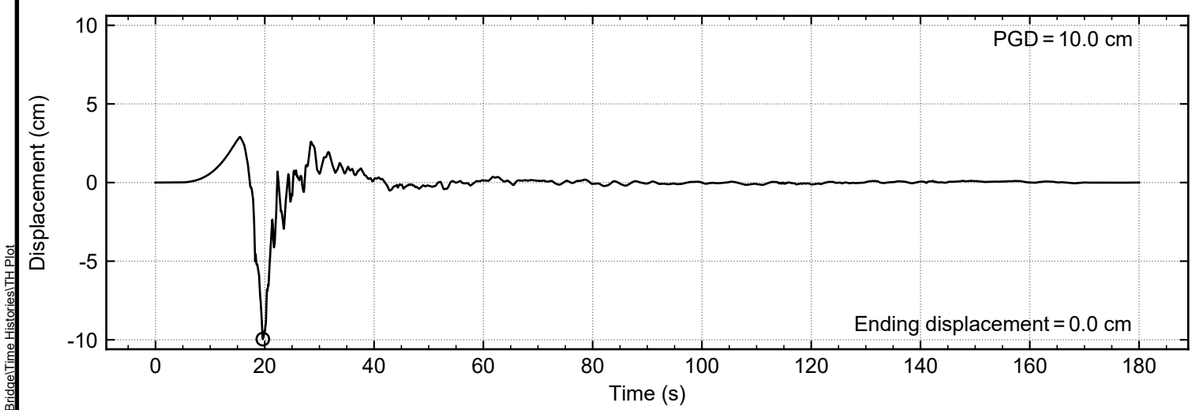

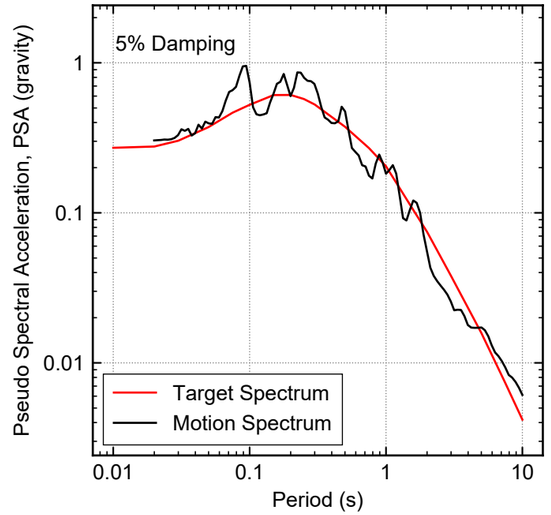

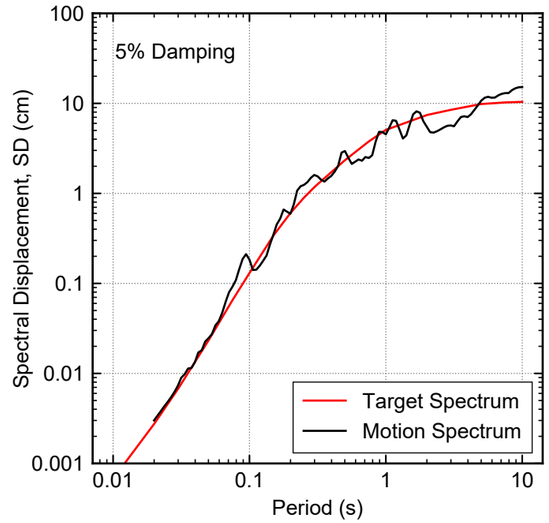

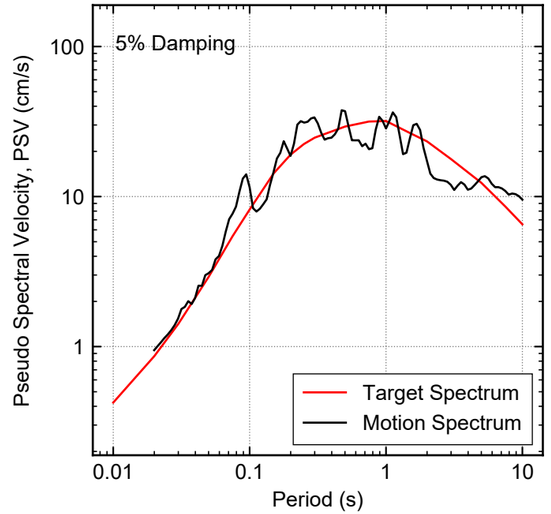

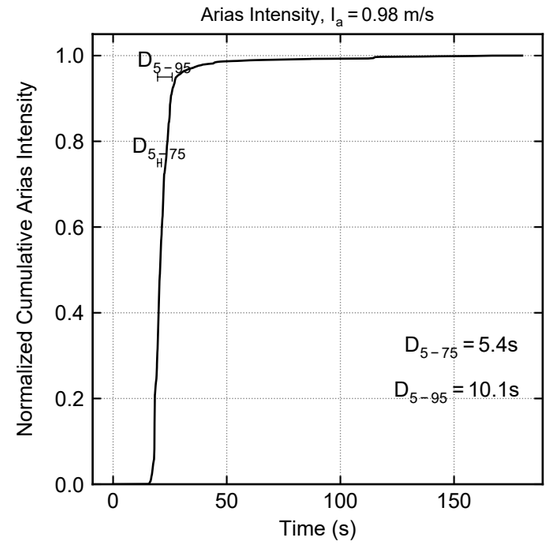

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 0.851 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

NIIGATA, JAPAN 2004
NIGH12, E
SCALED TIME HISTORY
1,000-YEAR CRUSTAL

November 2021 102636-007

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. G-3

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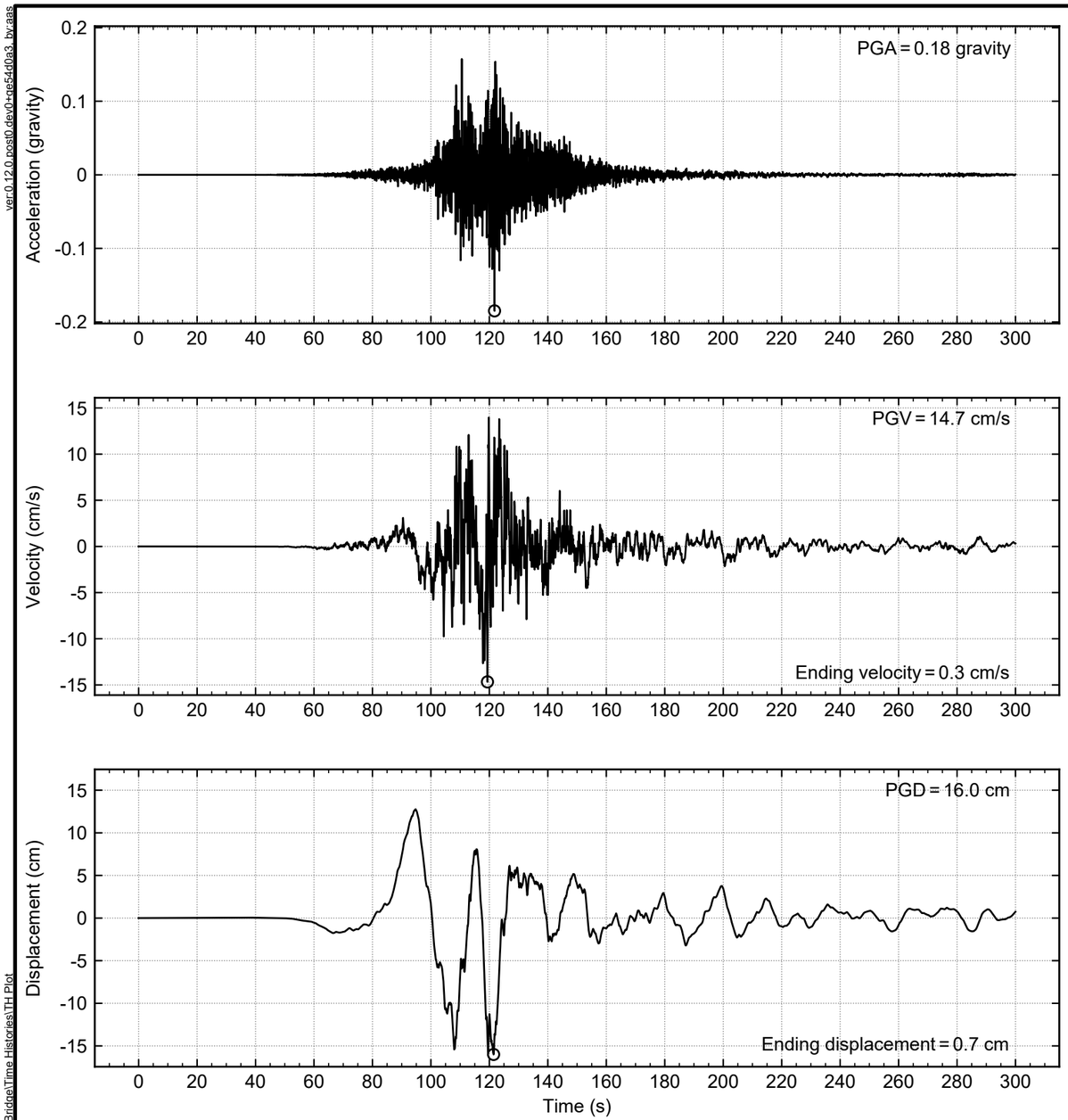

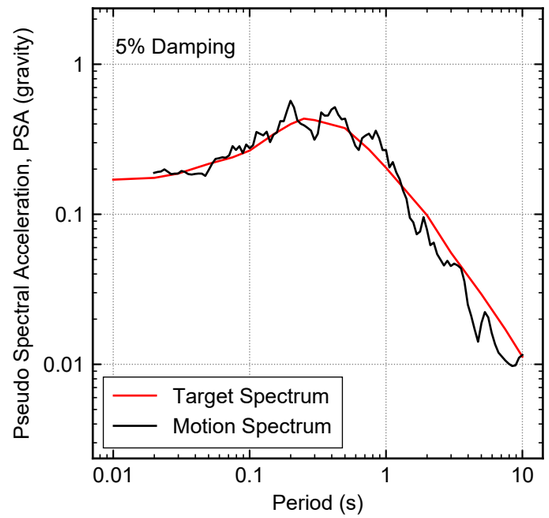

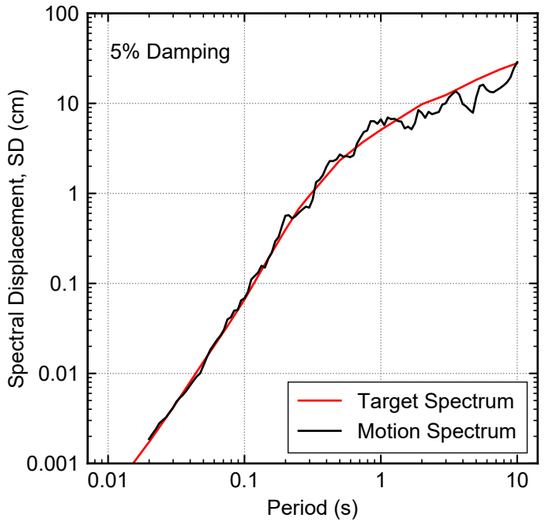

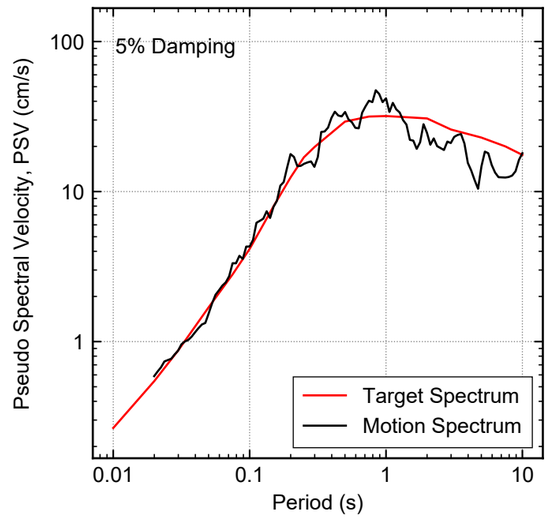

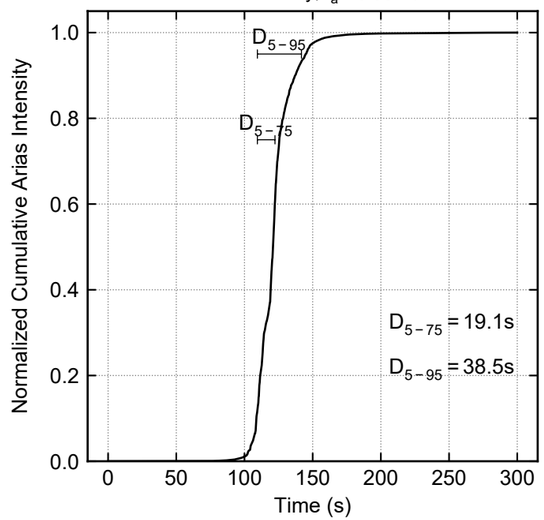

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 0.684 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

MAULE, CHILE 2010
ANTU, 90°
SCALED TIME HISTORY
1,000-YEAR INTERFACE

November 2021 102636-007

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. G-4

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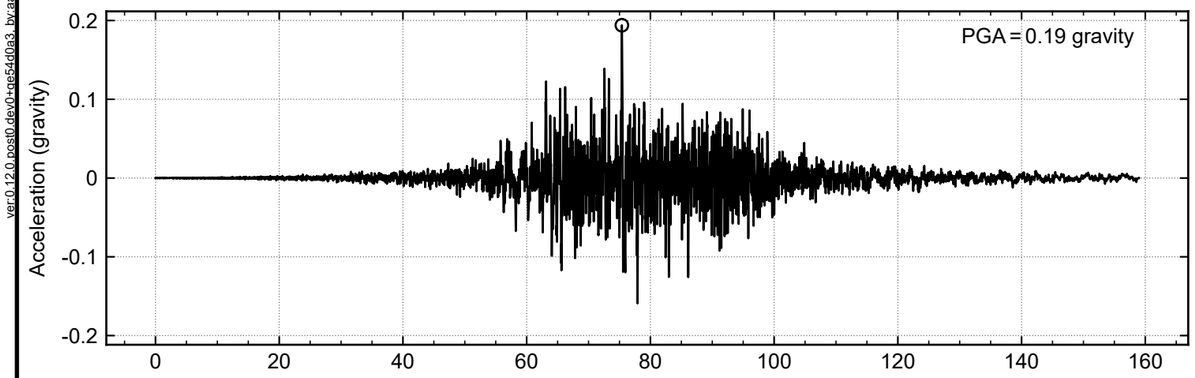

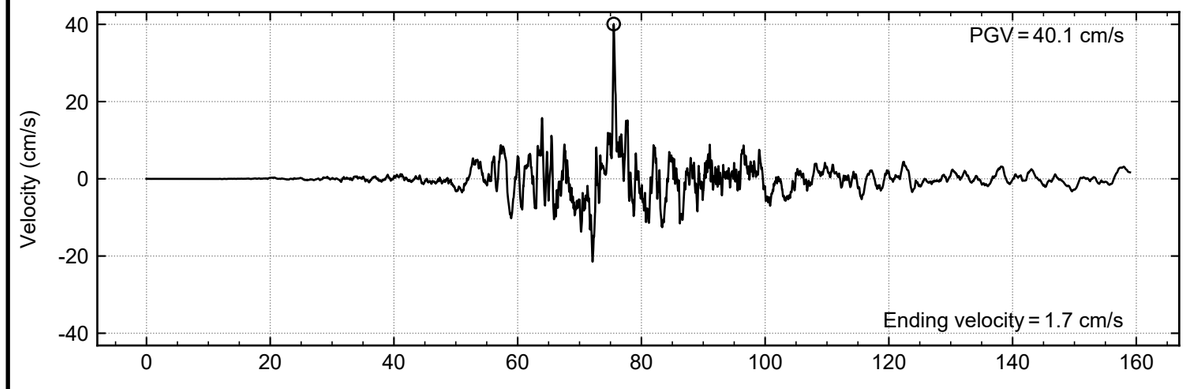

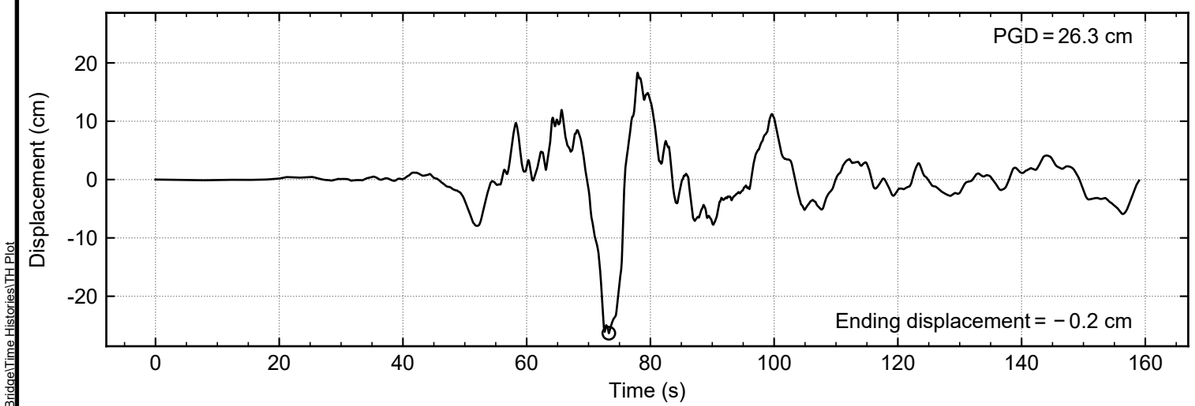

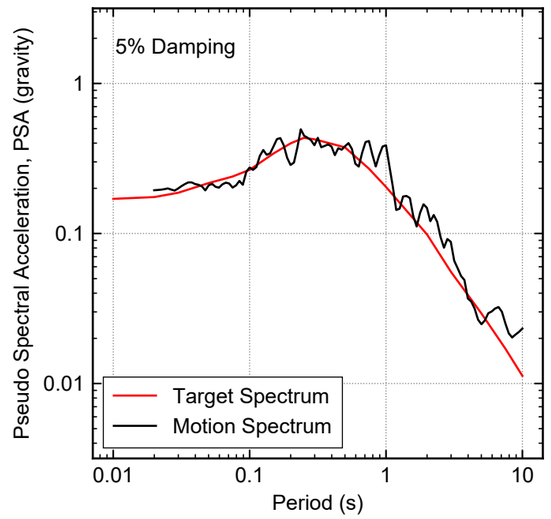

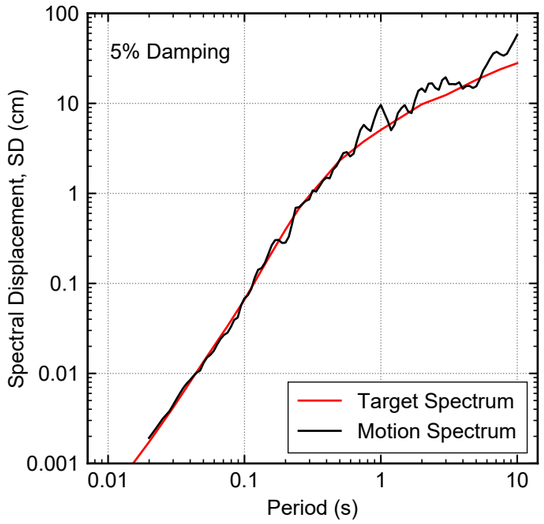

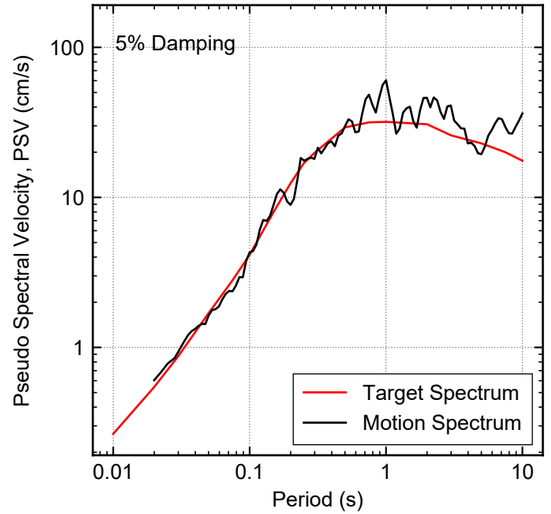

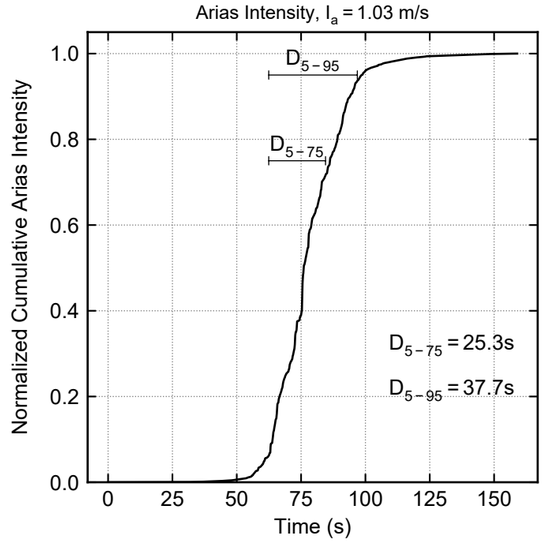

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 0.606 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

MAULE, CHILE 2010
SLUC, 90°
SCALED TIME HISTORY
1,000-YEAR INTERFACE

November 2021 102636-007

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. G-5

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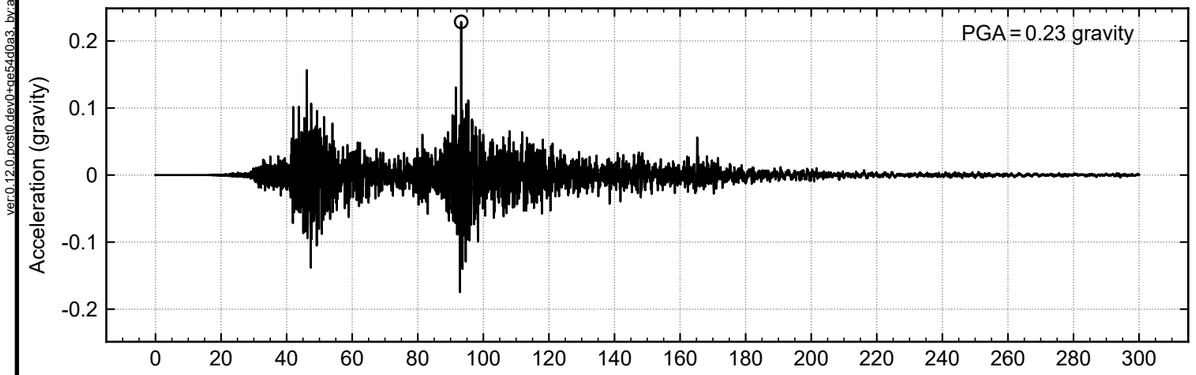

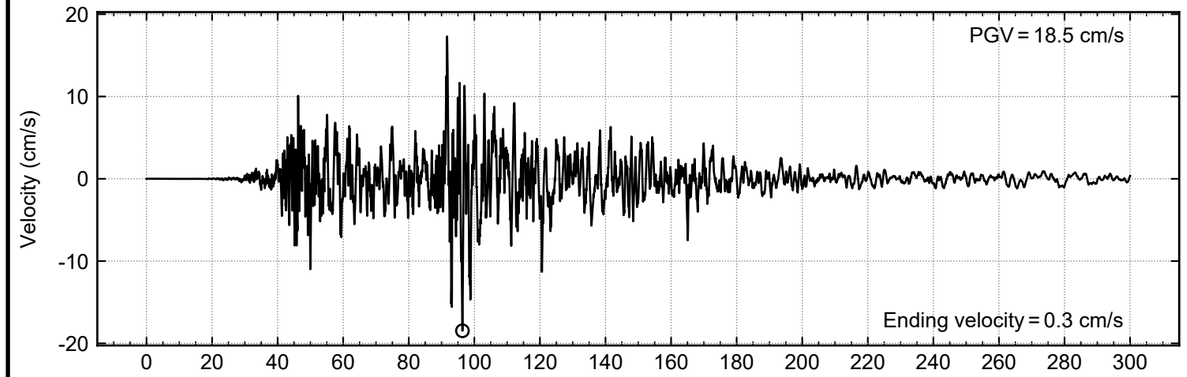

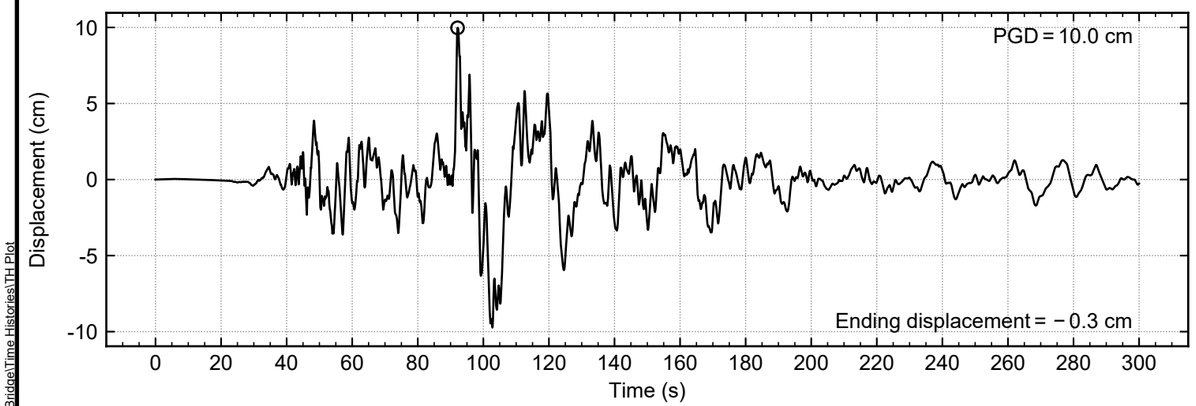

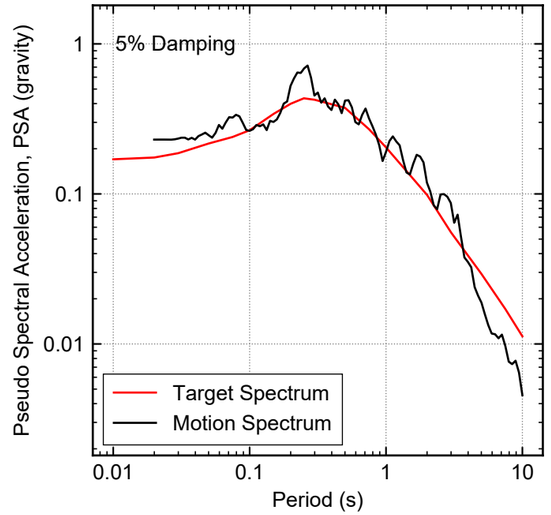

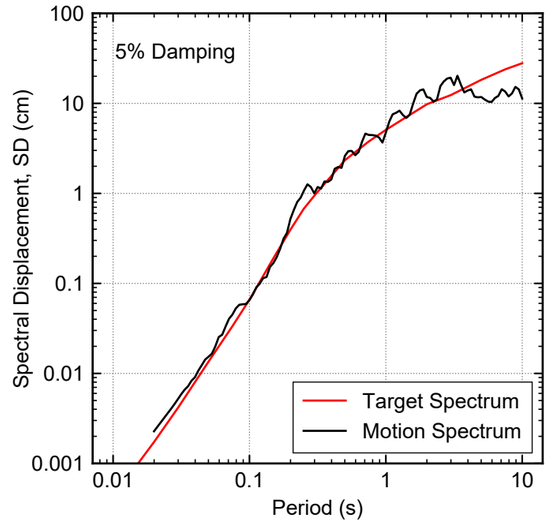

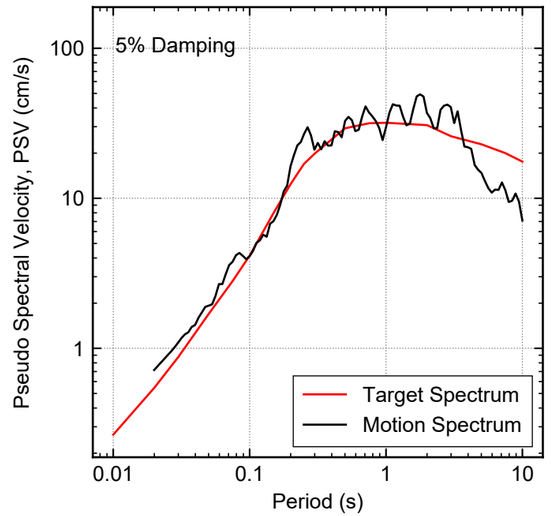

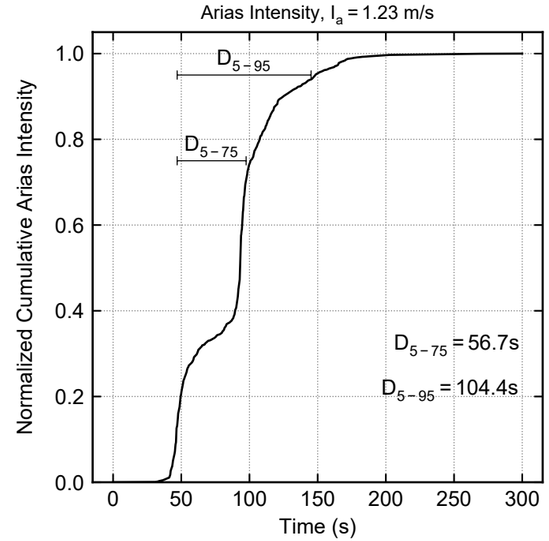

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 0.497 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

TOHOKU, JAPAN 2011
TAIWA, NS
SCALED TIME HISTORY
1,000-YEAR INTERFACE

November 2021 102636-007

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Geotechnical and Environmental Consultants

FIG. G-6

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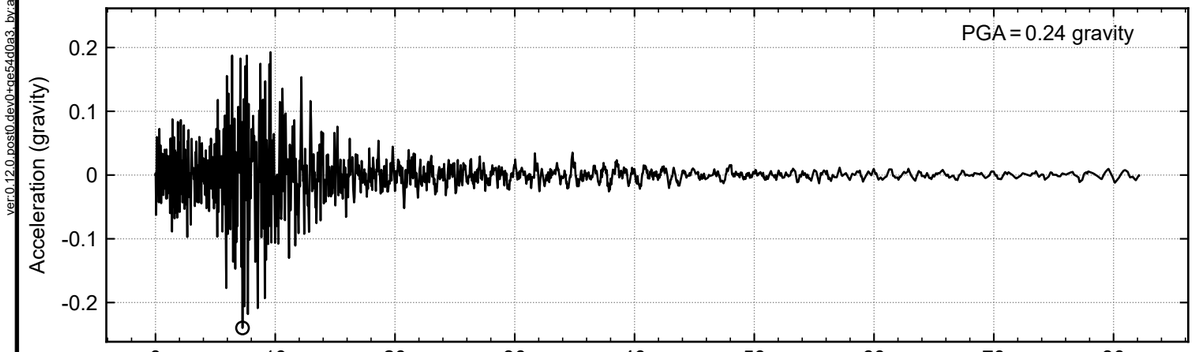

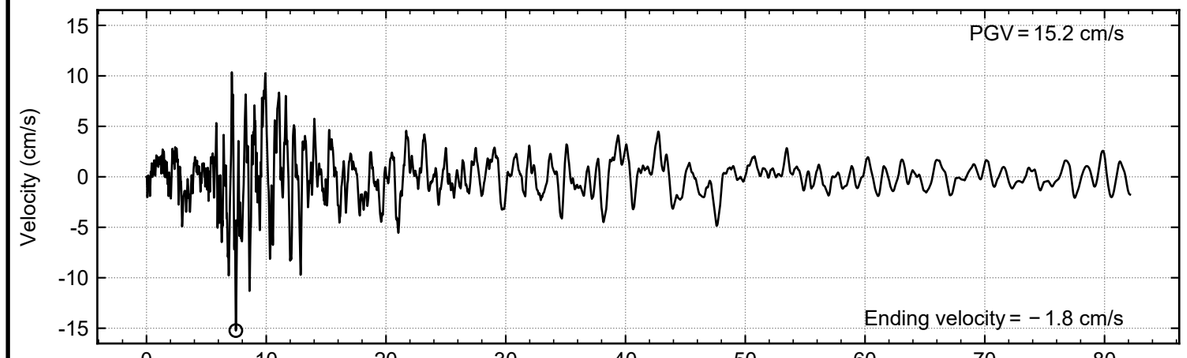

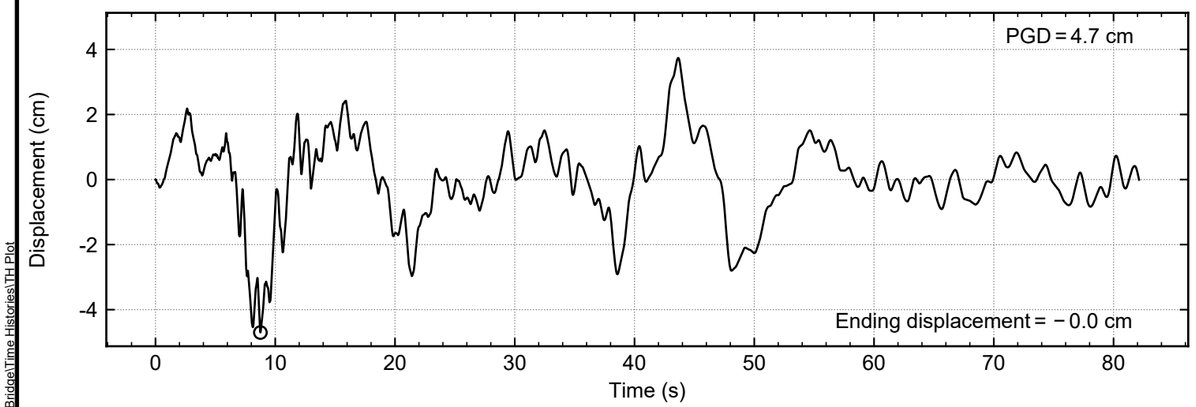

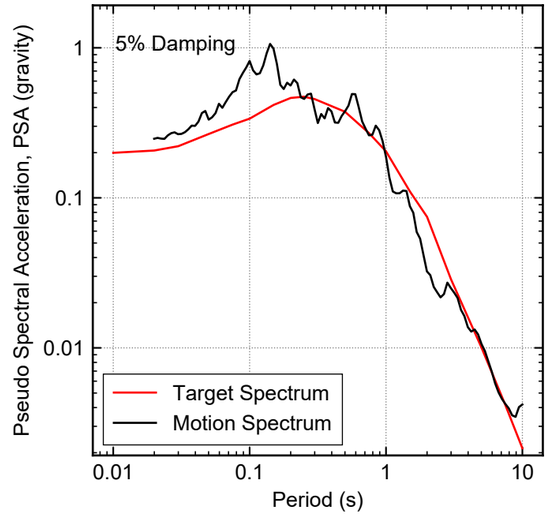

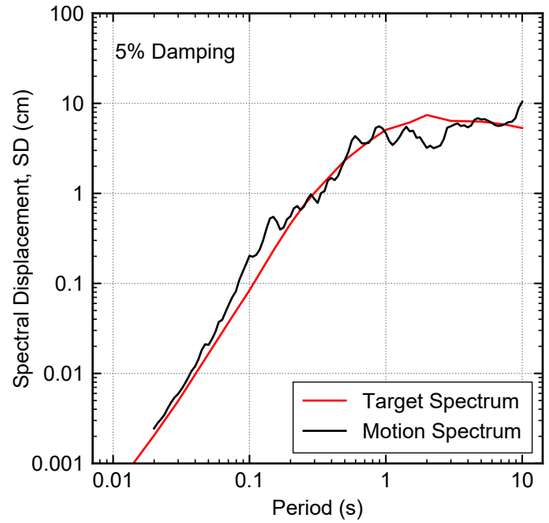

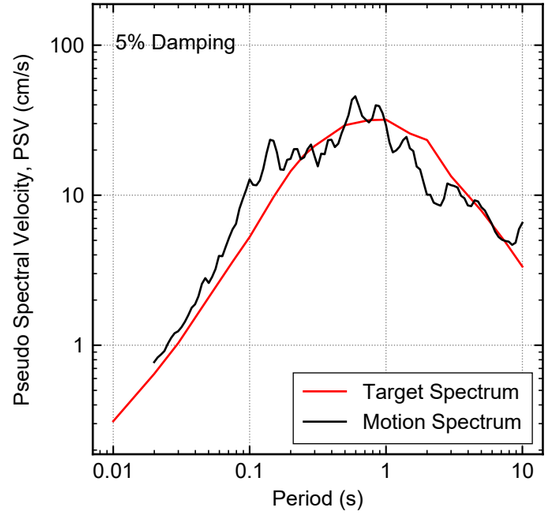

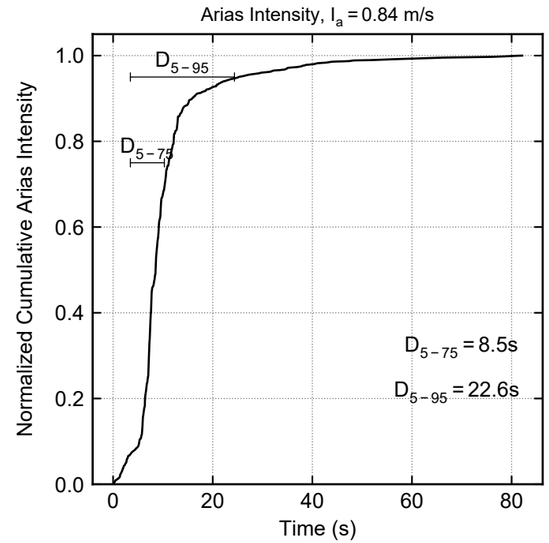

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 1.534 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

OLYMPIA, WA 1965
OLY0, 176°
SCALED TIME HISTORY
1,000-YEAR INTRASLAB

November 2021 102636-007

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Geotechnical and Environmental Consultants

FIG. G-7

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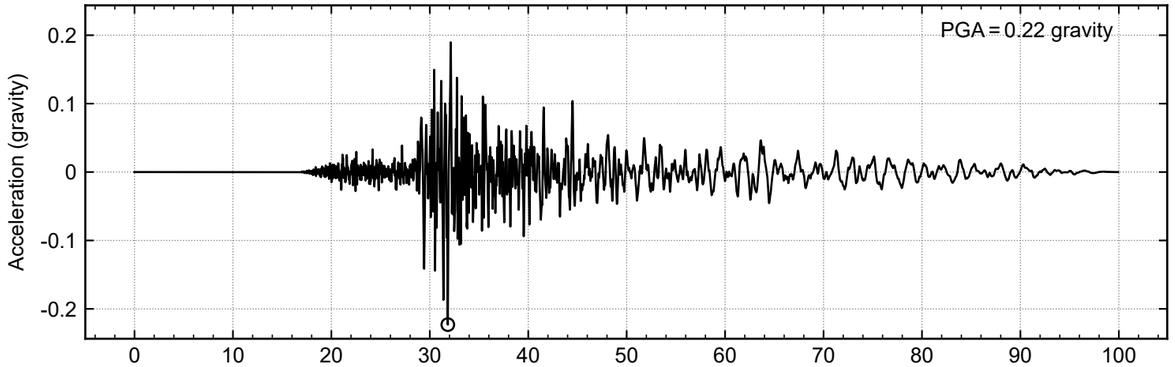

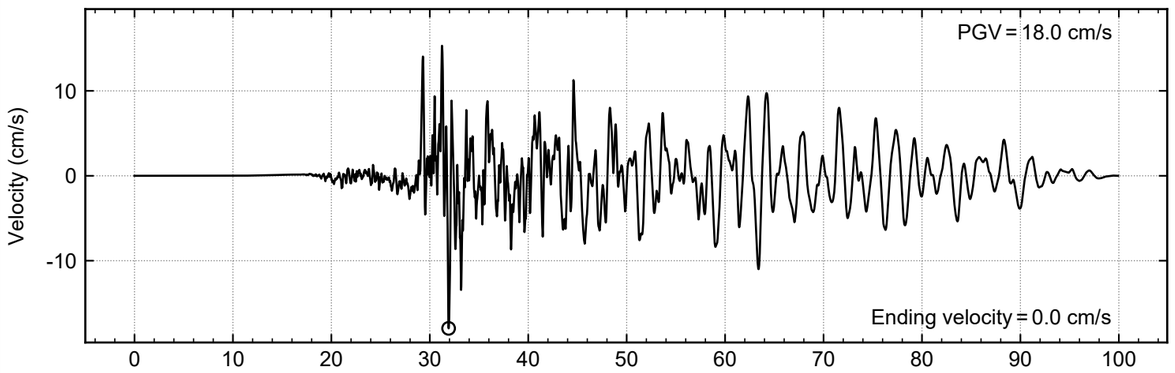

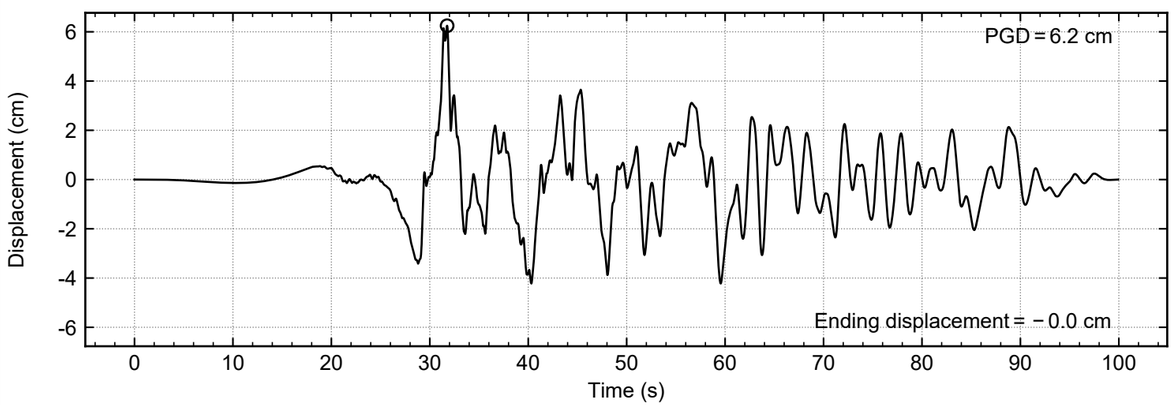

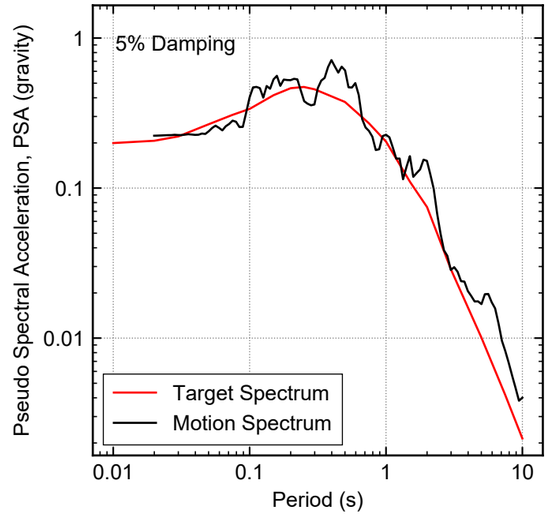

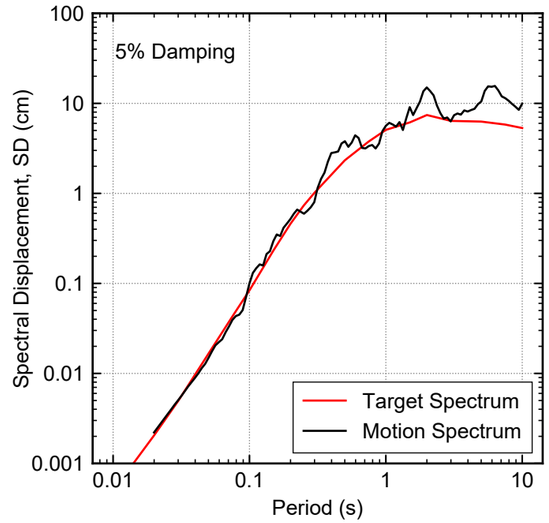

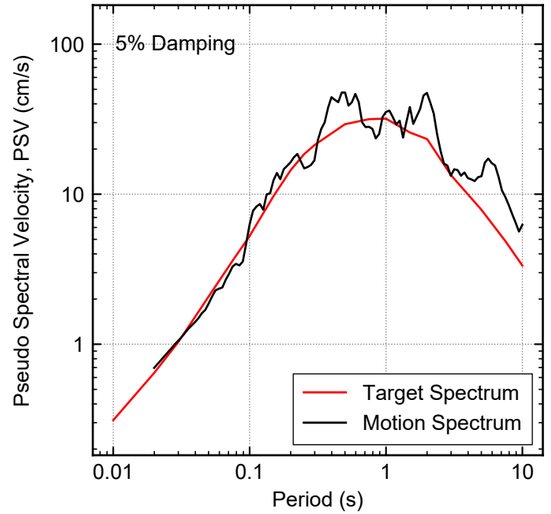

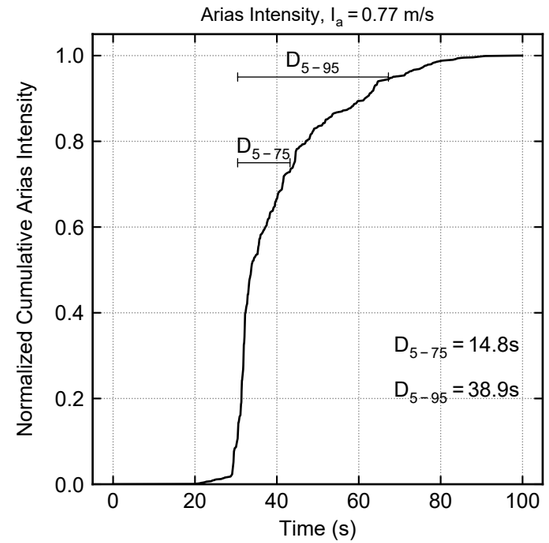

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 3.214 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

NISQUALLY, WA 2001
EARN, E
SCALED TIME HISTORY
1,000-YEAR INTRASLAB

November 2021 102636-007

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Geotechnical and Environmental Consultants

FIG. G-8

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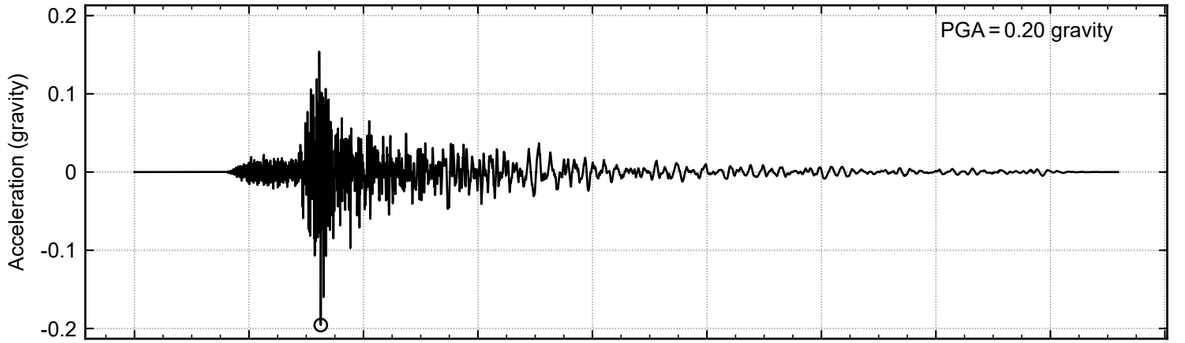

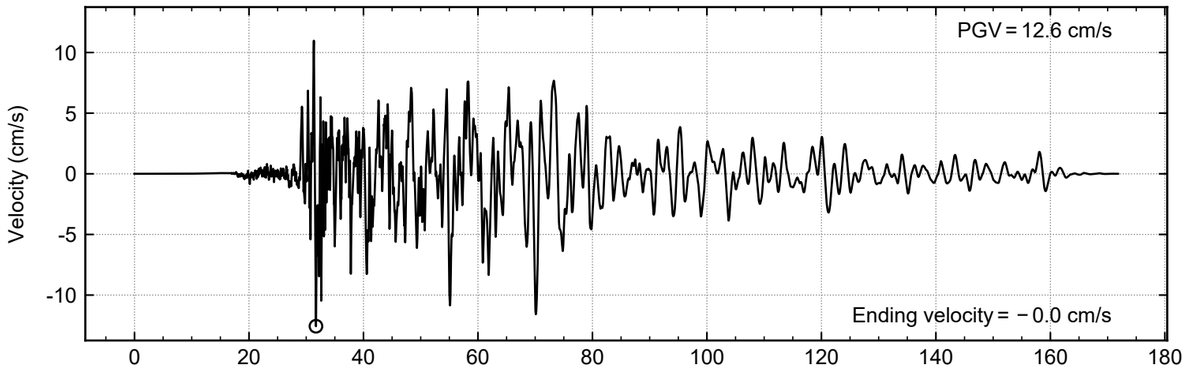

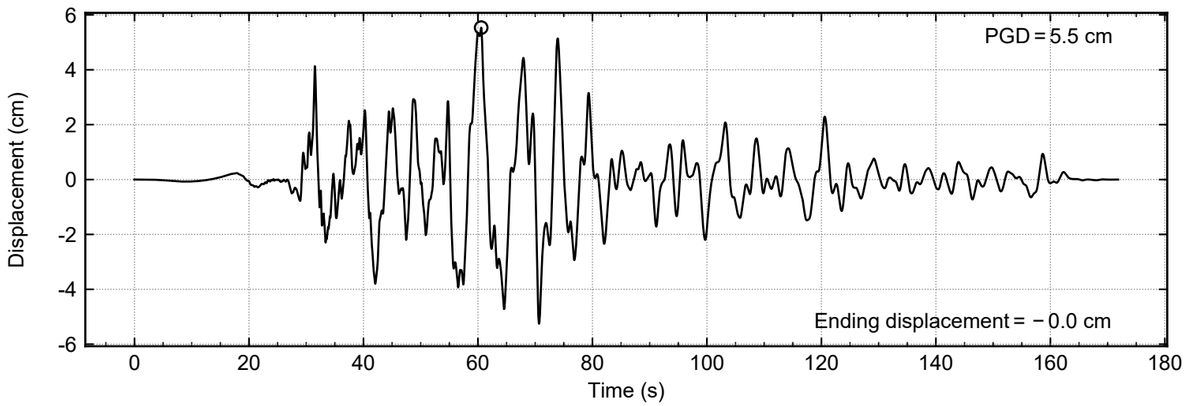

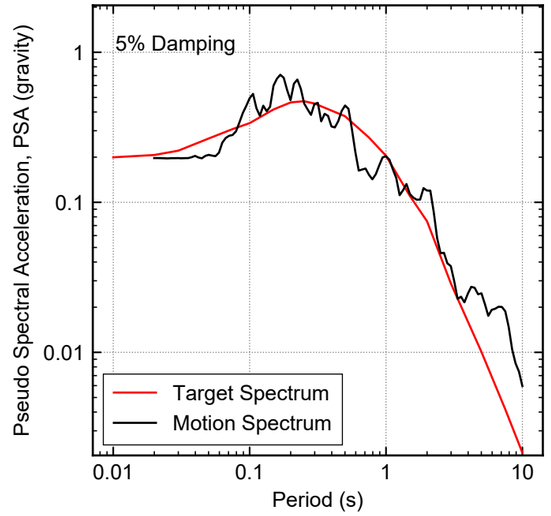

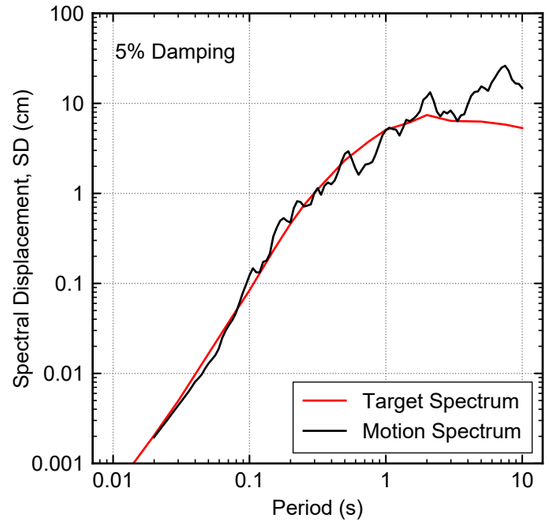

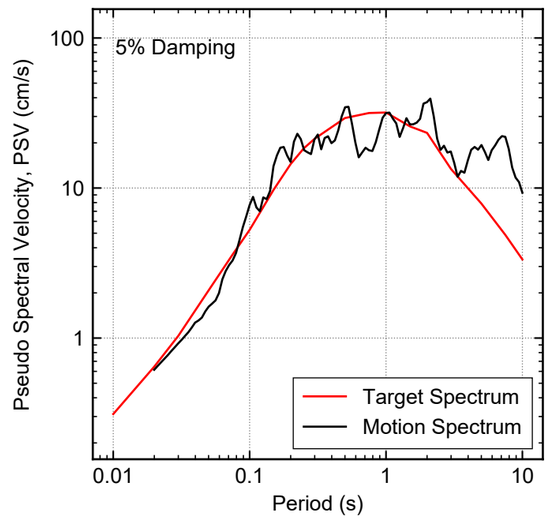

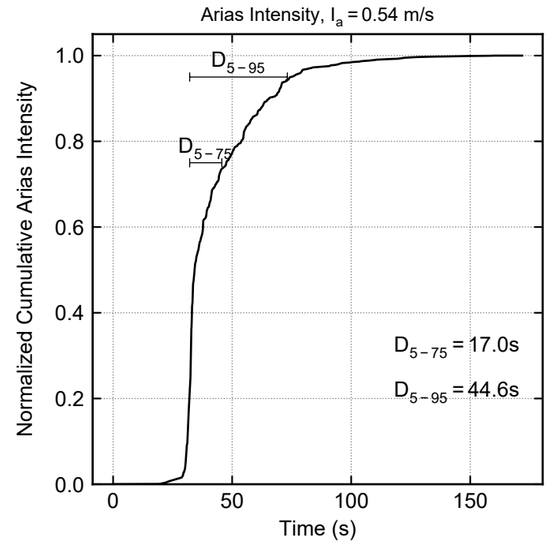

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 4.015 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

NISQUALLY, WA 2001
BEVT, E
SCALED TIME HISTORY
1,000-YEAR INTRASLAB

November 2021 102636-007

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Geotechnical and Environmental Consultants

FIG. G-9

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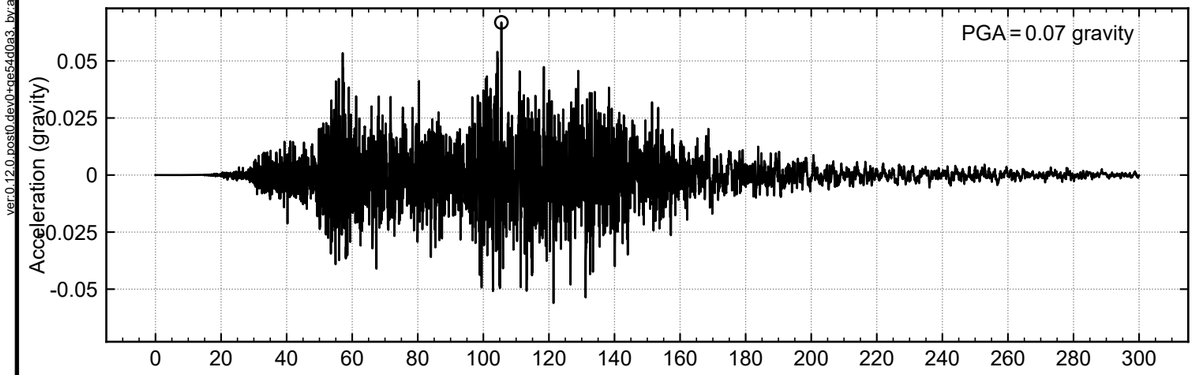

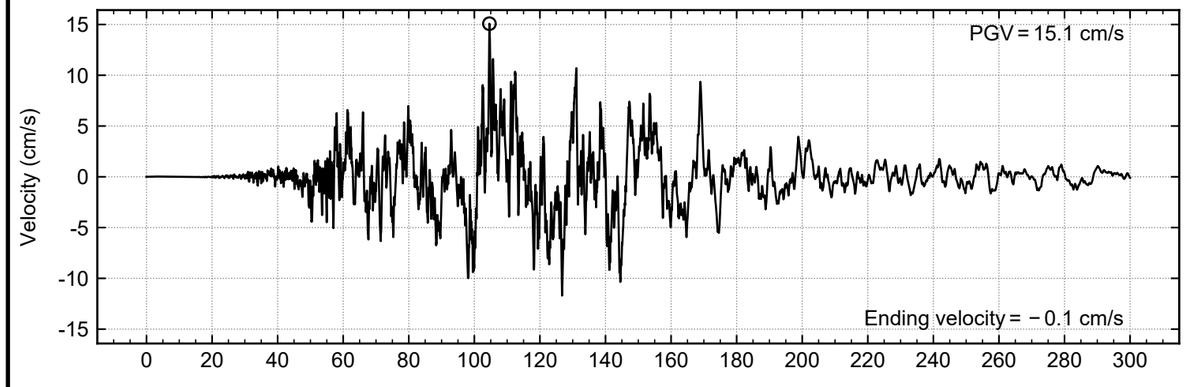

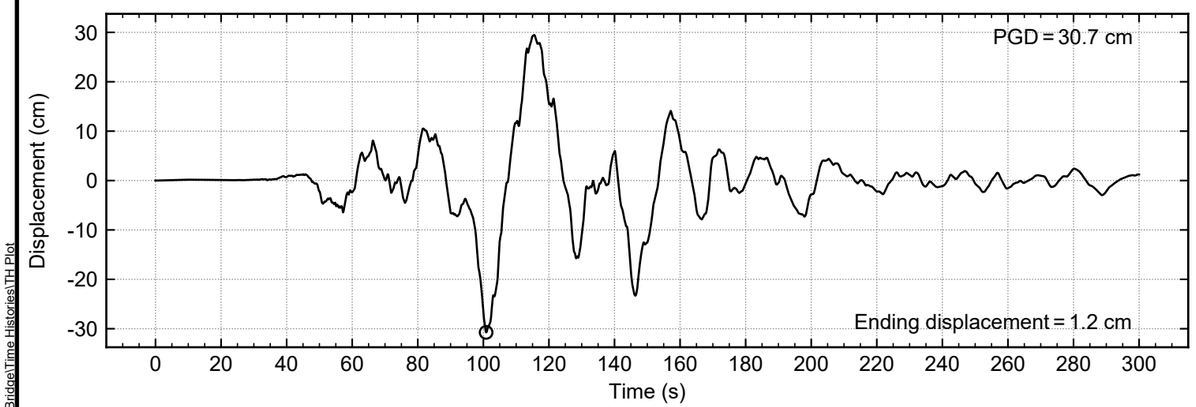

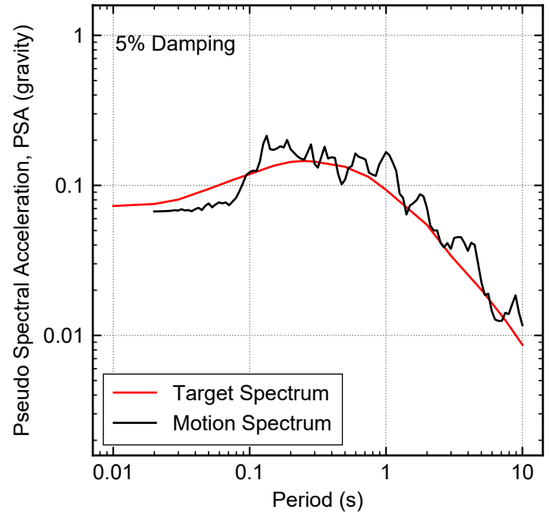

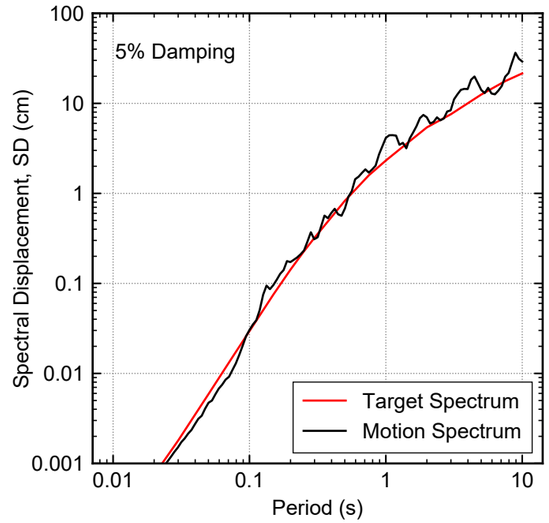

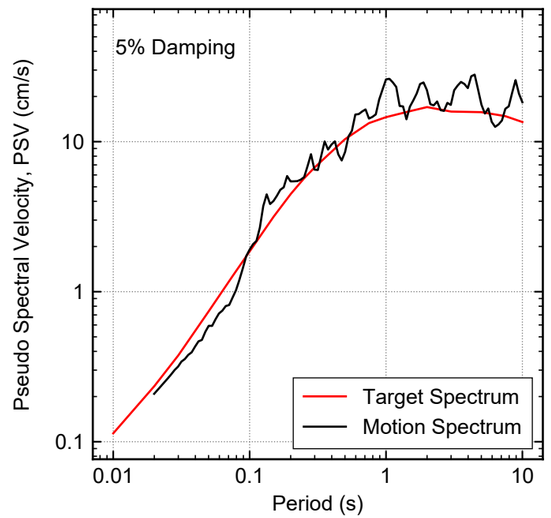

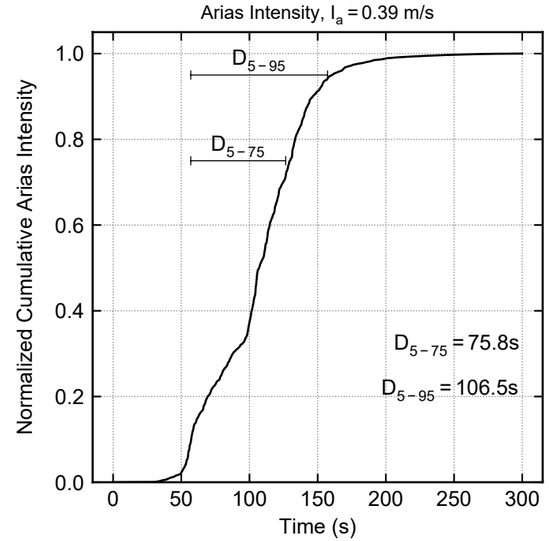

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 2.368 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

TOHOKU, JAPAN 2011
OGUNI, NS
SCALED TIME HISTORY
DETERMINISTIC INTERFACE

November 2021 102636-007

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FIG. G-10

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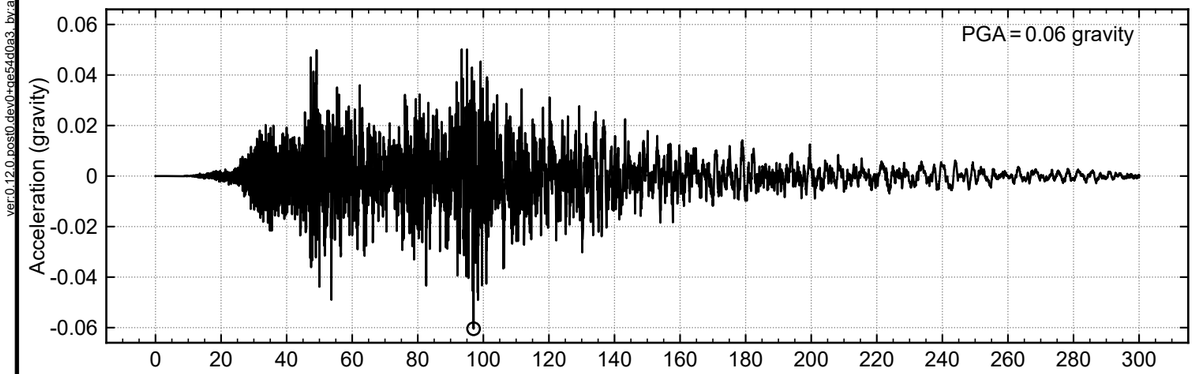

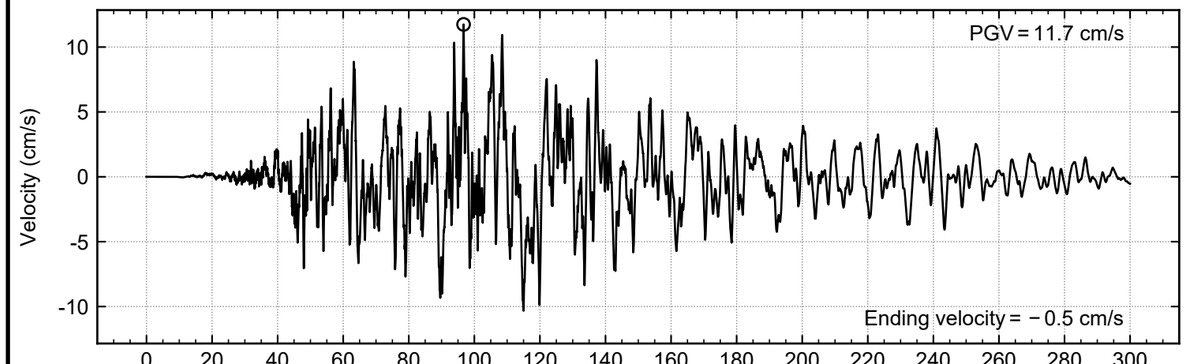

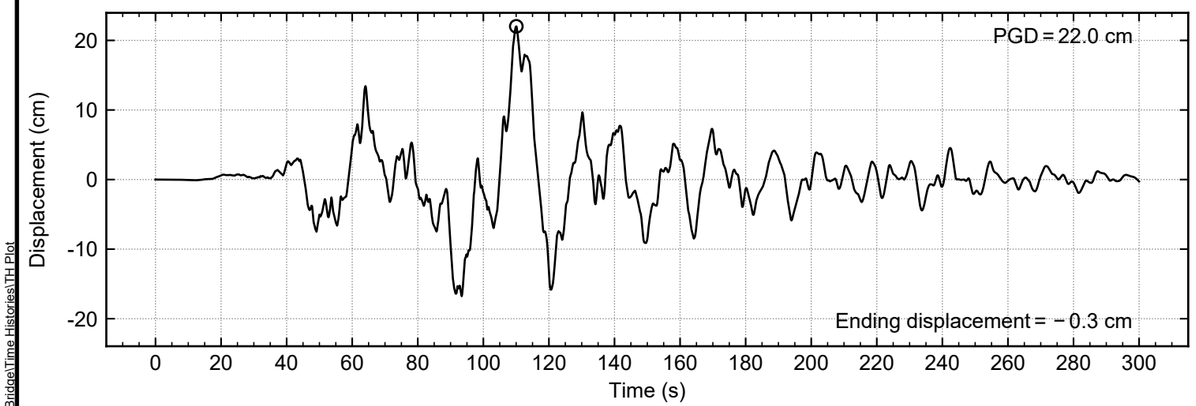

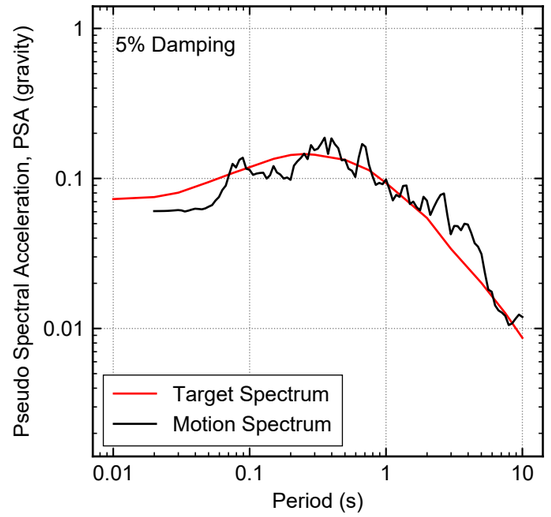

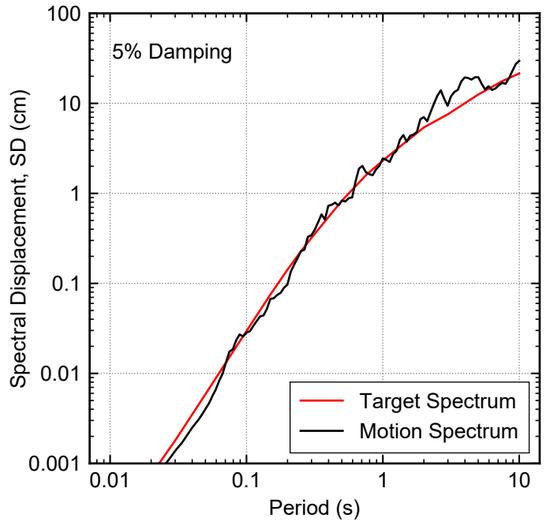

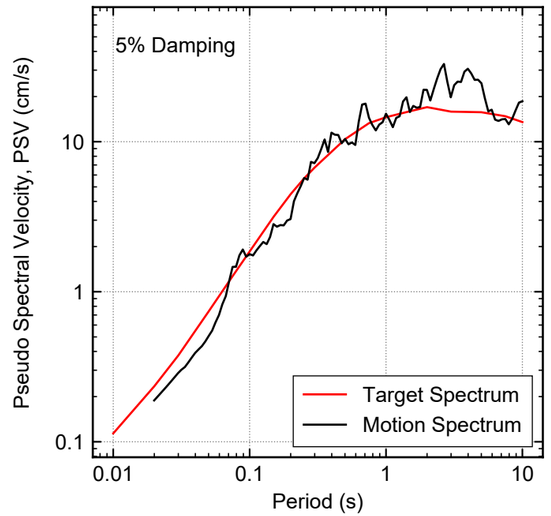

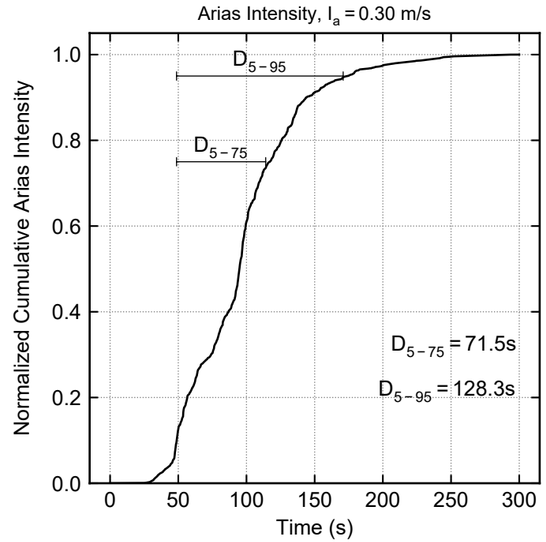

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 1.185 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

TOHOKU, JAPAN 2011
YOKOTE, EW
SCALED TIME HISTORY
DETERMINISTIC INTERFACE

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FIG. G-11

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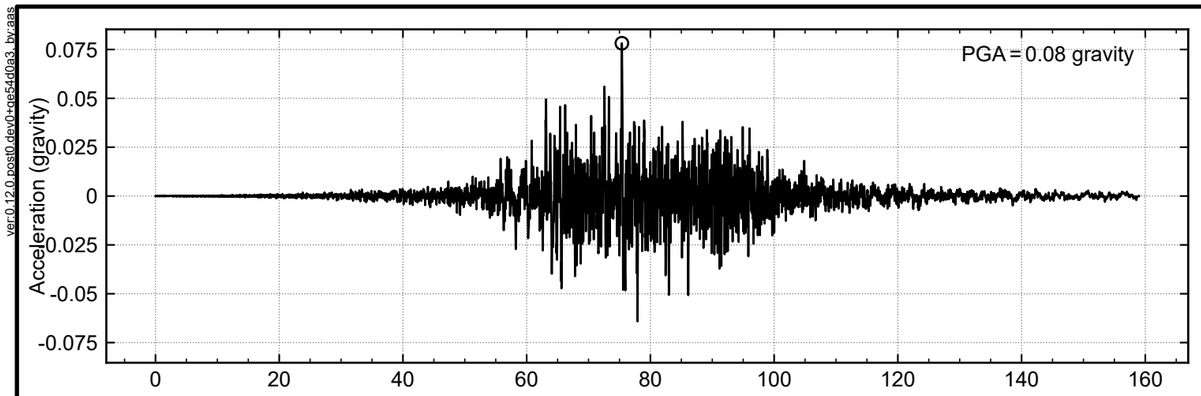

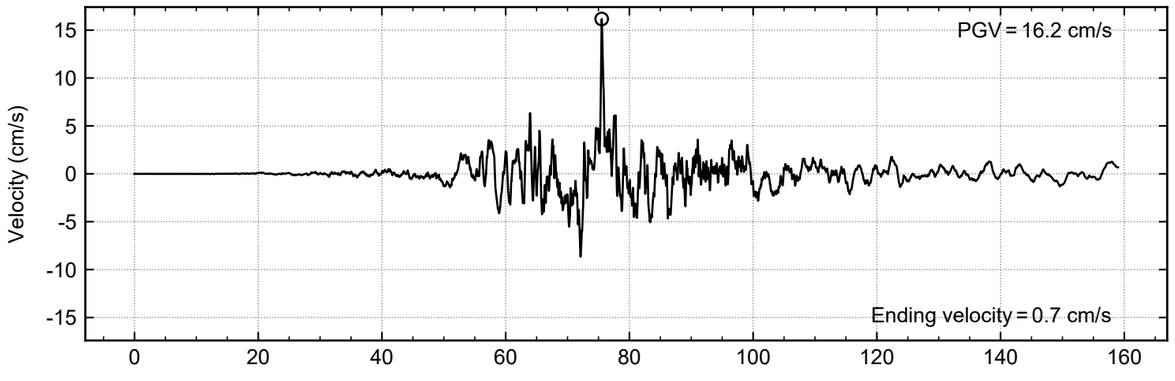

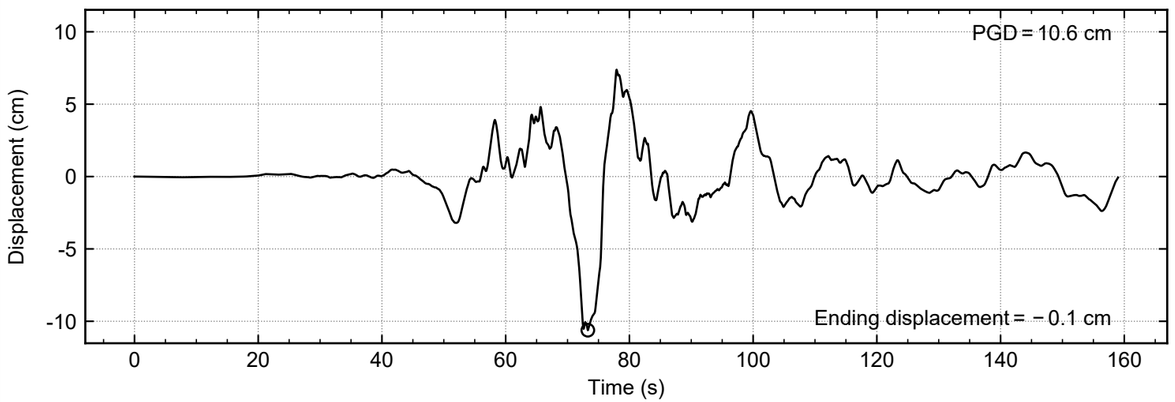

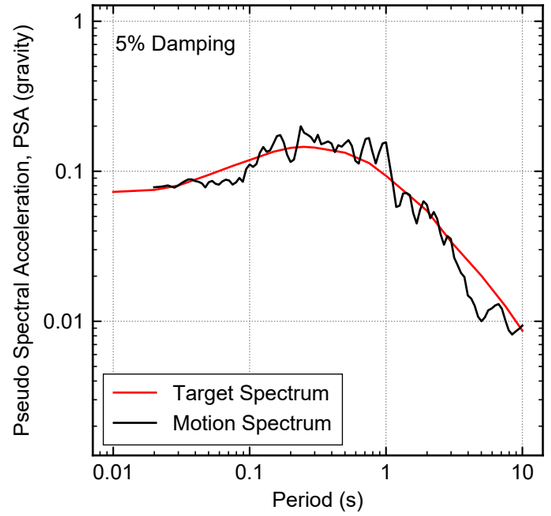

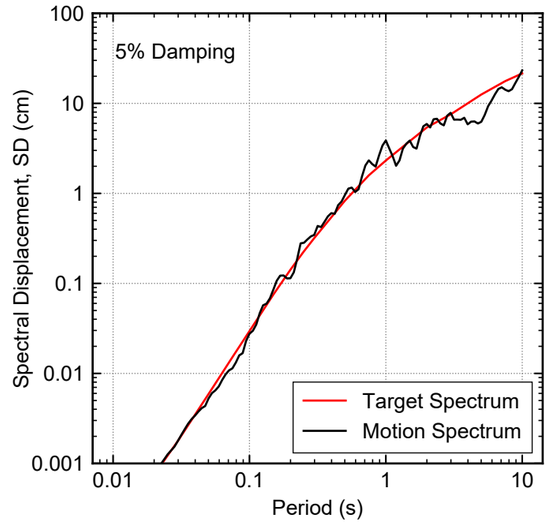

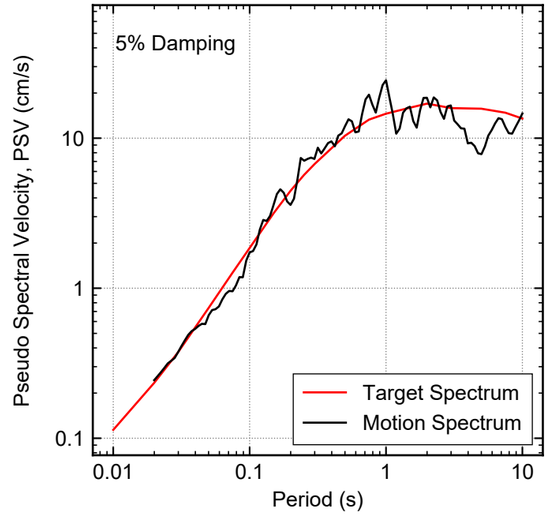

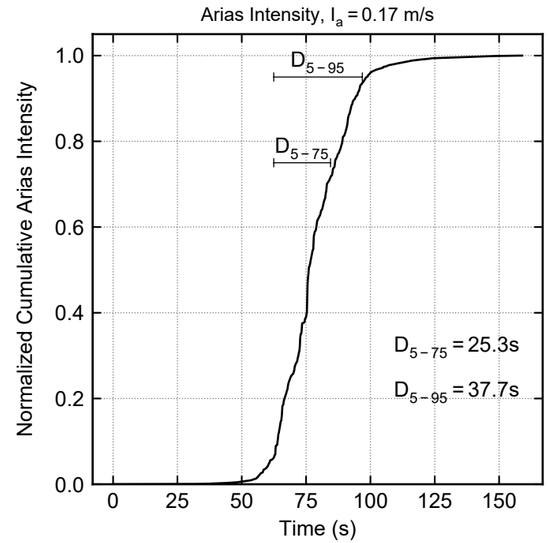

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 0.244 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

MAULE, CHILE 2010
SLUC, 90°
SCALED TIME HISTORY
DETERMINISTIC INTERFACE

November 2021 102636-007

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Geotechnical and Environmental Consultants

FIG. G-12

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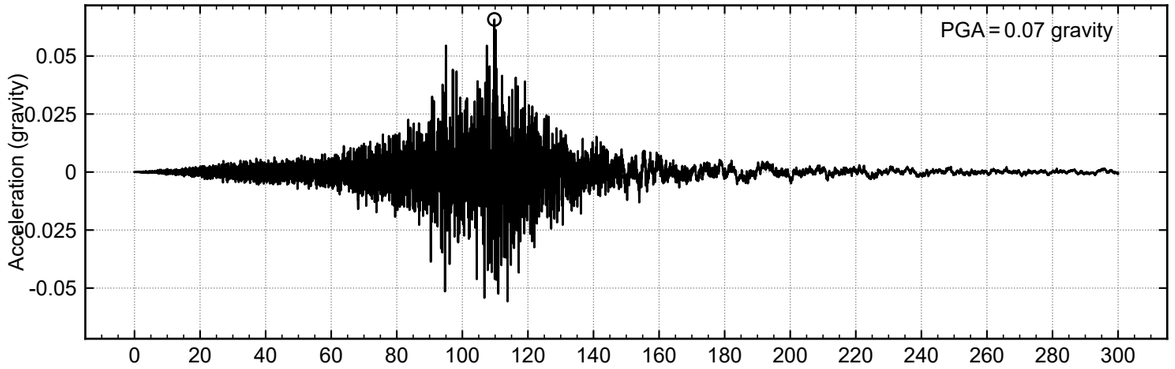

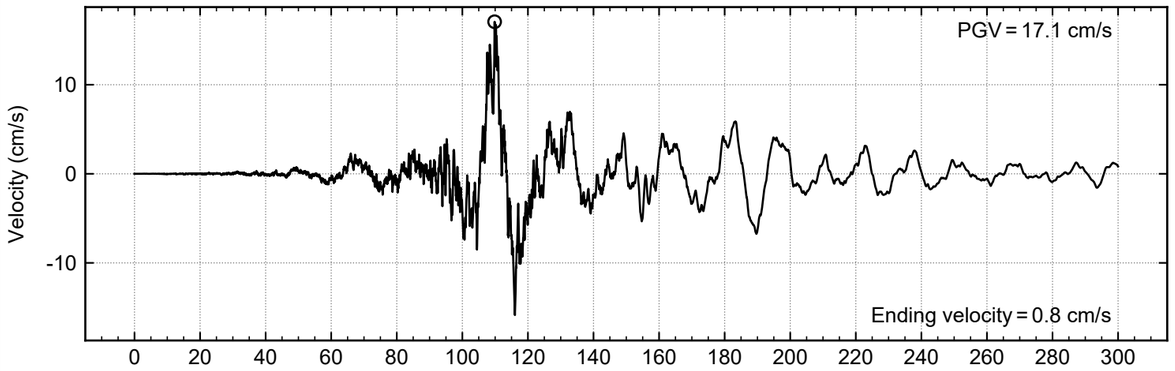

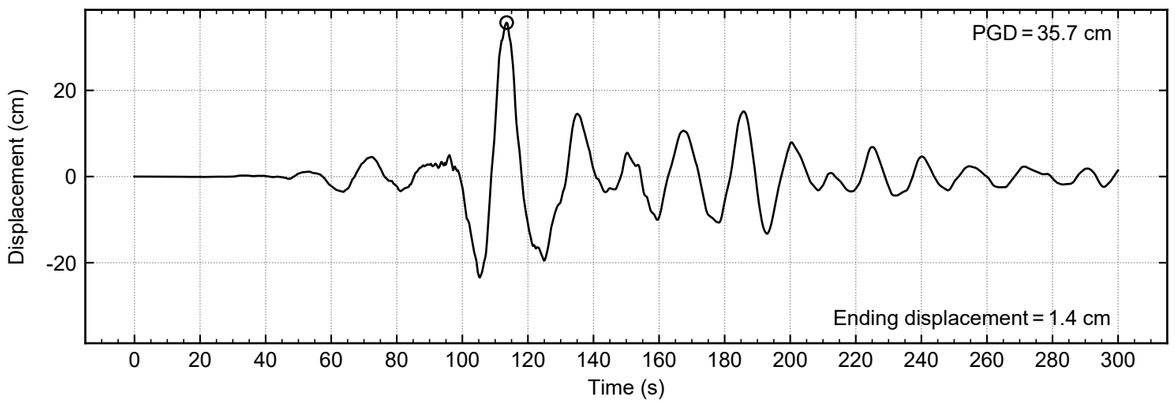

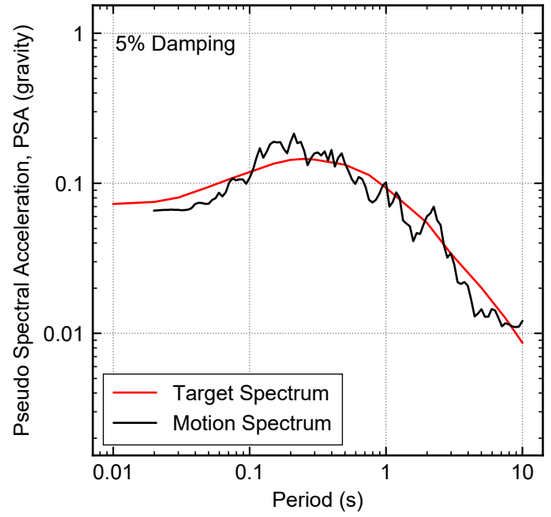

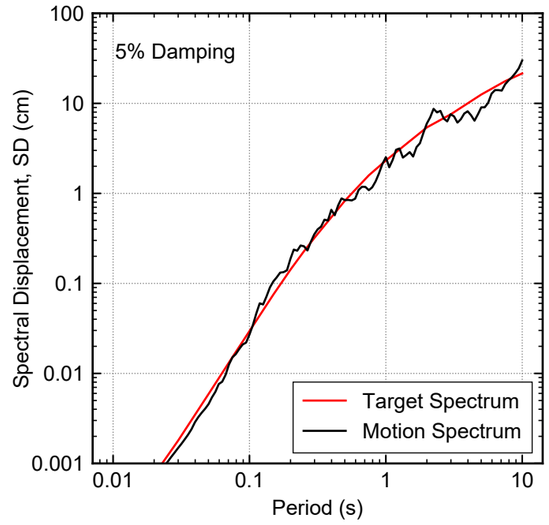

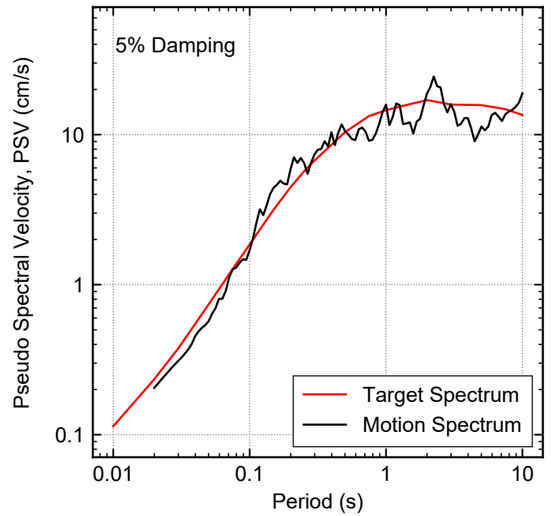

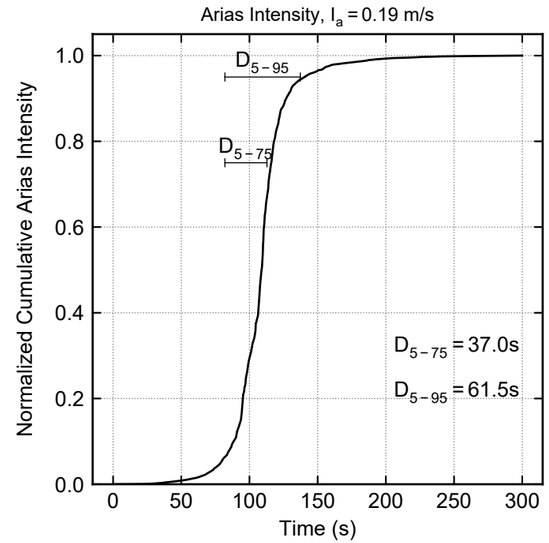

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 2.204 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

MAULE, CHILE 2010
VICH, 360°
SCALED TIME HISTORY
DETERMINISTIC INTERFACE

November 2021 102636-007

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Geotechnical and Environmental Consultants

FIG. G-13

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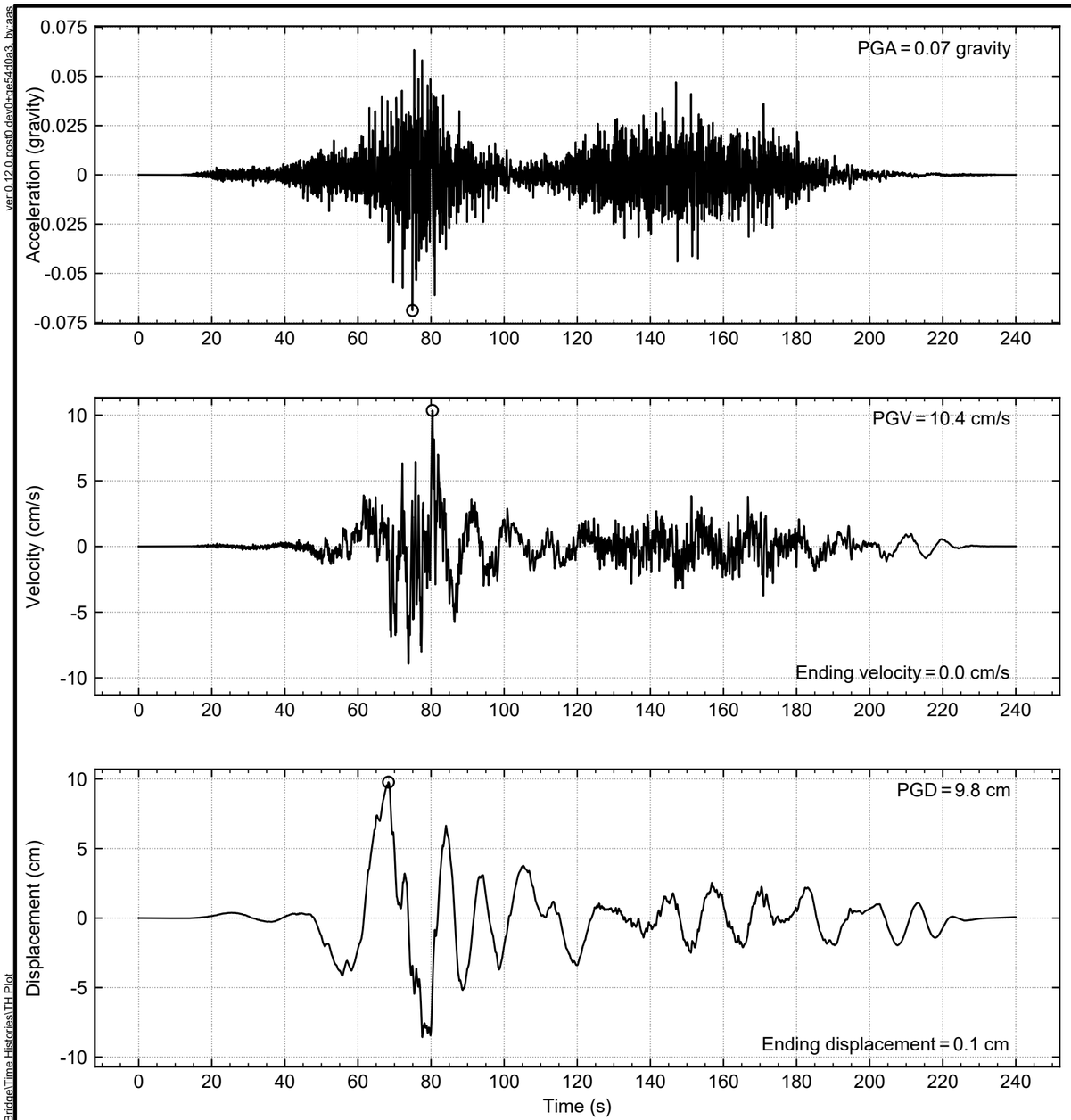

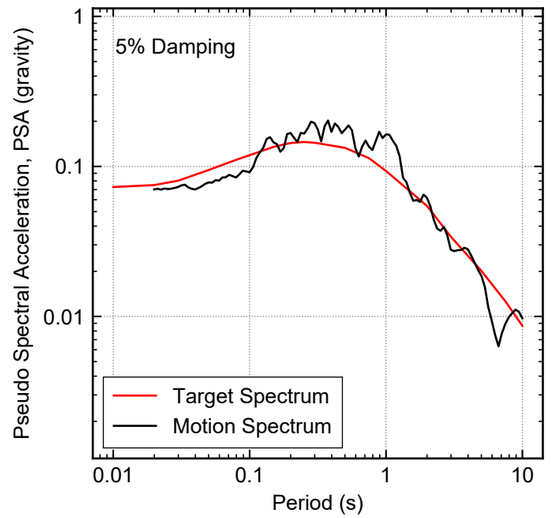

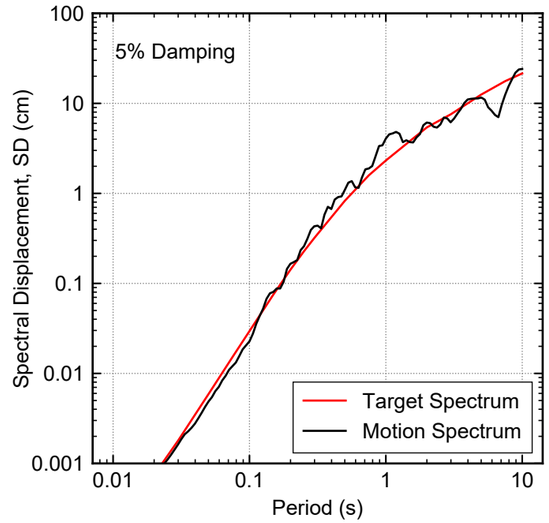

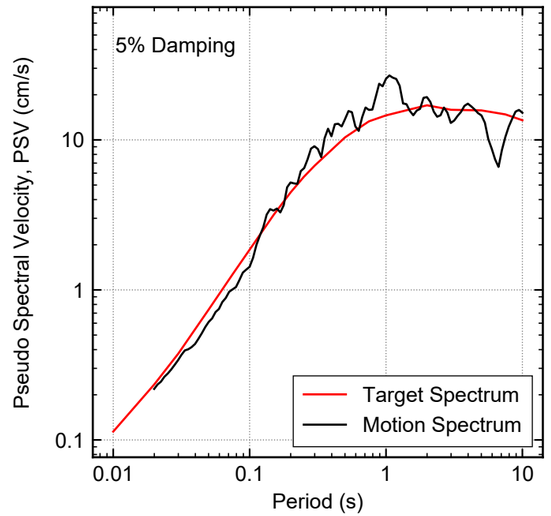

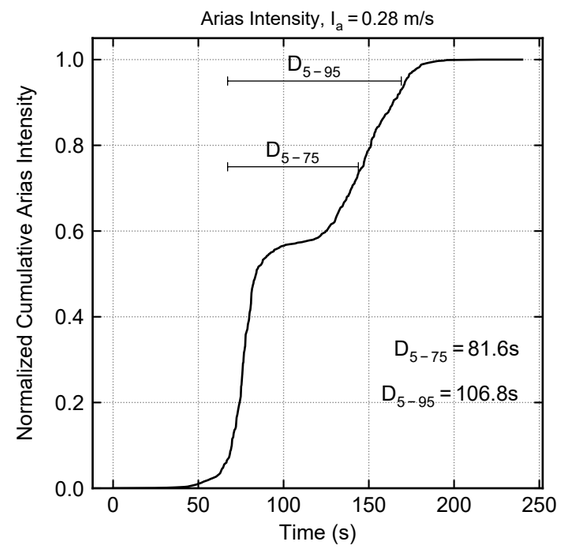

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 0.388 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

M9 PROJECT 2019
BURNSIDE BRIDGE 005, EW
SCALED TIME HISTORY
DETERMINISTIC INTERFACE

November 2021 102636-007

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Geotechnical and Environmental Consultants

FIG. G-14

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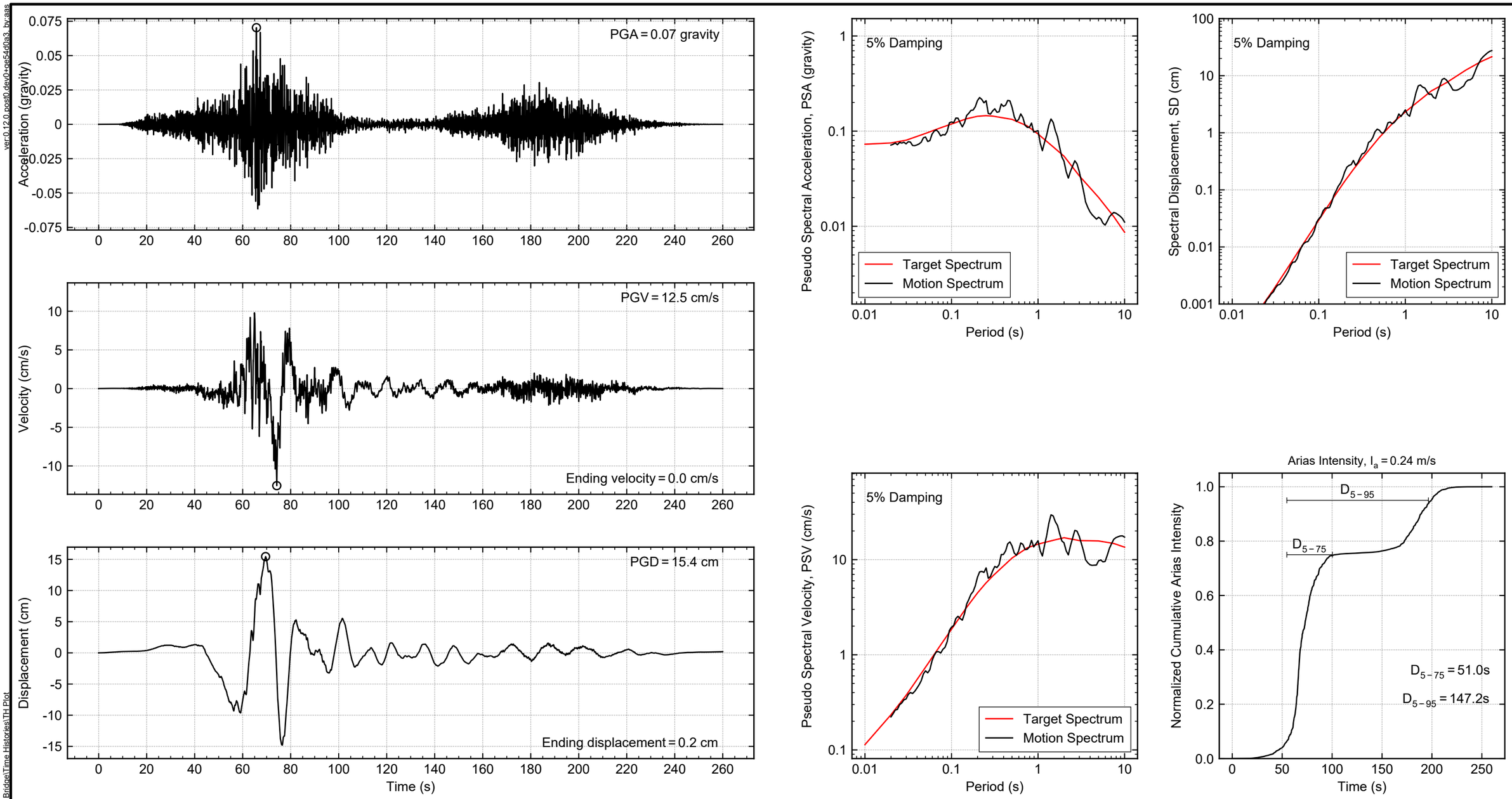

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 0.437 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

M9 PROJECT 2019
BURNSIDE BRIDGE 018, EW
SCALED TIME HISTORY
DETERMINISTIC INTERFACE

November 2021 102636-007

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FIG. G-15

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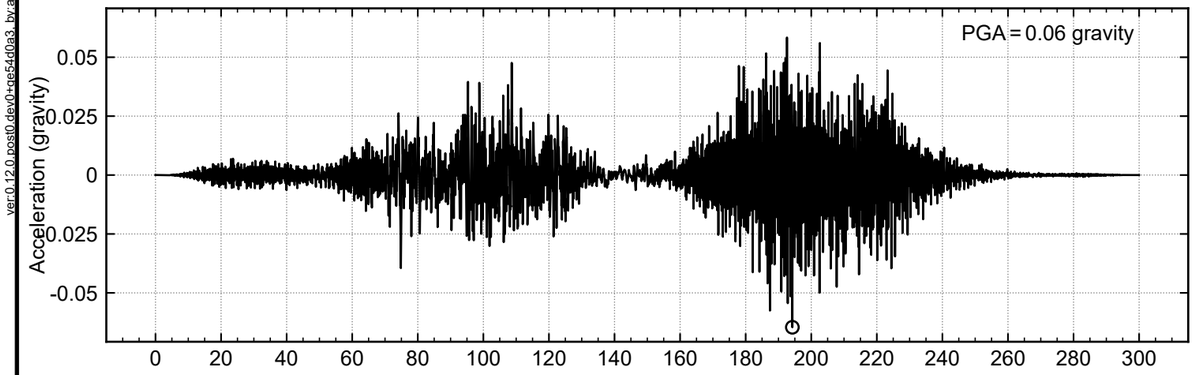

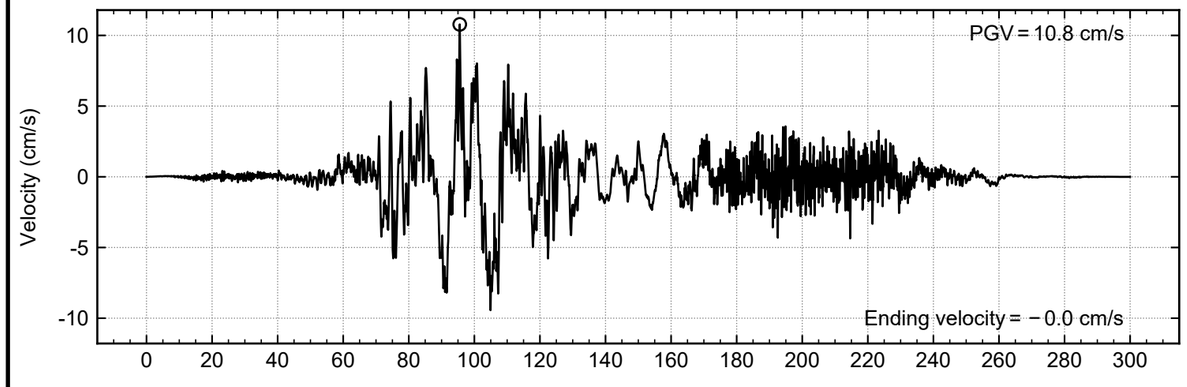

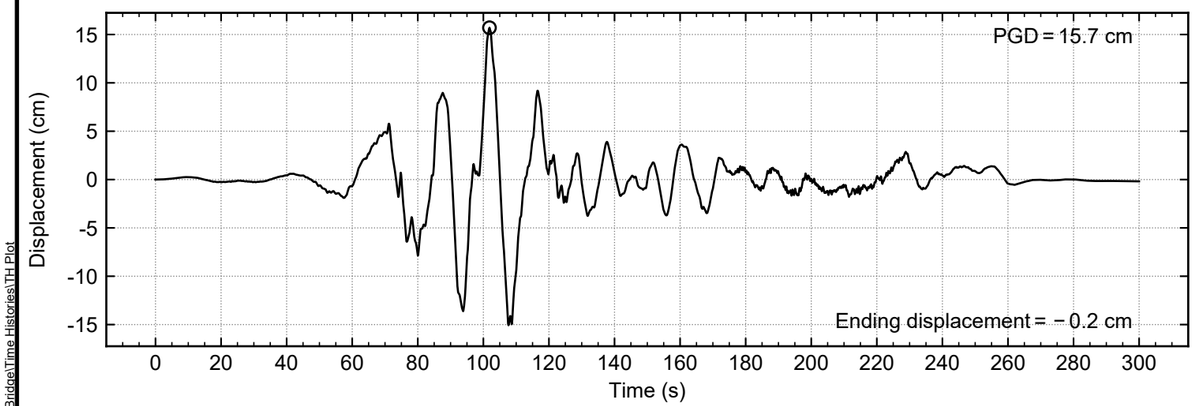

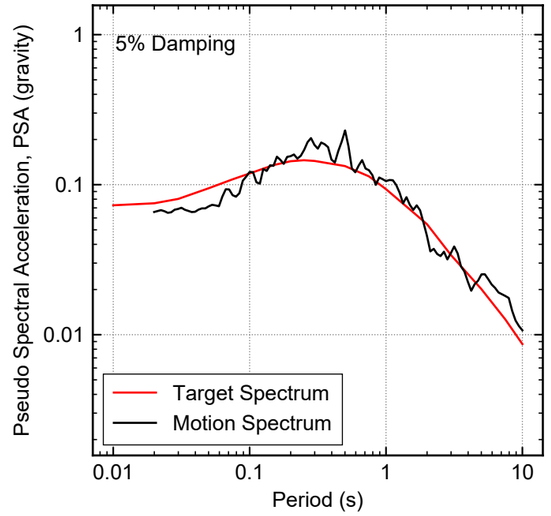

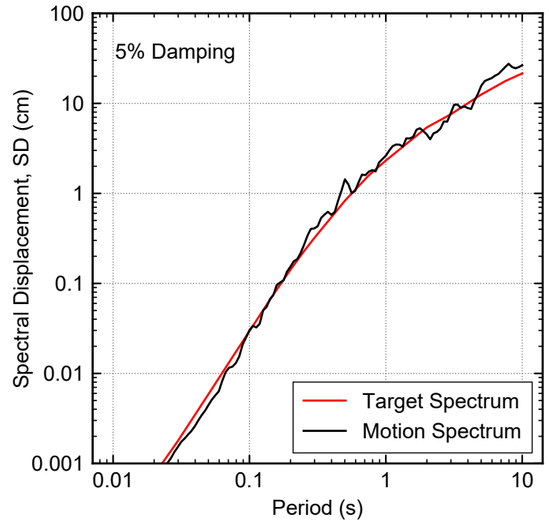

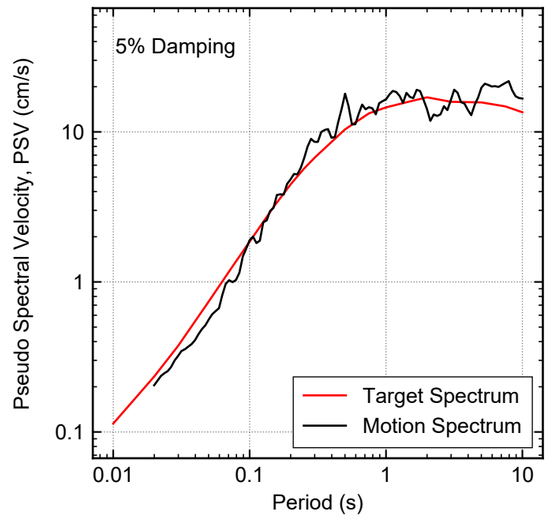

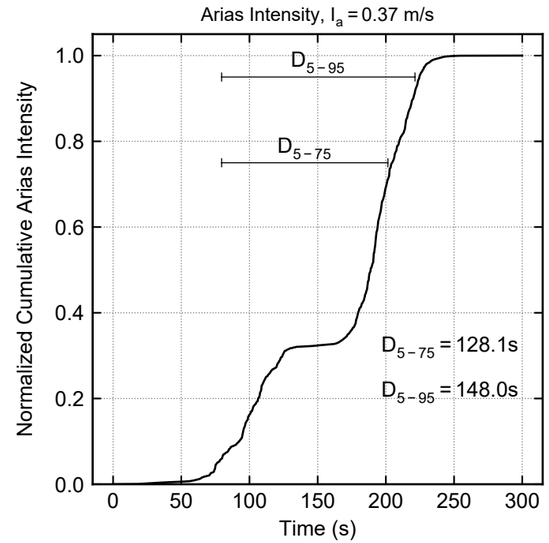

Notes:
1. PGA = peak ground acceleration; PGV = peak ground velocity; PGD = peak ground displacement
2. m/sec = meters per second
3. cm = centimeters
4. cm/s = centimeters per second
5. s = seconds
6. g = standard gravitational acceleration
7. D_{5-75} = significant duration from 5 to 75 percent of normalized cumulative Arias intensity
8. D_{5-95} = significant duration from 5 to 95 percent of normalized cumulative Arias intensity
9. Response spectra calculated using a linear interpolation of the acceleration ground motion
10. A scale factor of 0.553 was applied to the time history.

Earthquake Ready Burnside Bridge
Portland, Oregon

M9 PROJECT 2019
BURNSIDE BRIDGE 024, EW
SCALED TIME HISTORY
DETERMINISTIC INTERFACE

November 2021 102636-007

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Geotechnical and Environmental Consultants

FIG. G-16

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APPENDIX H: FLAC RESULTS

Appendix H

FLAC Results

CONTENTS

- FLAC input parameter summary plots
- Contour plots of permanent displacement, peak pore pressure ratio, and maximum shear strain
- Profile plots of permanent displacement, peak acceleration, peak shear strain, and peak excess pore pressure ratio
- Surface response spectrum and response spectral ratio summaries
- Tripartite response spectrum plots summarizing recommended design spectrum development
- Profile plots summarizing seismically induced settlement evaluations

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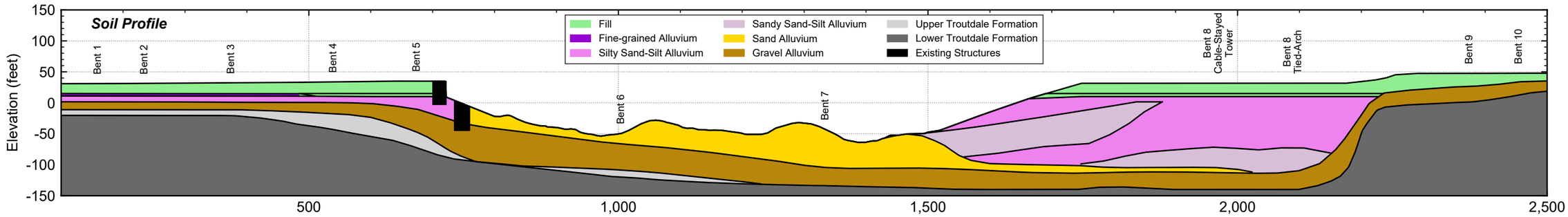

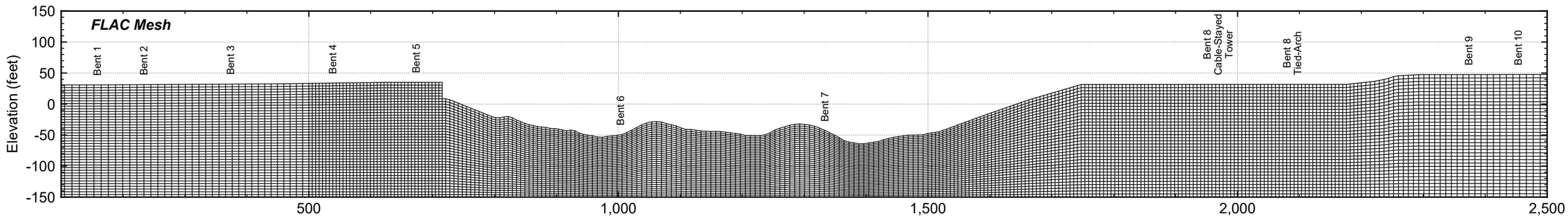

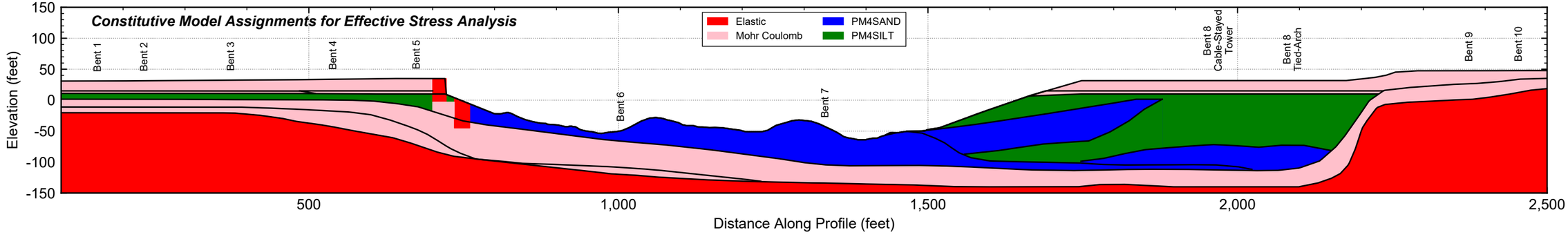

Earthquake Ready Burnside Bridge
Portland, Oregon

FLAC MODEL
SOIL LAYERING AND
MESH GEOMETRY

March 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-1

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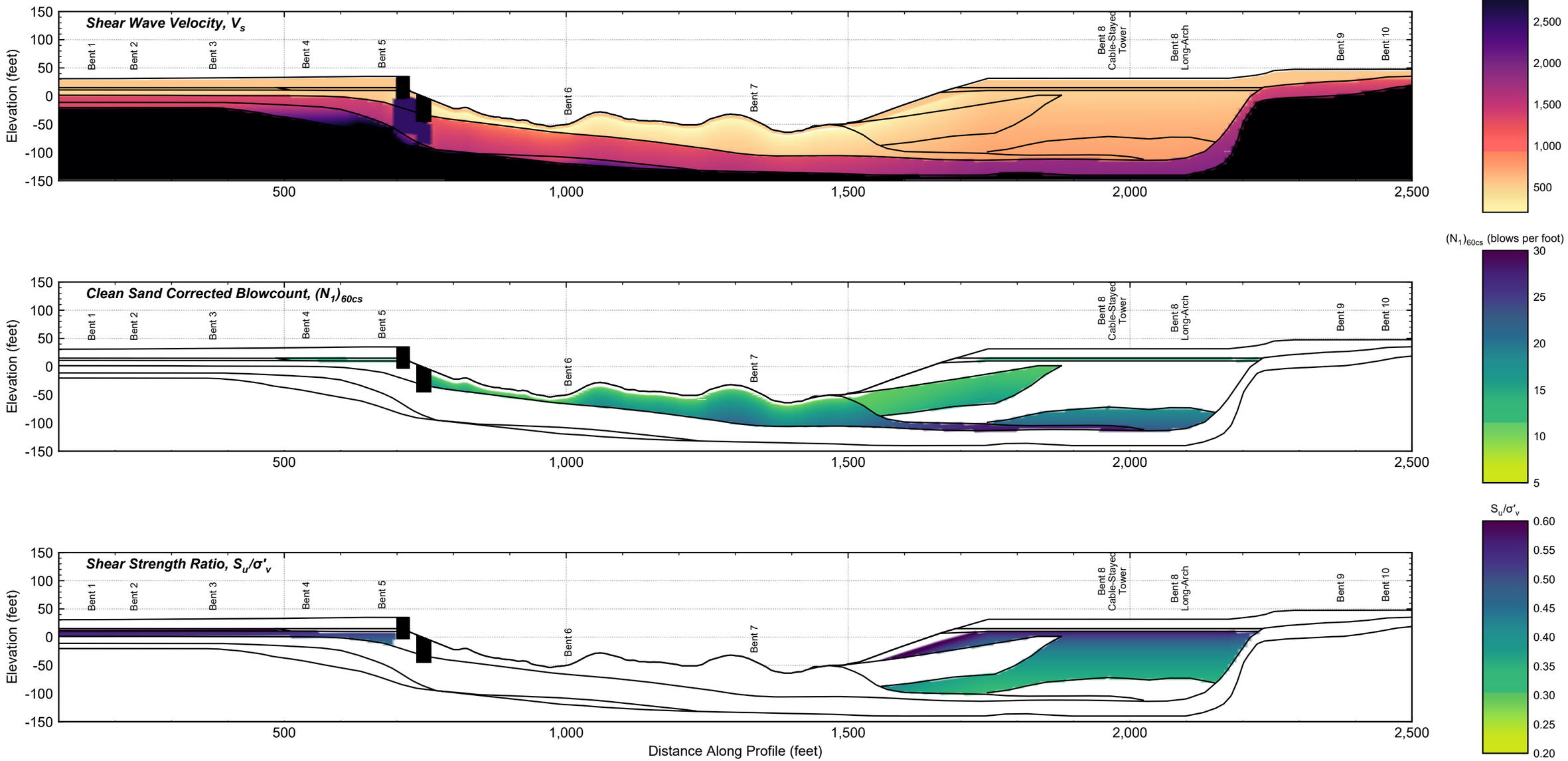

Earthquake Ready Burnside Bridge
Portland, Oregon

FLAC MODEL INPUTS
SHEAR WAVE VELOCITY
CORRECTED SPT BLOW COUNT
AND SHEAR STRENGTH RATIO

January 2022 102636-009

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FIG. H-2

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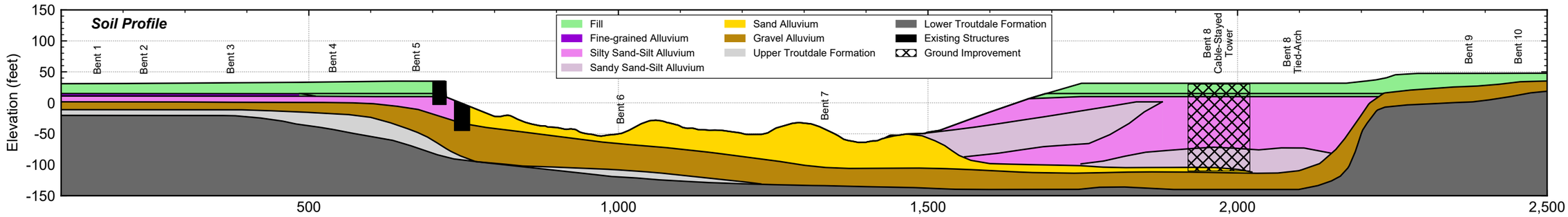

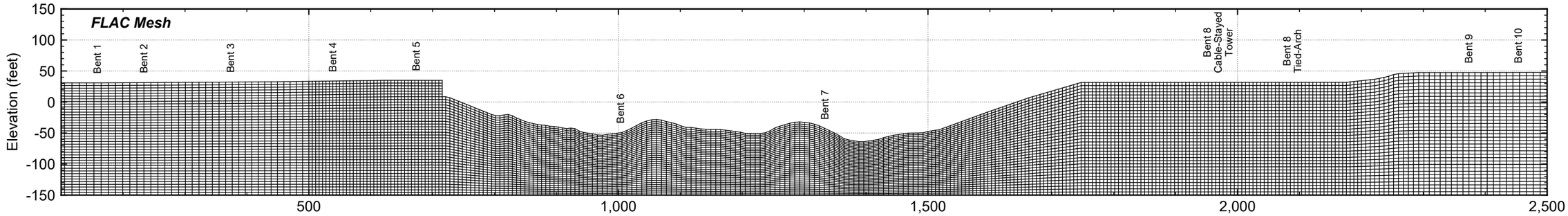

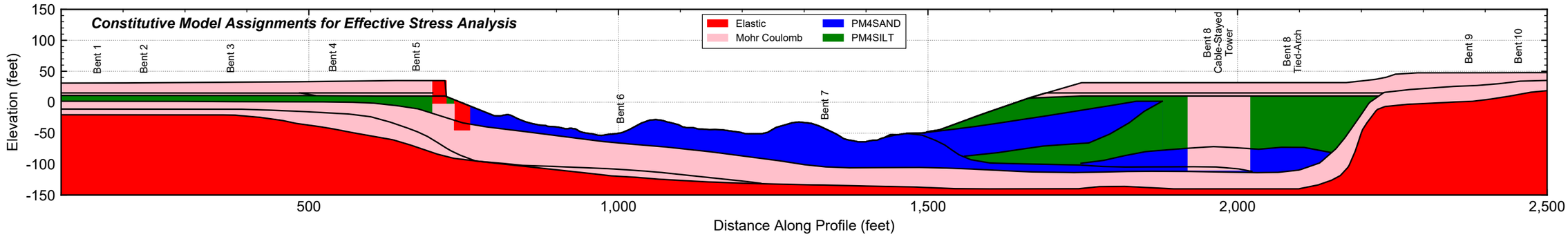

Earthquake Ready Burnside Bridge
Portland, Oregon

FLAC MODEL
SOIL LAYERING AND
MESH GEOMETRY
WITH GROUND IMPROVEMENT

March 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-3

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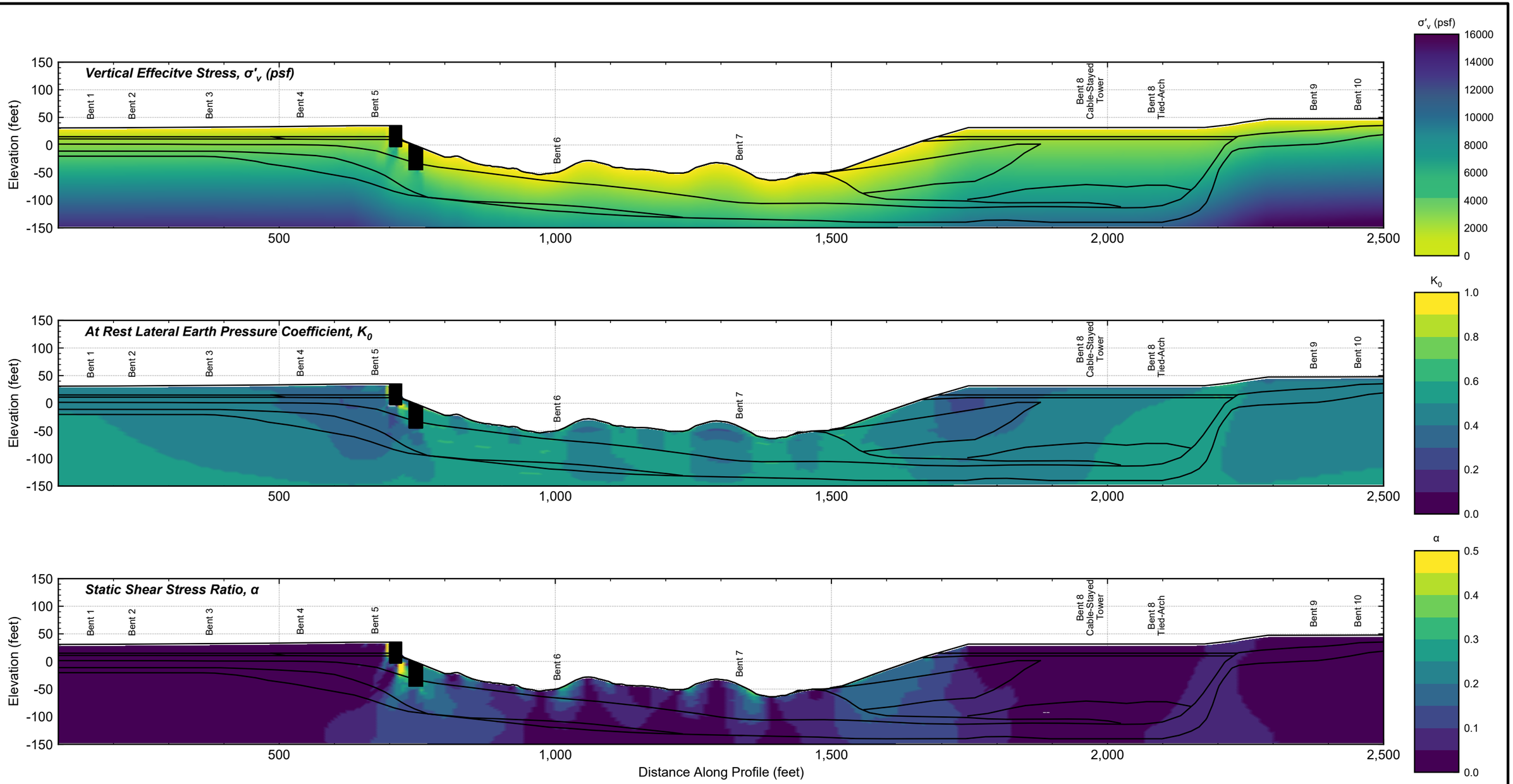

Earthquake Ready Burnside Bridge
Portland, Oregon

FLAC MODEL
STATIC STRESS STATE

March 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-4

I:\EF\PDX\102000s\102636 Burnside Bridge\Analysis\Site Response\NEPA Phase 2\FLAC\FLAC Input Summary

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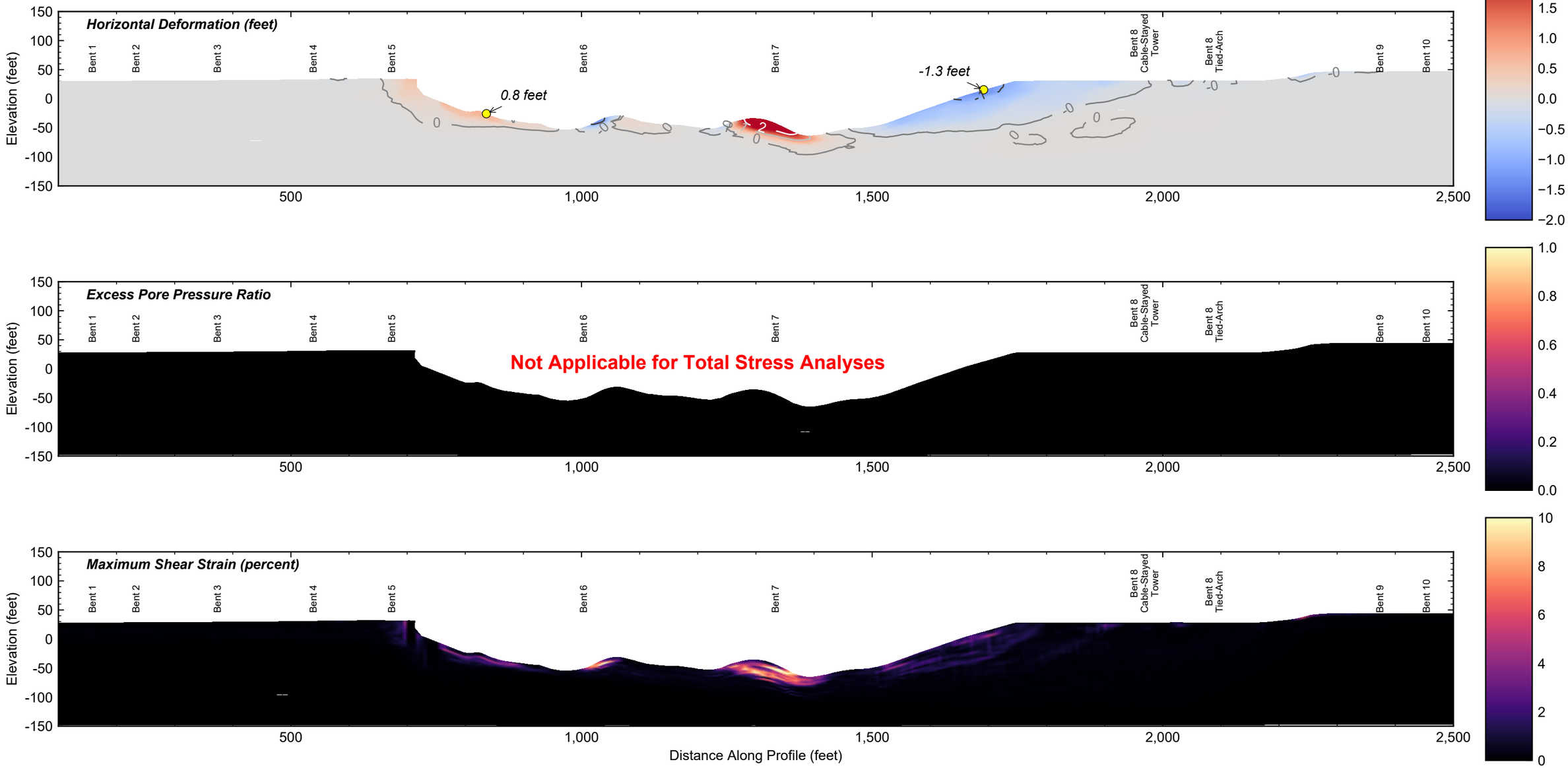
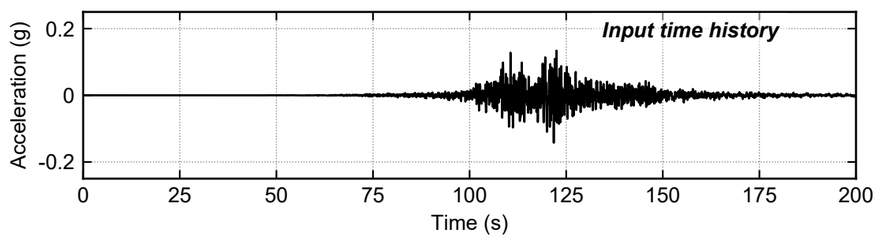


Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
MAULE - LA PLANTINA

April 2022 102636-009

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Geotechnical and Environmental Consultants

FIG. H-5

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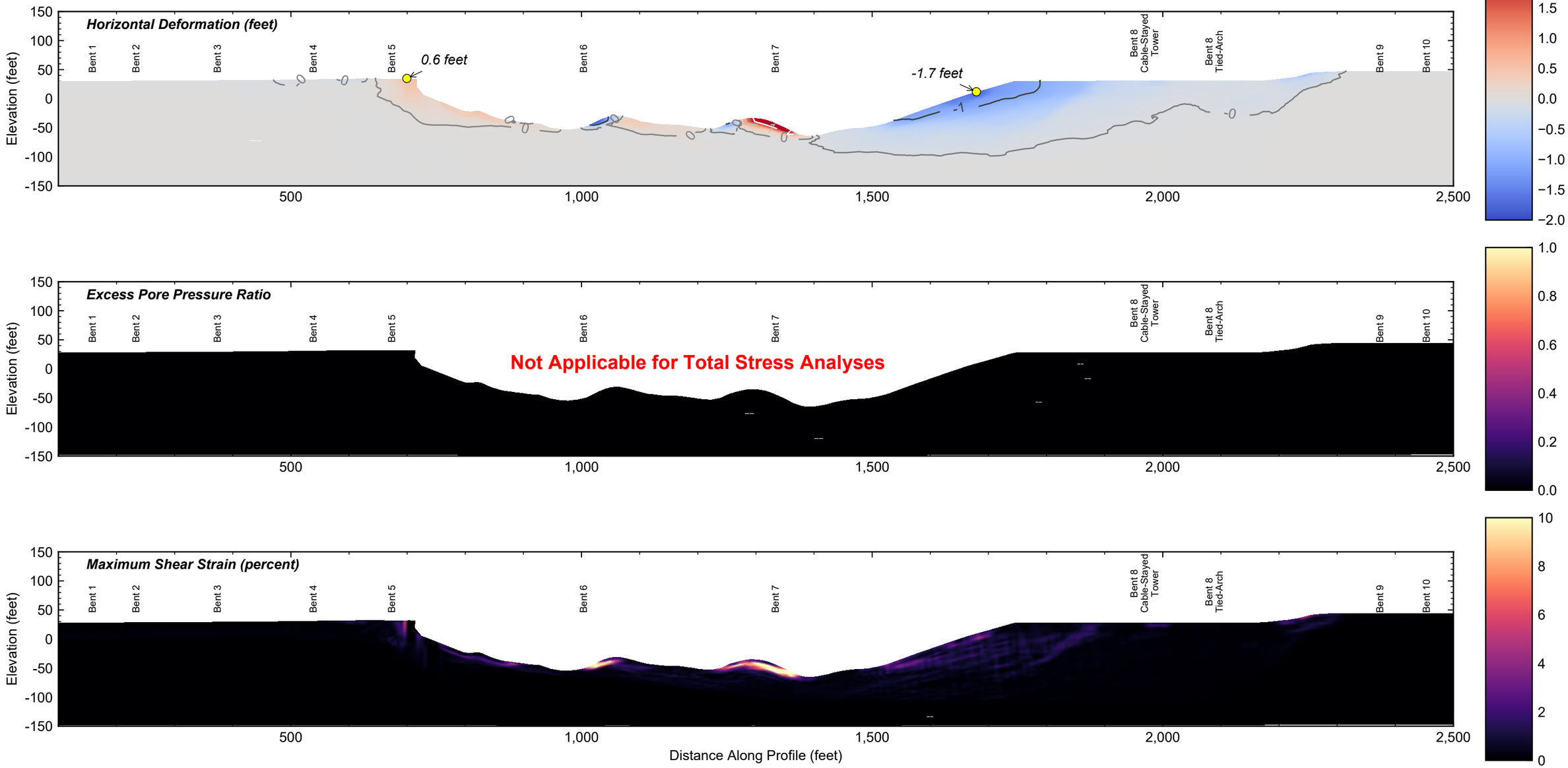
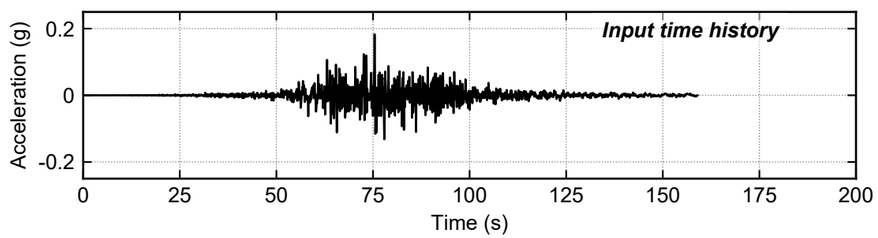


Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
MAULE - CERRO ST LUCIA

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-6

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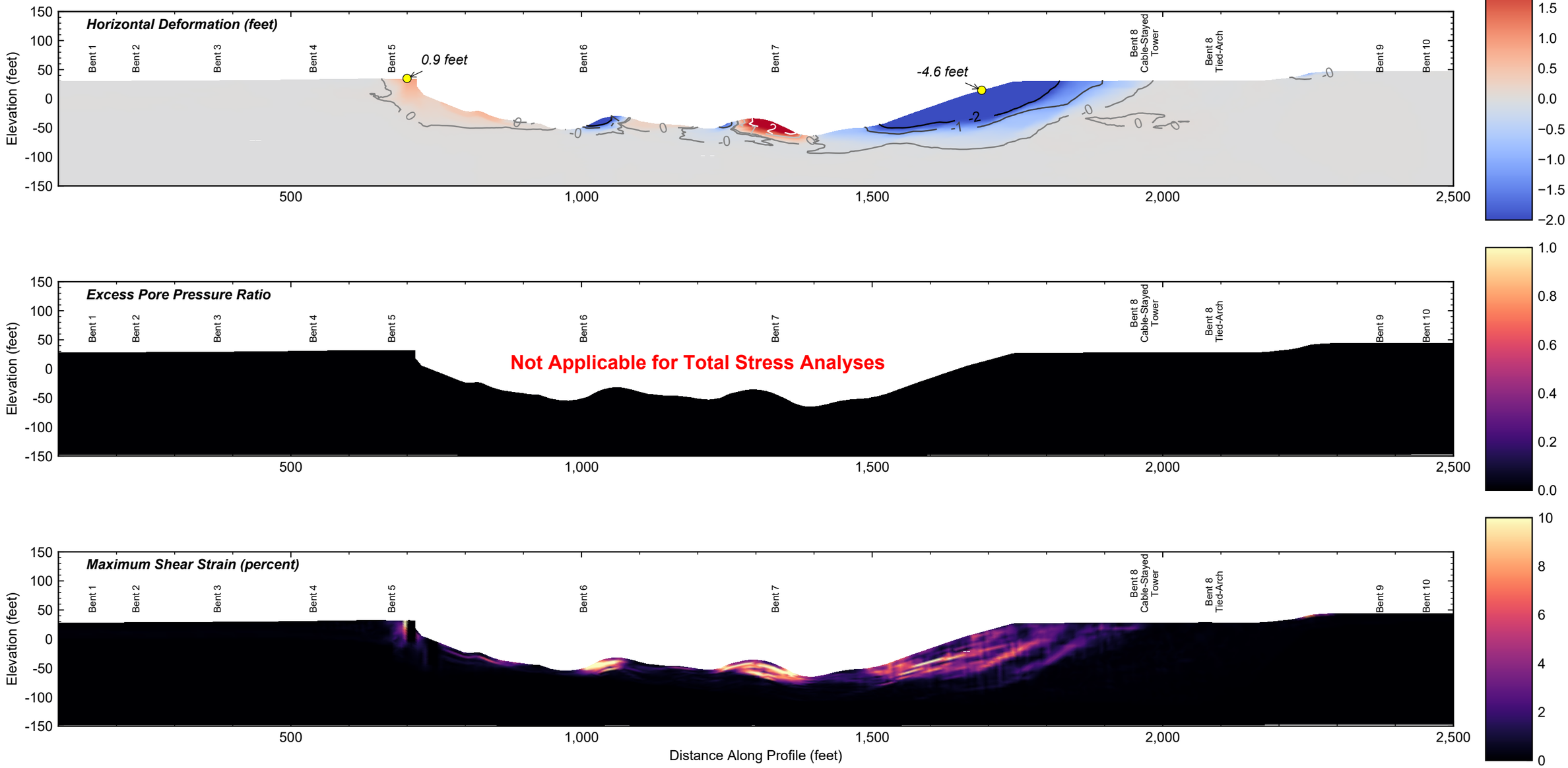
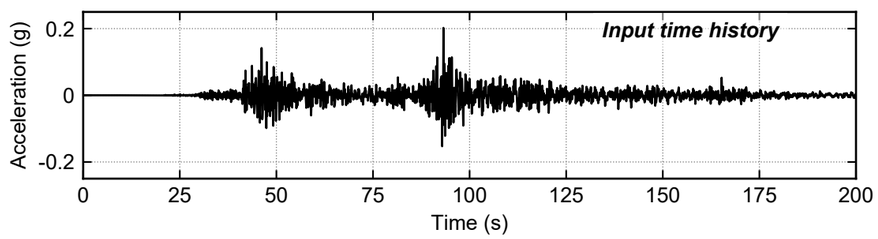


Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
TOHOKU - MYG009

April 2022 102636-009

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Geotechnical and Environmental Consultants

FIG. H-7

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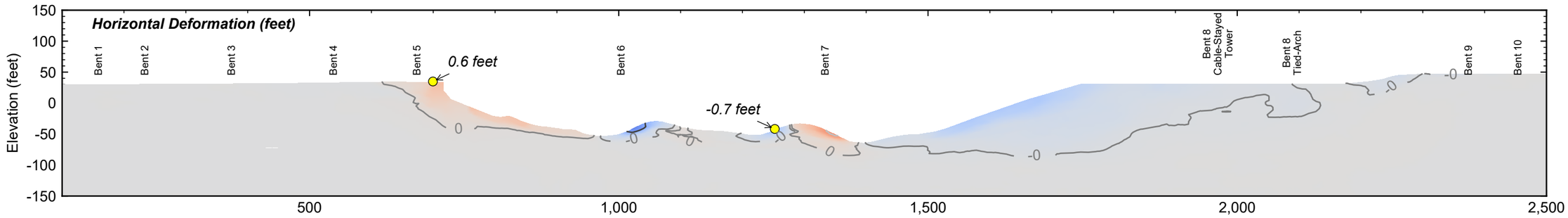
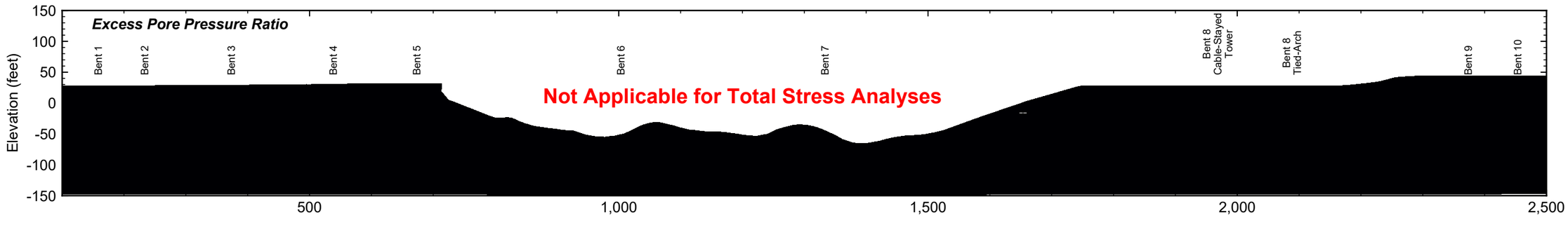
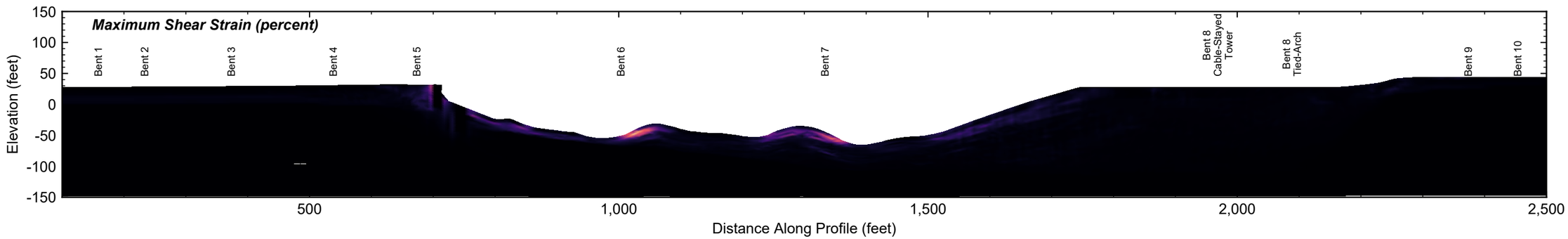
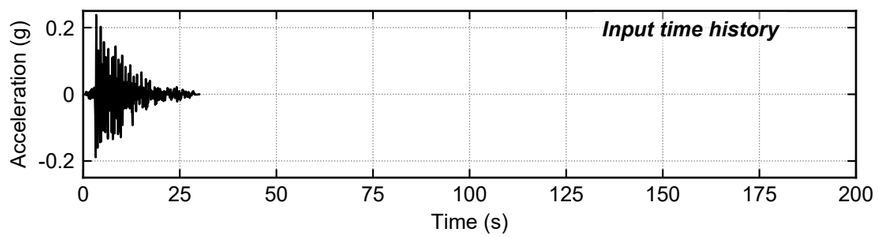






Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
NORTHRIDGE - BURBANK

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-8

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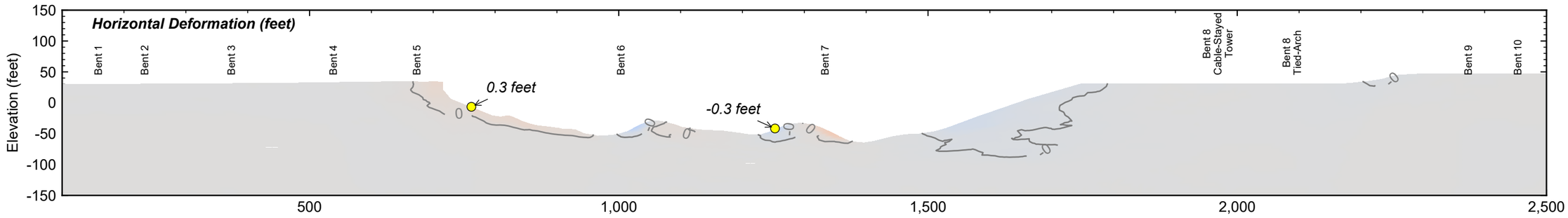
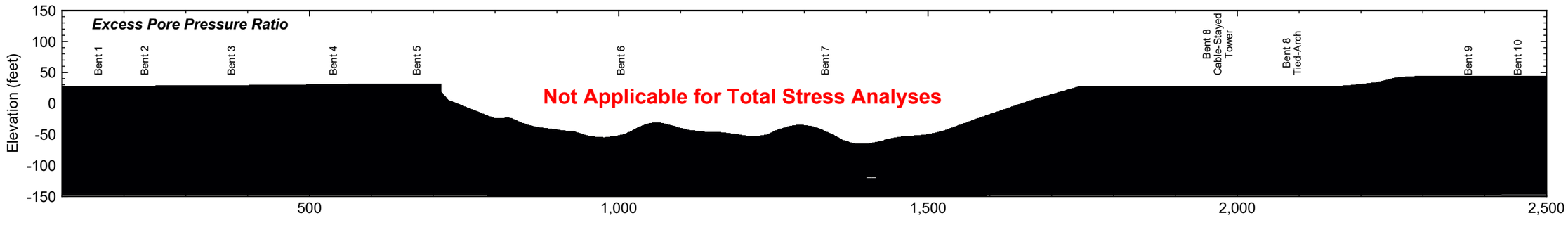
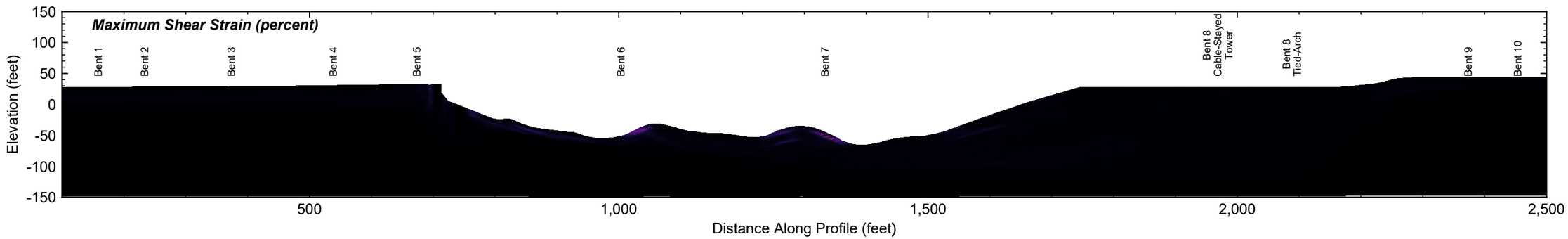
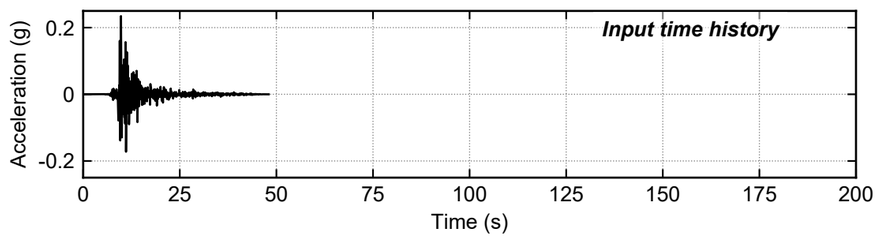






Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
CHRISTCHURCH - MQZ

April 2022 102636-009

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FIG. H-9

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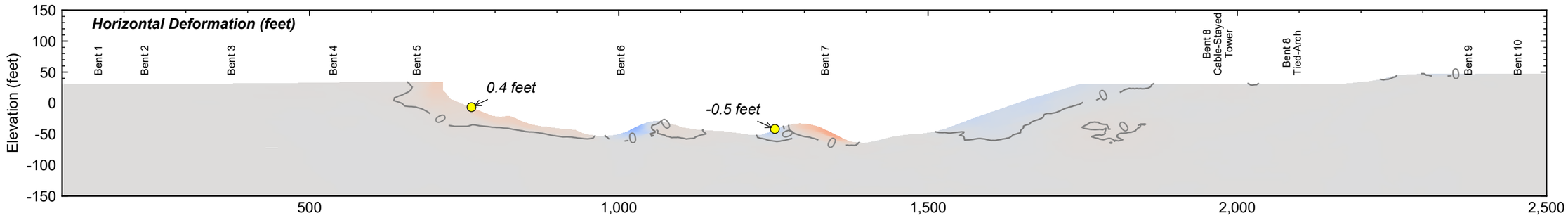
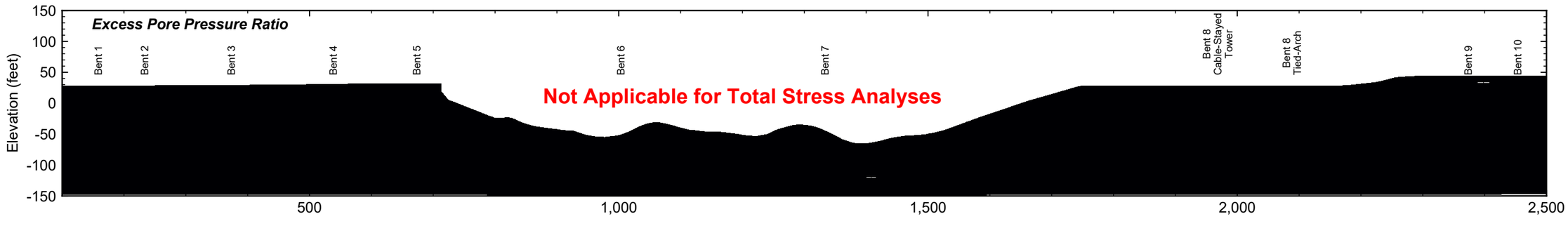
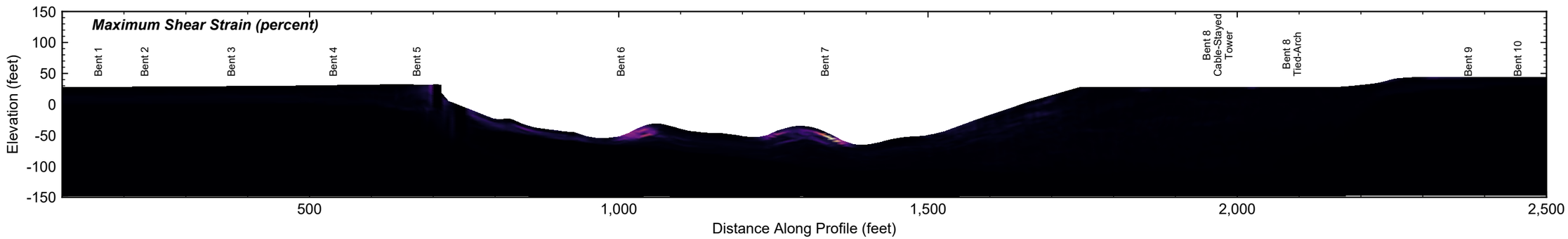
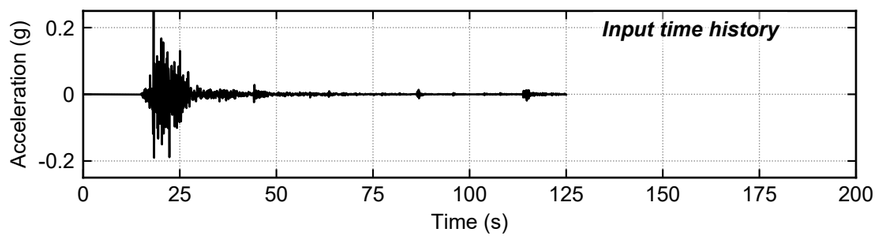






Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
NIIGATA - NIGH12

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FIG. H-10

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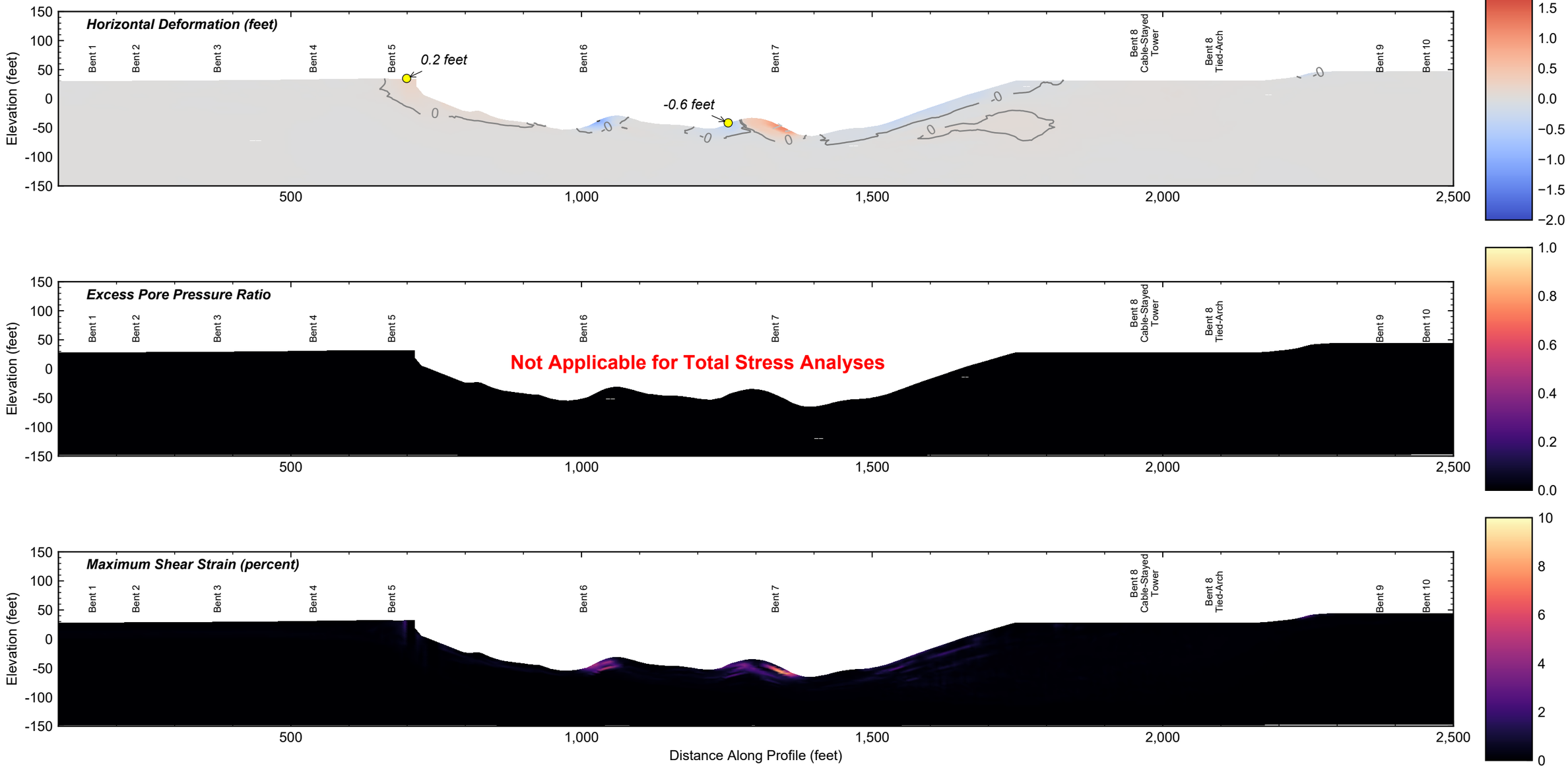
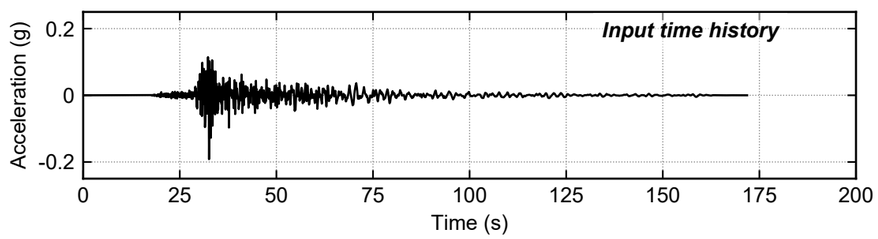


Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
NISQUALLY - BEVT

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FIG. H-11

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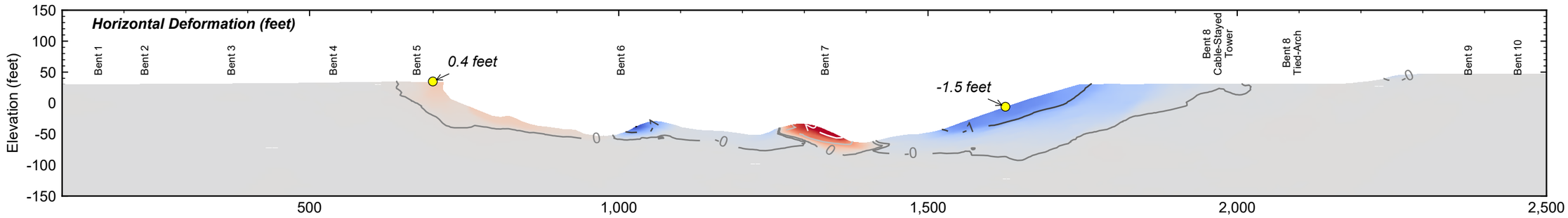
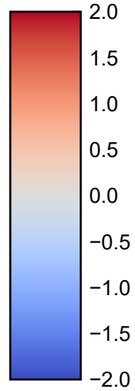
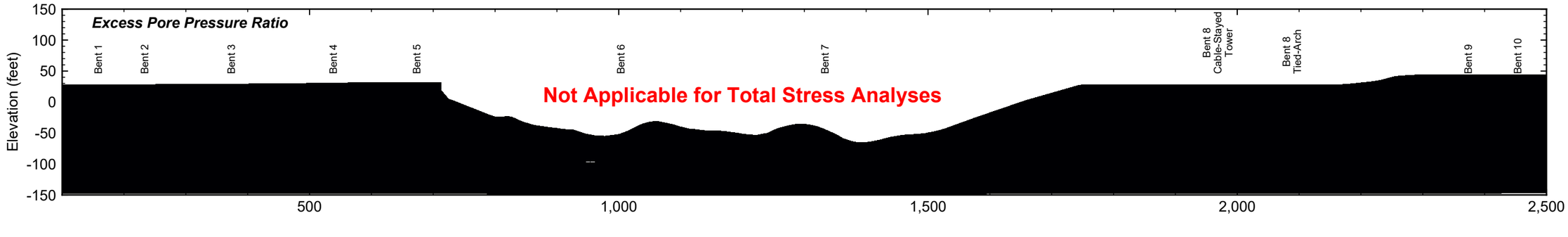
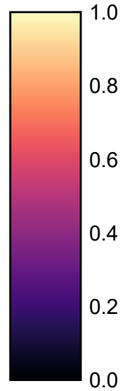
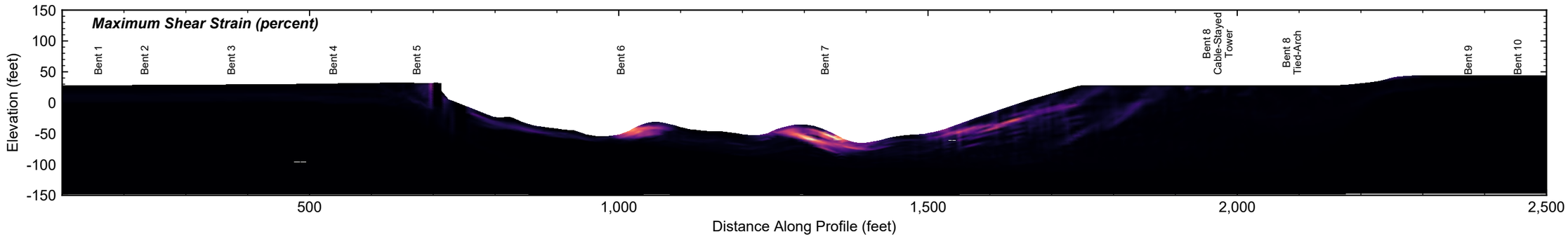
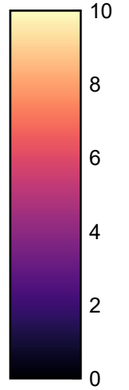




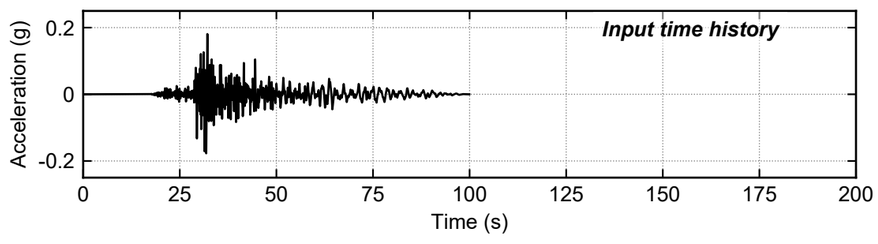








Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
NISQUALLY - EARN

April 2022 102636-009

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Geotechnical and Environmental Consultants

FIG. H-12

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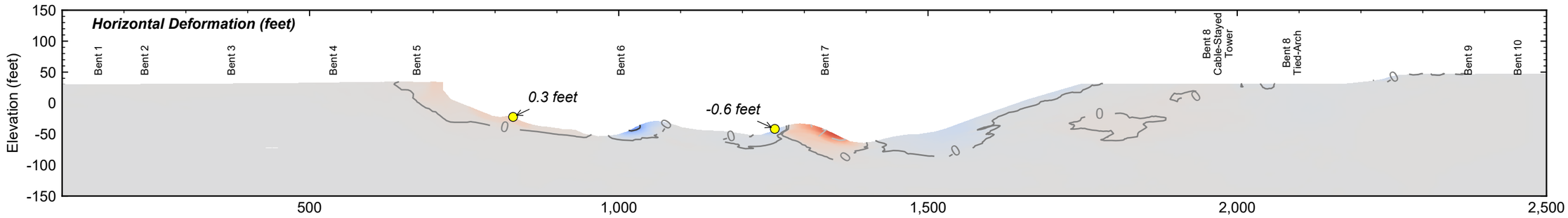
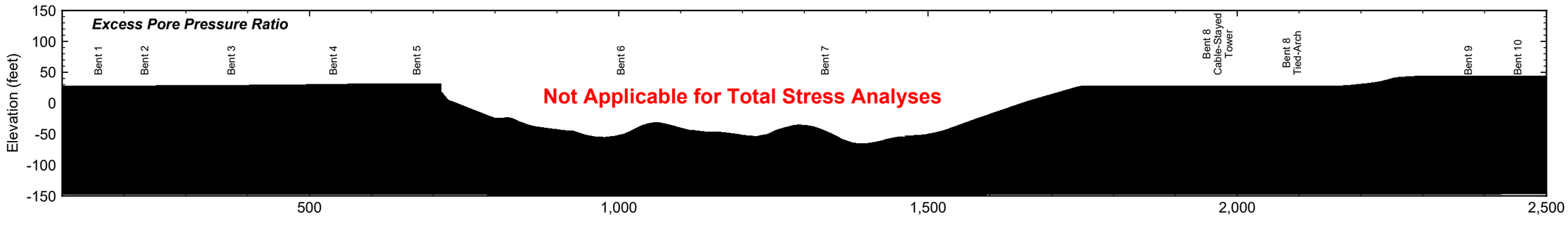
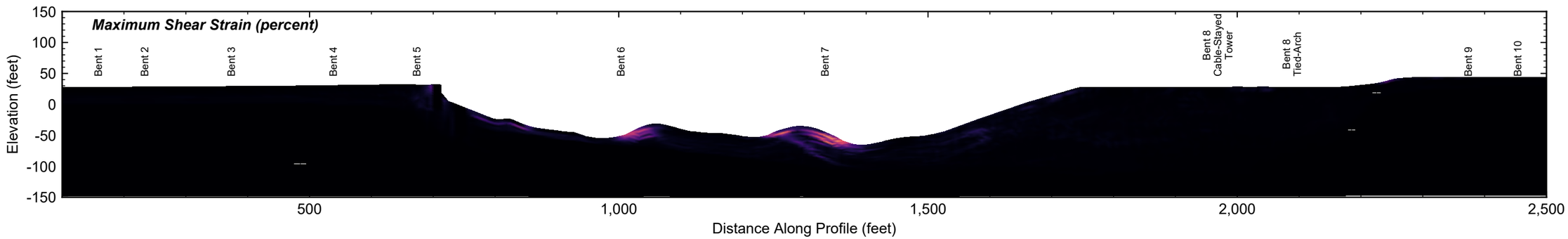
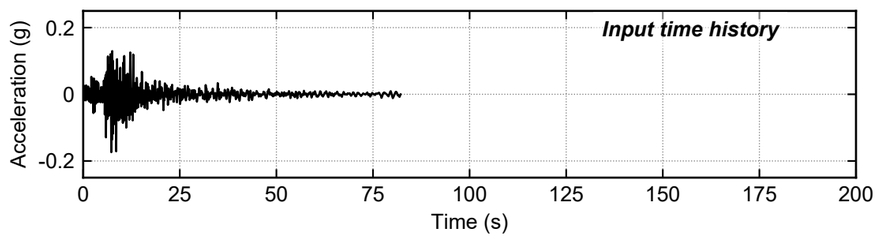






Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
WESTERN WA 1965 - OLYMPIA

April 2022 102636-009

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FIG. H-13

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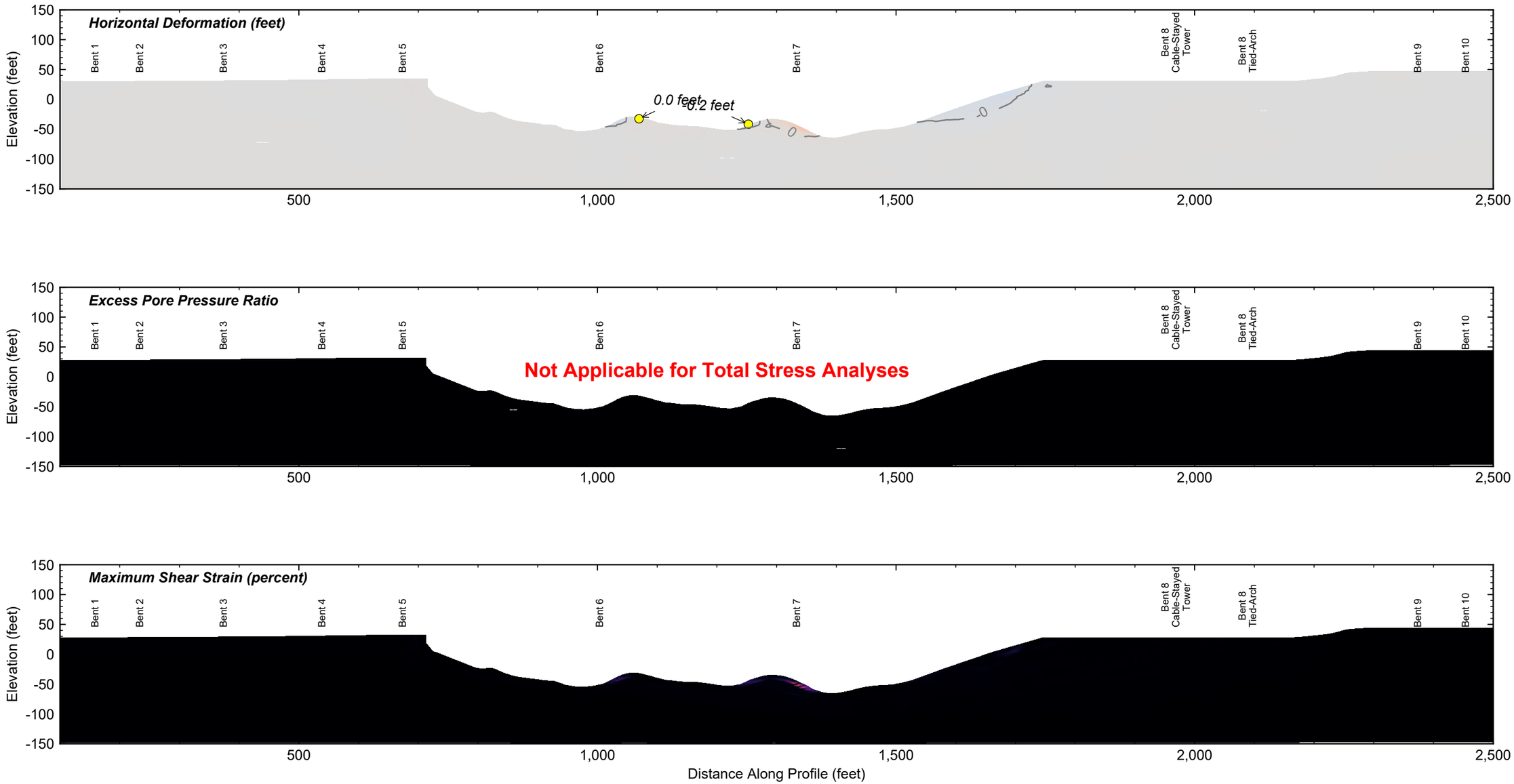
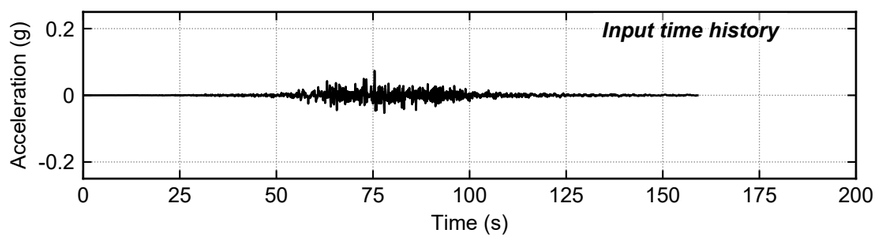


Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
MAULE - CERRO ST LUCIA

April 2022 102636-009

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Geotechnical and Environmental Consultants

FIG. H-14

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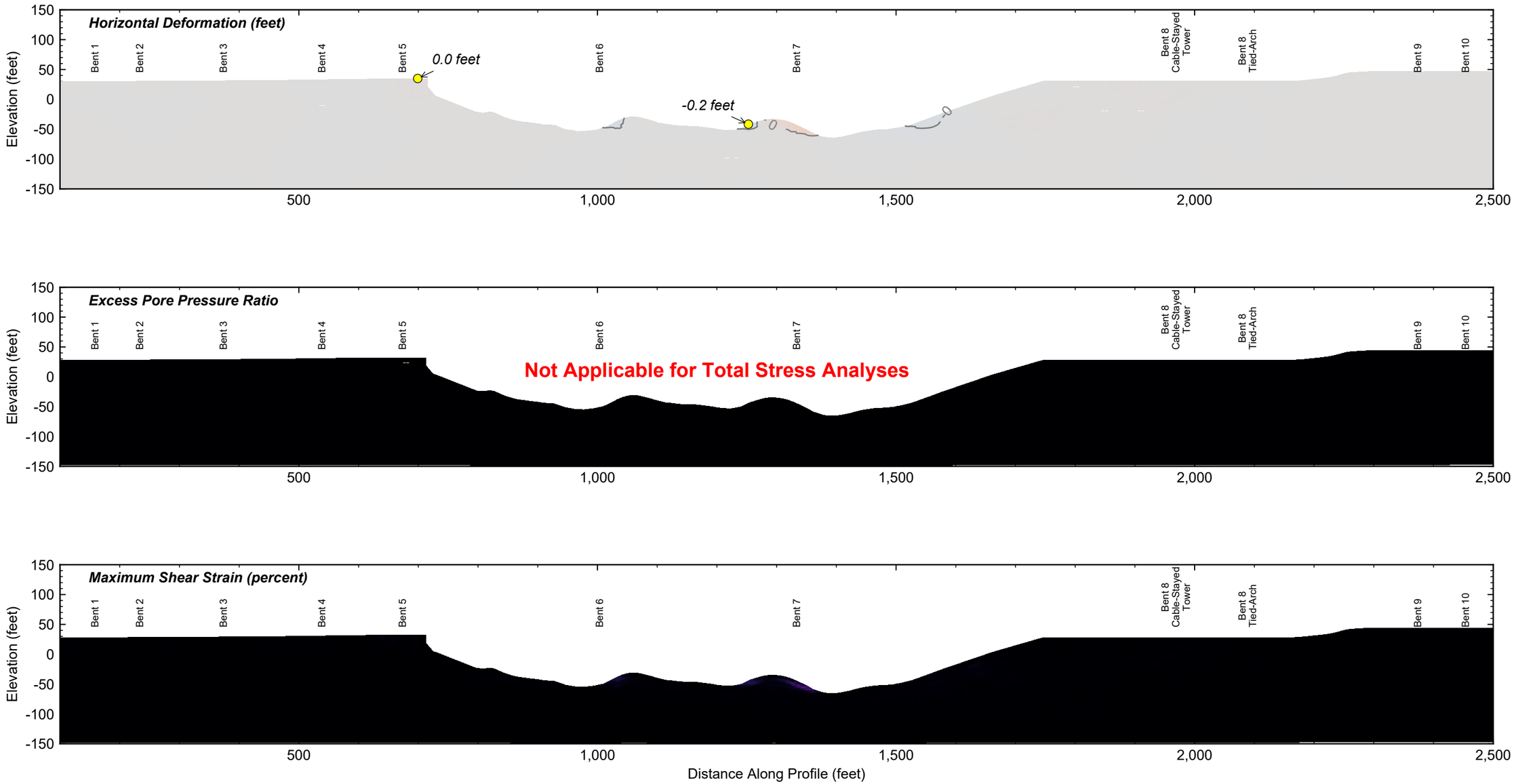
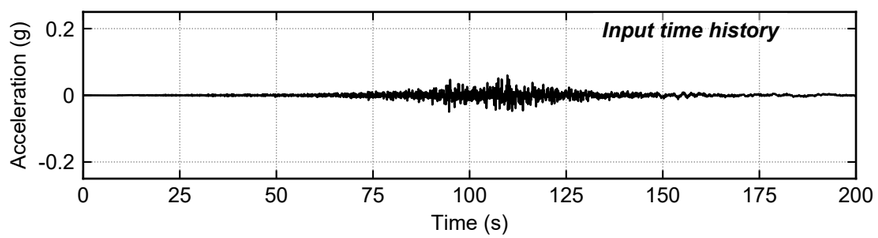


Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
MAULE - VICH

April 2022 102636-009

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Geotechnical and Environmental Consultants

FIG. H-15

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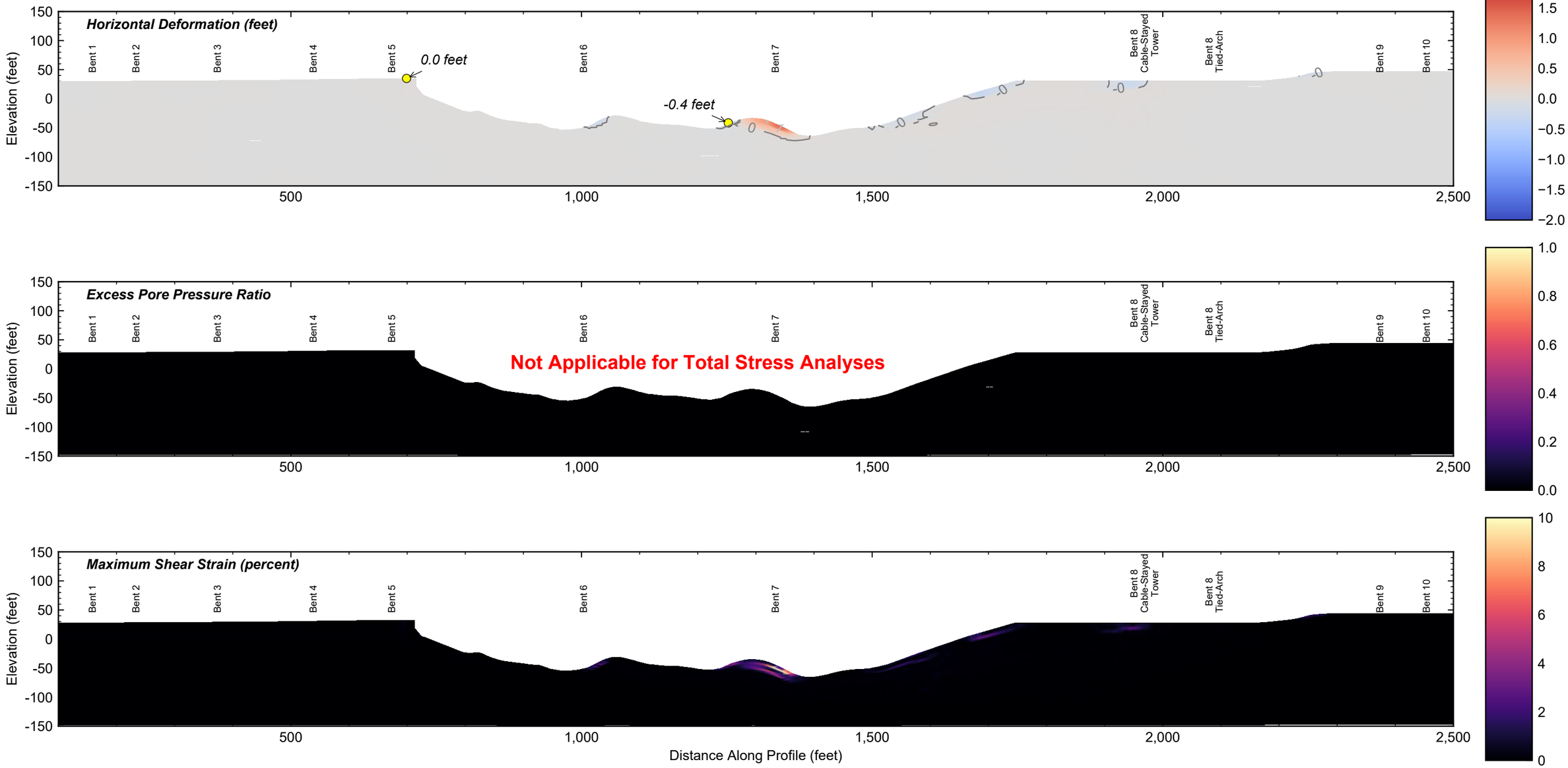
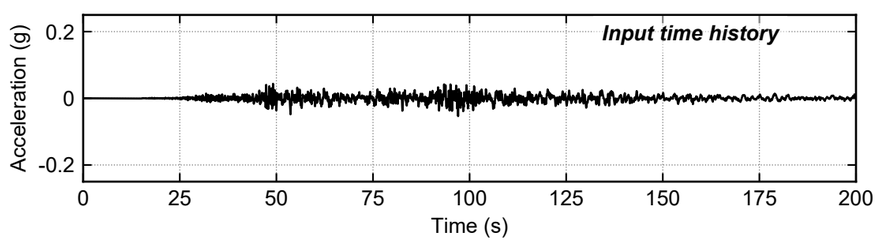


Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
TOHOKU - AKT017

April 2022 102636-009

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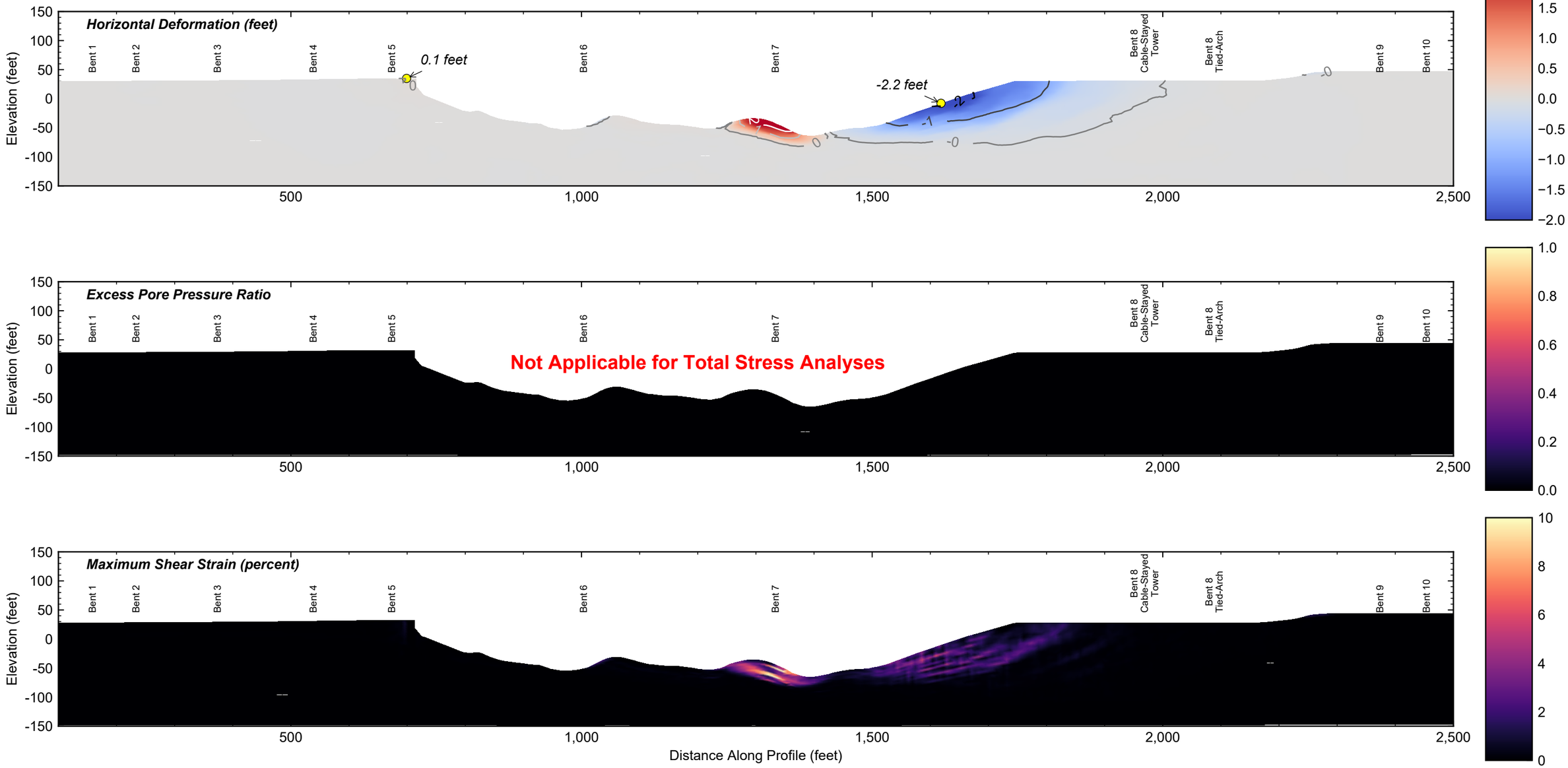
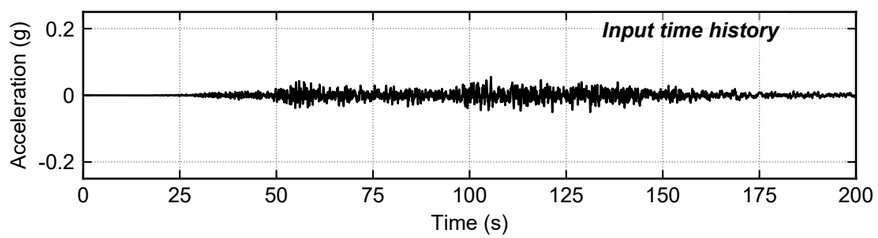
FIG. H-16

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
TOHOKU - YMTH05

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FIG. H-17

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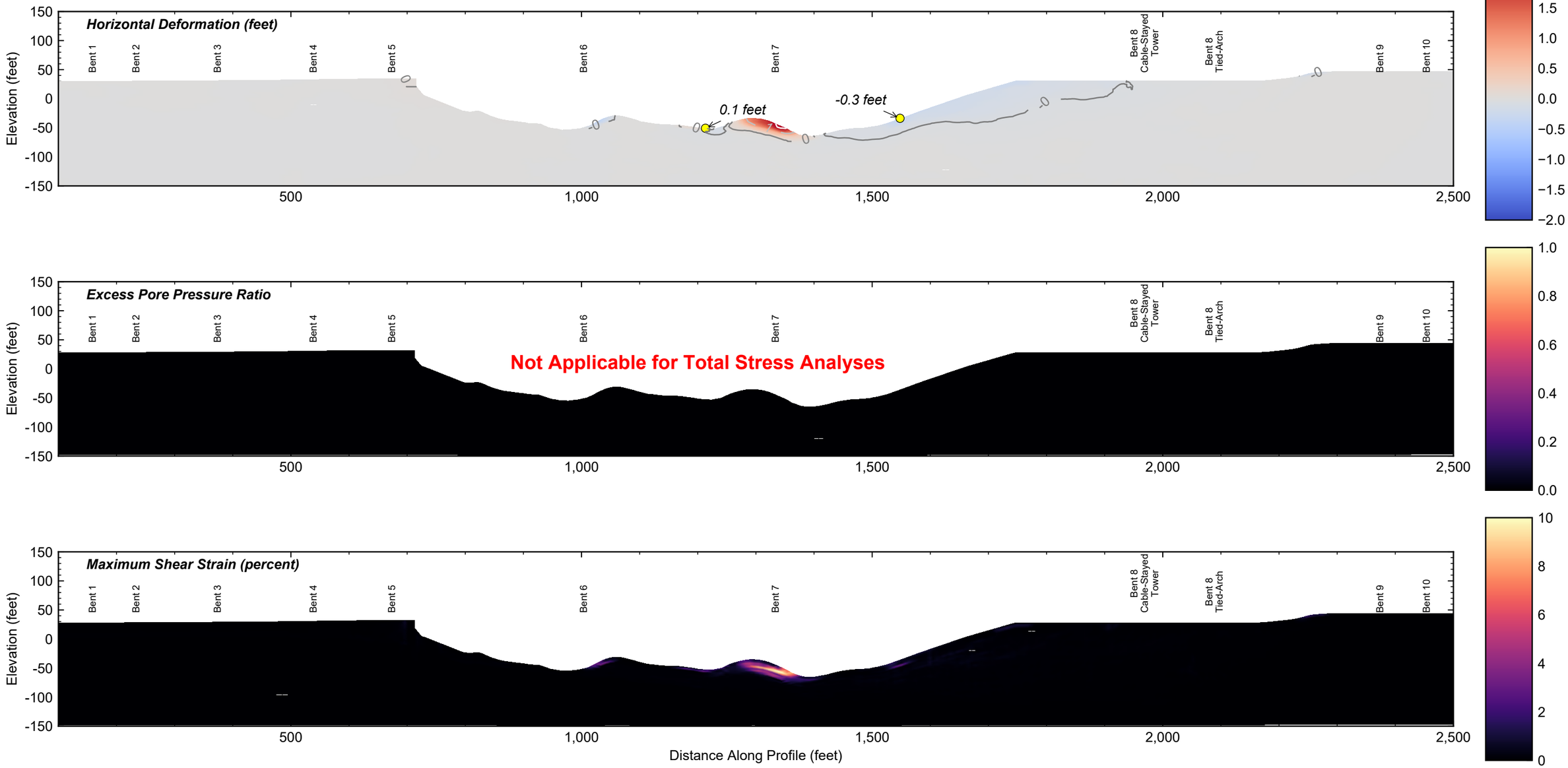
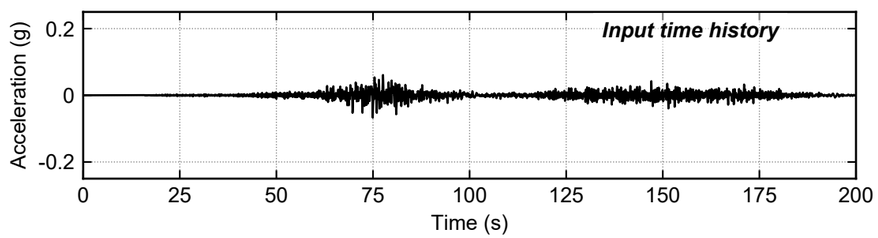


Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
M9 PROJECT - CSZ005

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FIG. H-18

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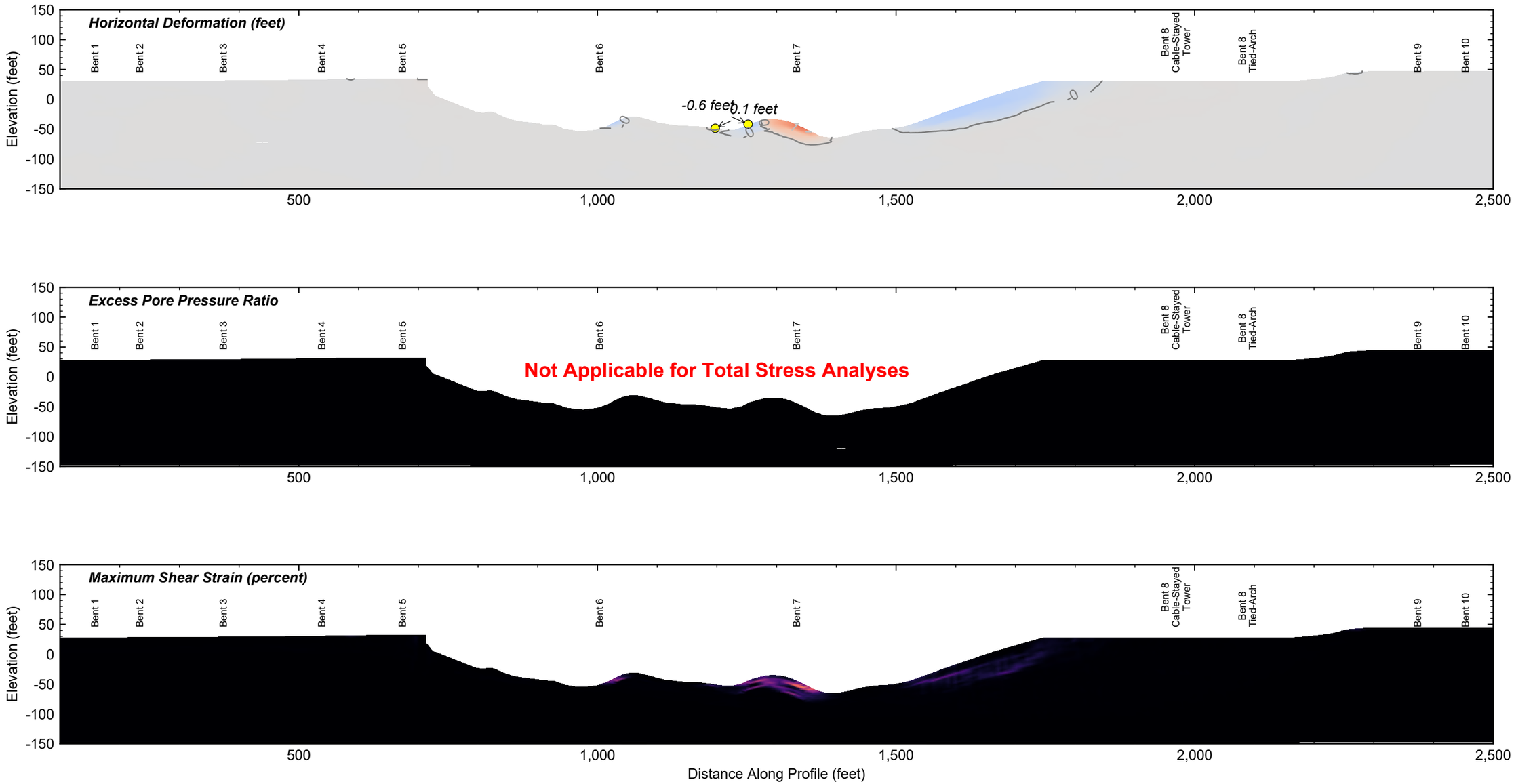
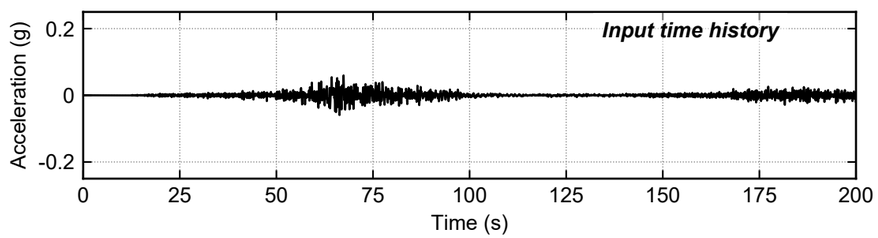


Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
M9 PROJECT - CSZ018

April 2022 102636-009

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Geotechnical and Environmental Consultants

FIG. H-19

C:\ FLACPROCESS\Burnside

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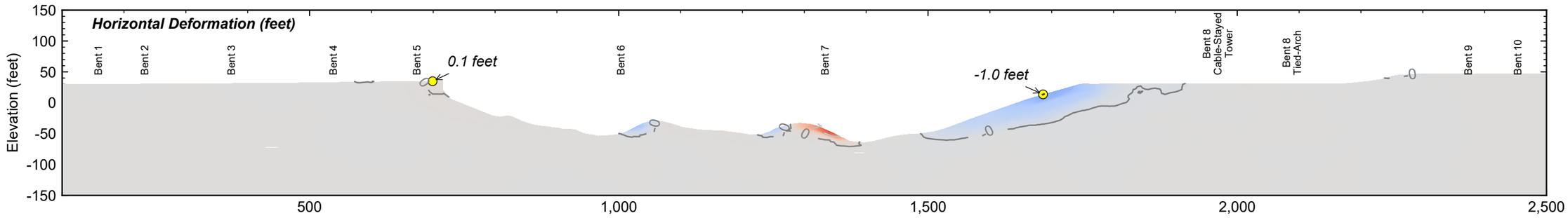
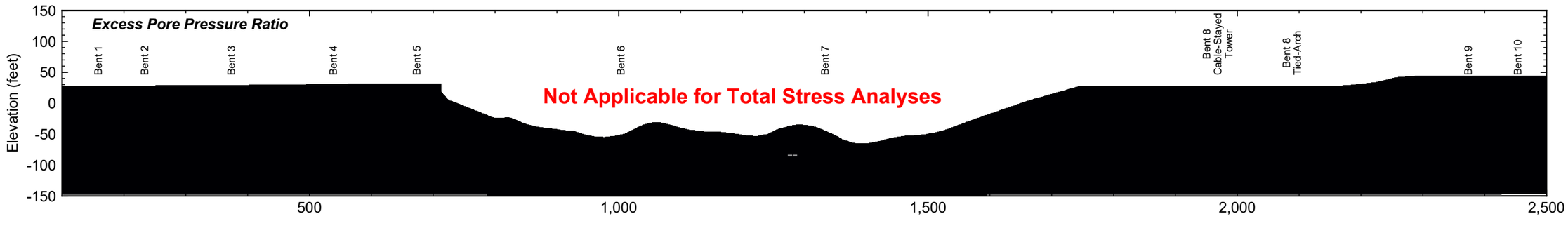
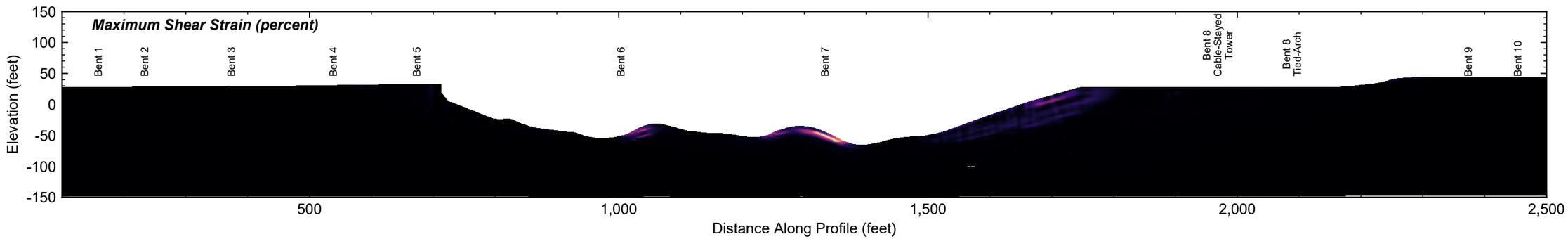
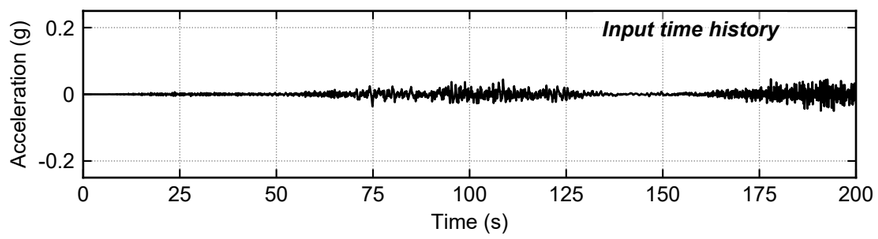






Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
M9 PROJECT - CSZ024

April 2022 102636-009

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Geotechnical and Environmental Consultants

FIG. H-20

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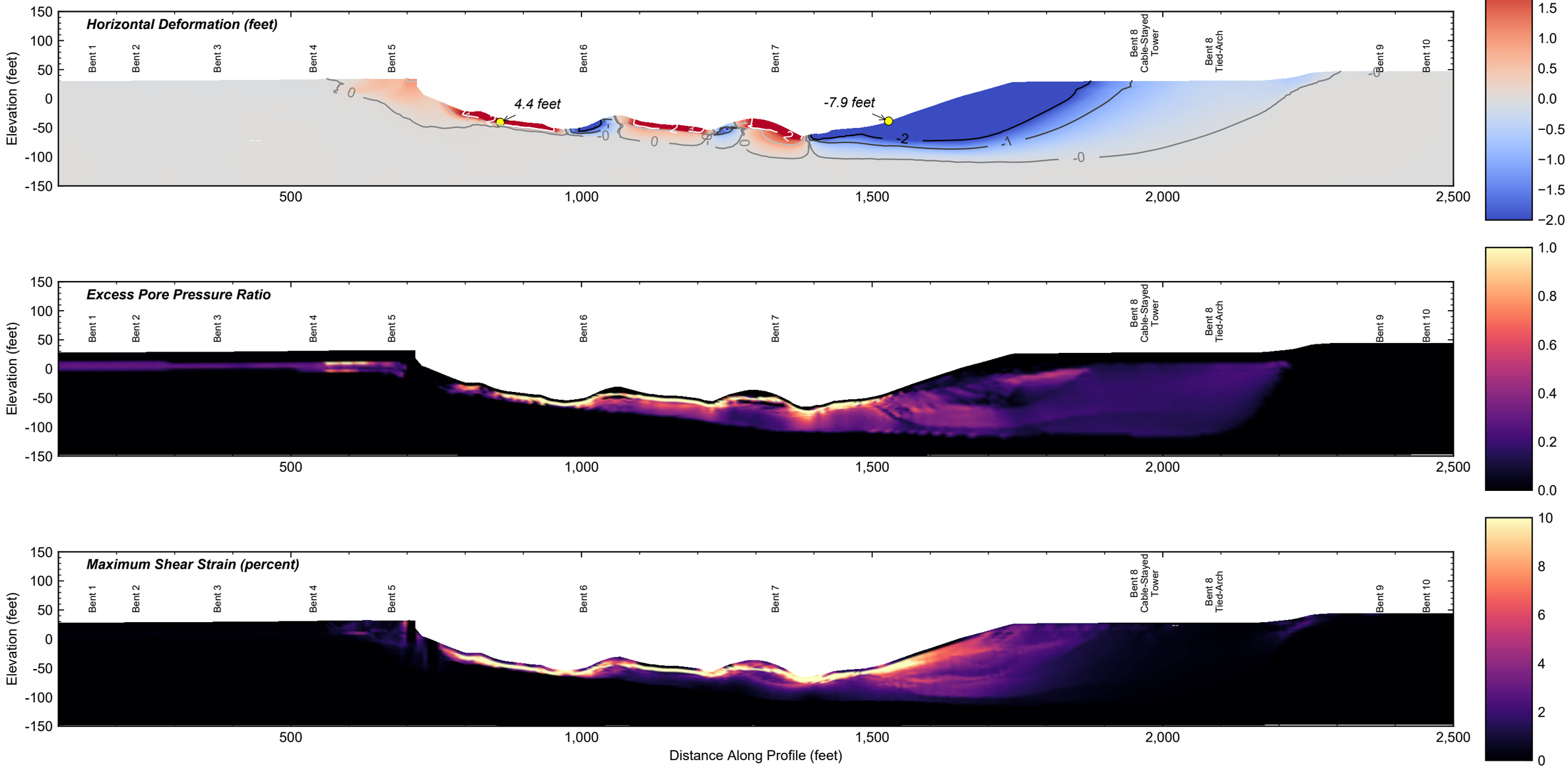
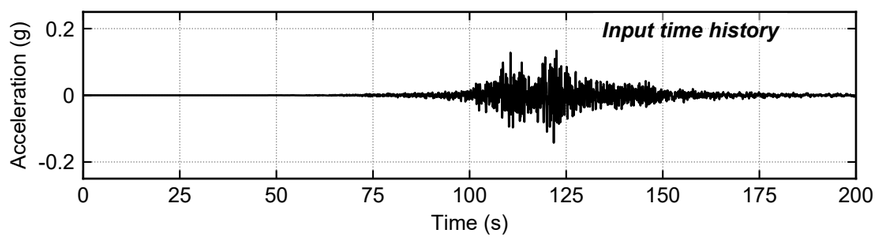


Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
MAULE - LA PLANTINA

April 2022 102636-009

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Geotechnical and Environmental Consultants

FIG. H-21

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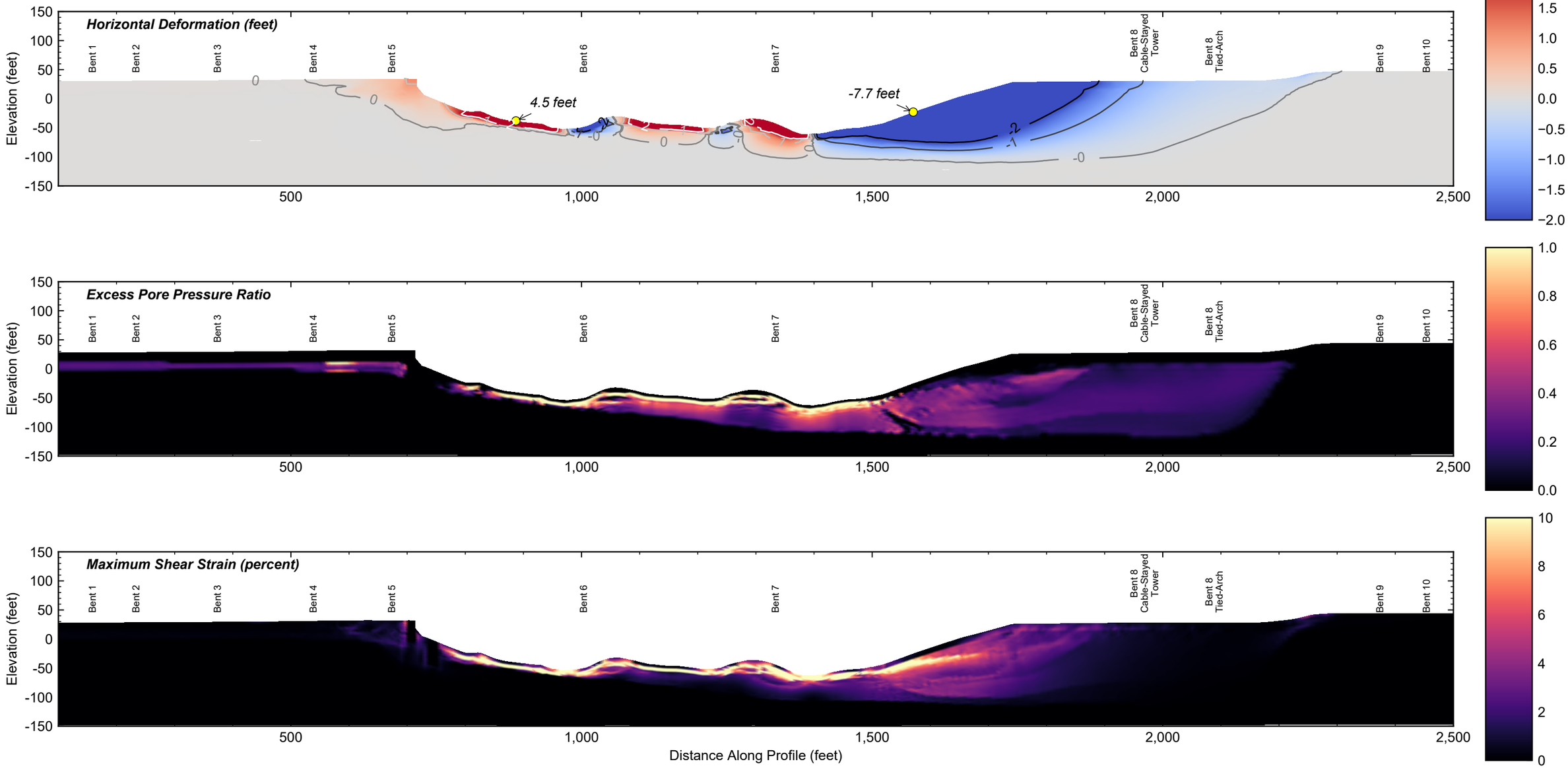
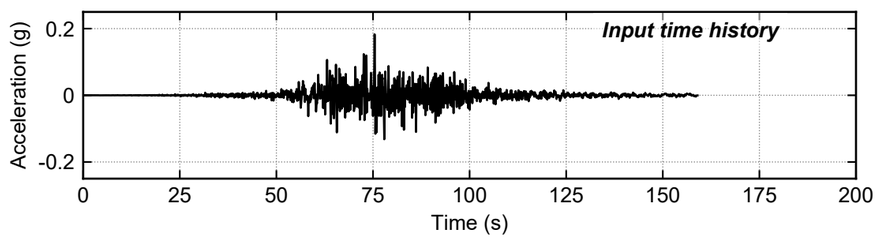


Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
MAULE - CERRO ST LUCIA

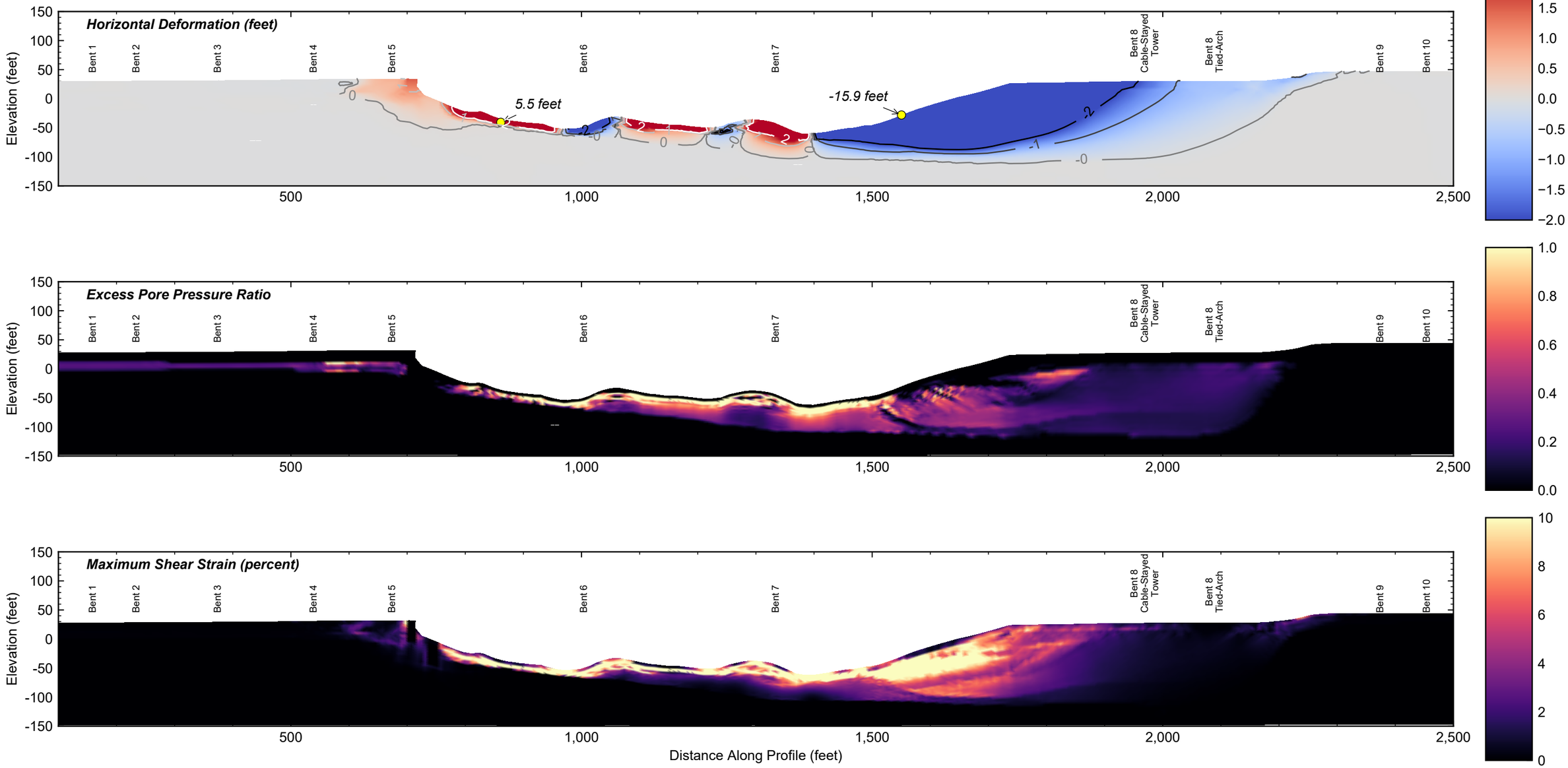
April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

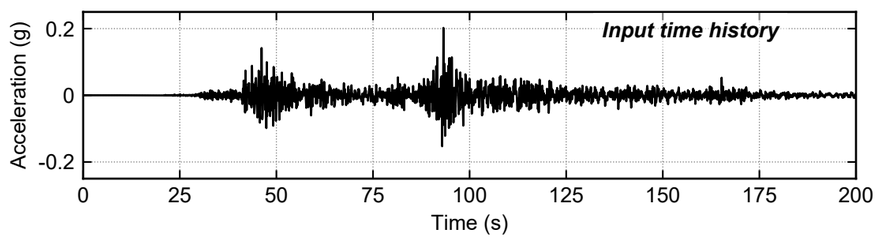
FIG. H-22

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
TOHOKU - MYG009

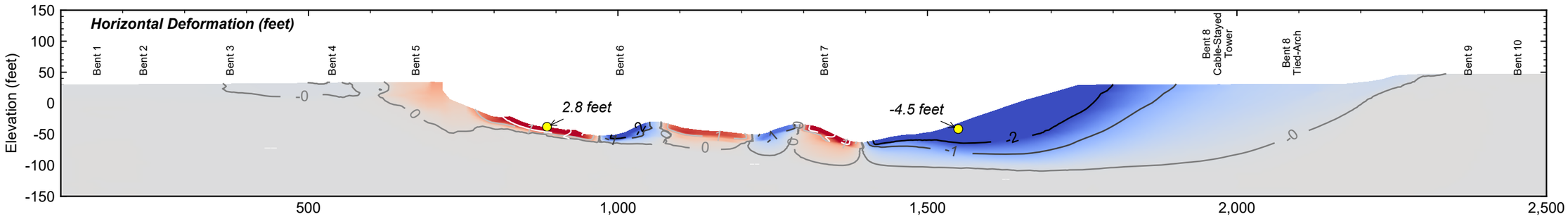
April 2022 102636-009

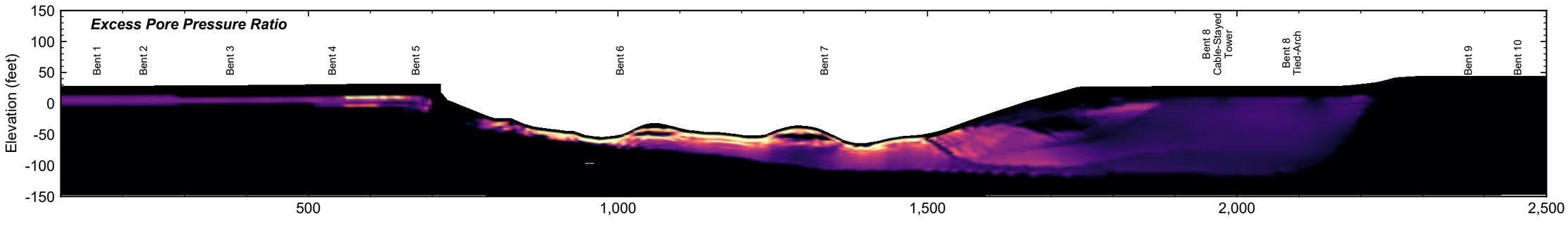
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

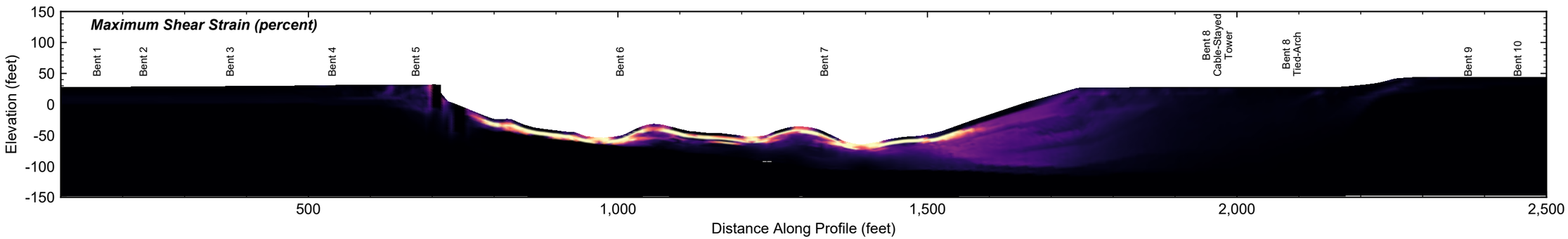
FIG. H-23

C:\ FLACPROCESS\Burnside

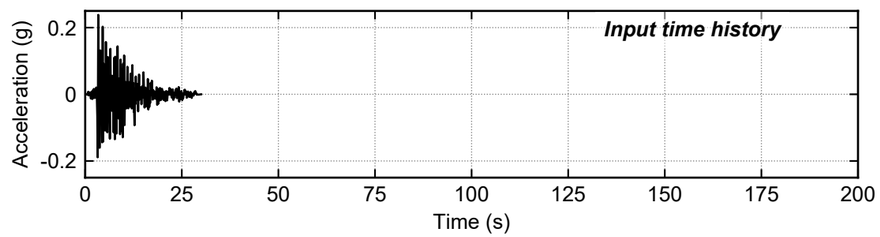
ver:0.11.1.post8.dev0+gf486e7d.by:SSS







Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
NORTHRIDGE - BURBANK

April 2022 102636-009

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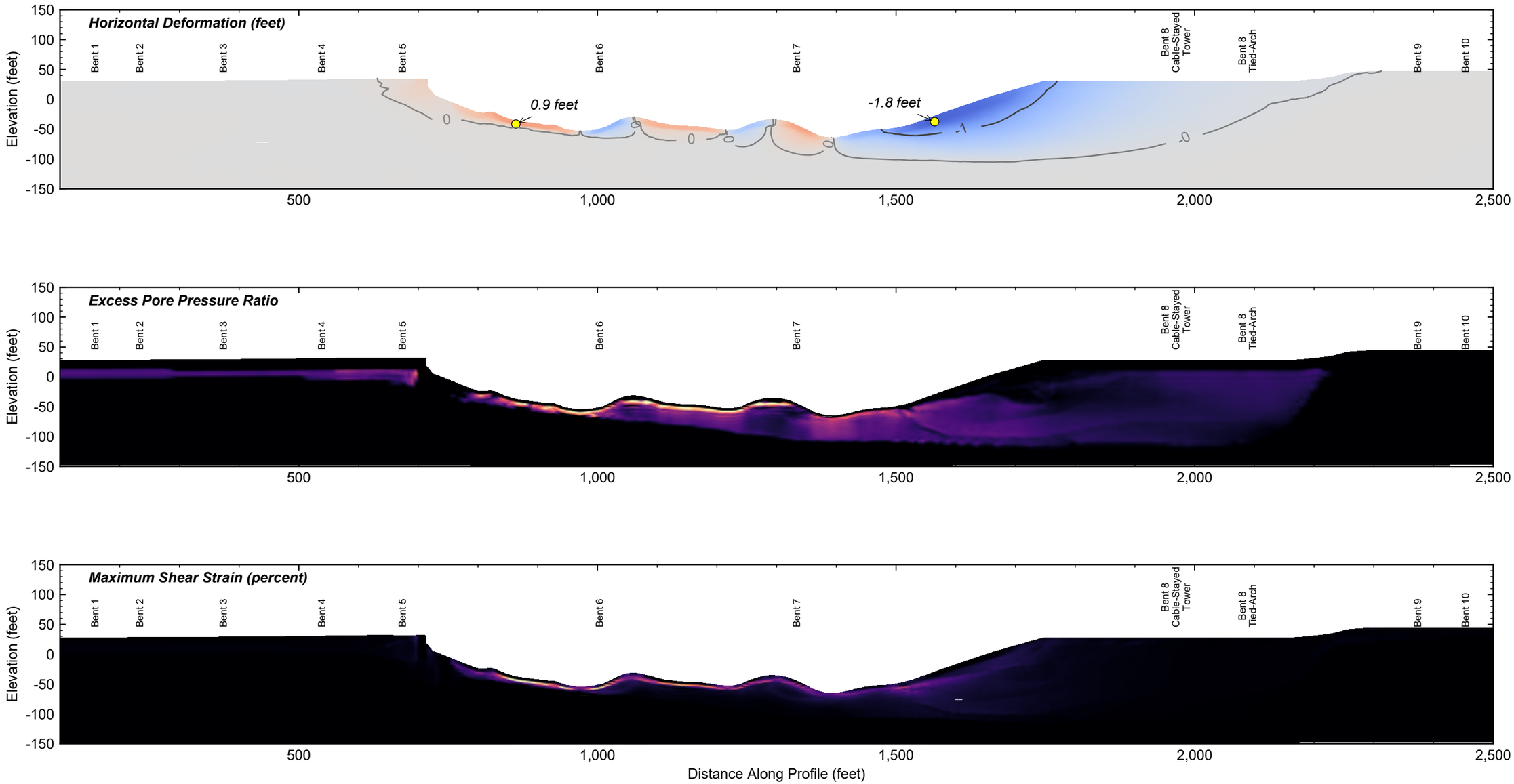
Geotechnical and Environmental Consultants

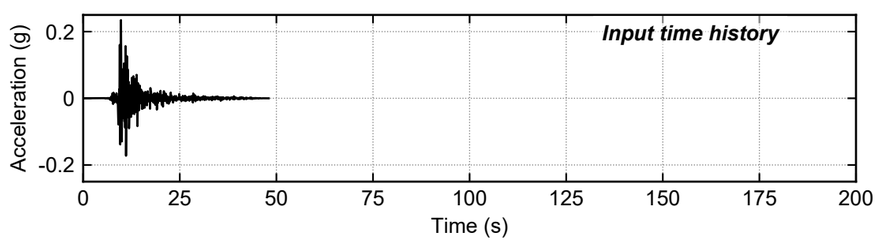
FIG. H-24

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
CHRISTCHURCH - MQZ

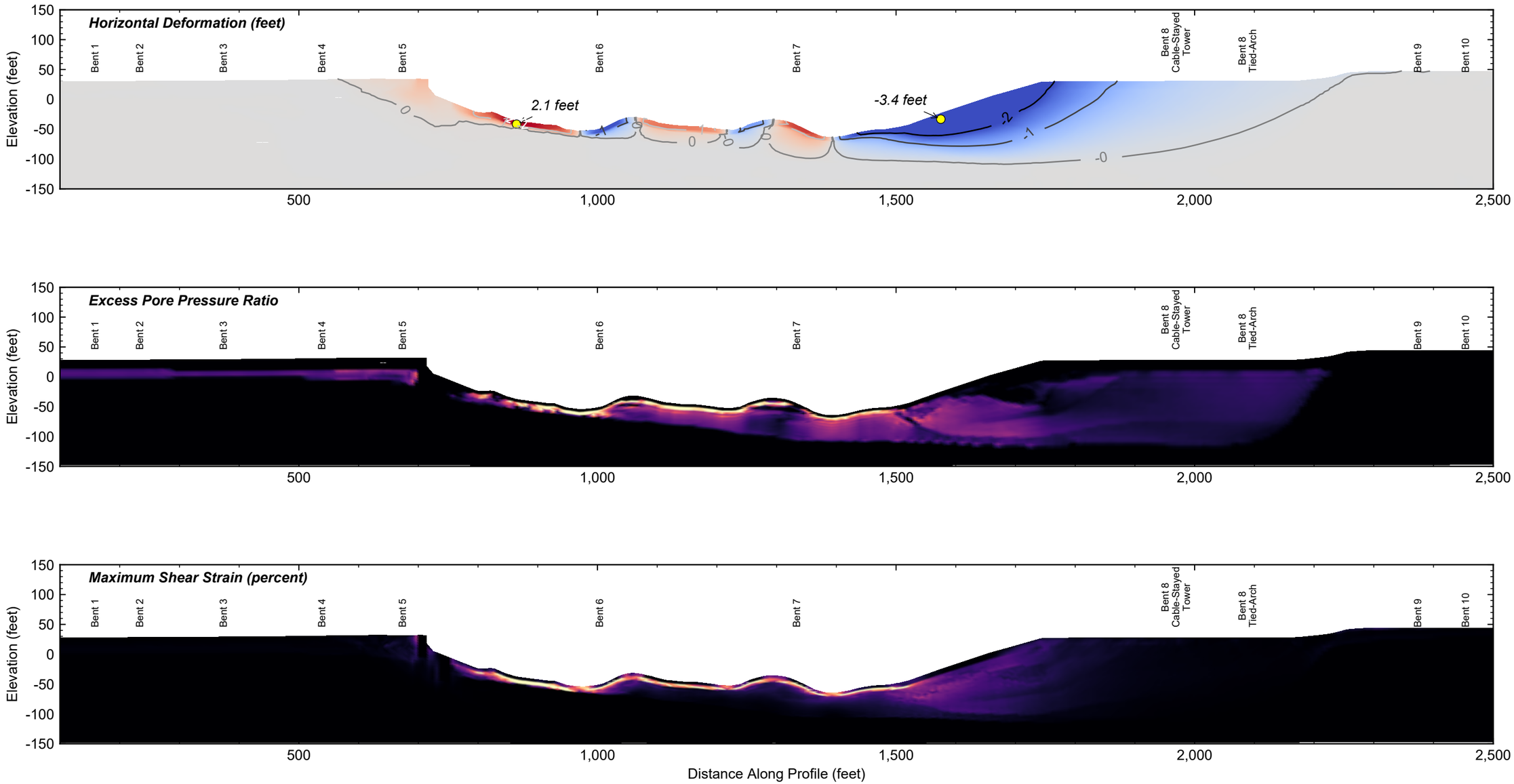
April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

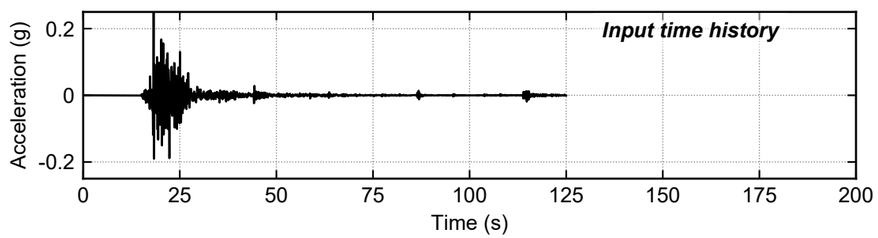
FIG. H-25

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
NIIGATA - NIGH12

April 2022 102636-009

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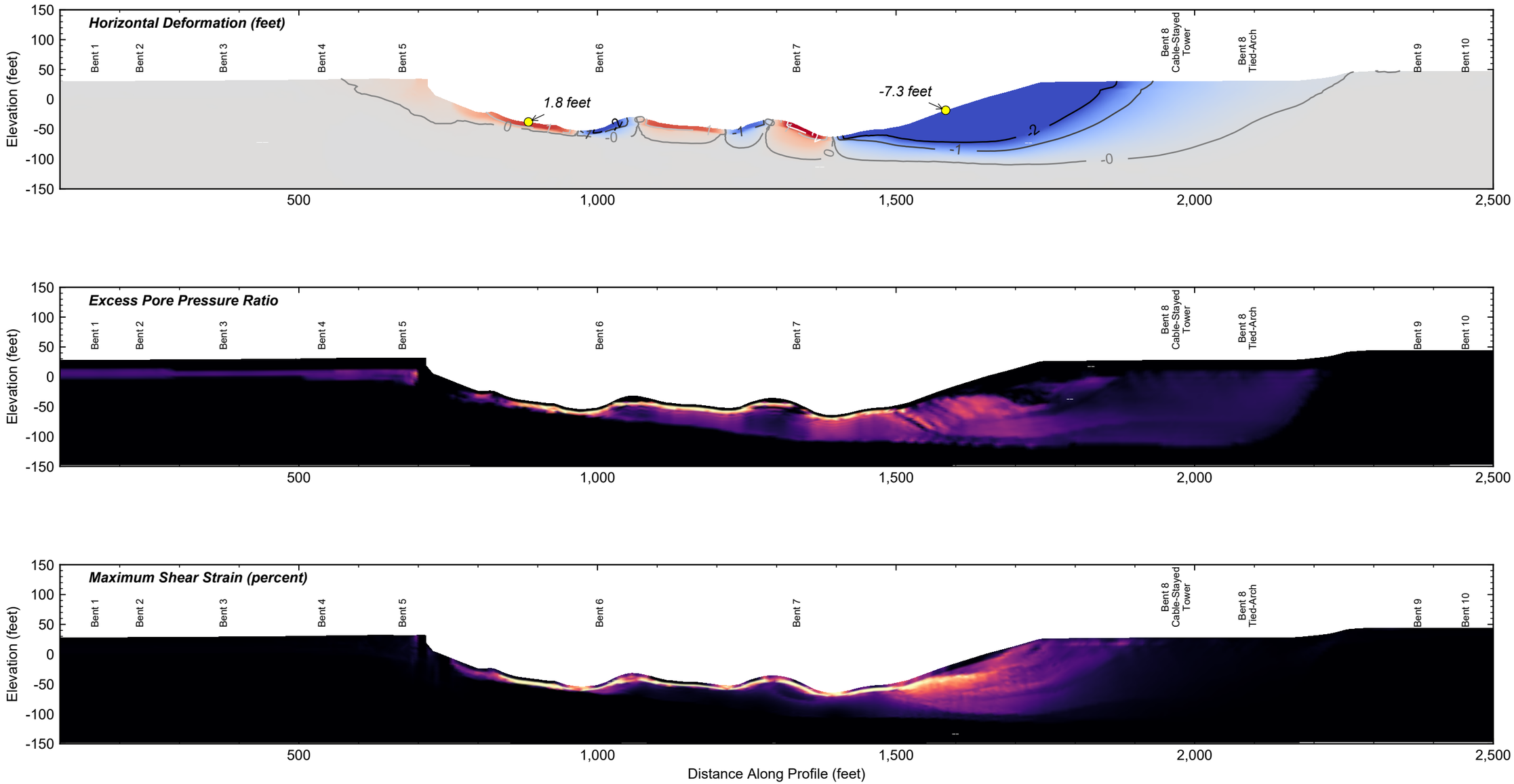
Geotechnical and Environmental Consultants

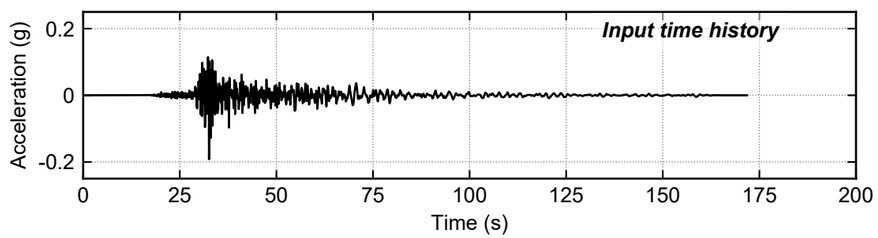
FIG. H-26

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
NISQUALLY - BEVT

April 2022 102636-009

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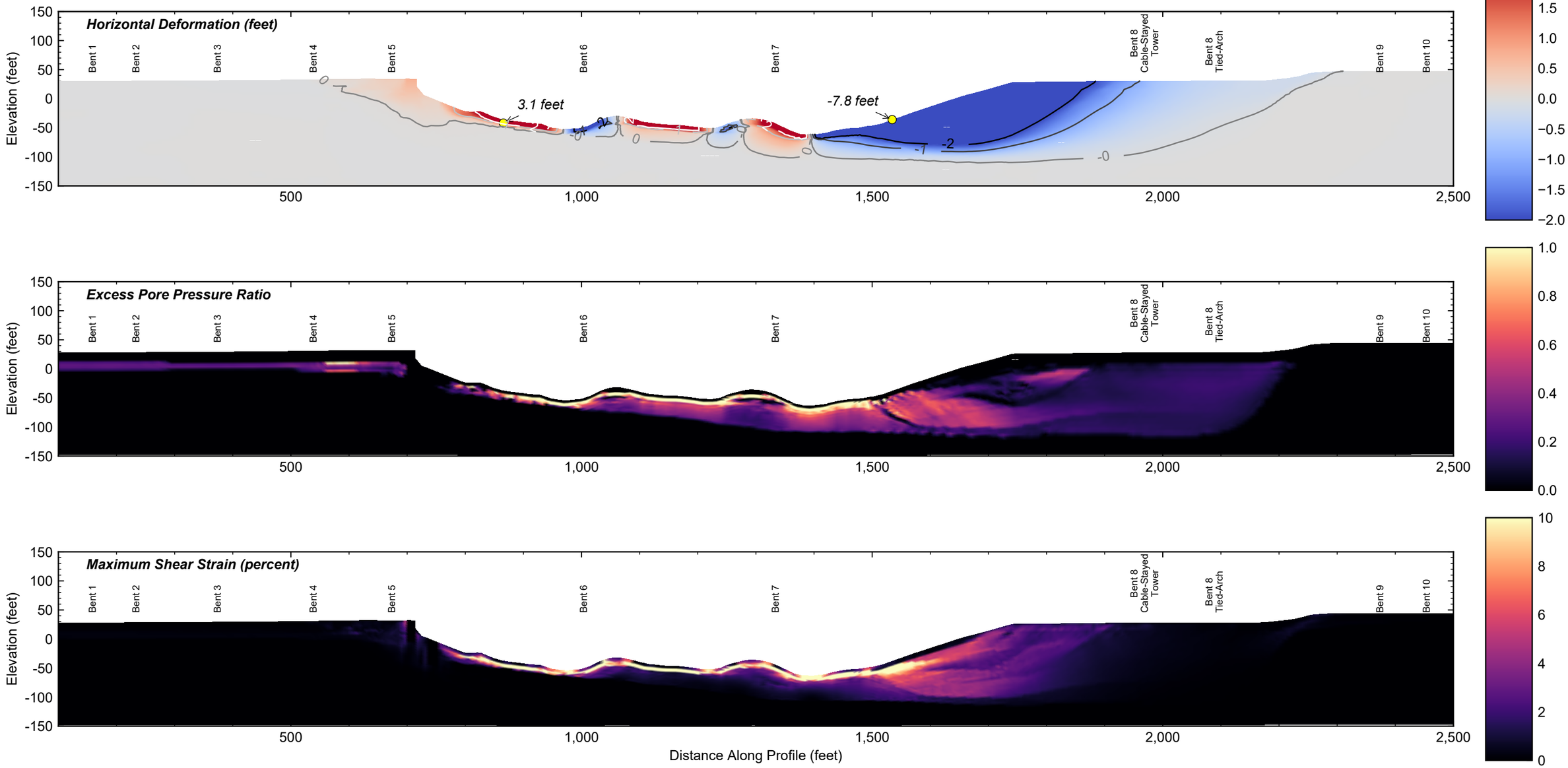
Geotechnical and Environmental Consultants

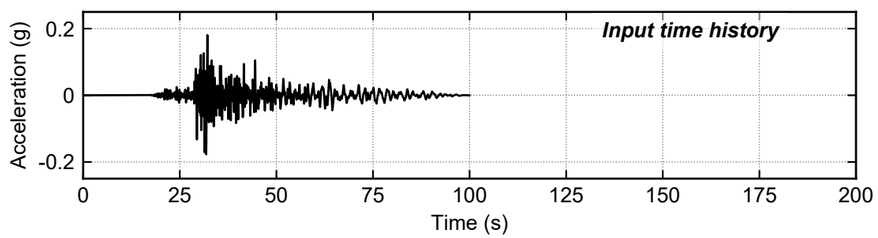
FIG. H-27

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
NISQUALLY - EARN

April 2022 102636-009

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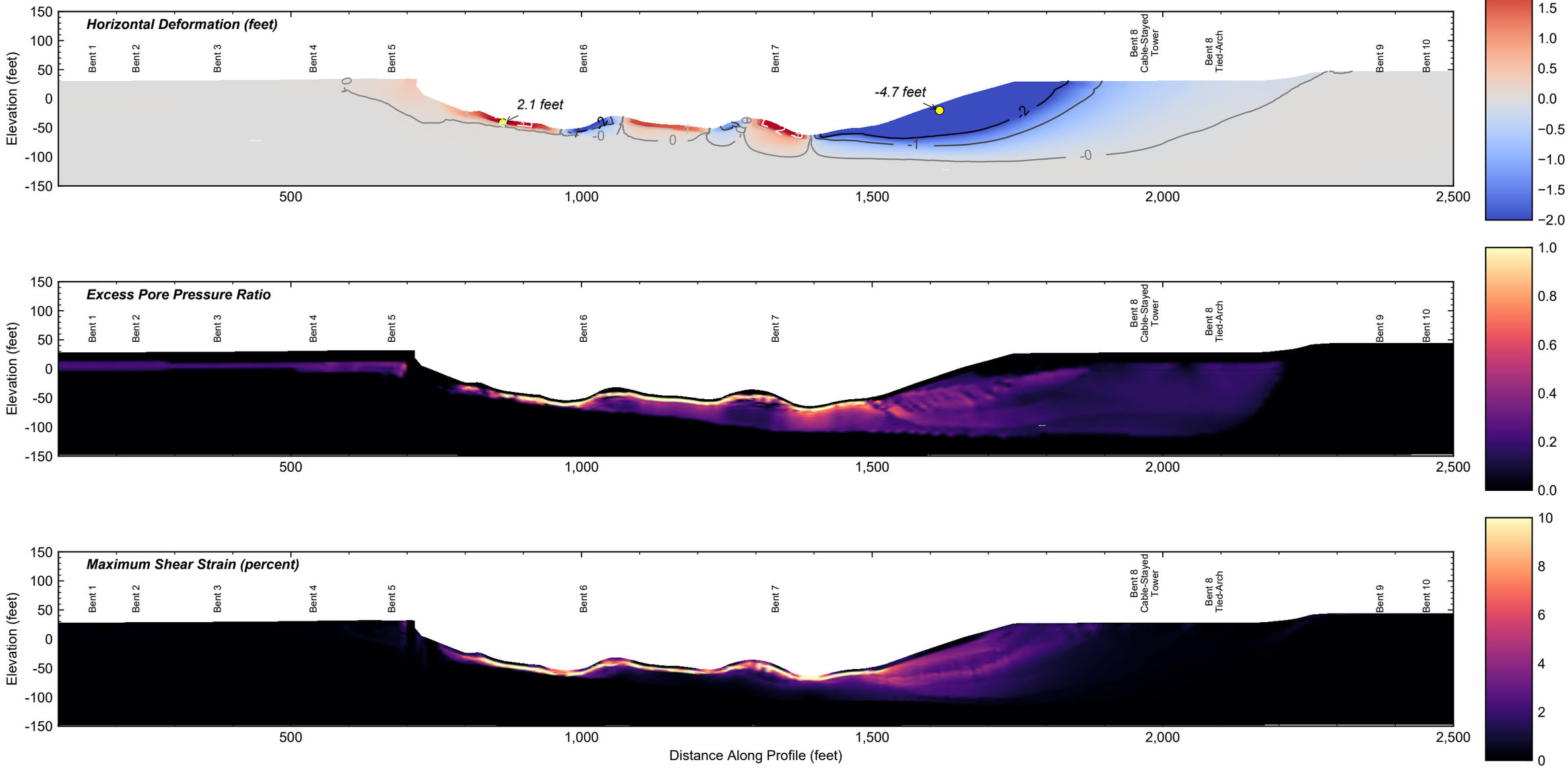
Geotechnical and Environmental Consultants

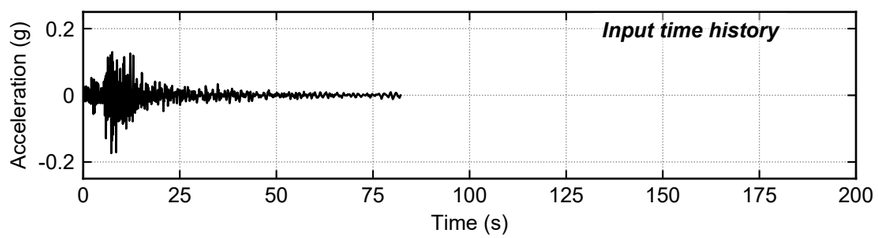
FIG. H-28

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
WESTERN WA 1965 - OLYMPIA

April 2022 102636-009

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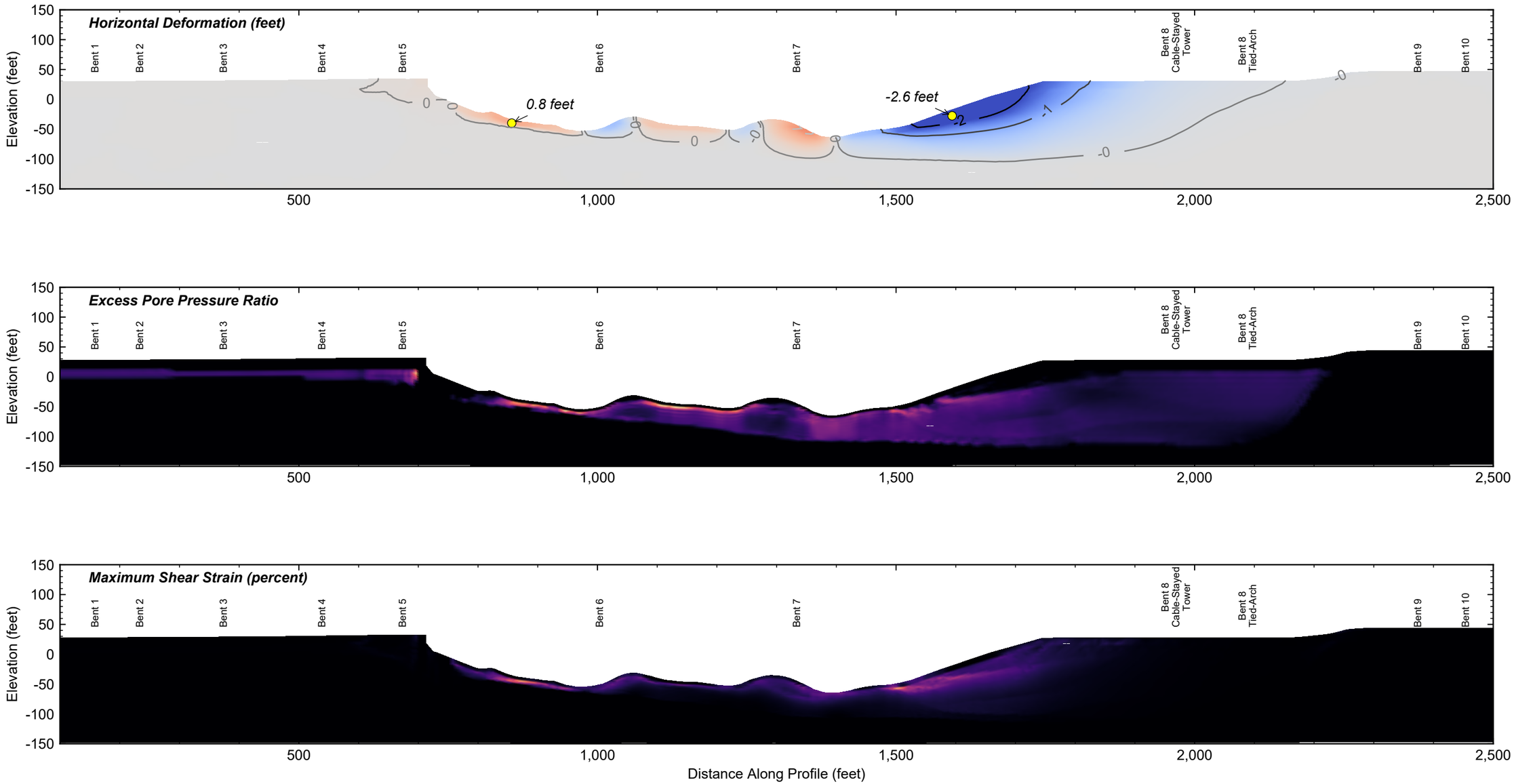
Geotechnical and Environmental Consultants

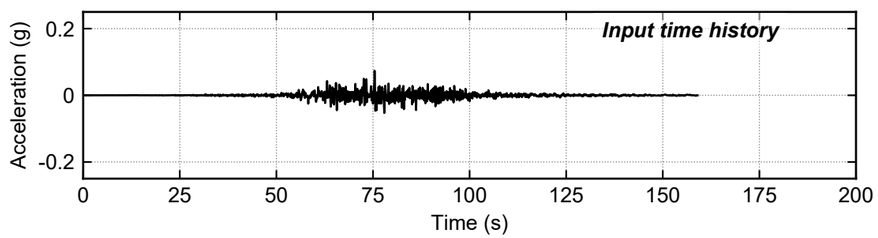
FIG. H-29

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
MAULE - CERRO ST LUCIA

April 2022 102636-009

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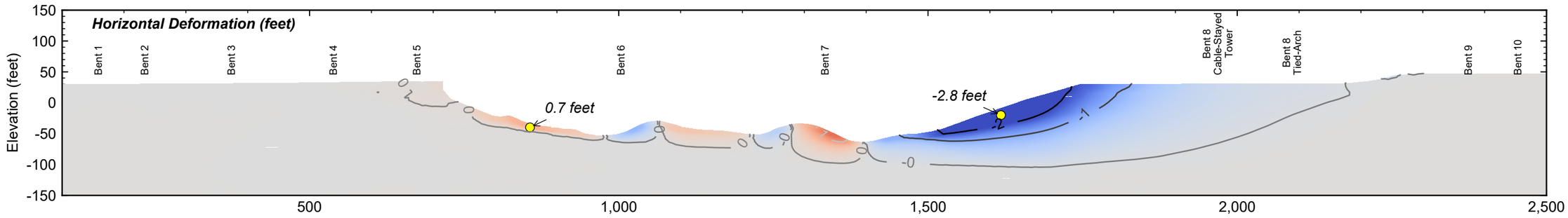
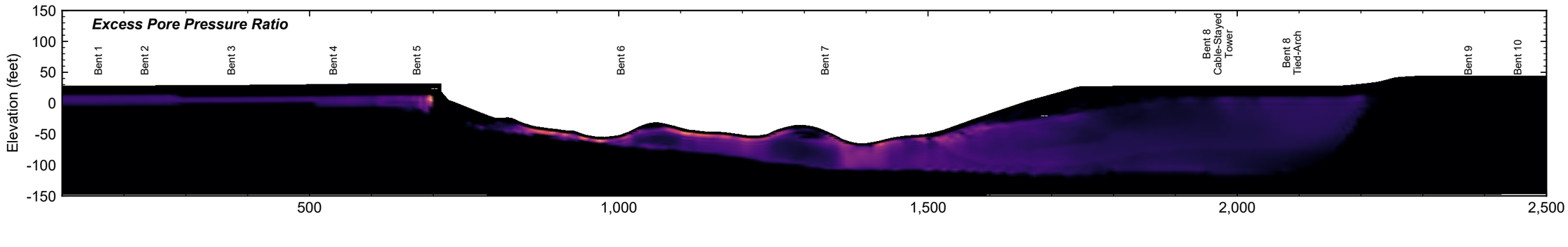
Geotechnical and Environmental Consultants

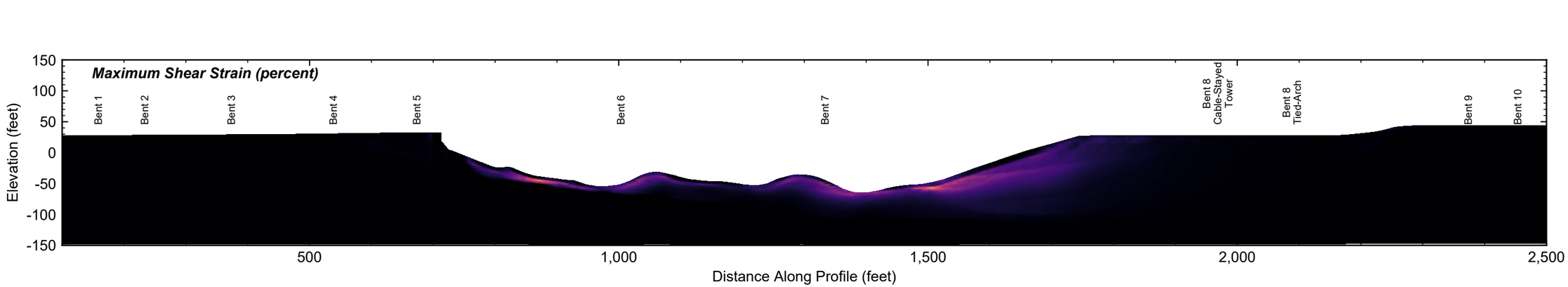
FIG. H-30

C:\ FLACPROCESS\Burnside

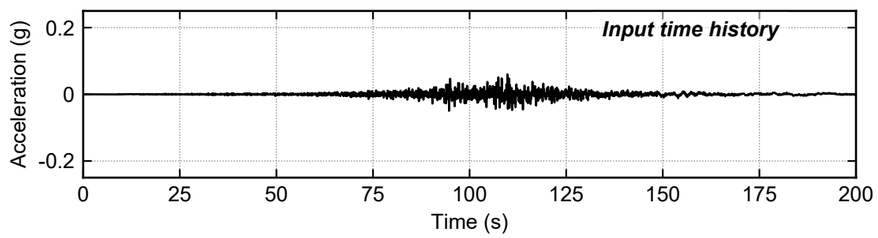
ver:0.11.1.post8.dev0+gf486e7d.by:SSS







Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
MAULE - VICH

April 2022 102636-009

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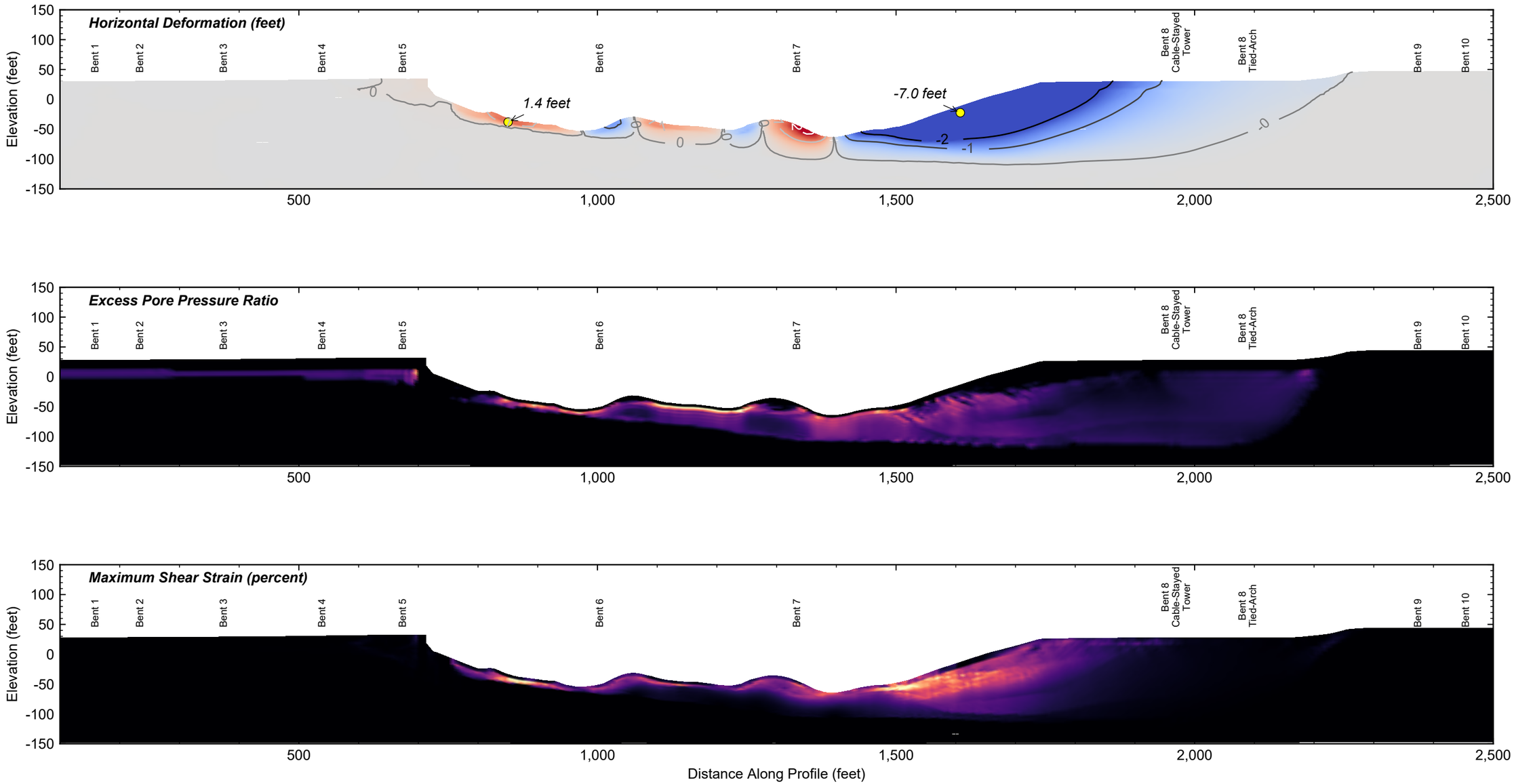
Geotechnical and Environmental Consultants

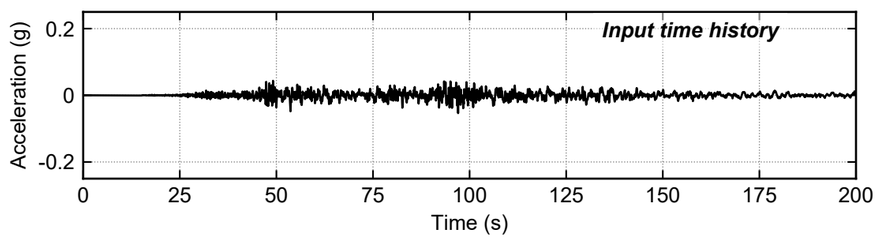
FIG. H-31

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
TOHOKU - AKT017

April 2022 102636-009

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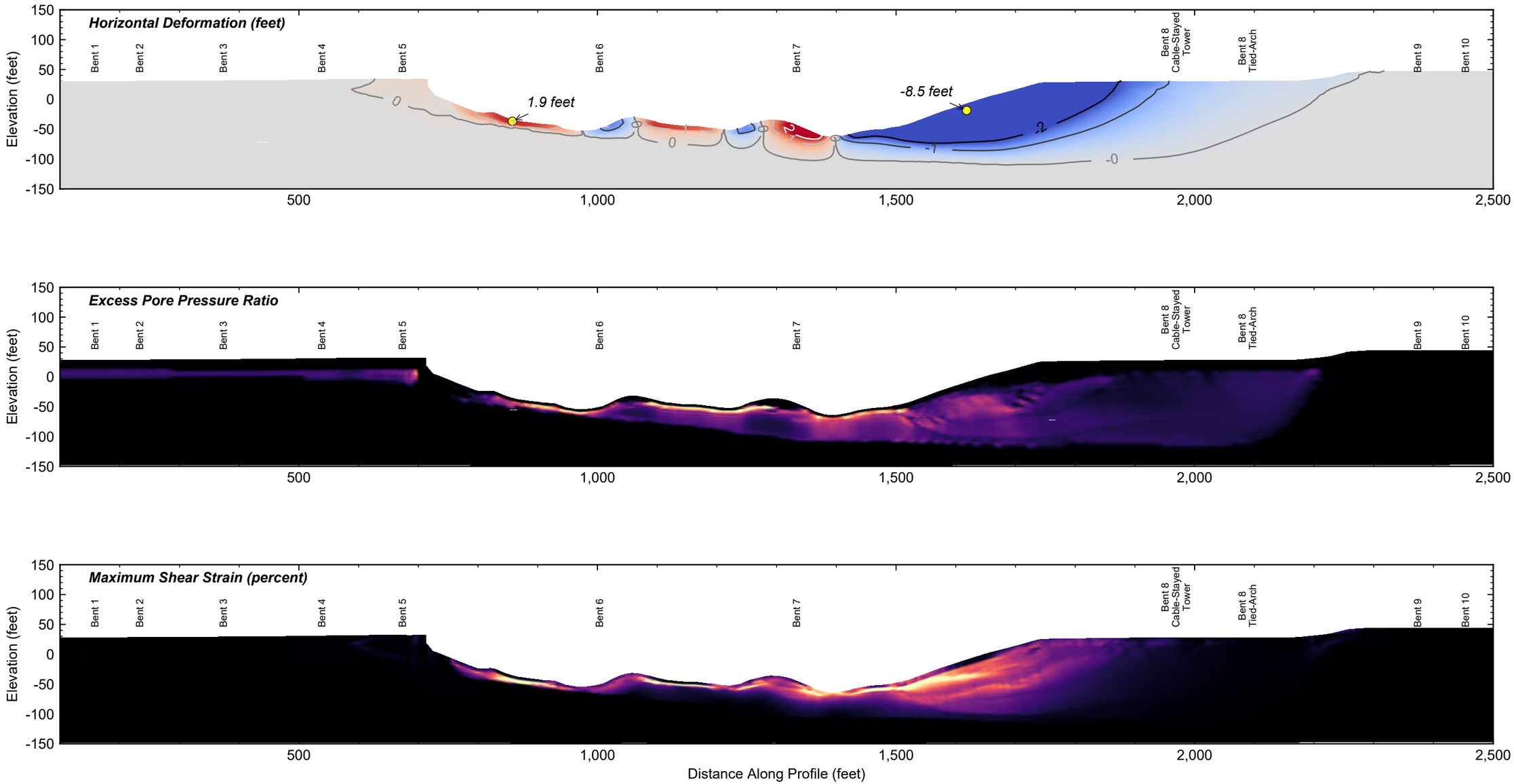
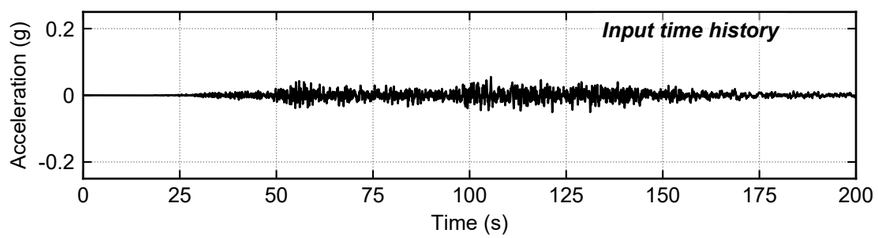
FIG. H-32

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
TOHOKU - YMTH05

April 2022 102636-009

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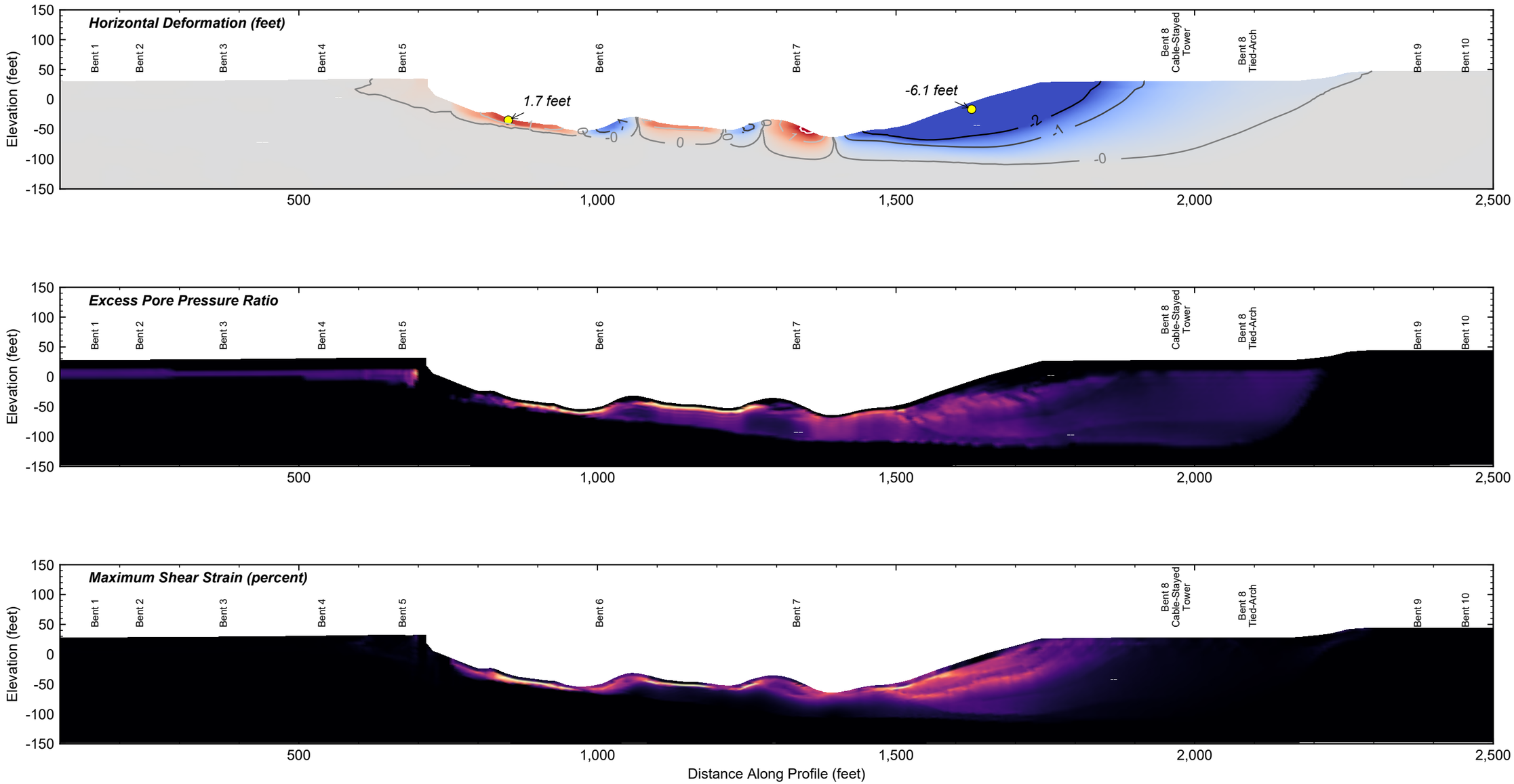
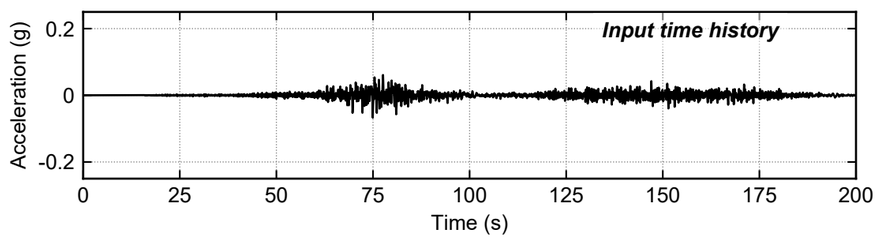
FIG. H-33

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
M9 PROJECT - CSZ005

April 2022 102636-009

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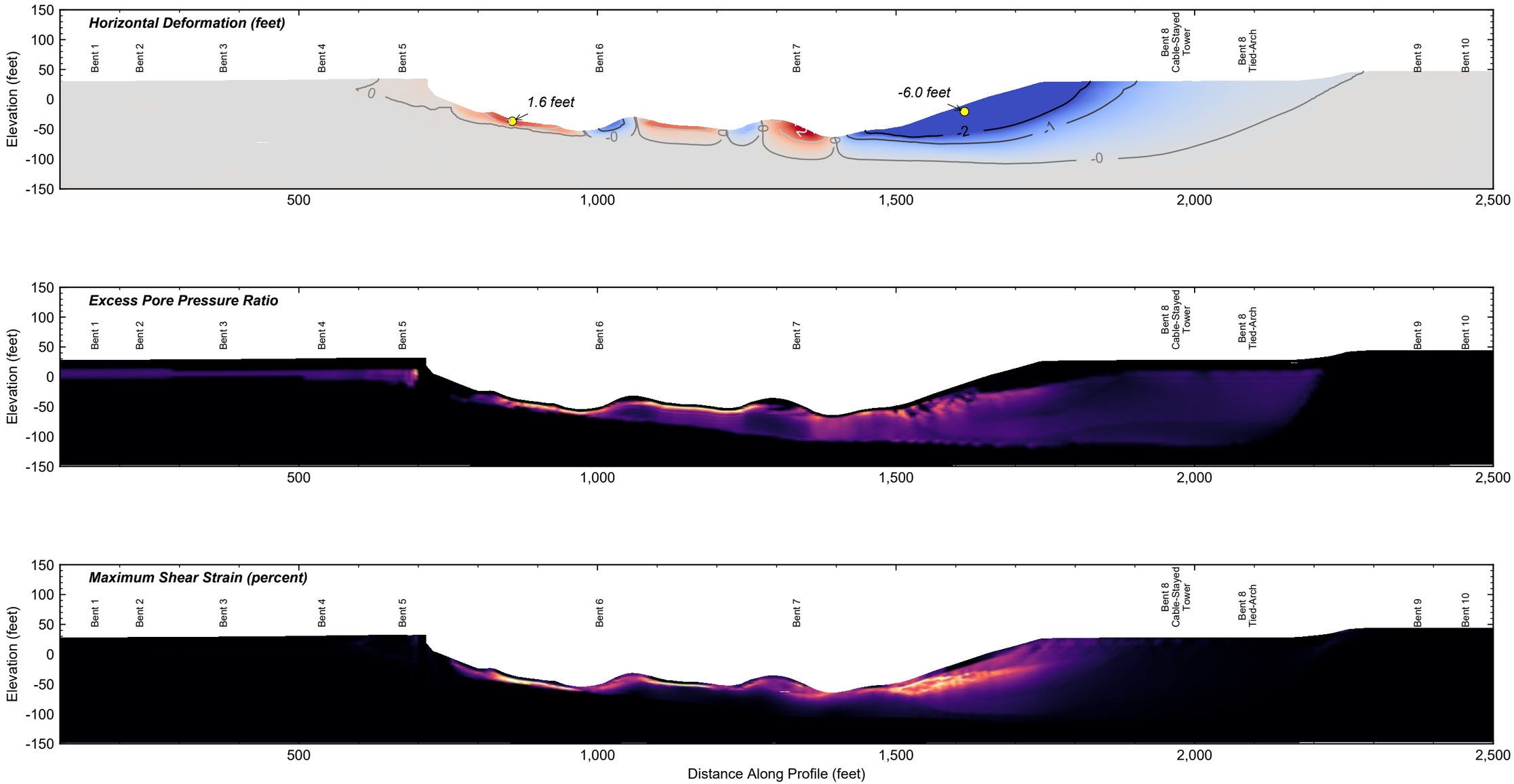
Geotechnical and Environmental Consultants

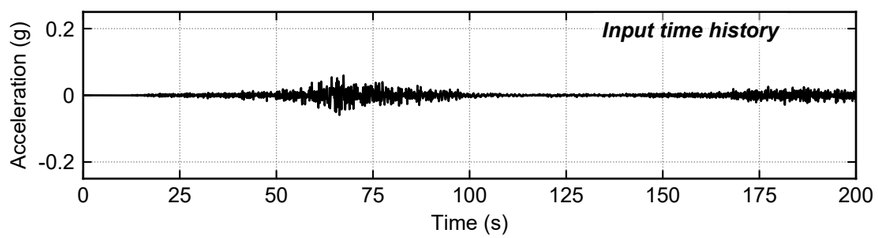
FIG. H-34

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
M9 PROJECT - CSZ018

April 2022 102636-009

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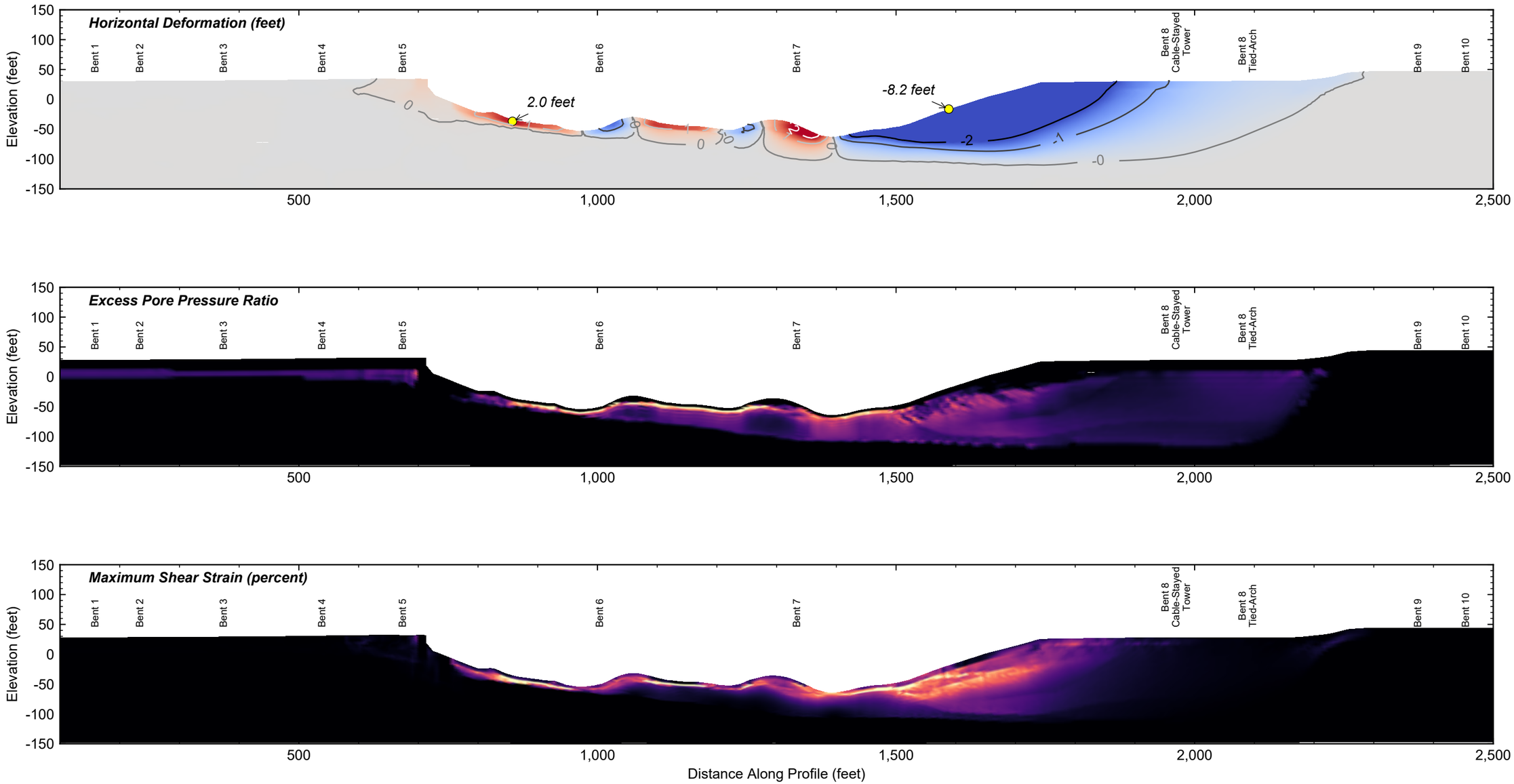
Geotechnical and Environmental Consultants

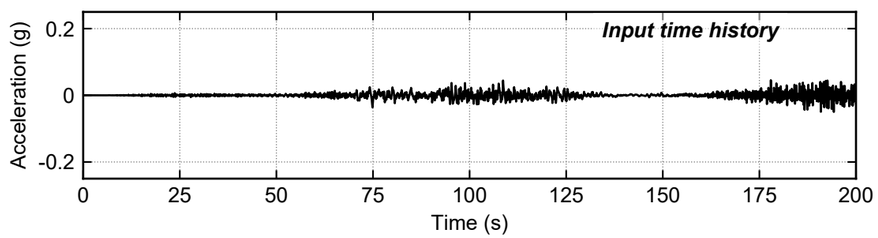
FIG. H-35

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
M9 PROJECT - CSZ024

April 2022 102636-009

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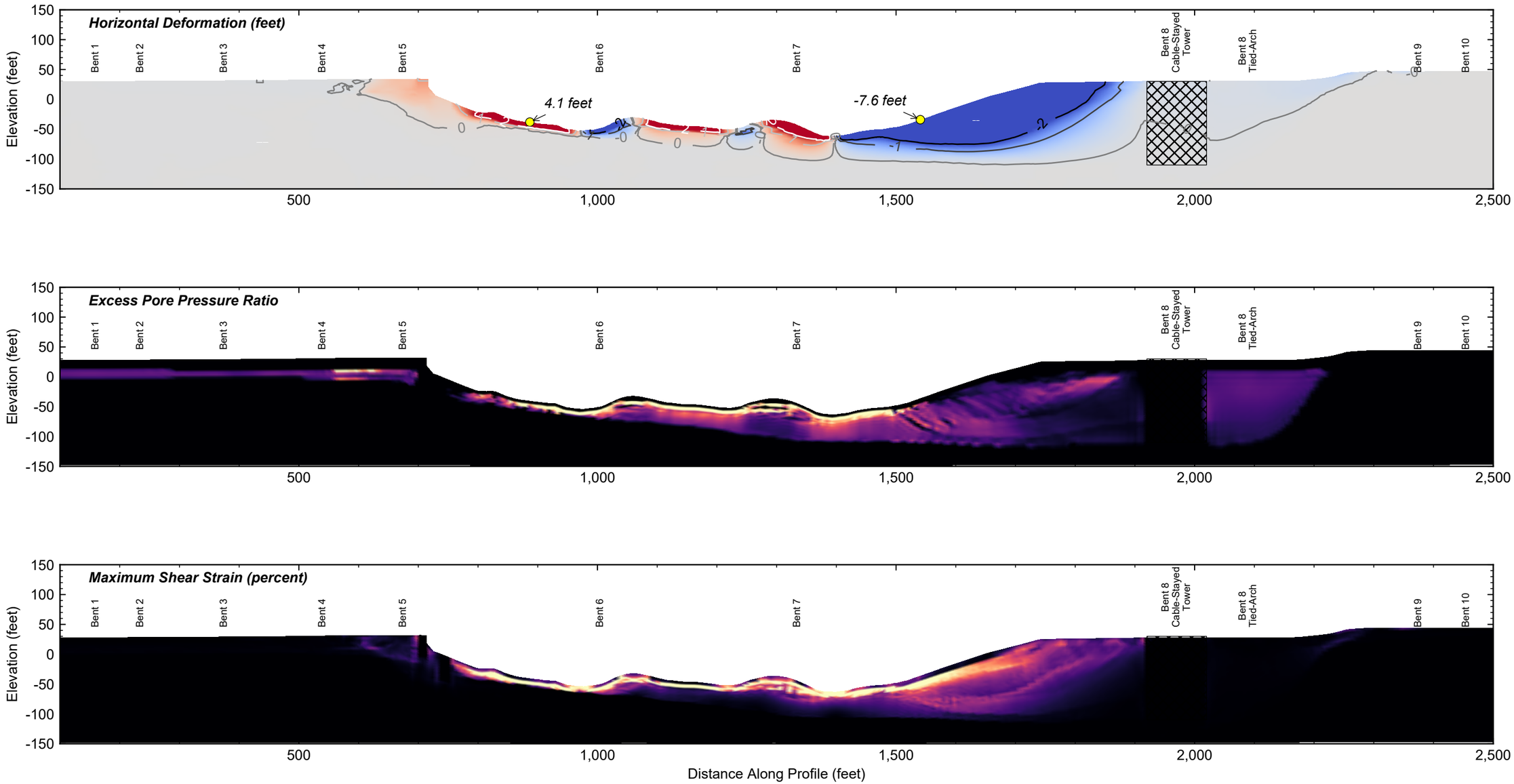
Geotechnical and Environmental Consultants

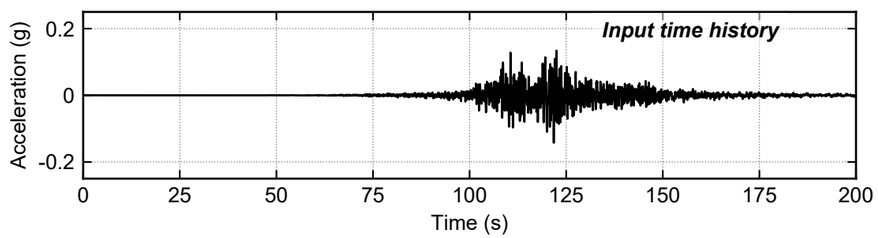
FIG. H-36

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE WITH GI EFFECTIVE STRESS ANALYSIS 1,000-YEAR PROBABILISTIC MAULE - LA PLANTINA

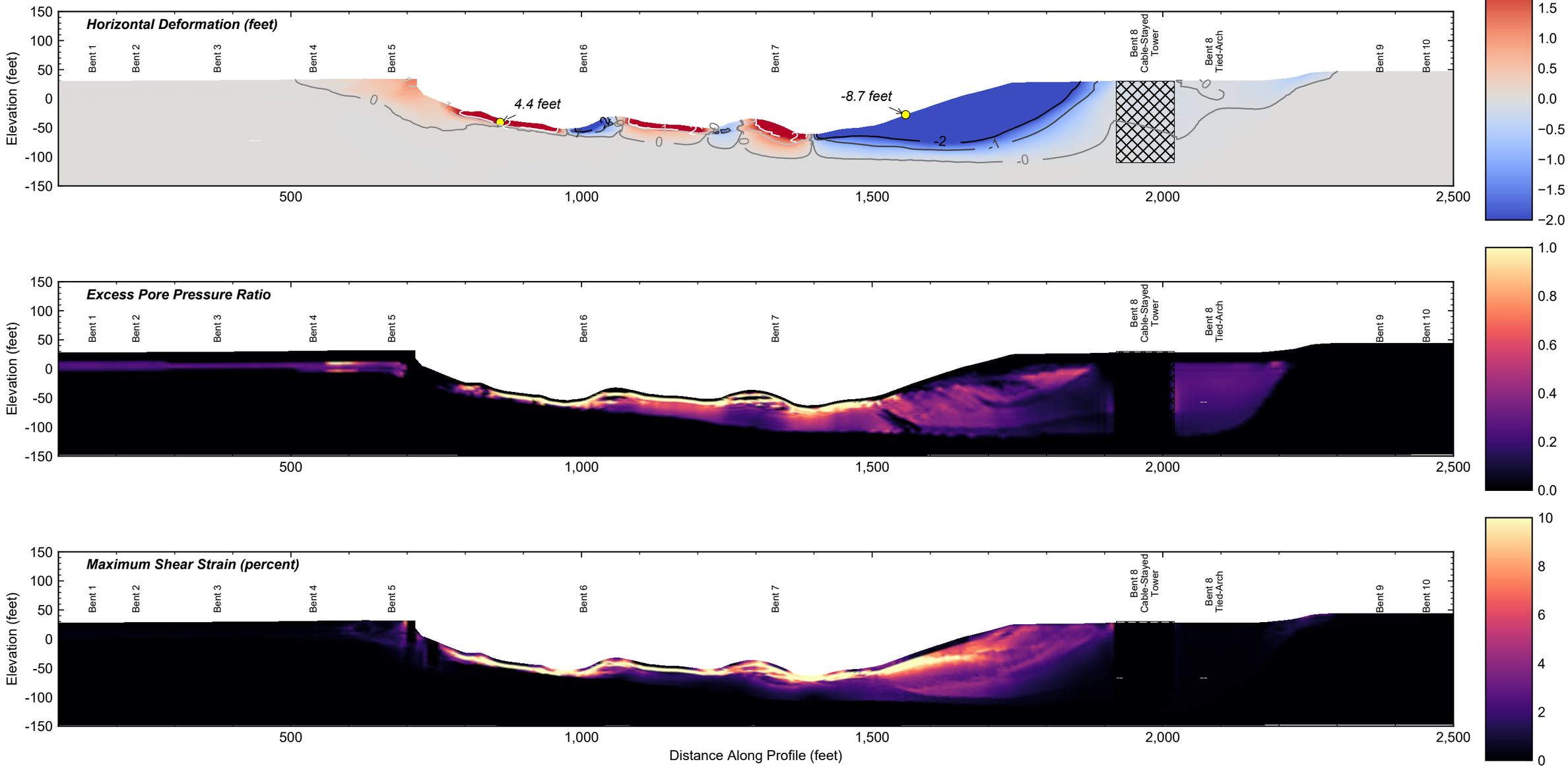
April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

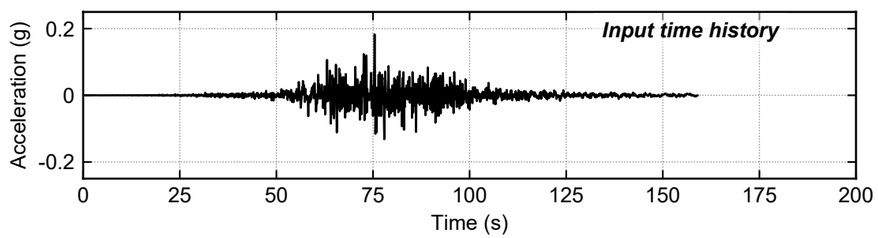
FIG. H-37

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE WITH GI EFFECTIVE STRESS ANALYSIS 1,000-YEAR PROBABILISTIC MAULE - CERRO ST LUCIA

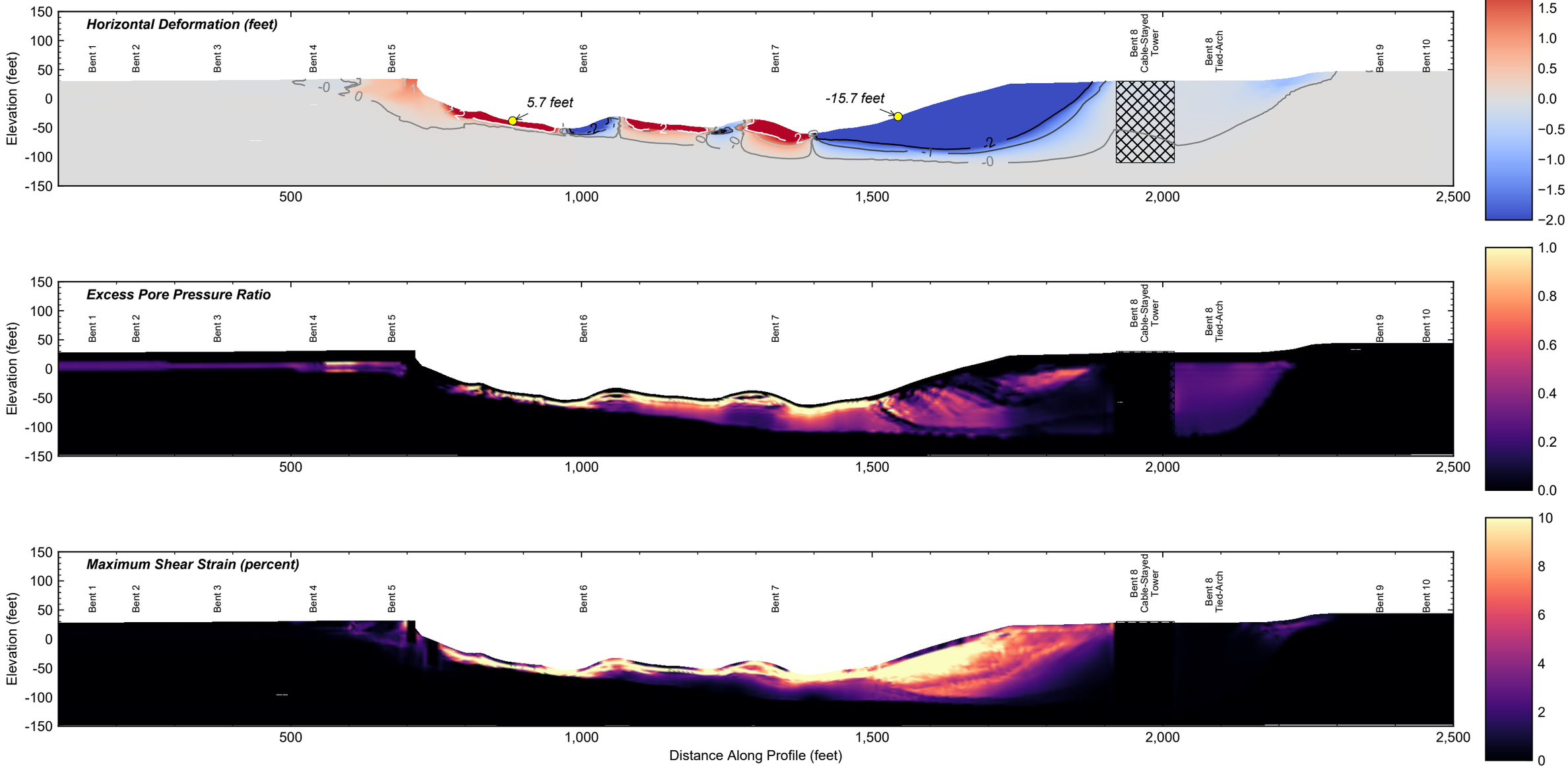
April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

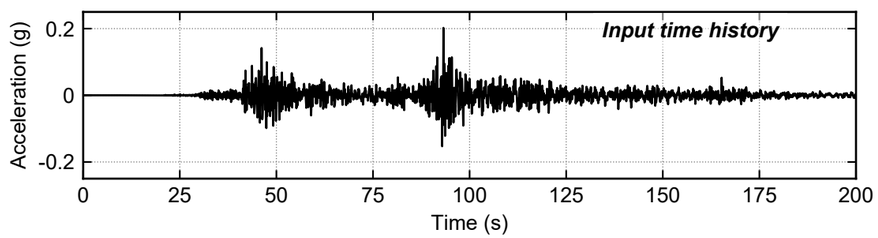
FIG. H-38

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE WITH GI EFFECTIVE STRESS ANALYSIS 1,000-YEAR PROBABILISTIC TOHOKU - MYG009

April 2022 102636-009

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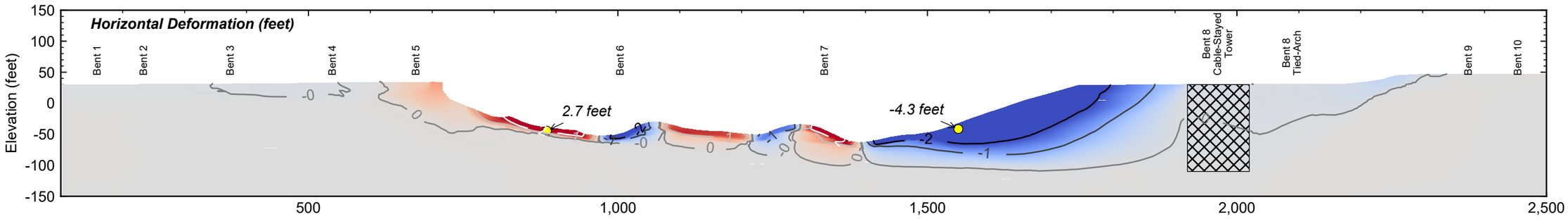
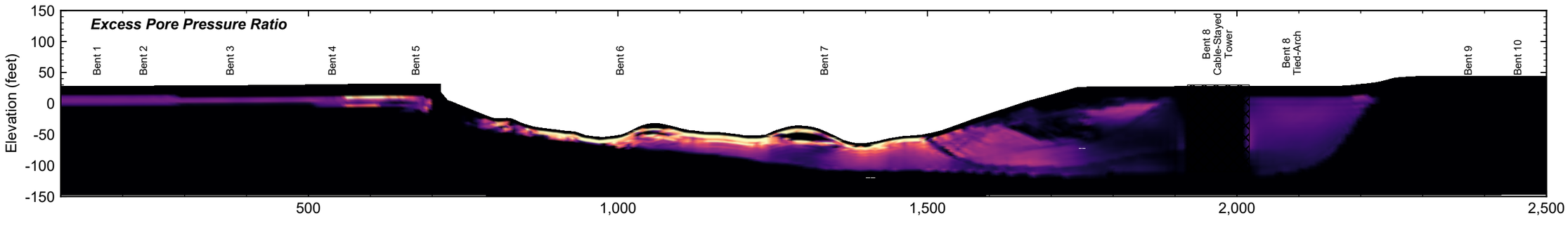
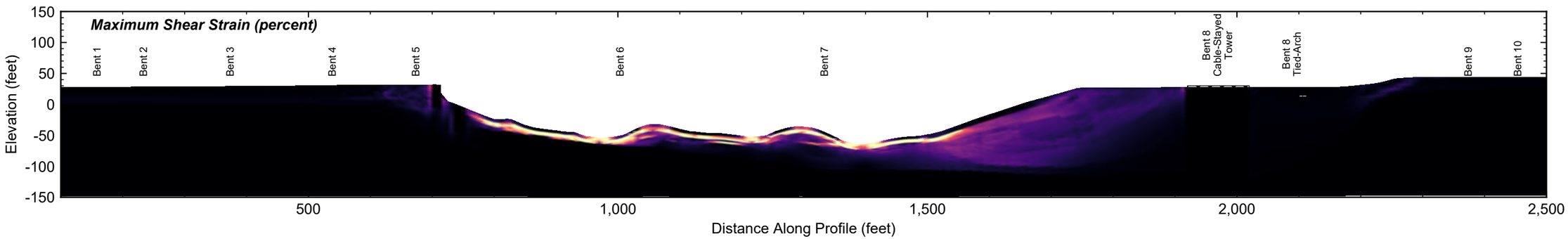
FIG. H-39

C:\ FLACPROCESS\Burnside

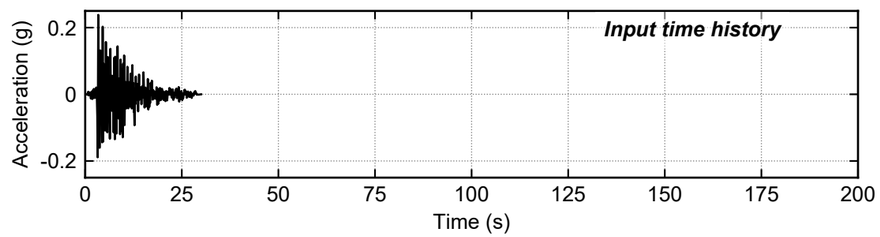
ver:0.11.1.post8.dev0+gf486e7d.by:SSS







Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE WITH GI EFFECTIVE STRESS ANALYSIS 1,000-YEAR PROBABILISTIC NORTHRIDGE - BURBANK

April 2022 102636-009

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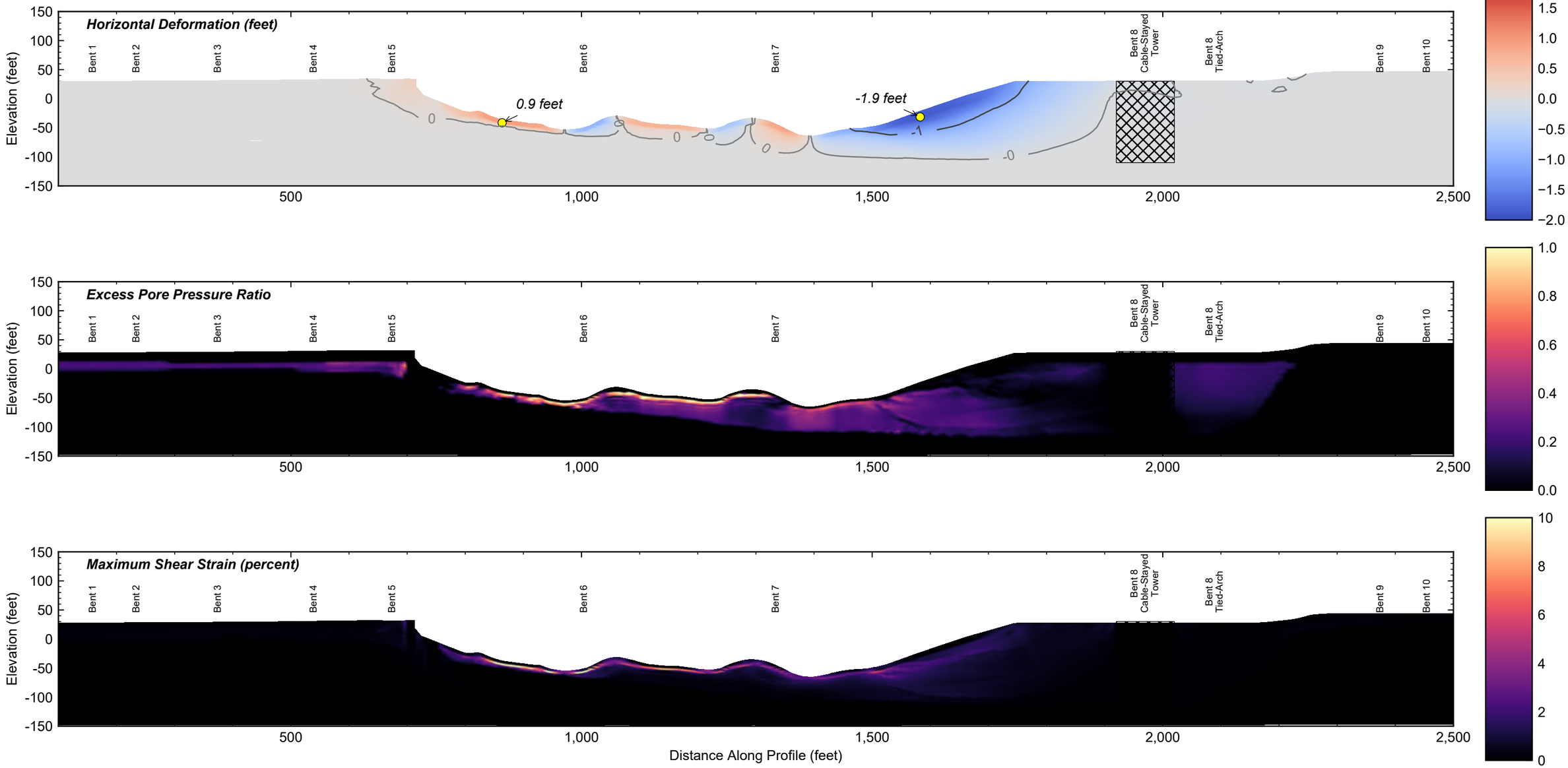
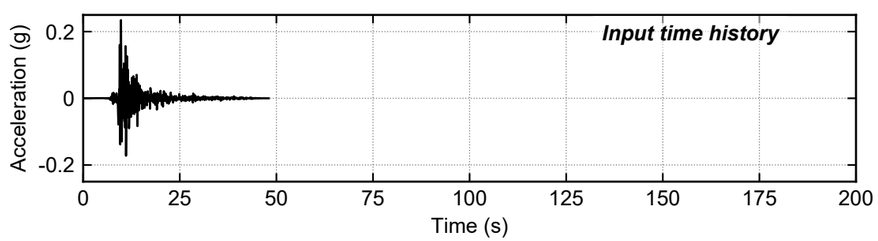
FIG. H-40

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE WITH GI EFFECTIVE STRESS ANALYSIS 1,000-YEAR PROBABILISTIC CHRISTCHURCH - MQZ

April 2022 102636-009

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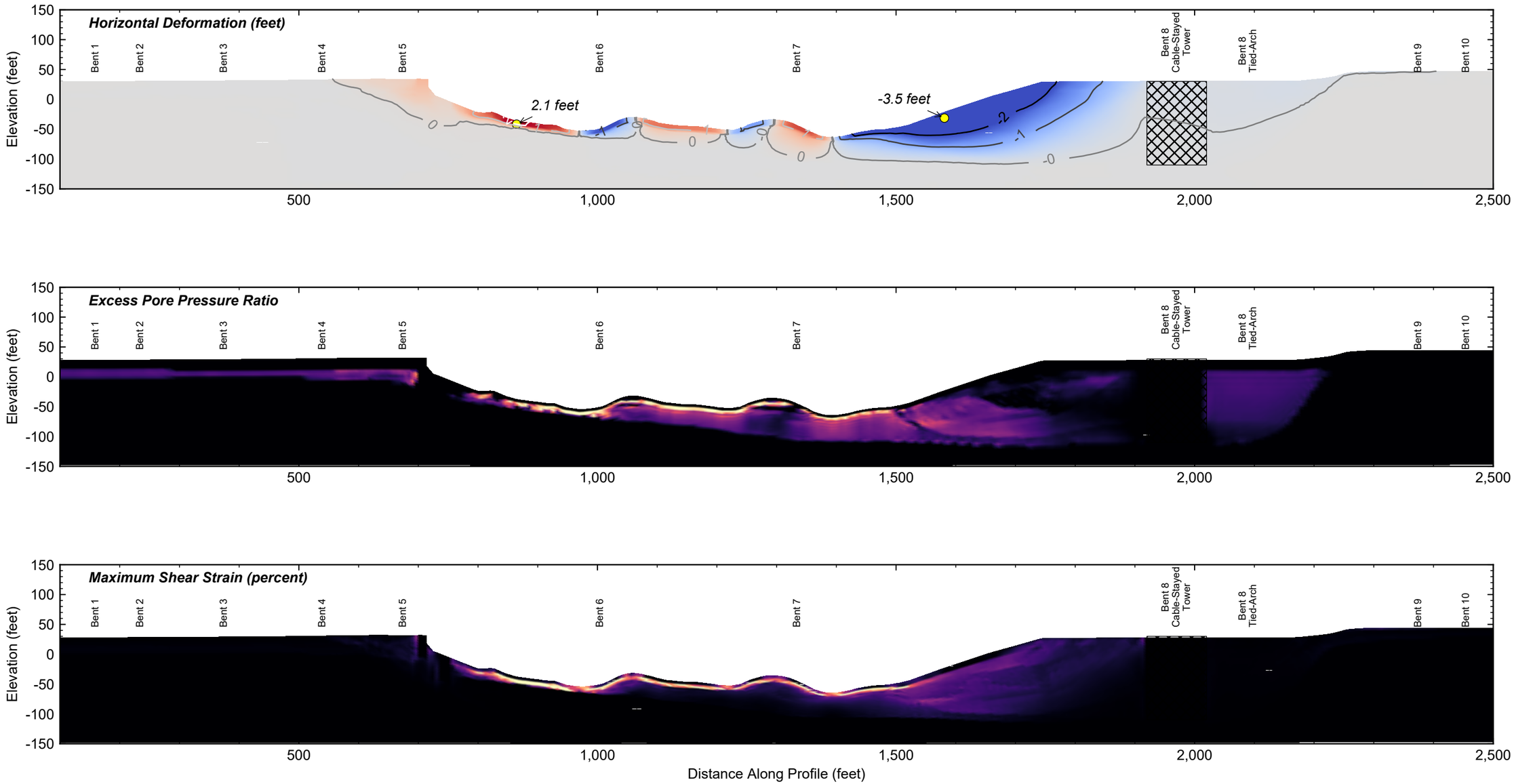
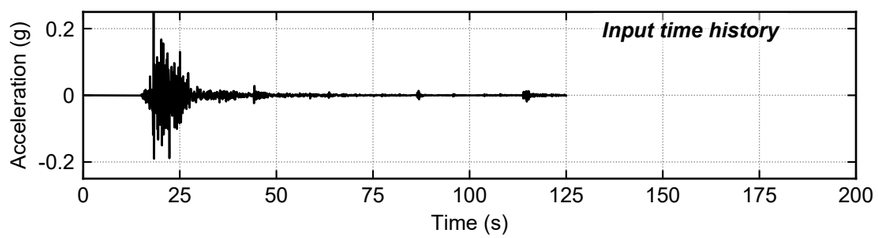
FIG. H-41

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE WITH GI EFFECTIVE STRESS ANALYSIS 1,000-YEAR PROBABILISTIC NIIGATA - NIGH12

April 2022 102636-009

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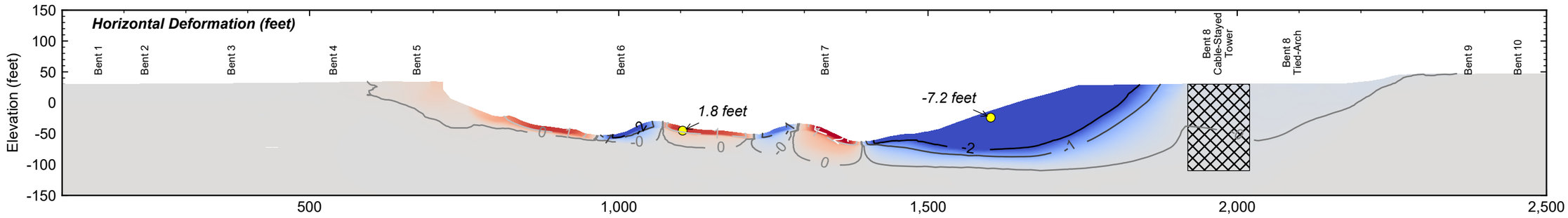
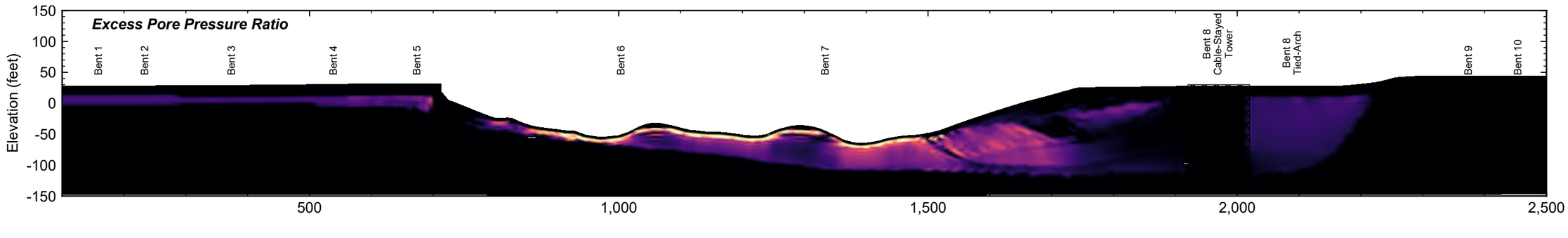
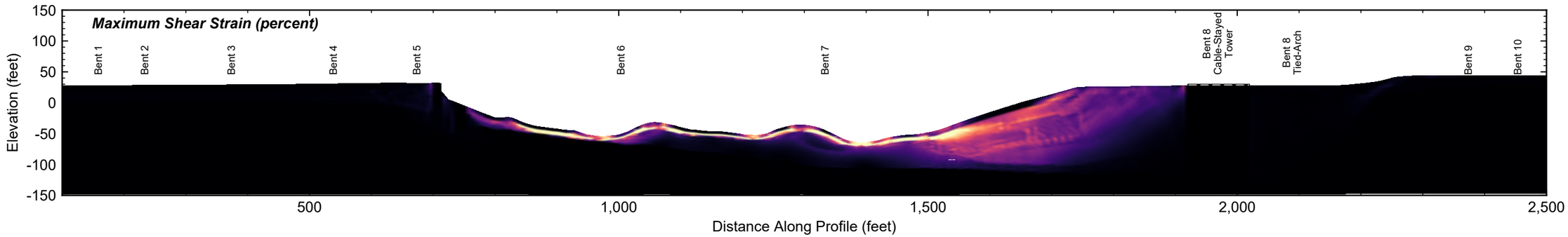
FIG. H-42

C:\ FLACPROCESS\Burnside

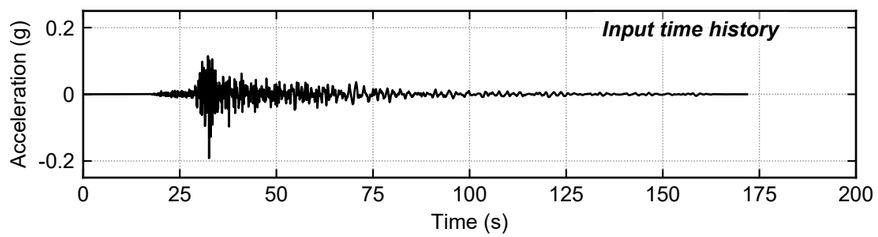
ver:0.11.1.post8.dev0+gf486e7d.by:SSS







Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE WITH GI EFFECTIVE STRESS ANALYSIS 1,000-YEAR PROBABILISTIC NISQUALLY - BEVT

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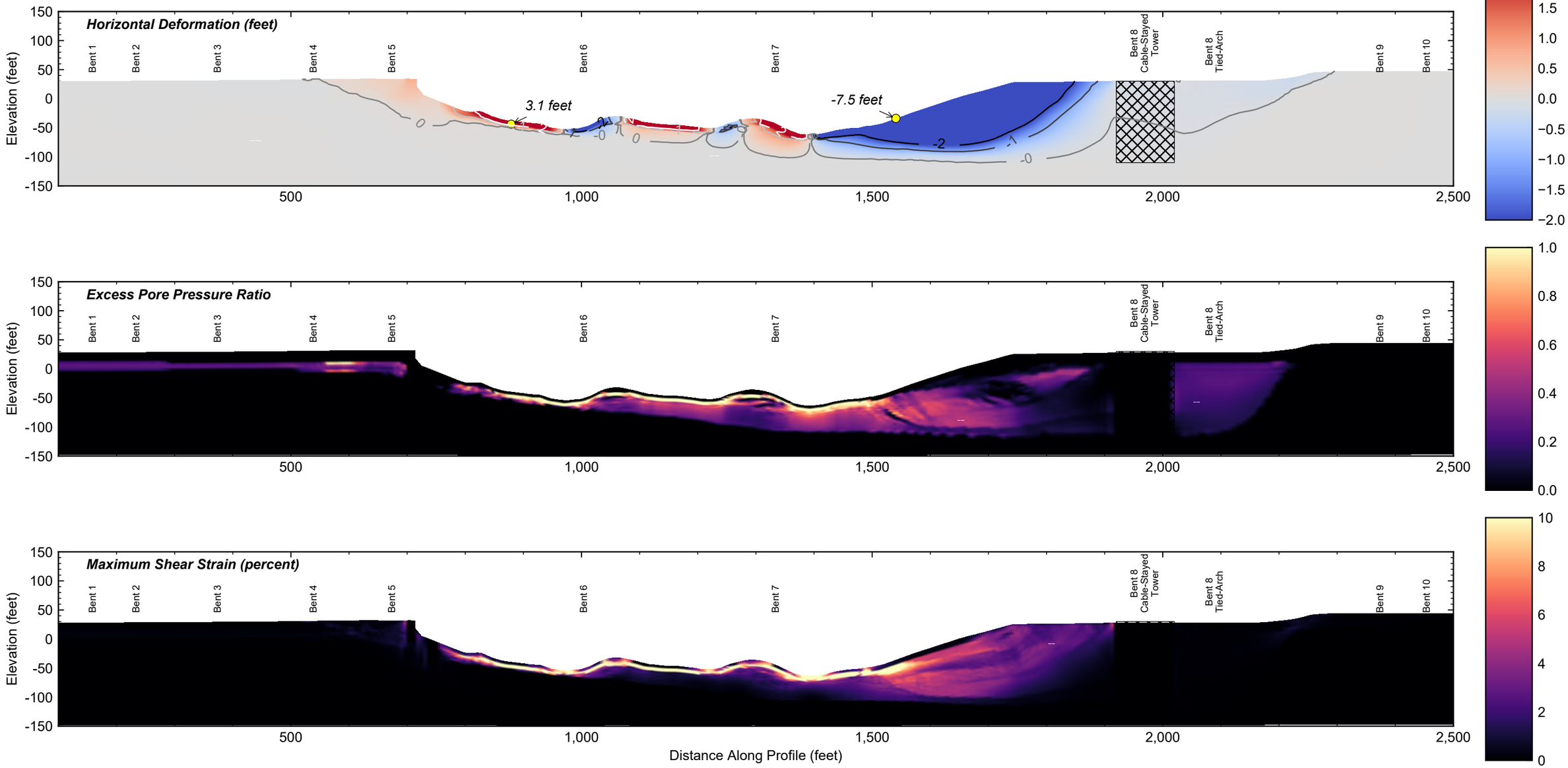
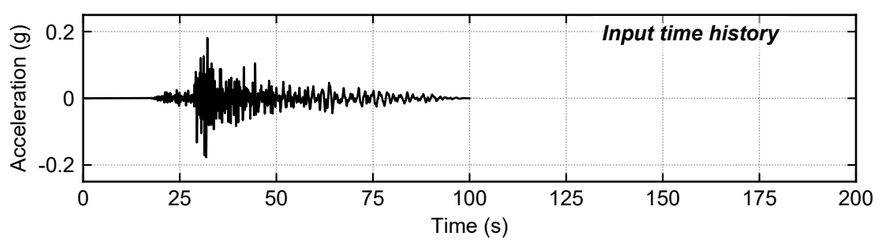
FIG. H-43

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE WITH GI EFFECTIVE STRESS ANALYSIS 1,000-YEAR PROBABILISTIC NISQUALLY - EARN

April 2022 102636-009

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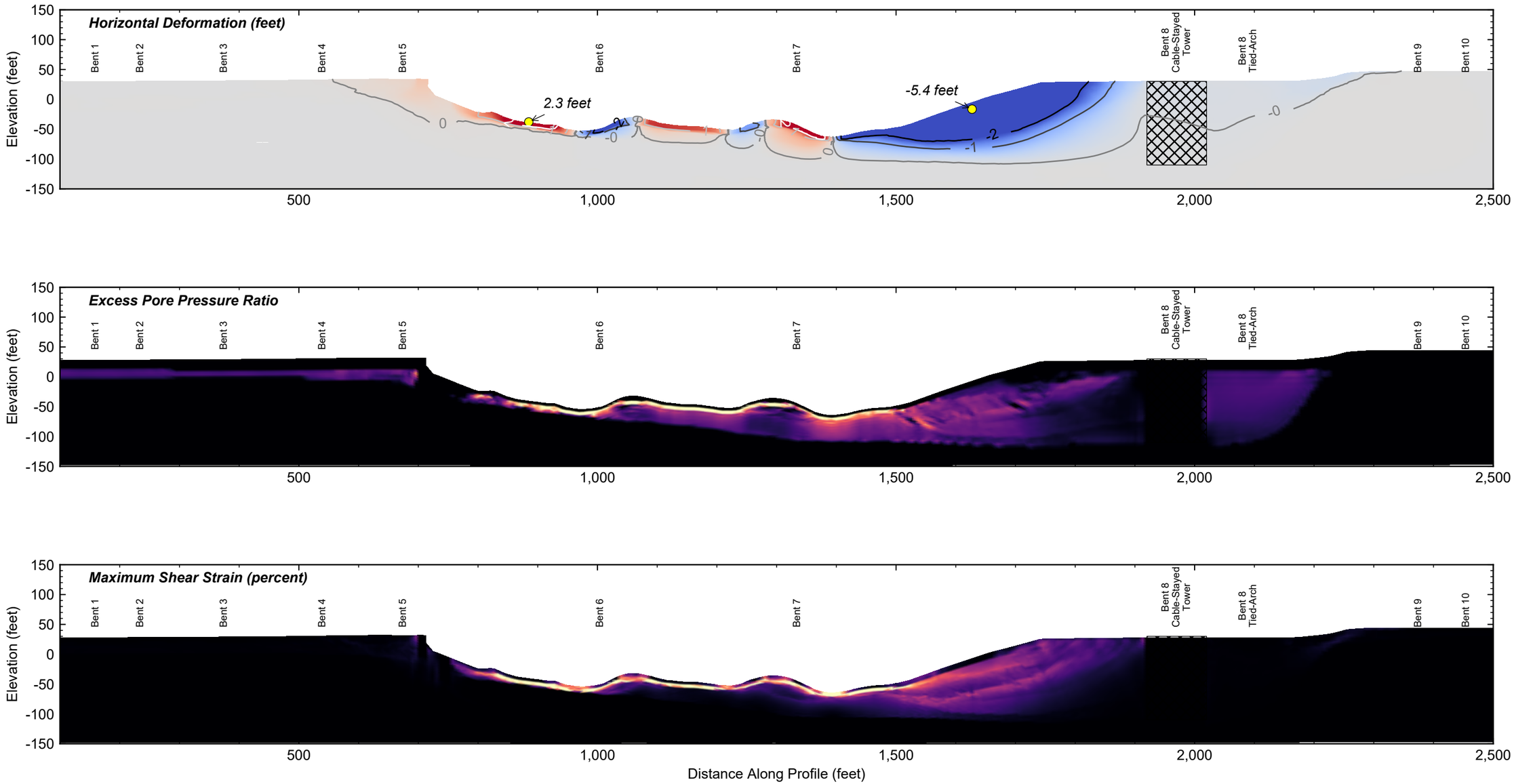
Geotechnical and Environmental Consultants

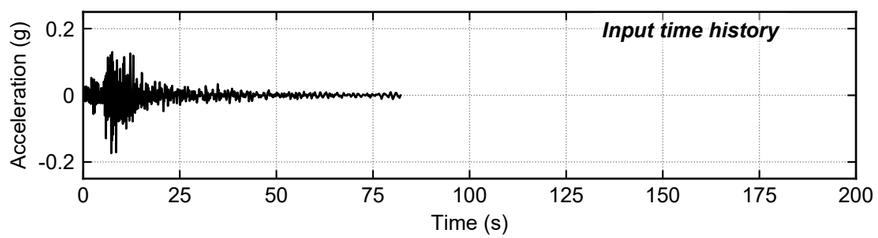
FIG. H-44

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The plots are shown at an exageration of 1 Vertical:1 Horizontal (no exageration).
2. Results represent end of simulation conditions.
3. s = seconds
   fps = feet per second



Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE WITH GI EFFECTIVE STRESS ANALYSIS 1,000-YEAR PROBABILISTIC WESTERN WA 1965 - OLYMPIA

April 2022 102636-009

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FIG. H-45

C:\ FLACPROCESS\Burnside

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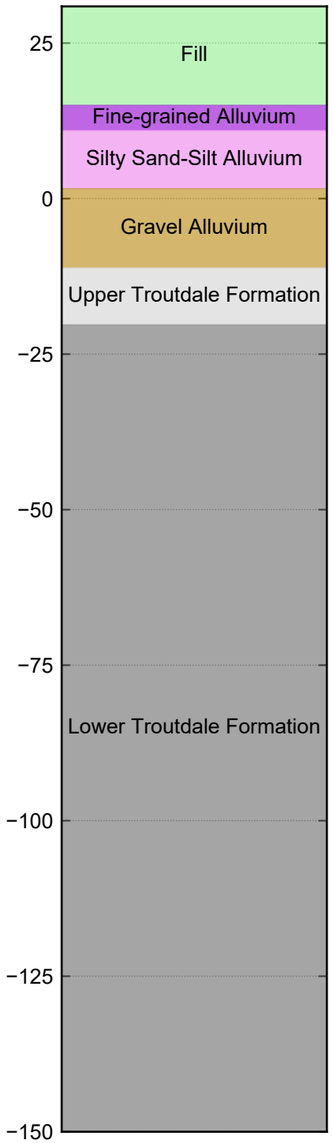
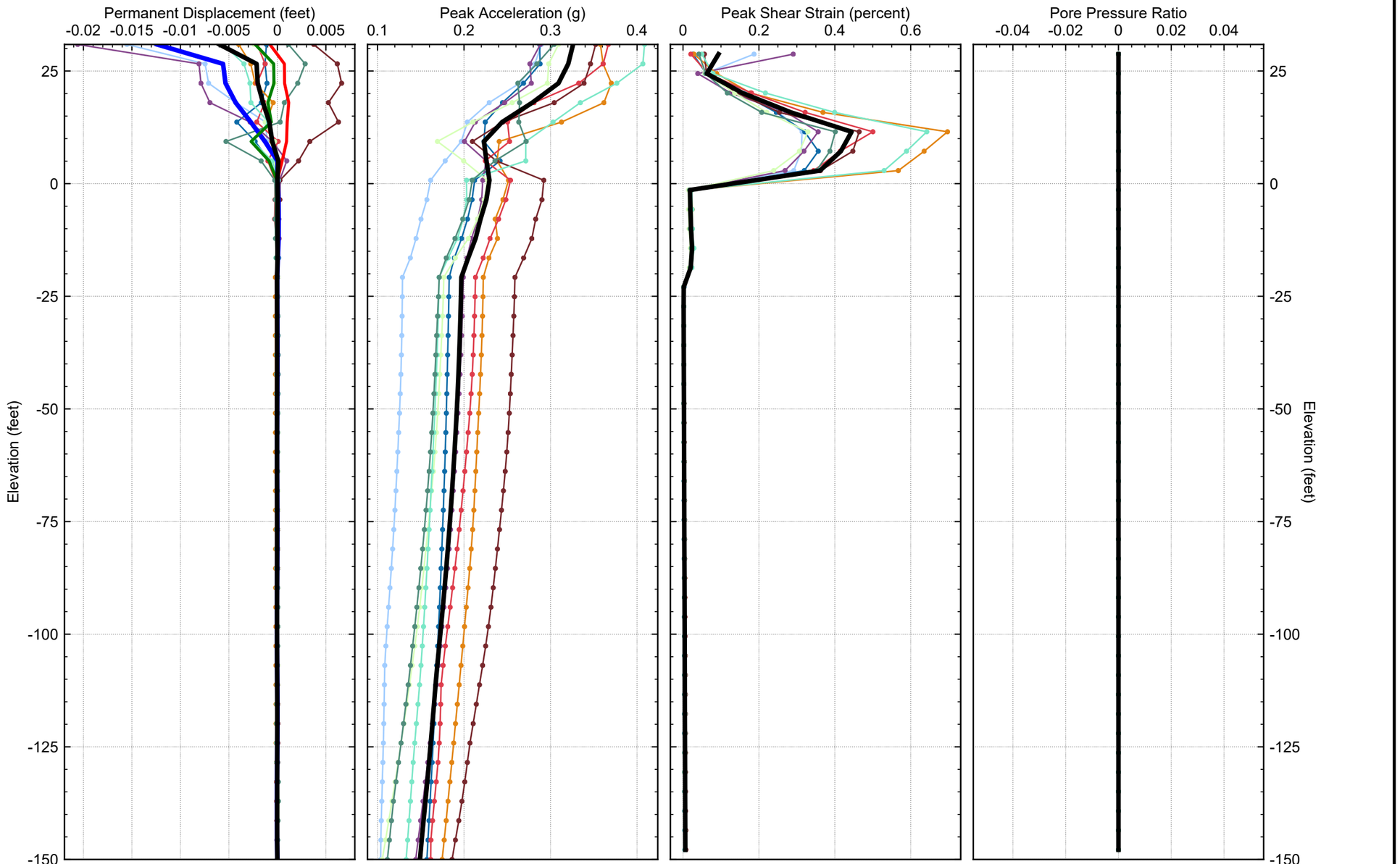
Bent 1
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
1,000-YEAR PROBABILISTIC
BENT 1

April 2022 102636-009

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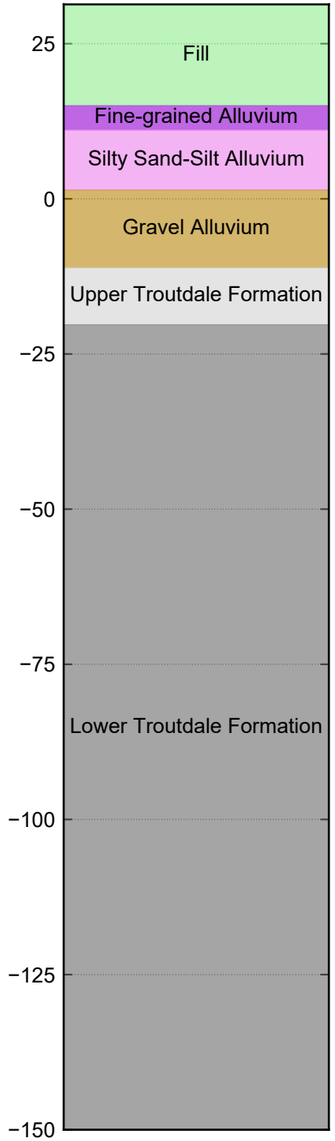
Geotechnical and Environmental Consultants

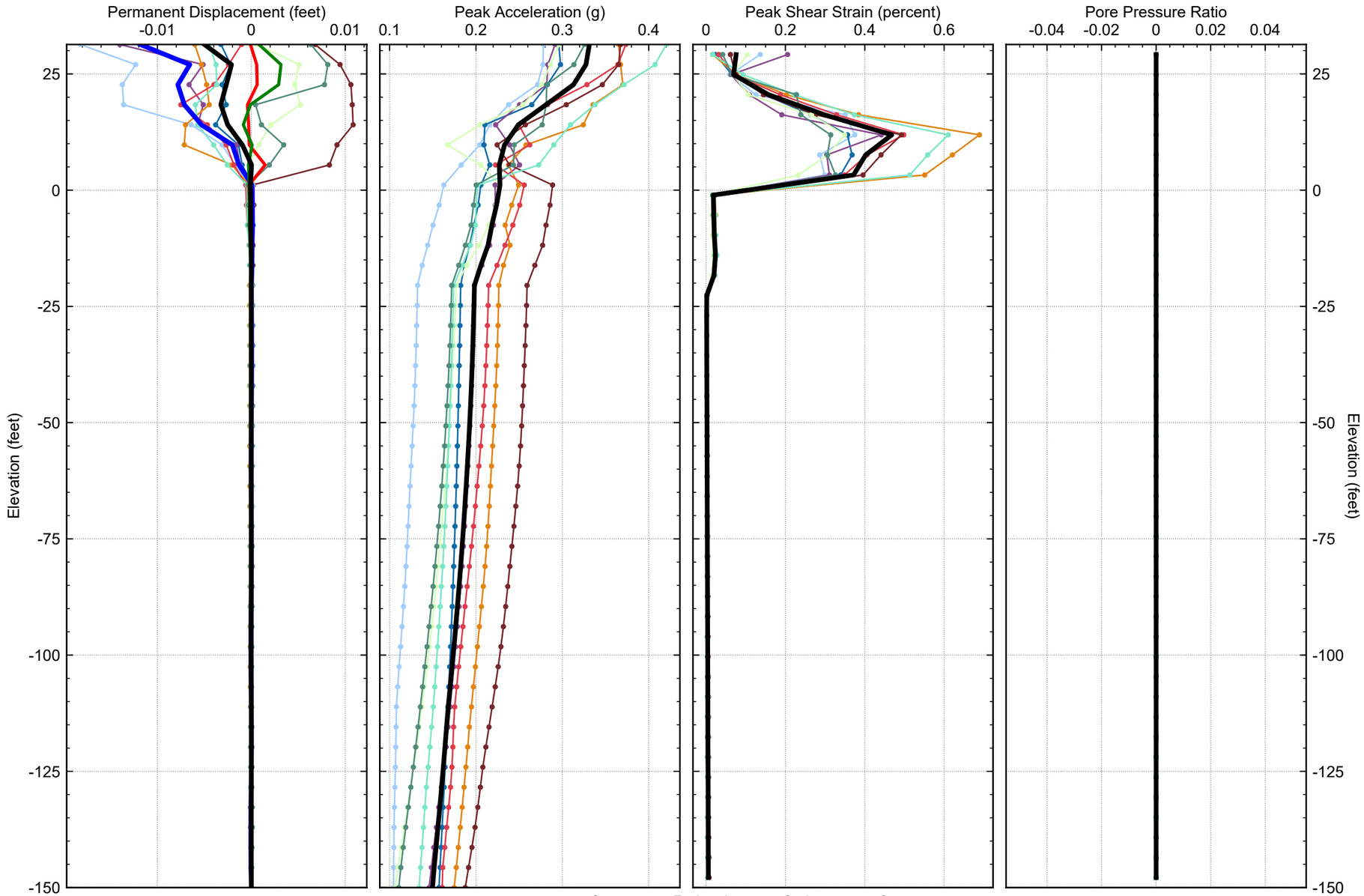
FIG. H-46

C:_FLAC\PROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 2
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
1,000-YEAR PROBABILISTIC
BENT 2

April 2022 102636-009

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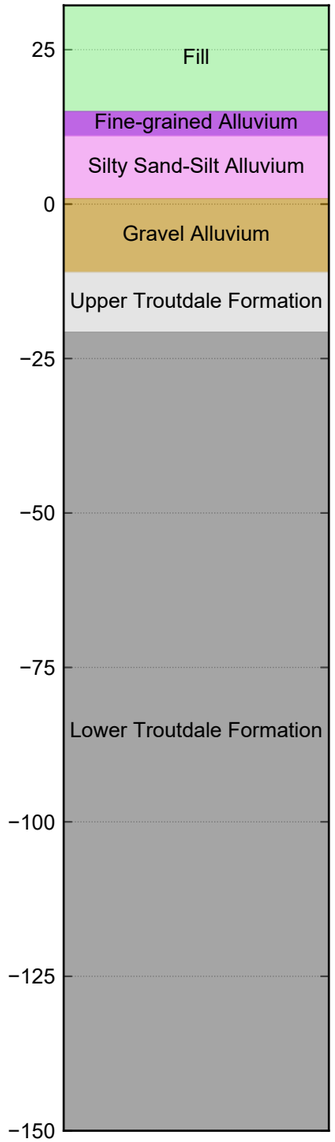
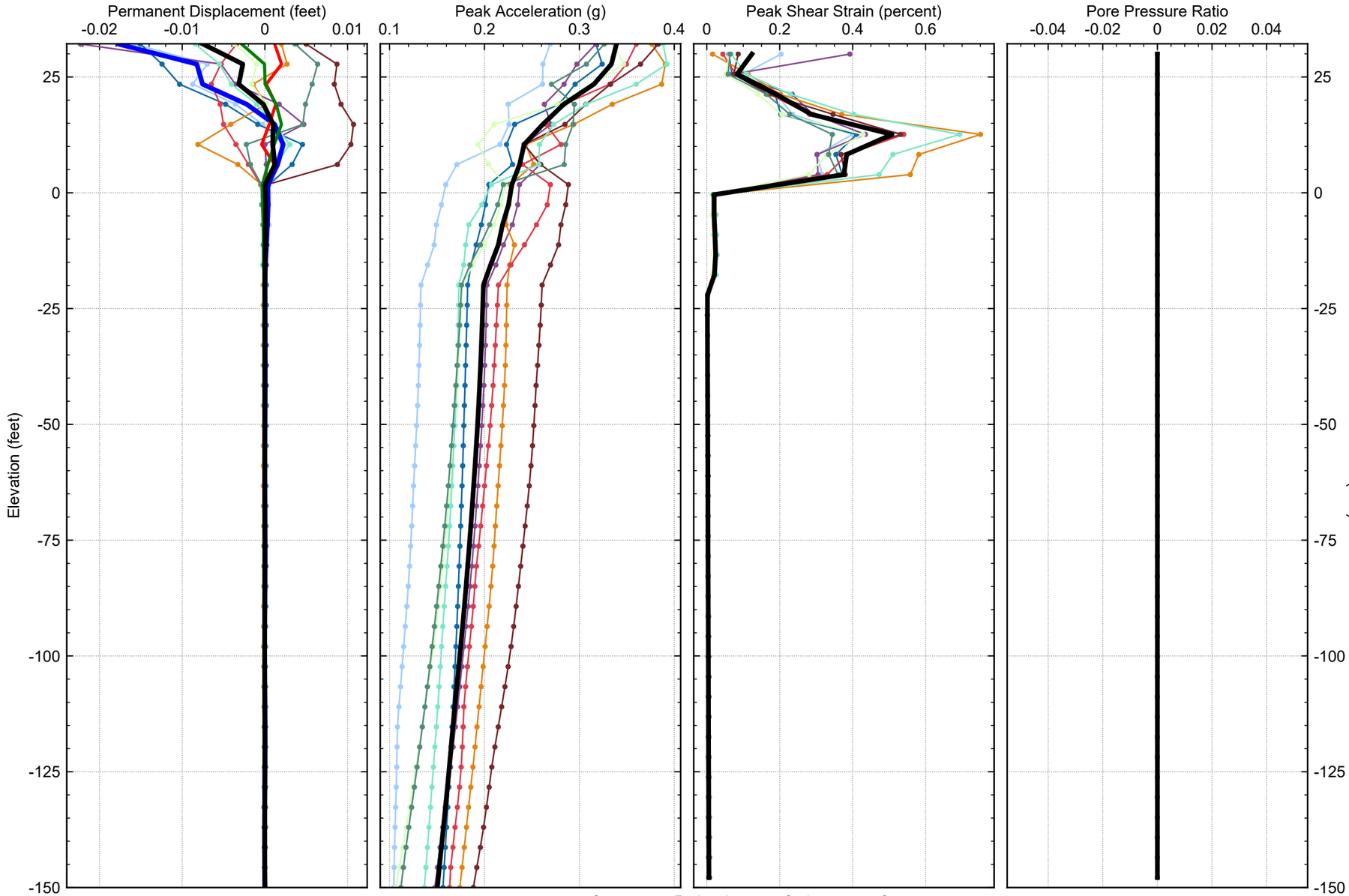
FIG. H-47

C:_FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 3
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.
CSZ Motion Average			
CRUSTAL Motion Average			
SLAB Motion Average			
All Motion Average (see notes)			

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
1,000-YEAR PROBABILISTIC
BENT 3

April 2022 102636-009

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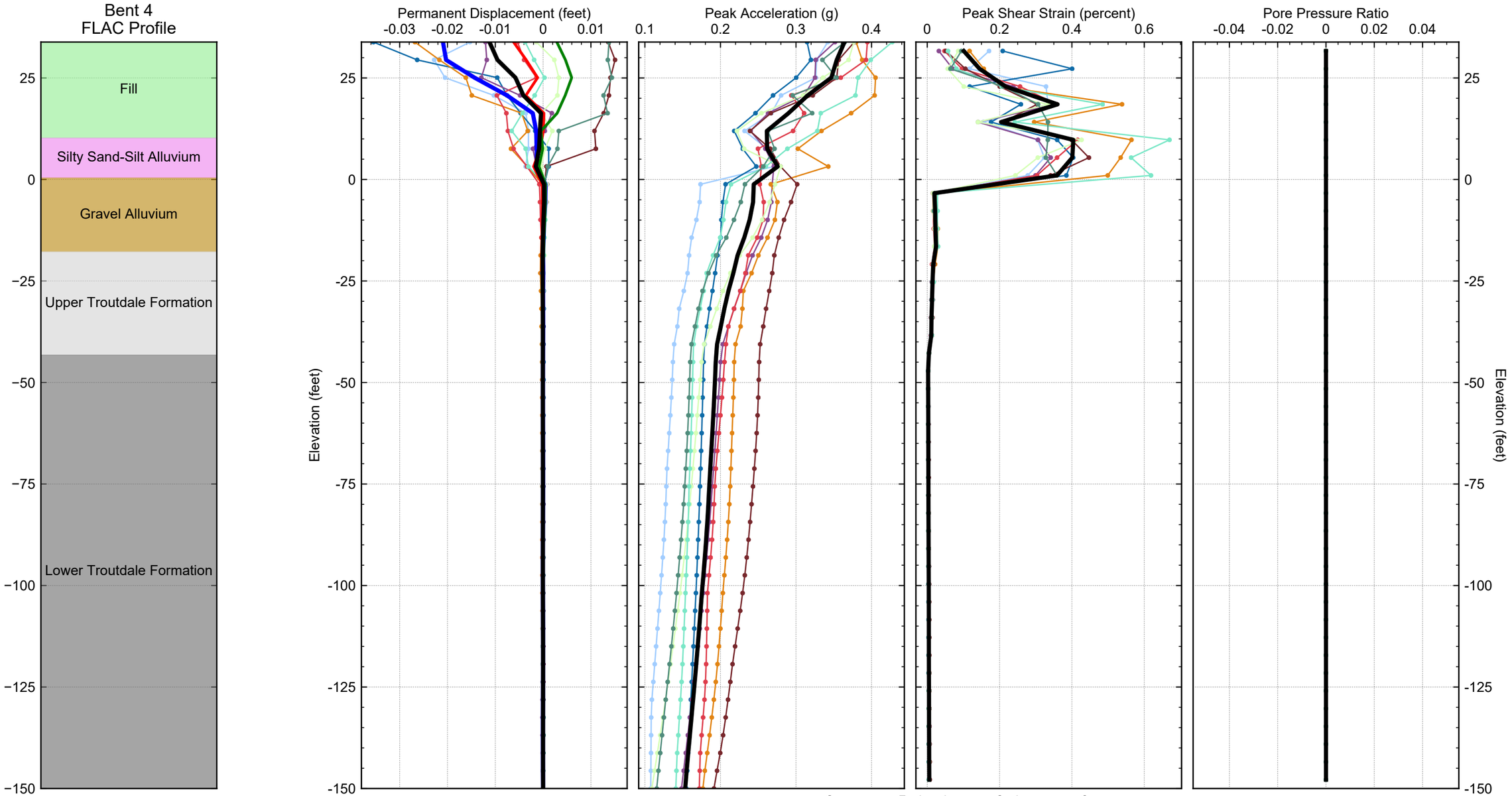
FIG. H-48

C:_FLAC\PROCESS\Burnside

ver.0.11.1.post8.dev0+gf486e7d.by.SSS



Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
1,000-YEAR PROBABILISTIC
BENT 4

April 2022 102636-009

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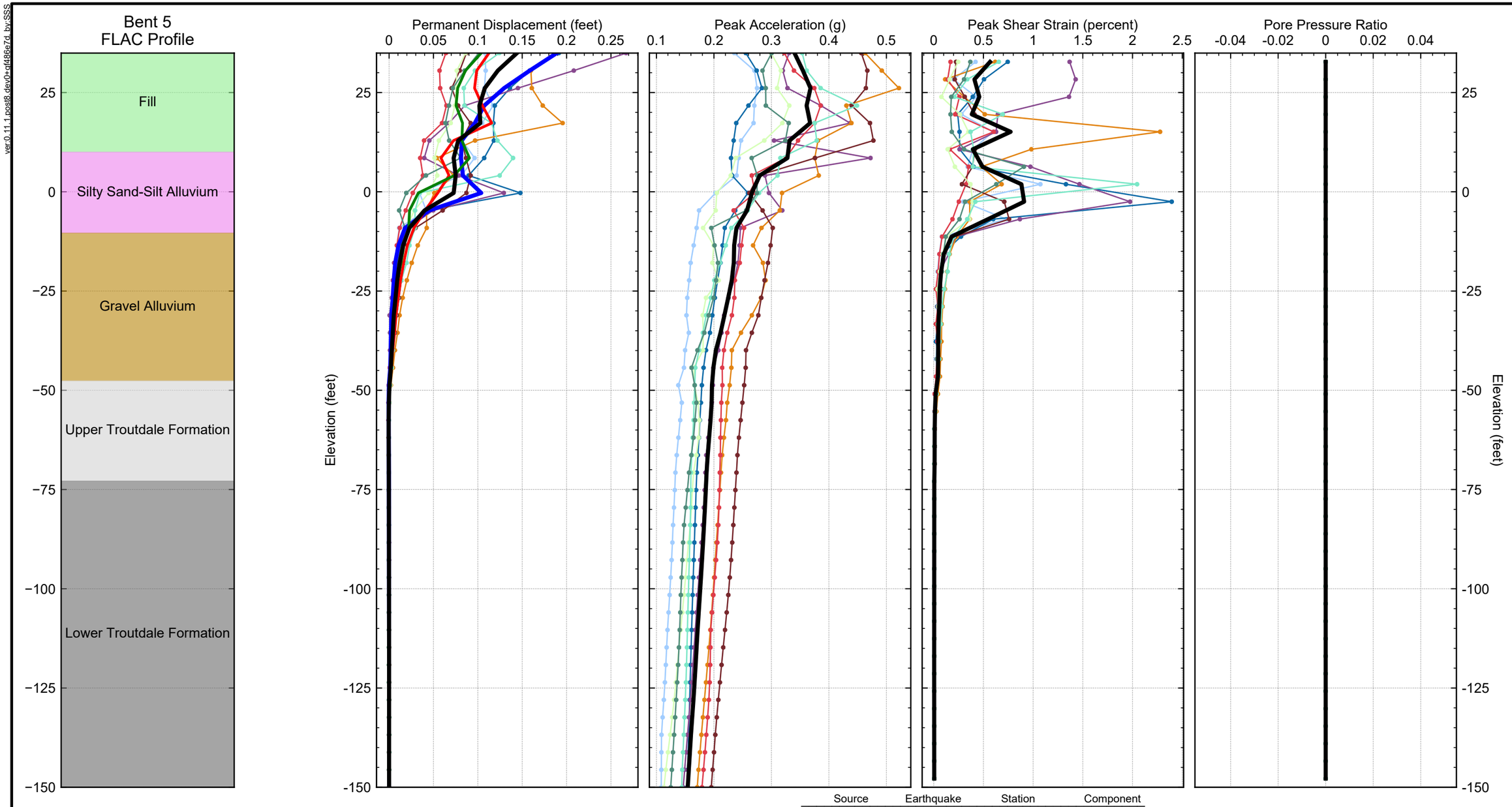
FIG. H-49

G:_FLAC\PROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
1,000-YEAR PROBABILISTIC
BENT 5

April 2022 102636-009

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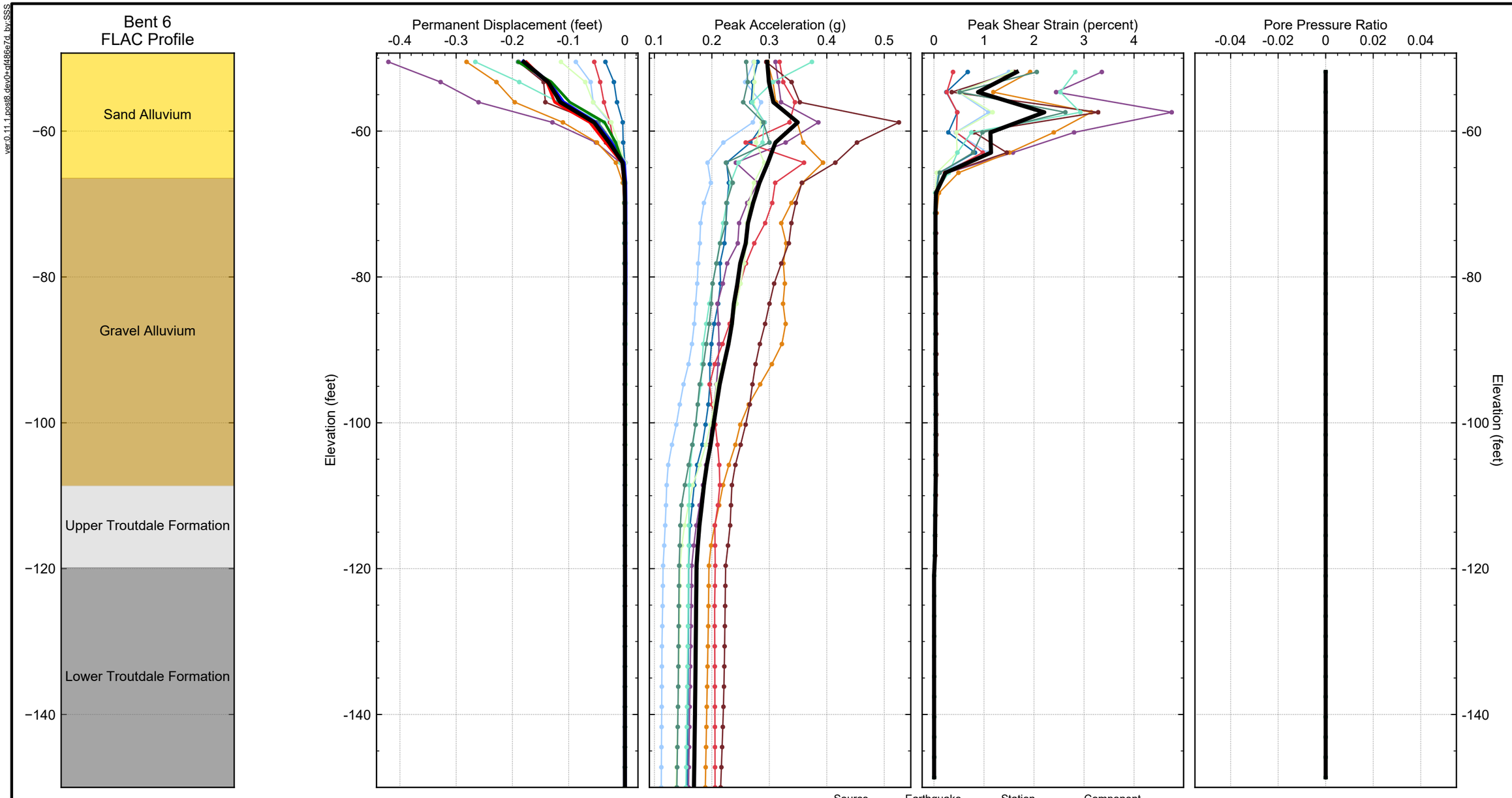
Geotechnical and Environmental Consultants

FIG. H-50

C:_FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.
CSZ Motion Average			
CRUSTAL Motion Average			
SLAB Motion Average			
All Motion Average (see notes)			

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
1,000-YEAR PROBABILISTIC
BENT 6

April 2022 102636-009

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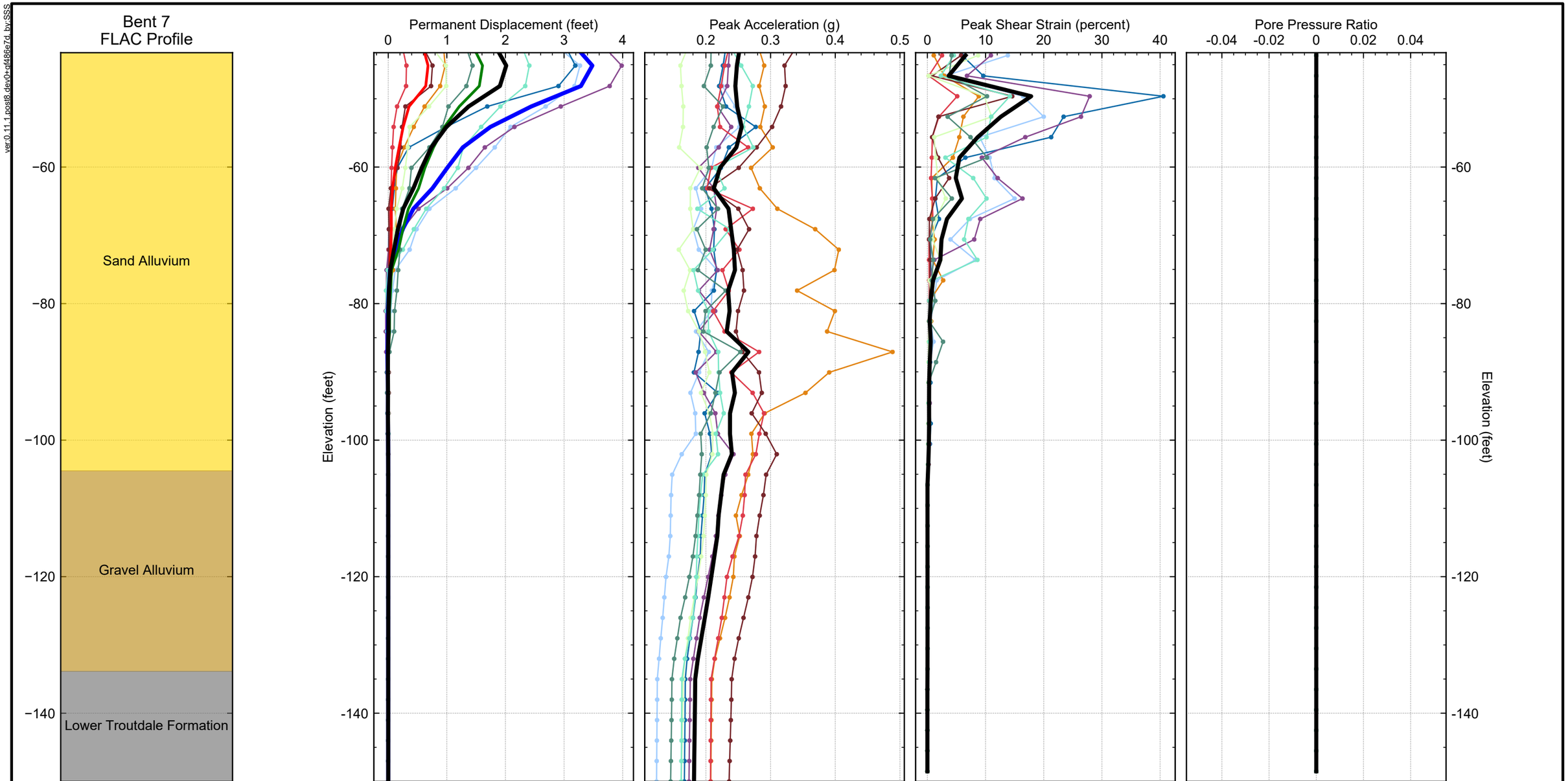
FIG. H-51

C:_FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
1,000-YEAR PROBABILISTIC
BENT 7

April 2022 102636-009

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FIG. H-52

C:_FLAC\PROCESS\Burnside

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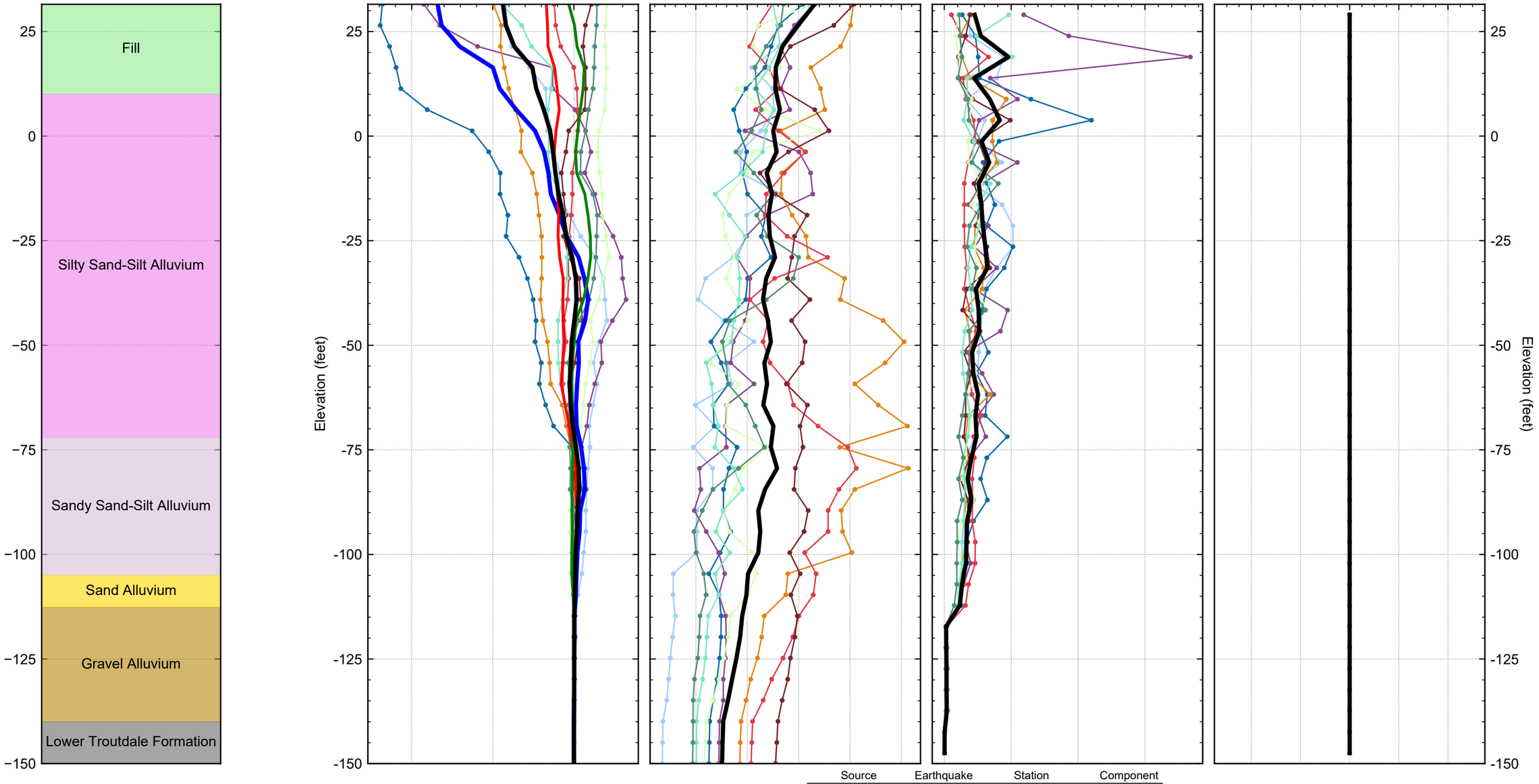

Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
1,000-YEAR PROBABILISTIC
BENT 8 CABLE-STAYED TOWER

April 2022 102636-009

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FIG. H-53

G:_FLAC\PROCESS\Burnside

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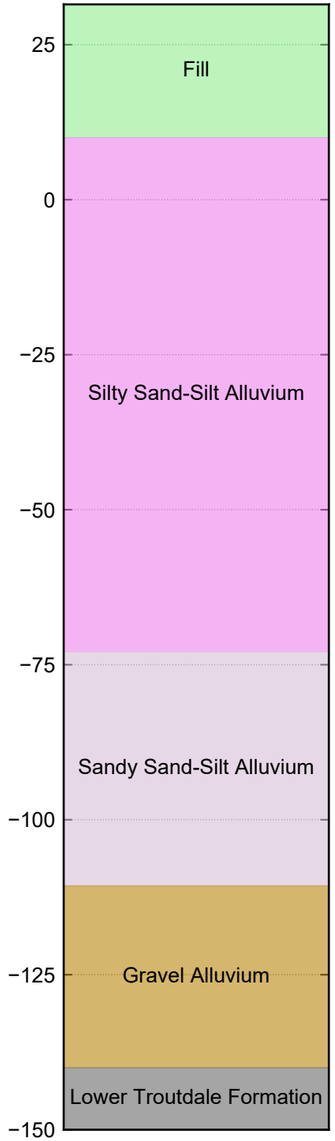
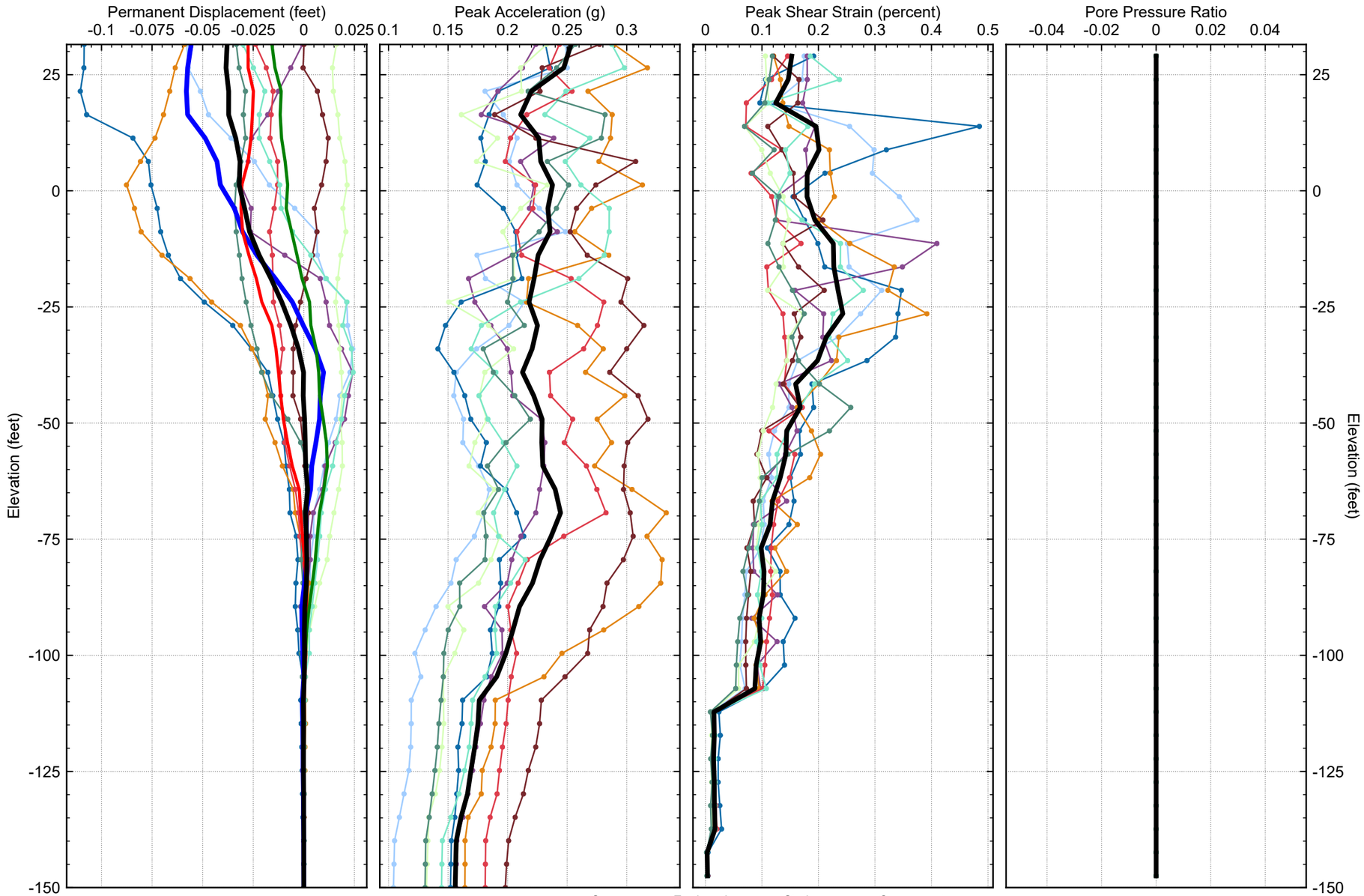
Bent 8 Tied-Arch
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
1,000-YEAR PROBABILISTIC
BENT 8 TIED-ARCH

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FIG. H-54

C:\ FLACPROCESS\Burnside

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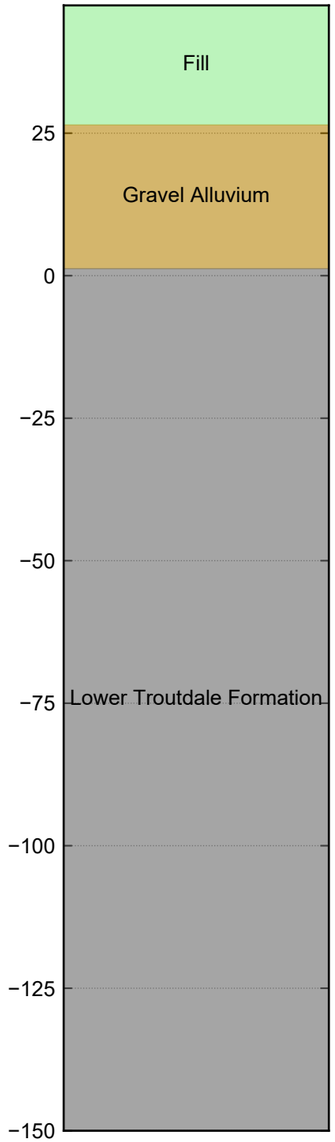
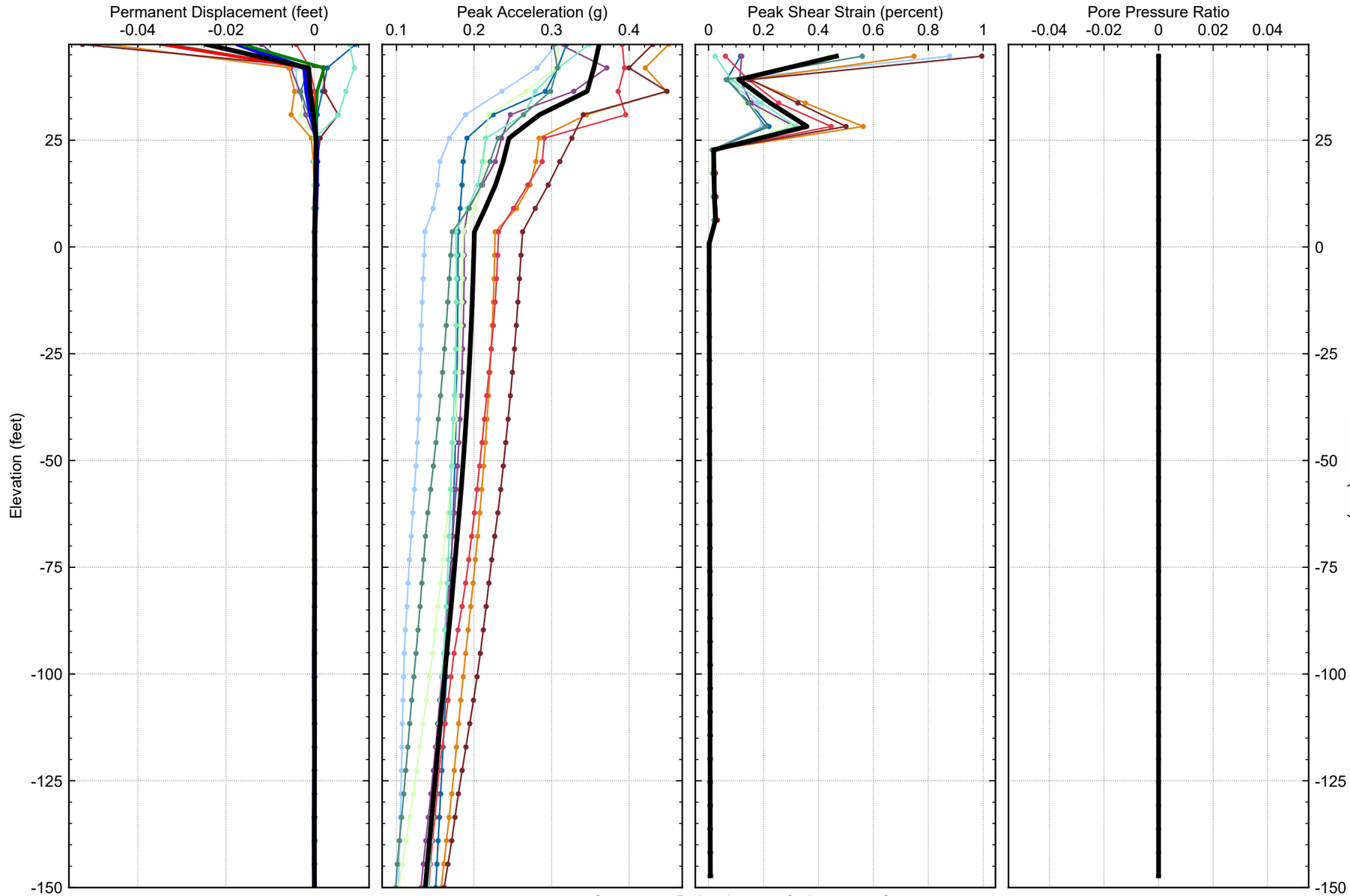
Bent 9
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
1,000-YEAR PROBABILISTIC
BENT 9

April 2022 102636-009

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FIG. H-55

C:\ FLACPROCESS\Burnside

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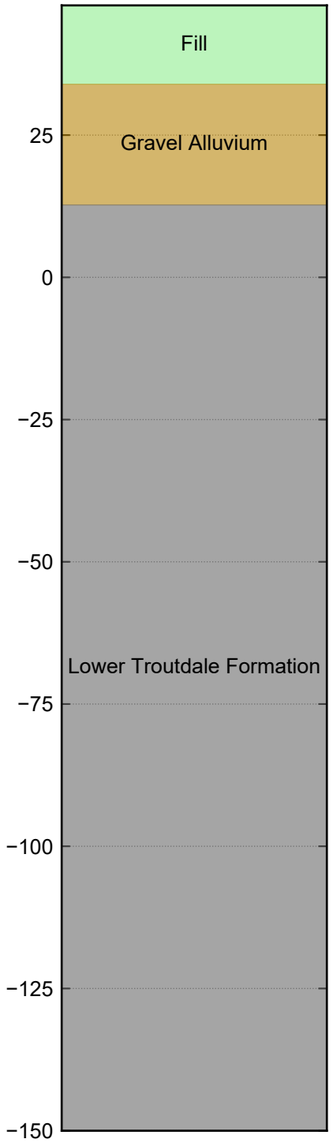
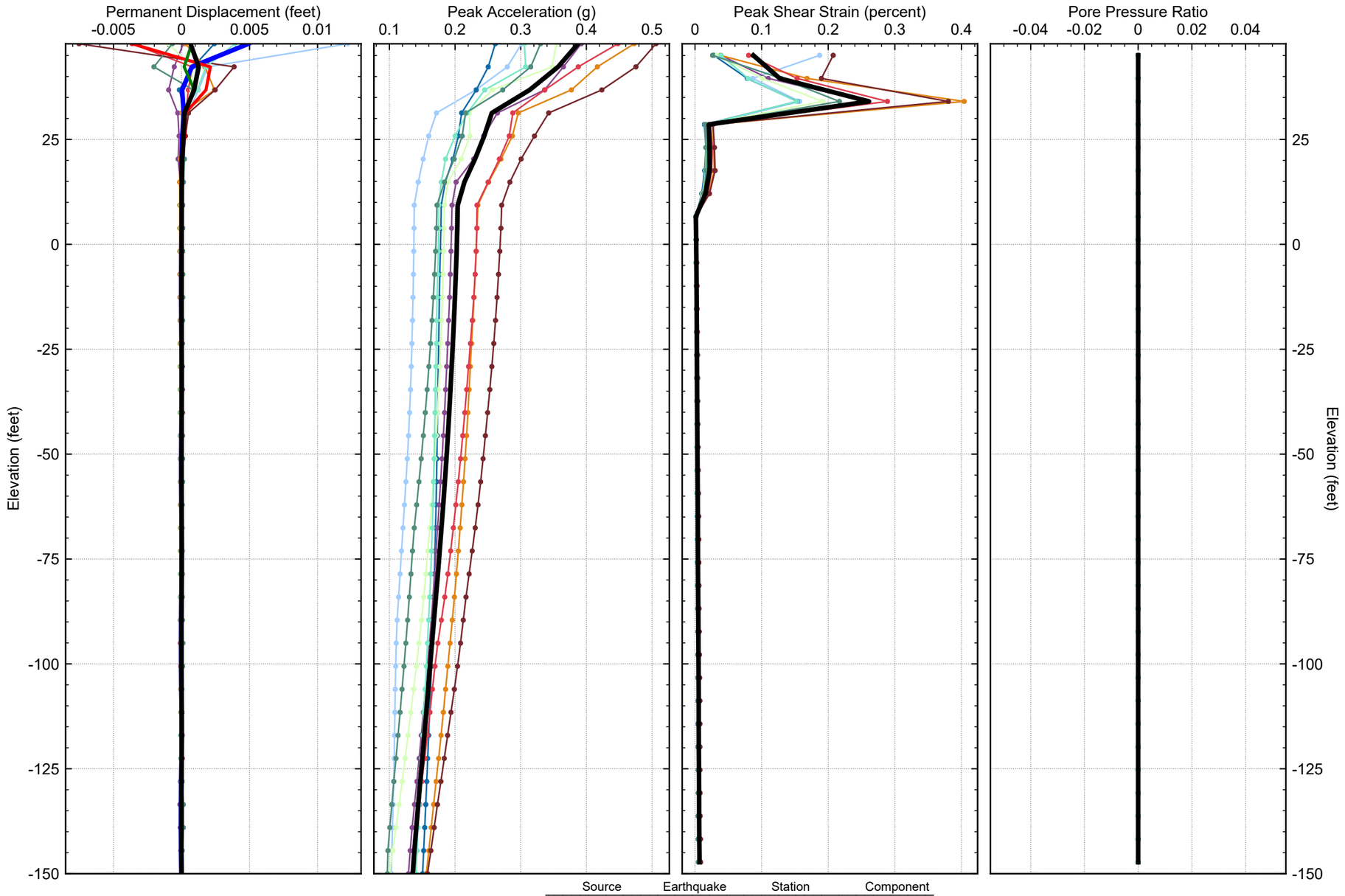
Bent 10
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
1,000-YEAR PROBABILISTIC
BENT 10

April 2022 102636-009

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FIG. H-56

C:_FLACPROCESS\Burnside

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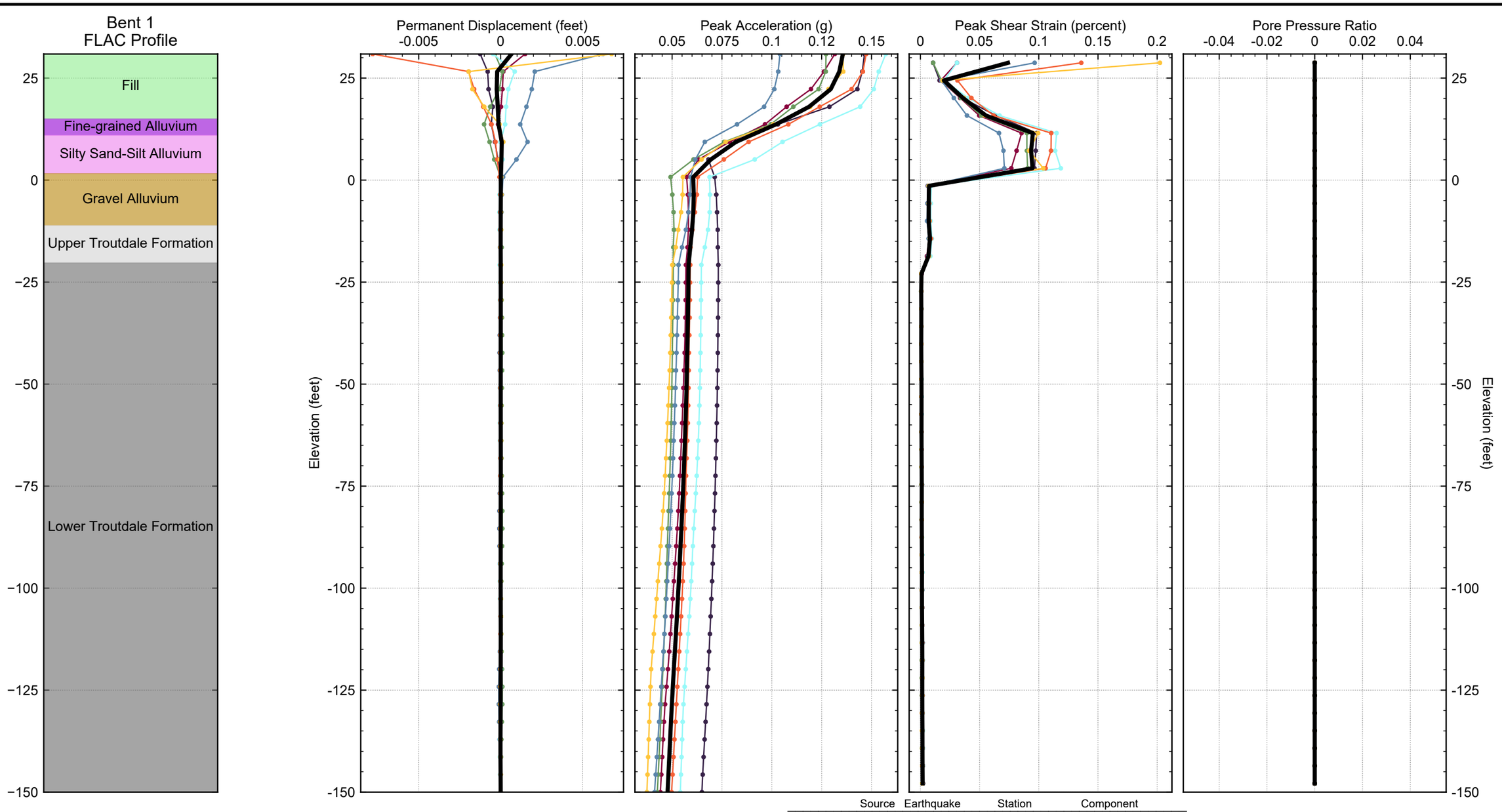

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
DETERMINISTIC CSZ
BENT 1

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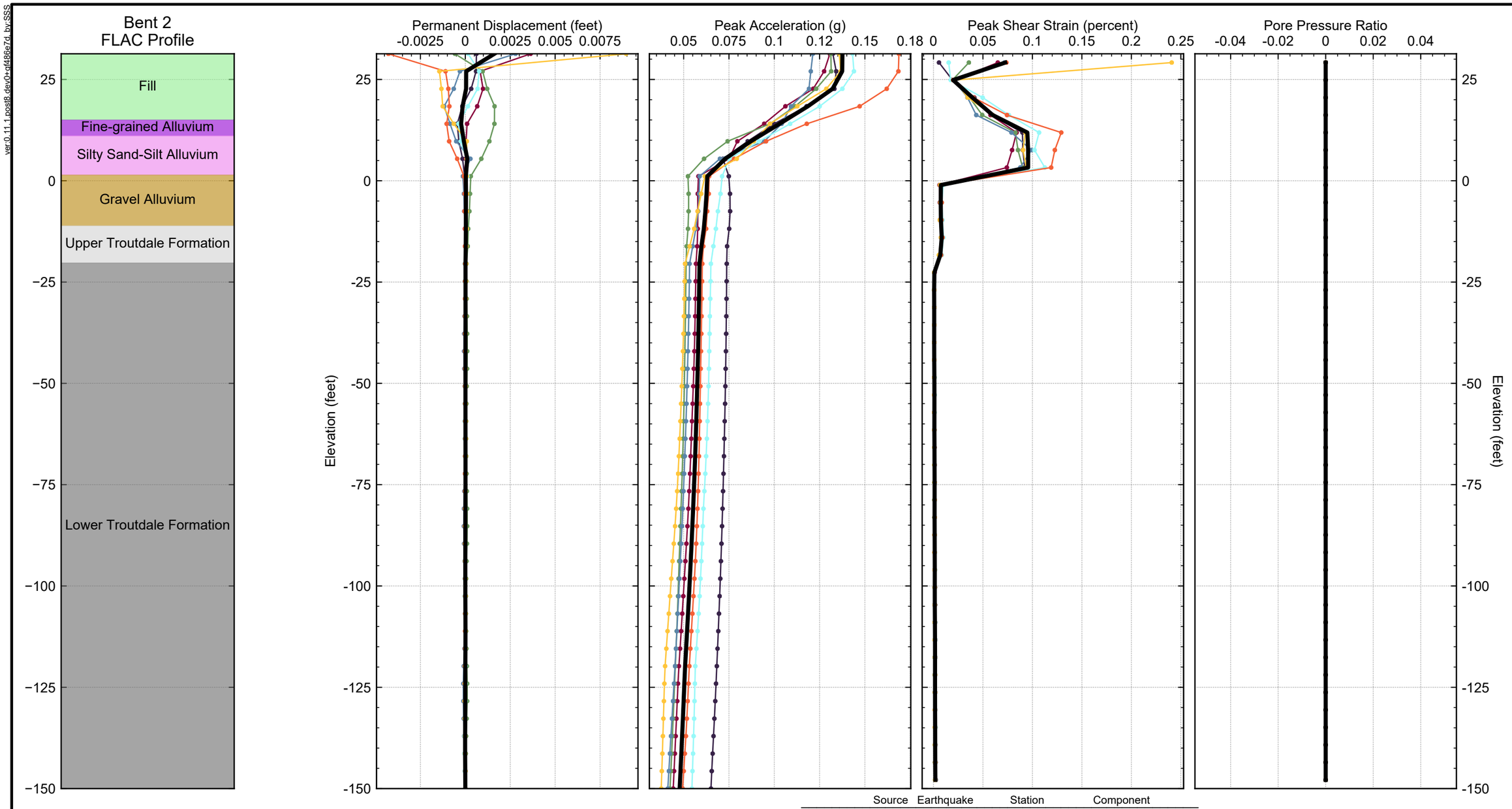
FIG. H-57

C:_FLAC\PROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
DETERMINISTIC CSZ
BENT 2

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FIG. H-58

C:_FLACPROCESS\Burnside

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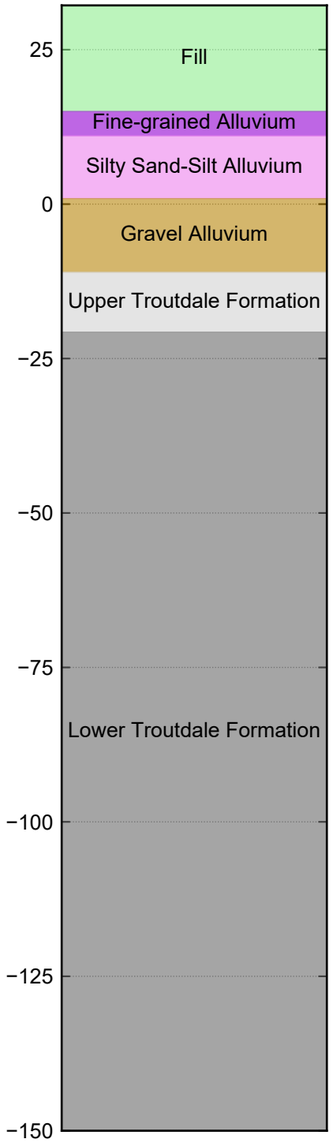
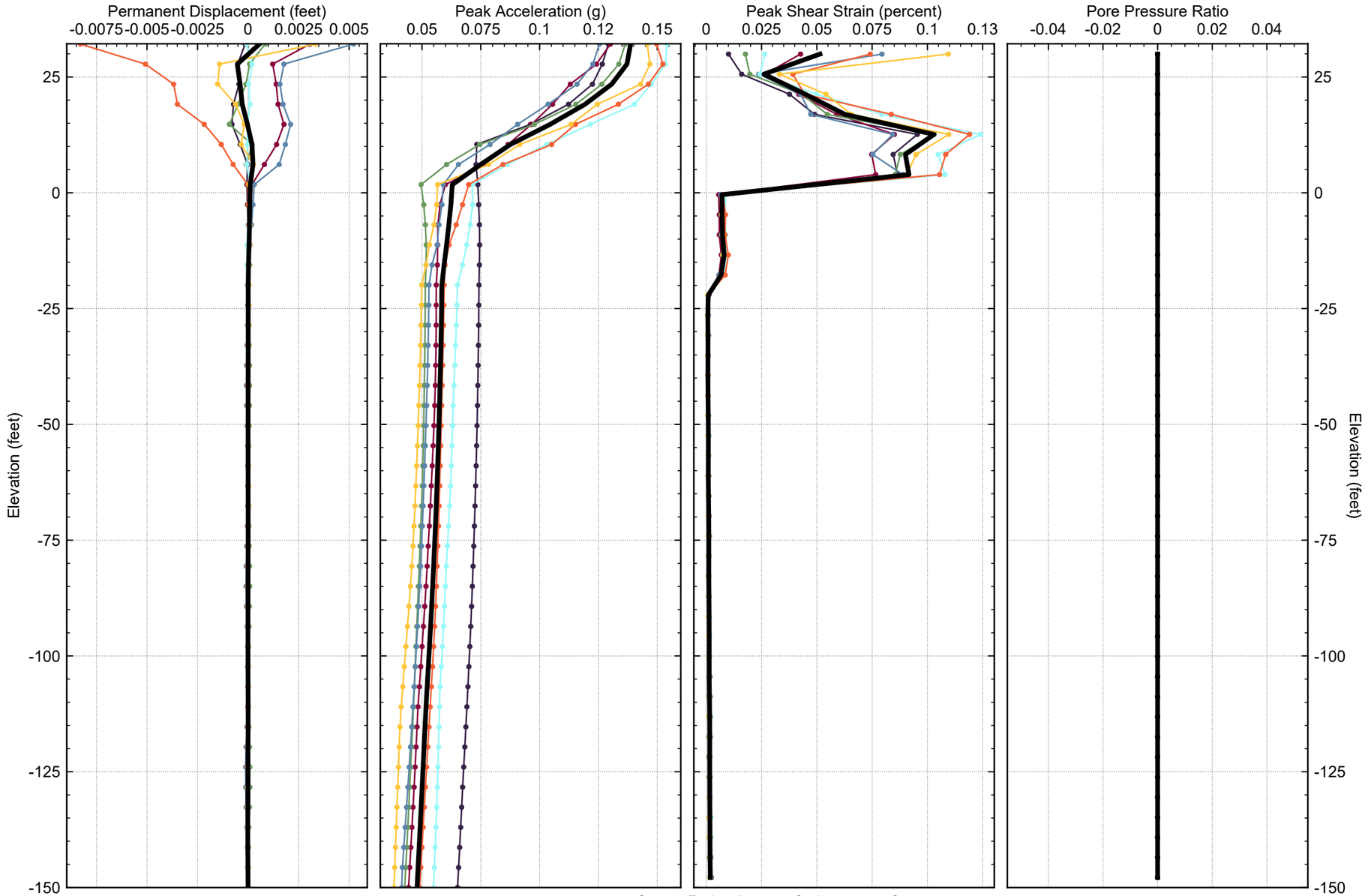
Bent 3
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
DETERMINISTIC CSZ
BENT 3

April 2022 102636-009

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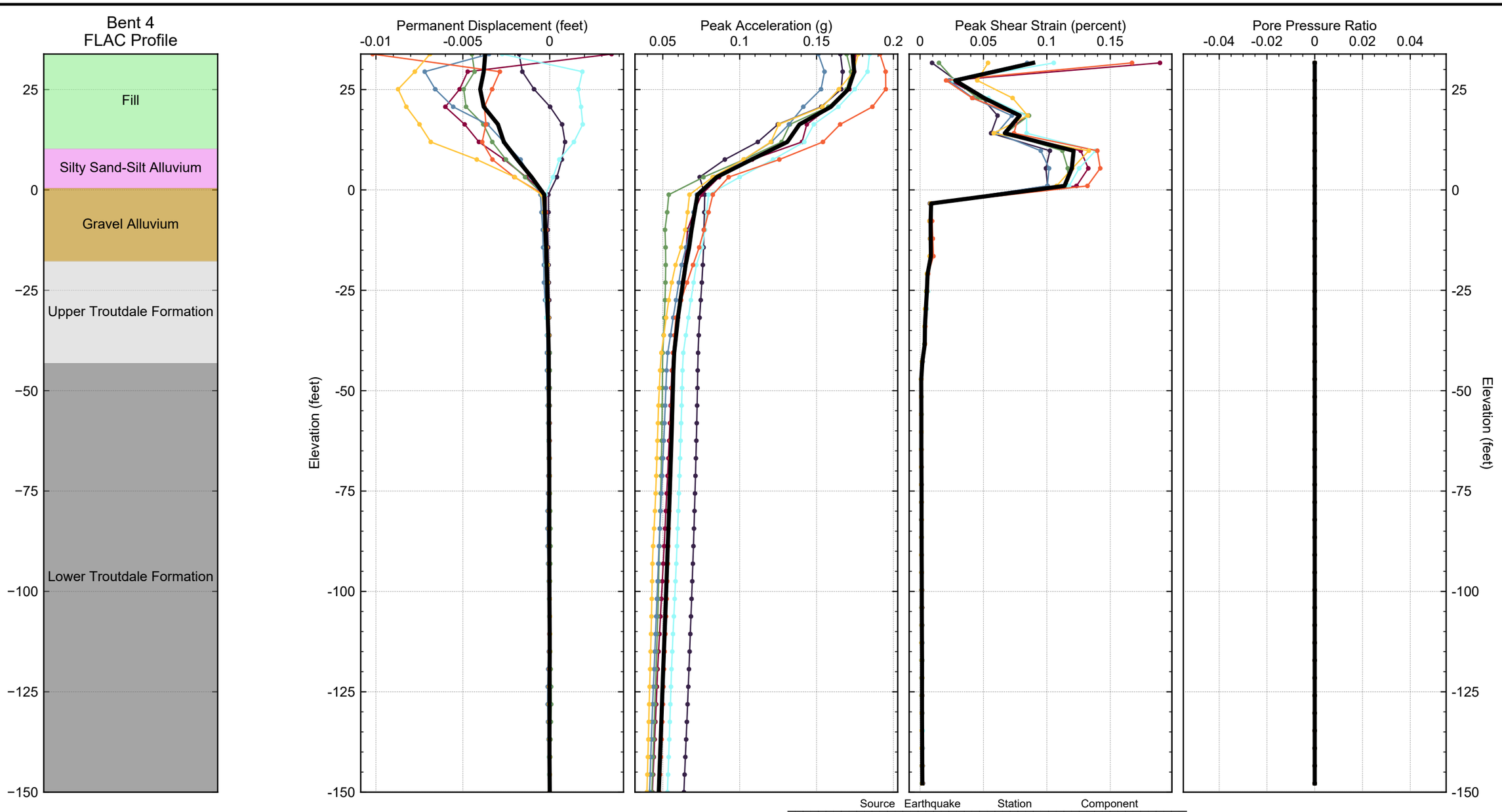
FIG. H-59

C:_FLAC\PROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
DETERMINISTIC CSZ
BENT 4

April 2022 102636-009

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FIG. H-60

C:_FLAC\PROCESS\Burnside

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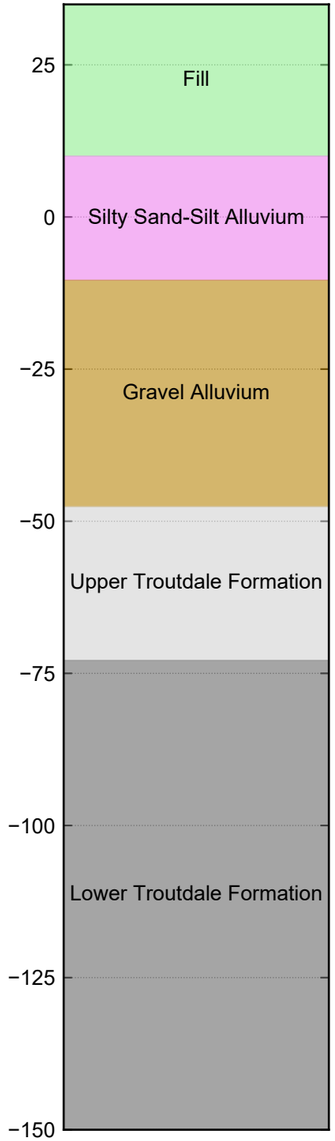
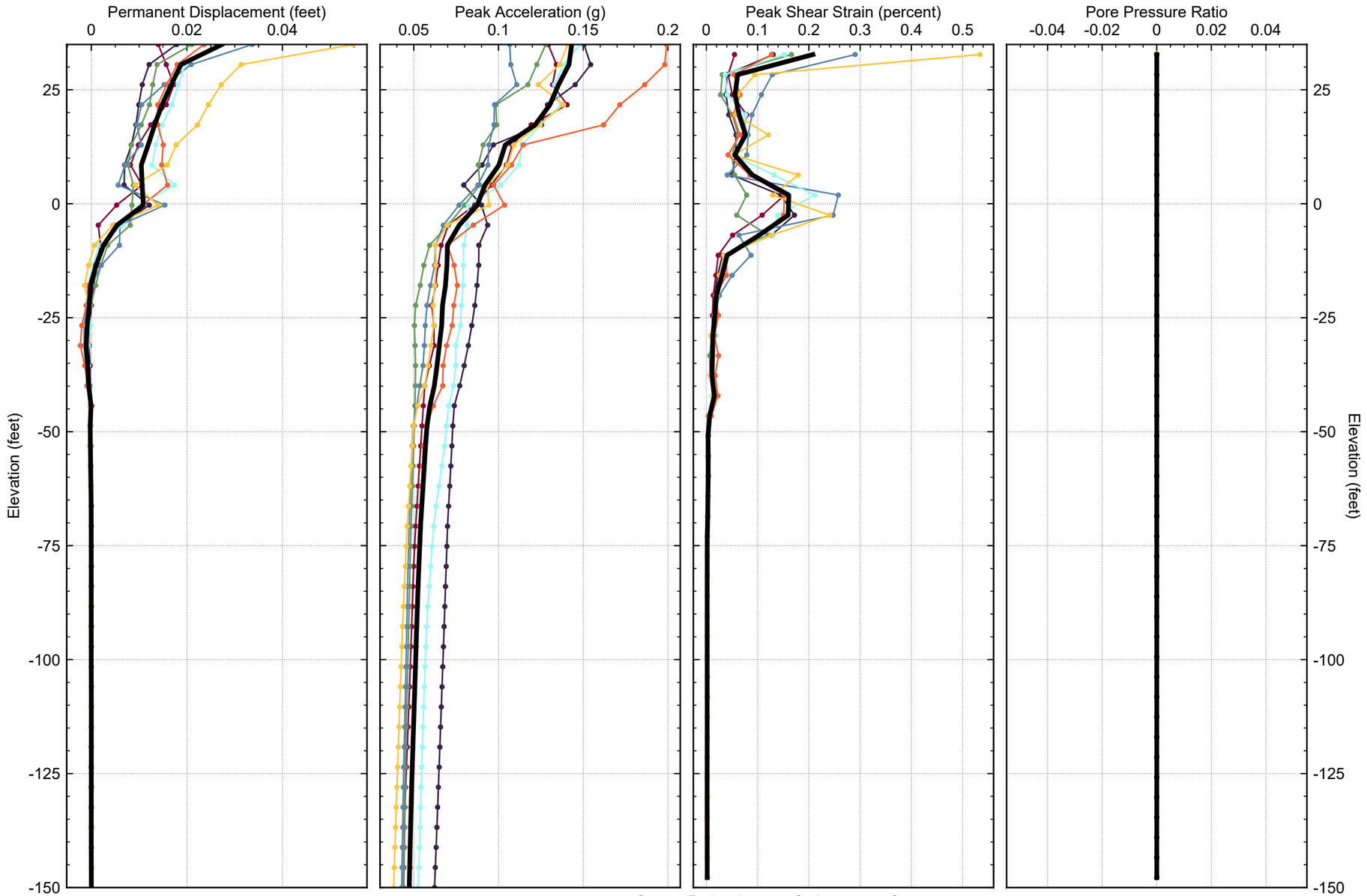
Bent 5
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
DETERMINISTIC CSZ
BENT 5

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FIG. H-61

C:_FLACPROCESS\Burnside

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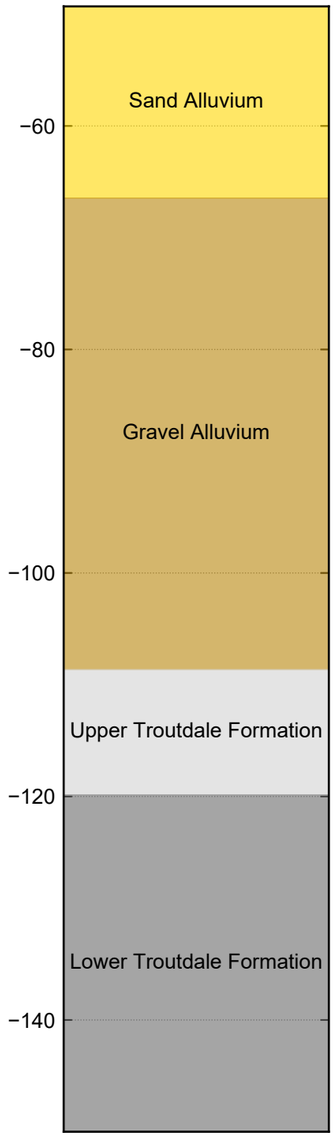
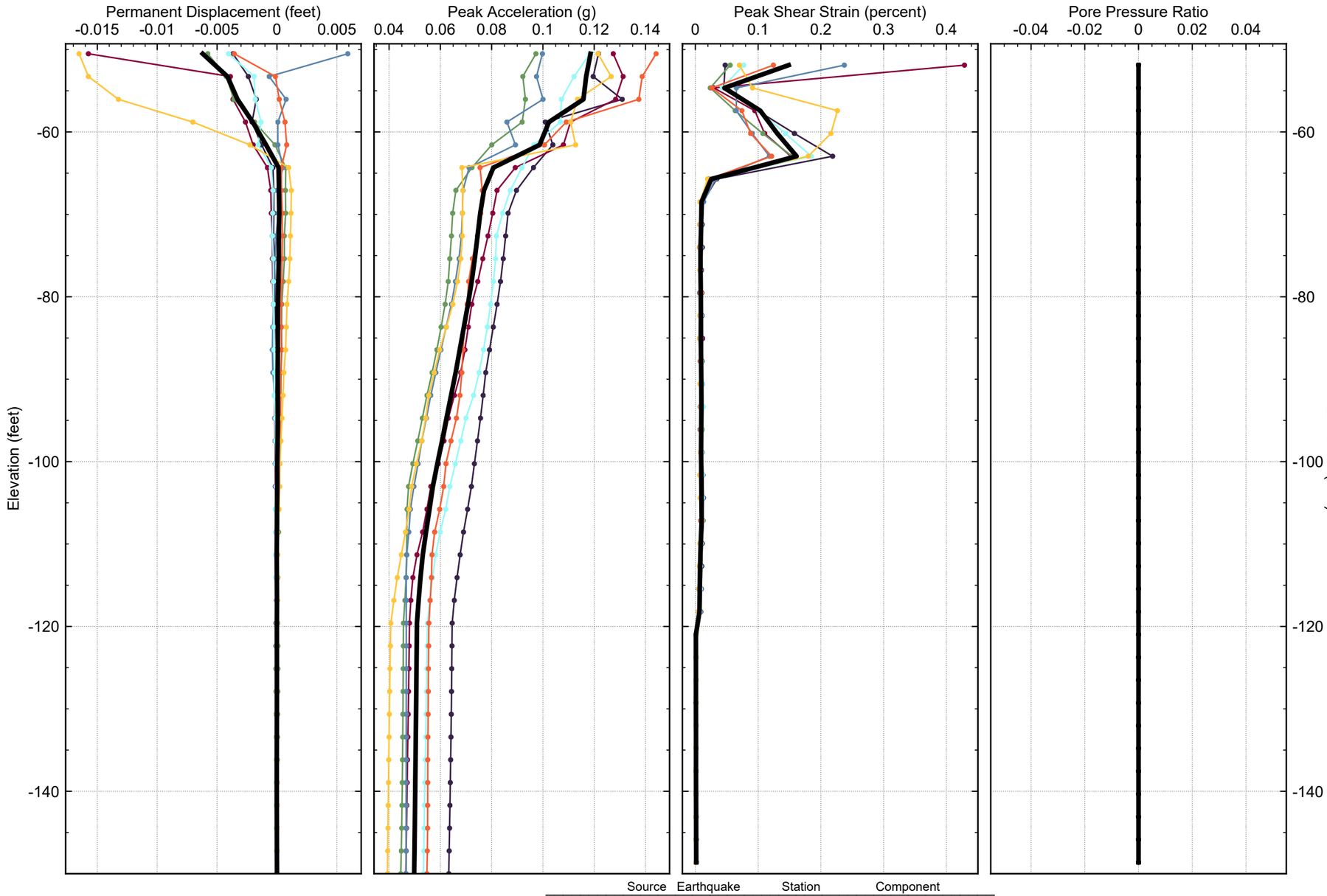
Bent 6
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
DETERMINISTIC CSZ
BENT 6

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FIG. H-62

C:_FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 7
FLAC Profile

Sand Alluvium

Gravel Alluvium

Lower Troutdale Formation

−60
−80
−100
−120
−140

Permanent Displacement (feet)
0 1 2

Peak Acceleration (g)
0.05 0.075 0.1 0.12 0.15

Peak Shear Strain (percent)
0 5 10 15 20 25

Pore Pressure Ratio
-0.04 -0.02 0 0.02 0.04

Elevation (feet)
-60
-80
-100
-120
-140

Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
DETERMINISTIC CSZ
BENT 7

April 2022 102636-009

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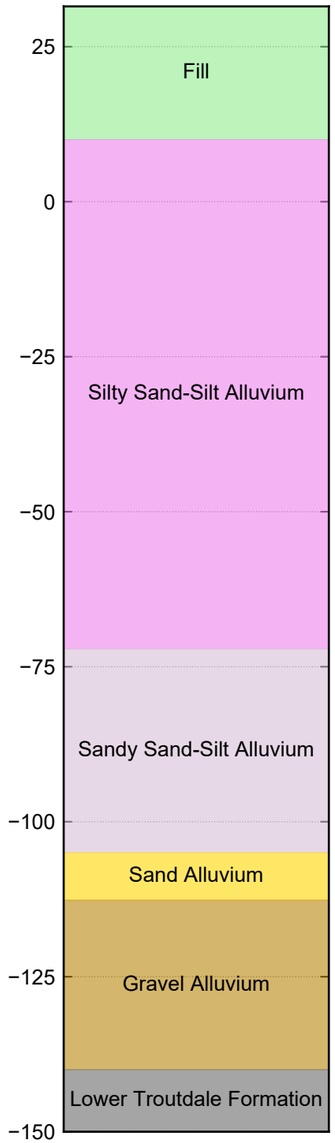
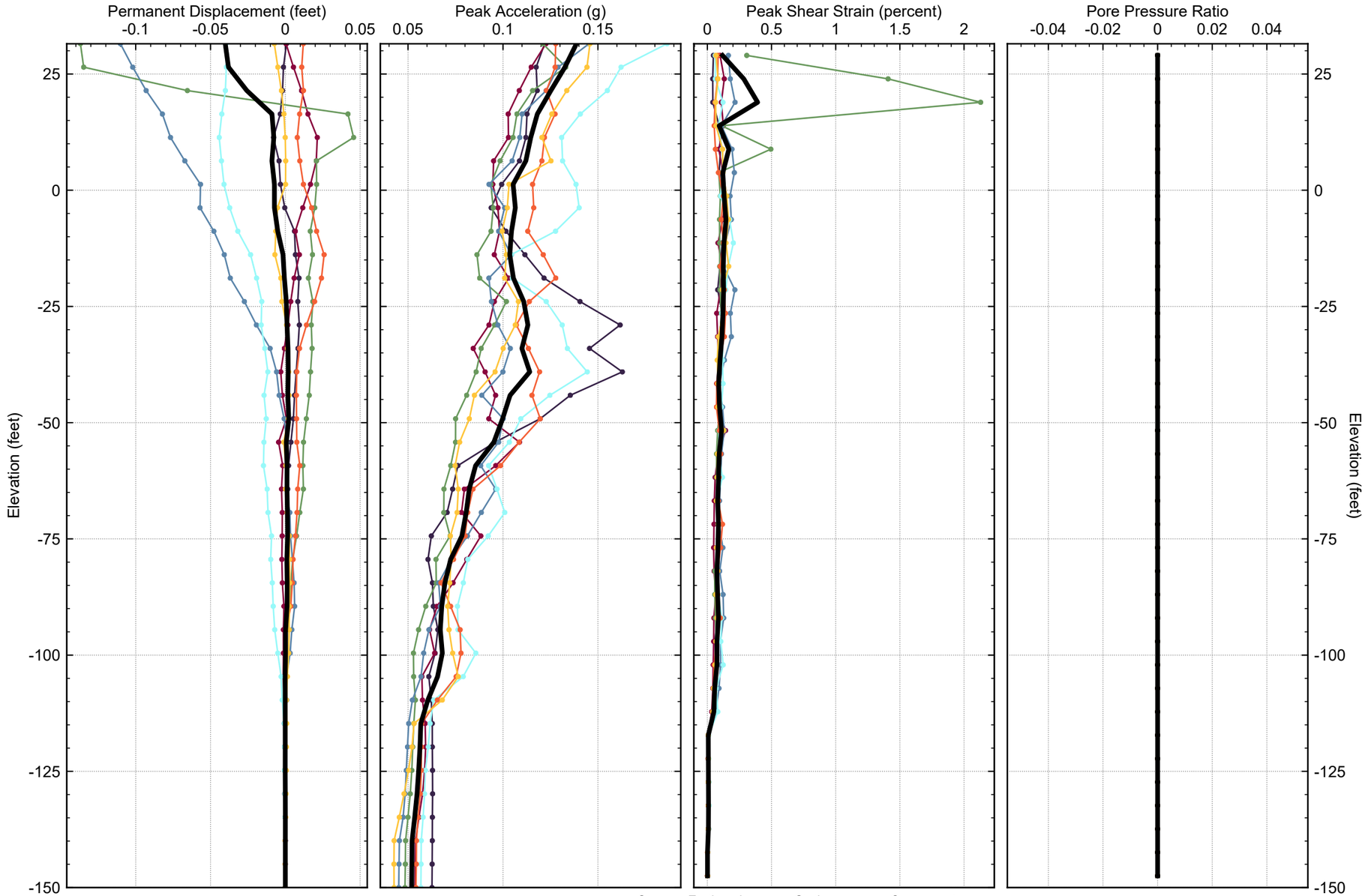
FIG. H-63

C:_FLACPROCESS\Burnside

ver.0.11.1.post8.dev0+gf486e7d.by.SSS

Bent 8 Cable-Stayed Tower FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
DETERMINISTIC CSZ
BENT 8 CABLE-STAYED TOWER

April 2022 102636-009

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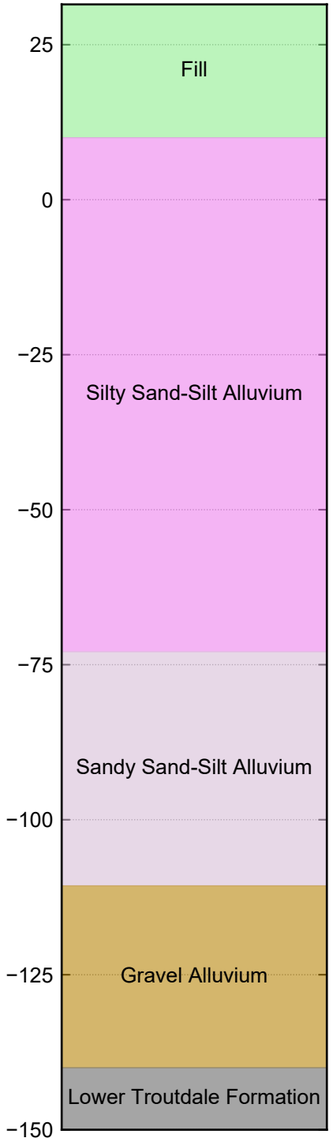
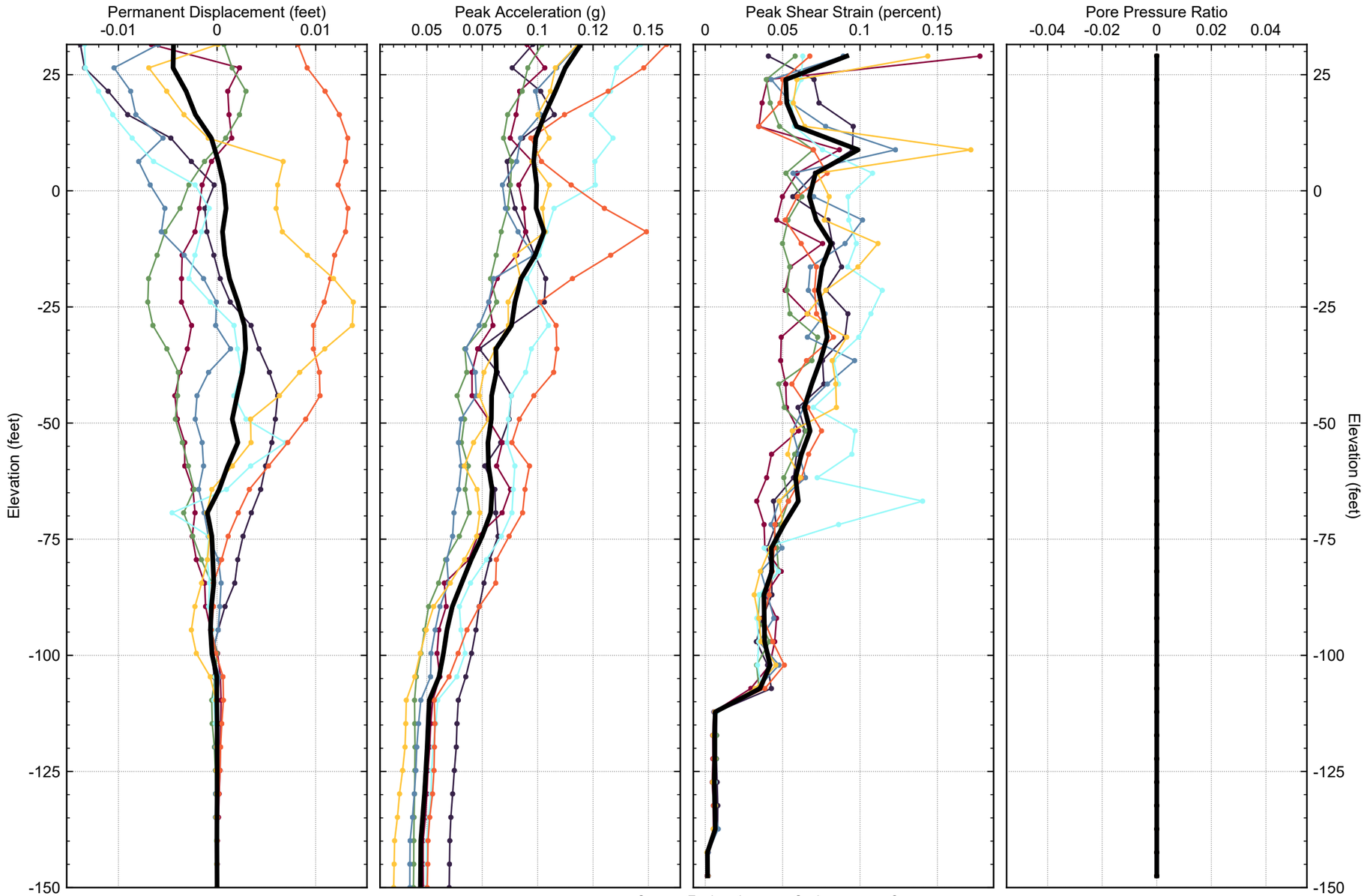
FIG. H-64

C:_FLACPROCESS\Burnside

ver.0.11.1.post8.dev0+gf486e7d.by.SSS

Bent 8 Tied-Arch FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
DETERMINISTIC CSZ
BENT 8 TIED-ARCH

April 2022 102636-009

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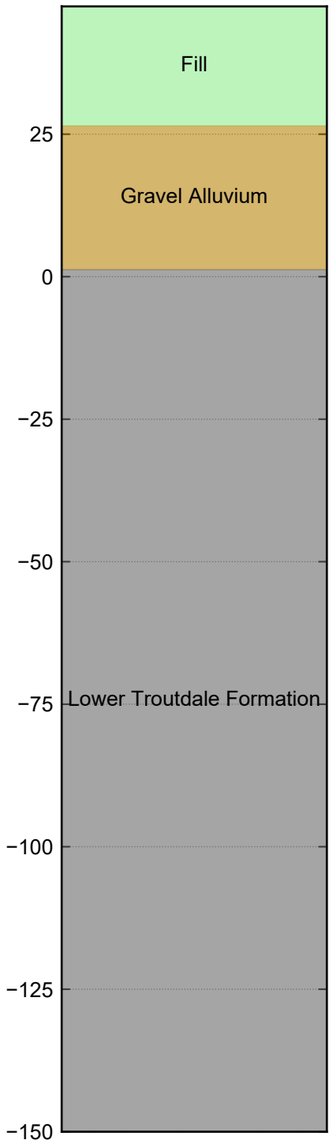
Geotechnical and Environmental Consultants

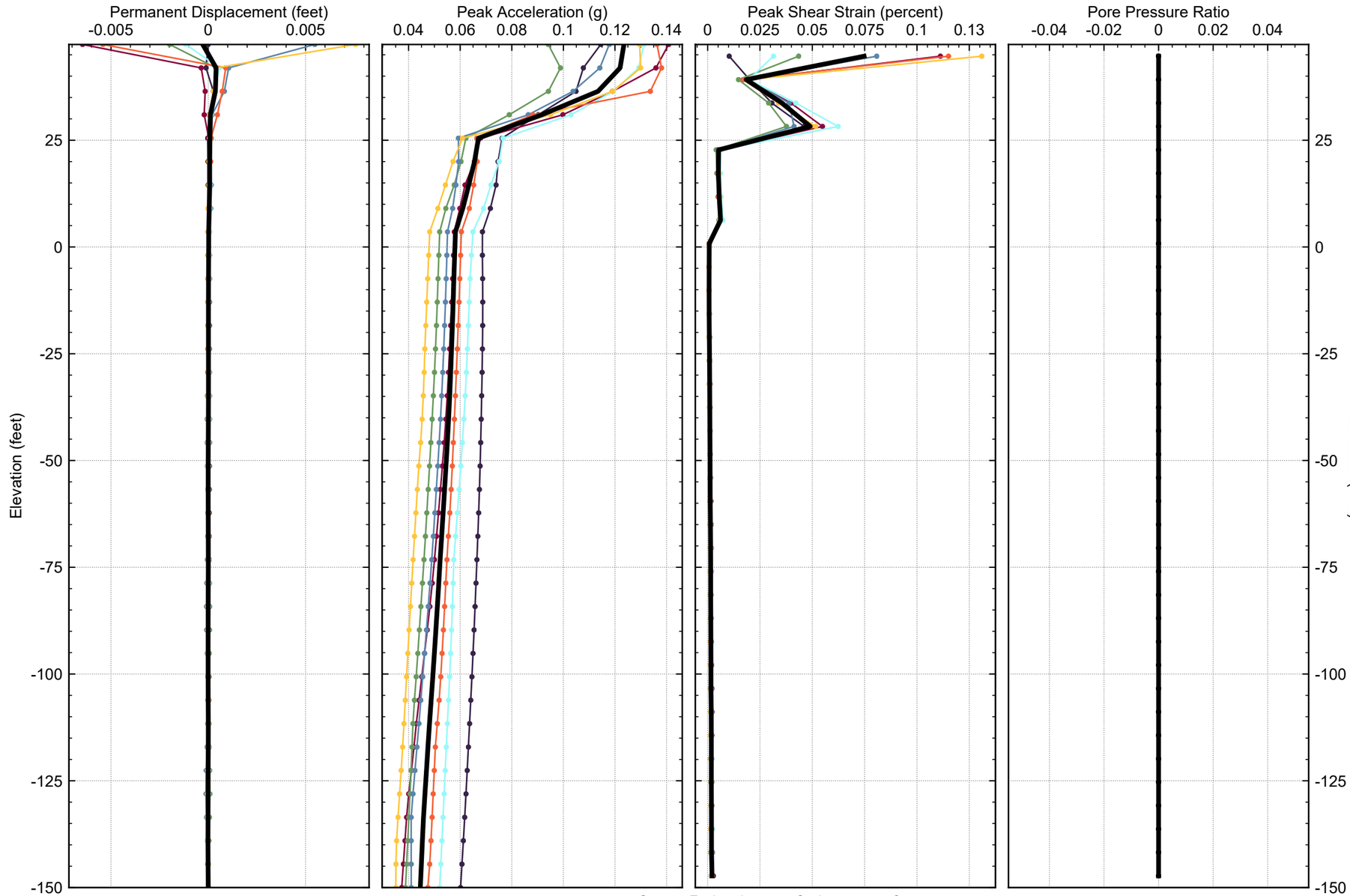
FIG. H-65

C:_FLAC\PROCESS\Burnside

ver.0.11.1.post8.dev0+gf486e7d.by.SSS

Bent 9
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
DETERMINISTIC CSZ
BENT 9

April 2022 102636-009

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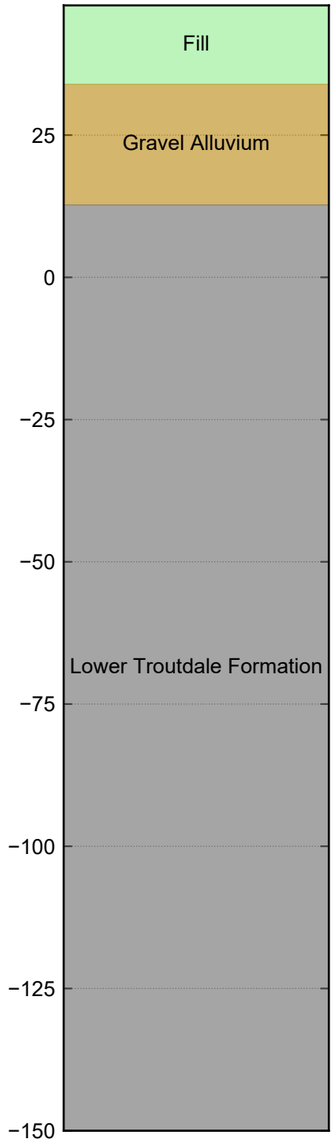
Geotechnical and Environmental Consultants

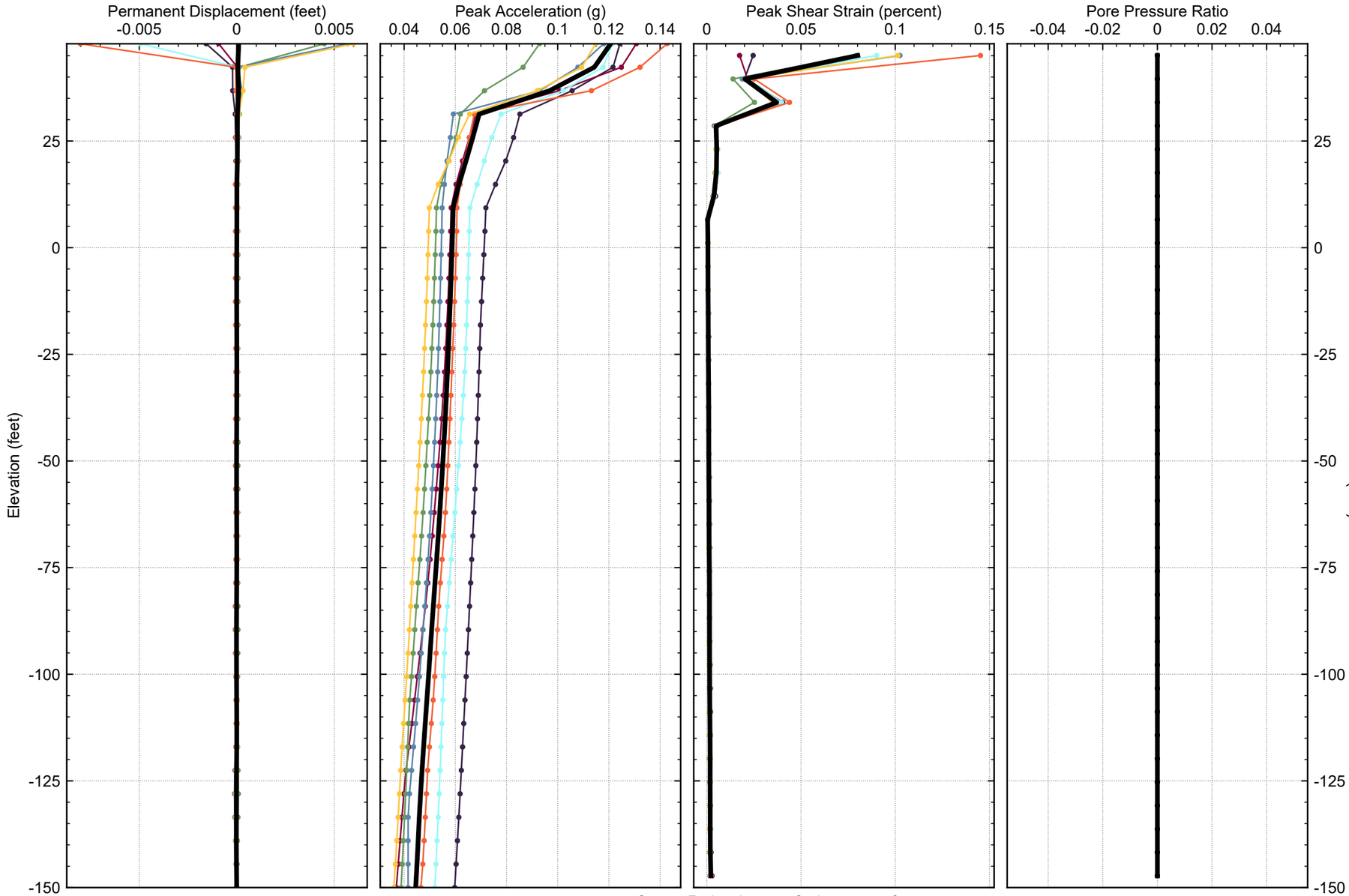
FIG. H-66

C:_FLACPROCESS\Burnside

ver.0.11.1.post8.dev0+gf486e7d.by.SSS

Bent 10
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
TOTAL STRESS
DETERMINISTIC CSZ
BENT 10

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FIG. H-67

C:_FLAC\PROCESS\Burnside

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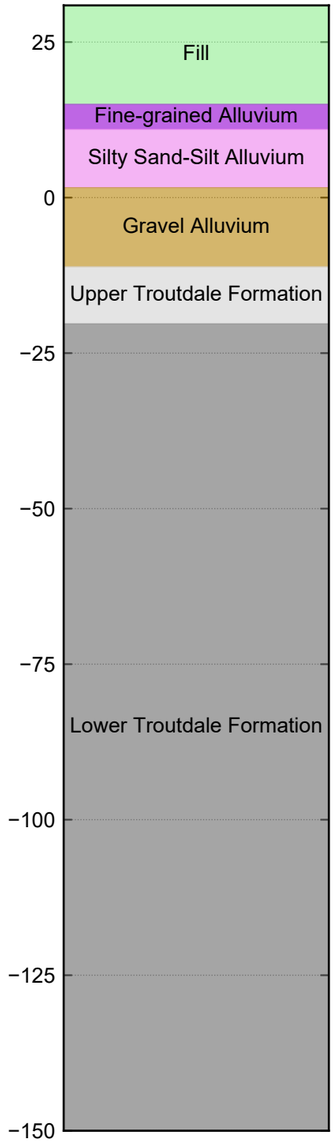
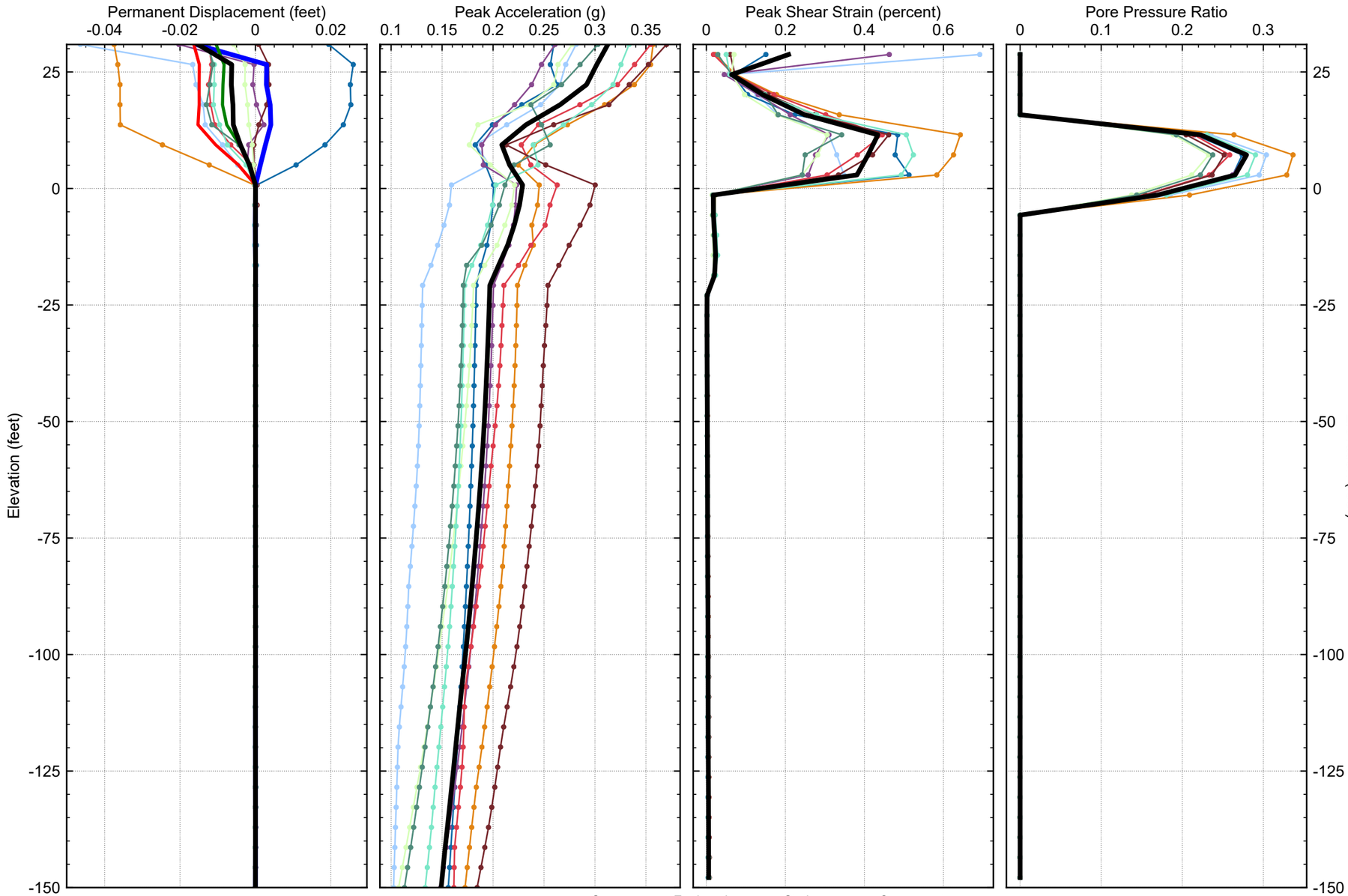
Bent 1
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
1,000-YEAR PROBABILISTIC
BENT 1

April 2022 102636-009

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FIG. H-68

C:_FLAC\PROCESS\Burnside

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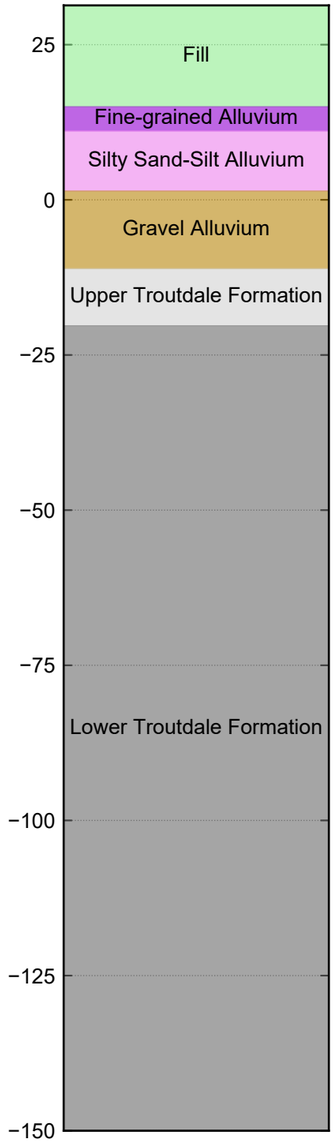
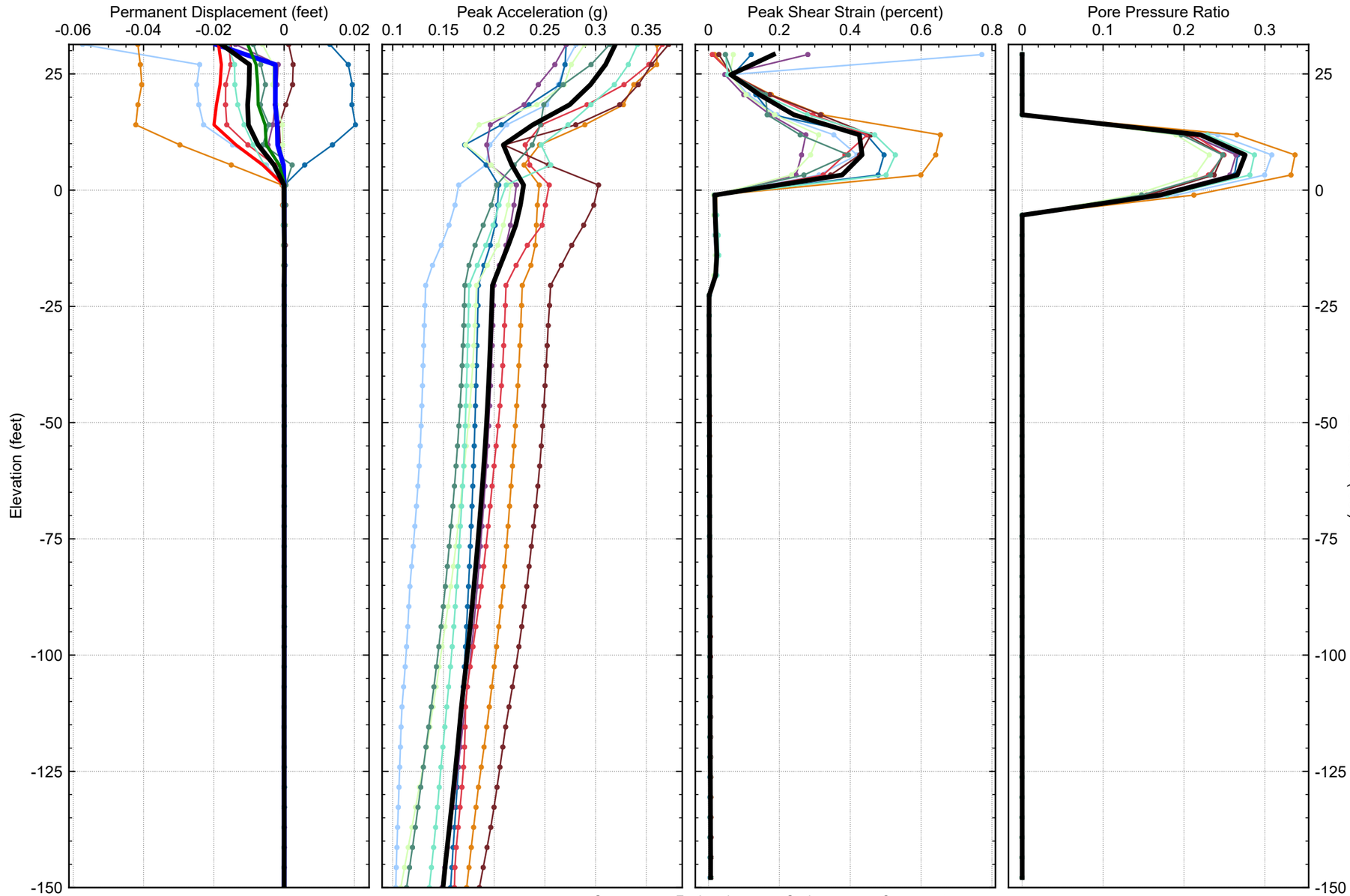
Bent 2
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
1,000-YEAR PROBABILISTIC
BENT 2

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FIG. H-69

C:_FLAGPROCESS\Burnside

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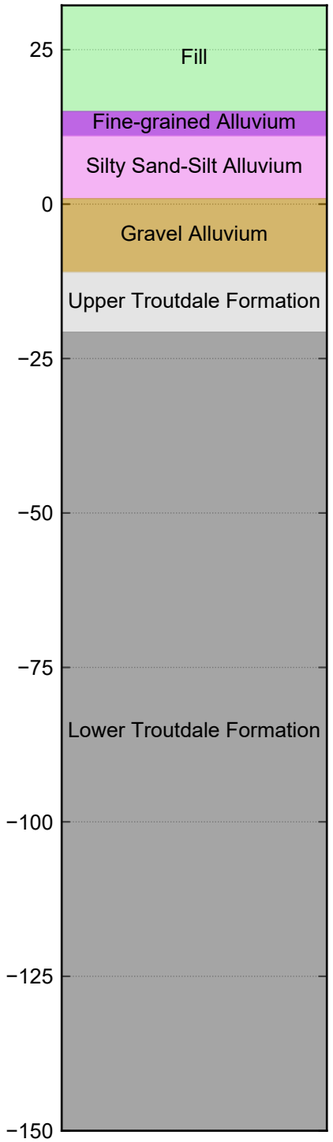
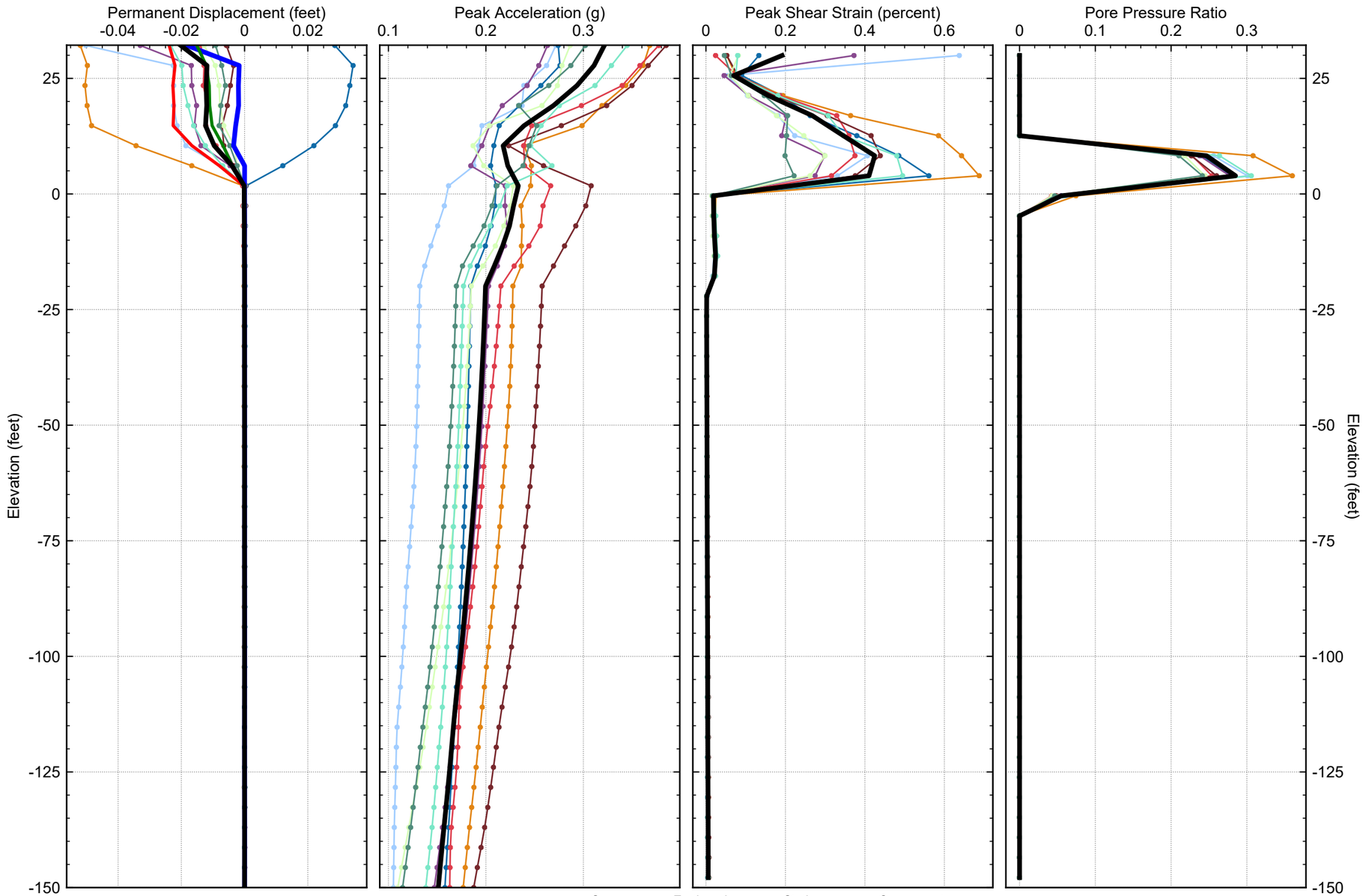
Bent 3
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
1,000-YEAR PROBABILISTIC
BENT 3

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FIG. H-70

C:_FLACPROCESS\Burnside

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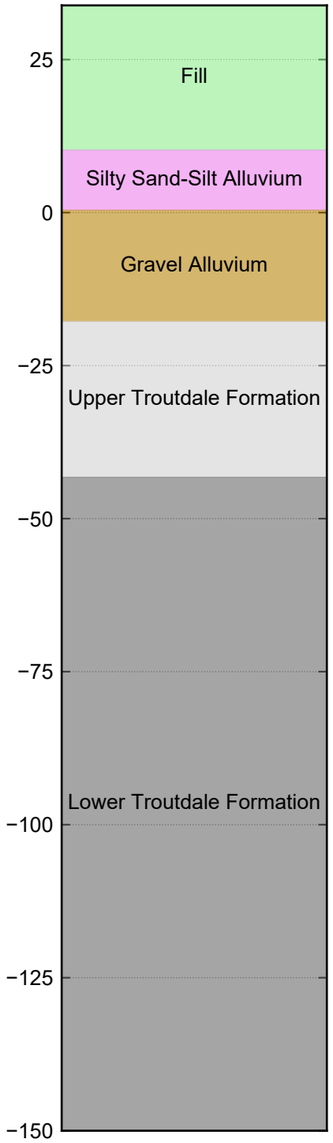
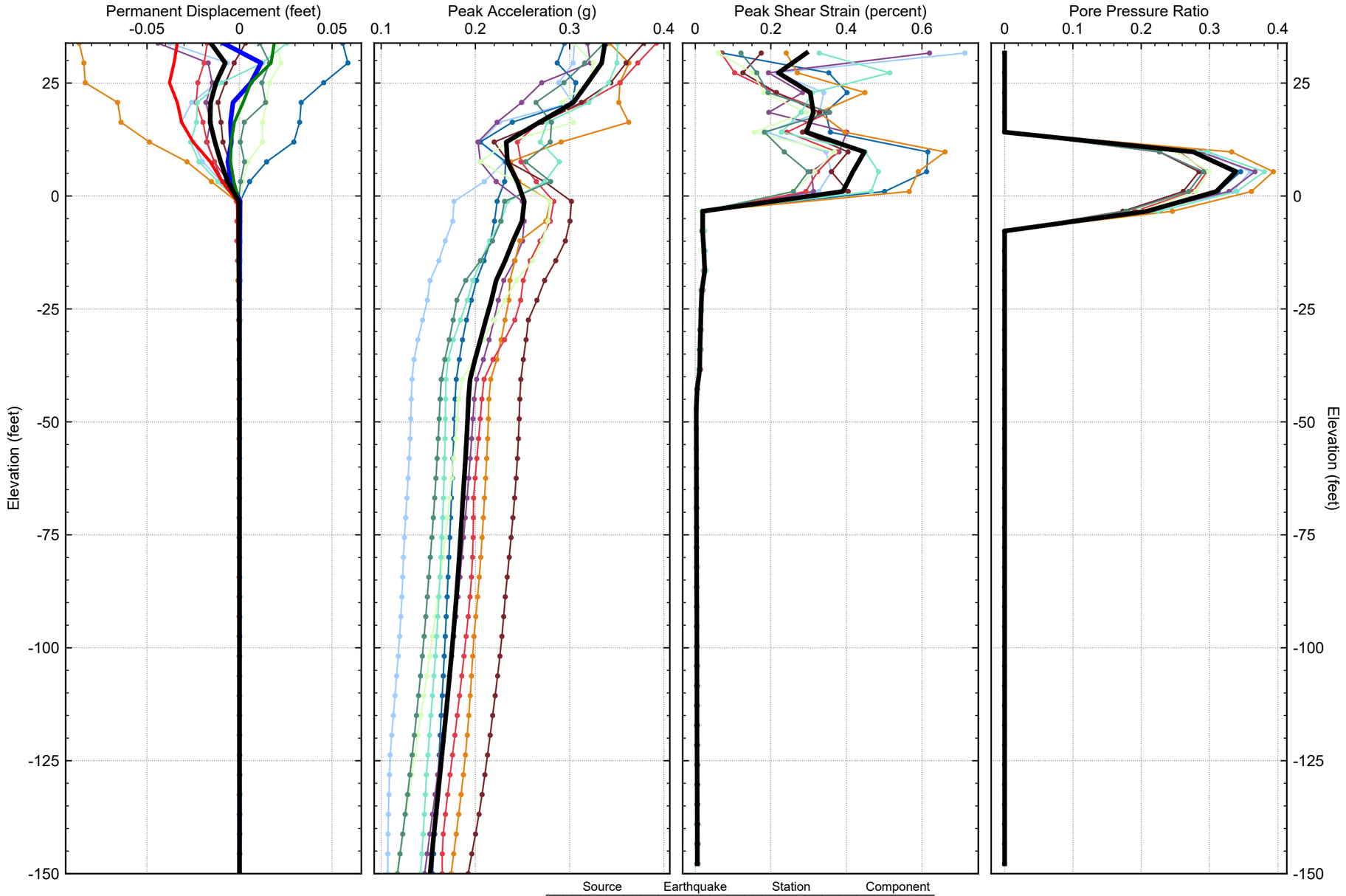
Bent 4
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
1,000-YEAR PROBABILISTIC
BENT 4

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FIG. H-71

C:_FLACPROCESS\Burnside

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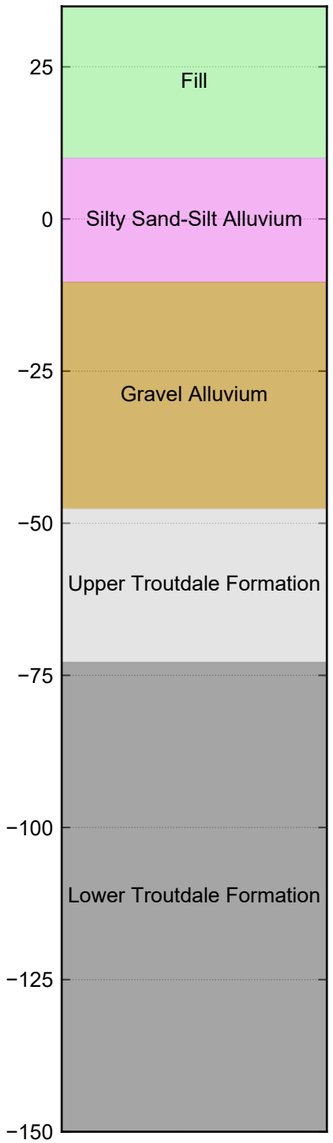
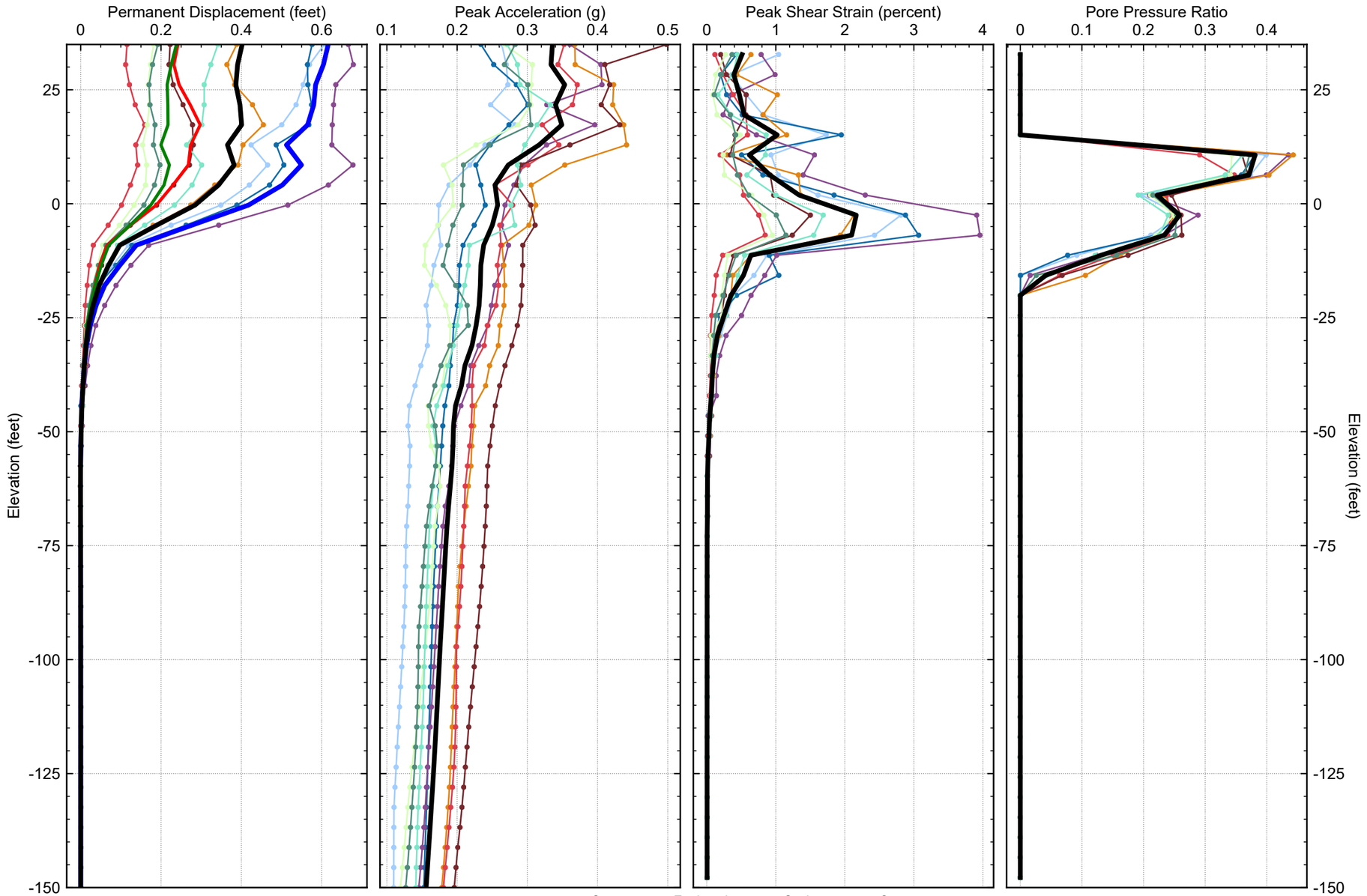
Bent 5
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
1,000-YEAR PROBABILISTIC
BENT 5

April 2022 102636-009

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FIG. H-72

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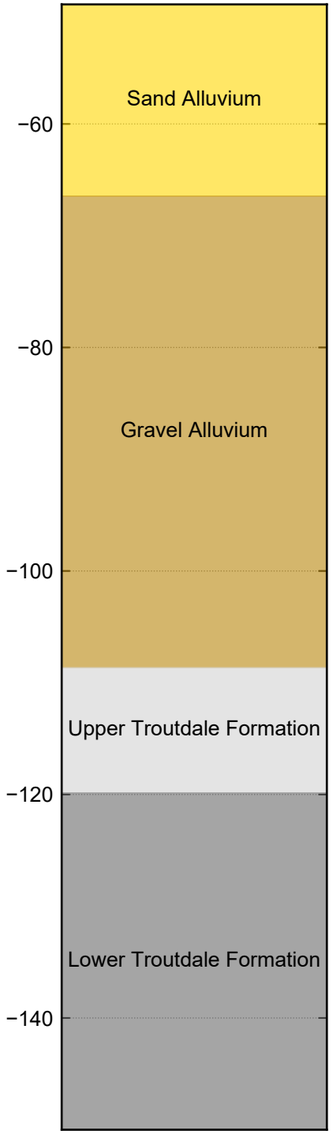
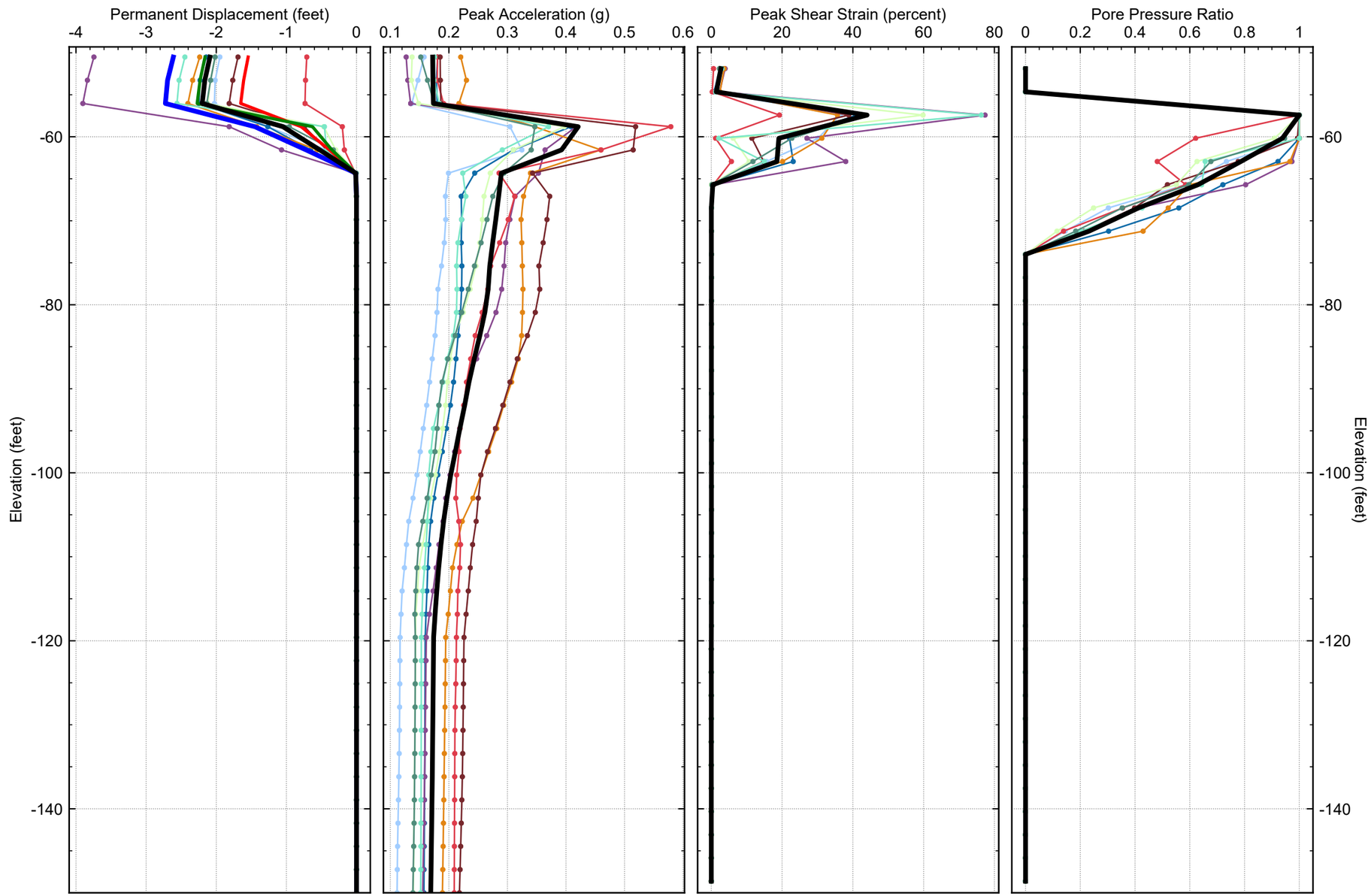
Bent 6
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
1,000-YEAR PROBABILISTIC
BENT 6

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FIG. H-73

C:_FLACPROCESS\Burnside

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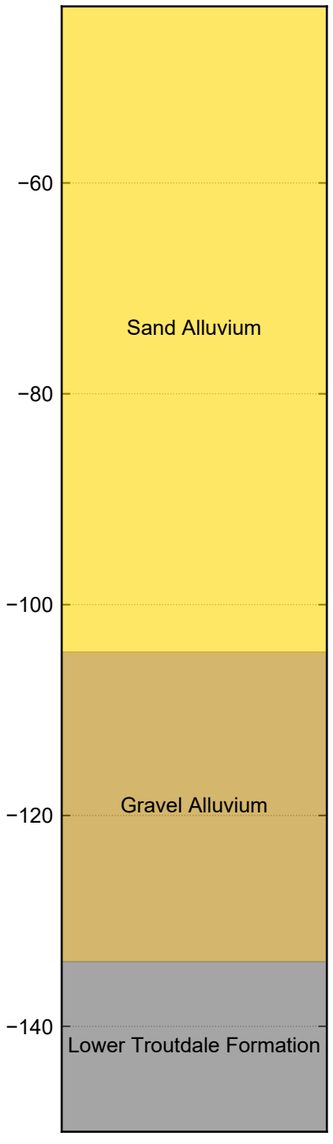
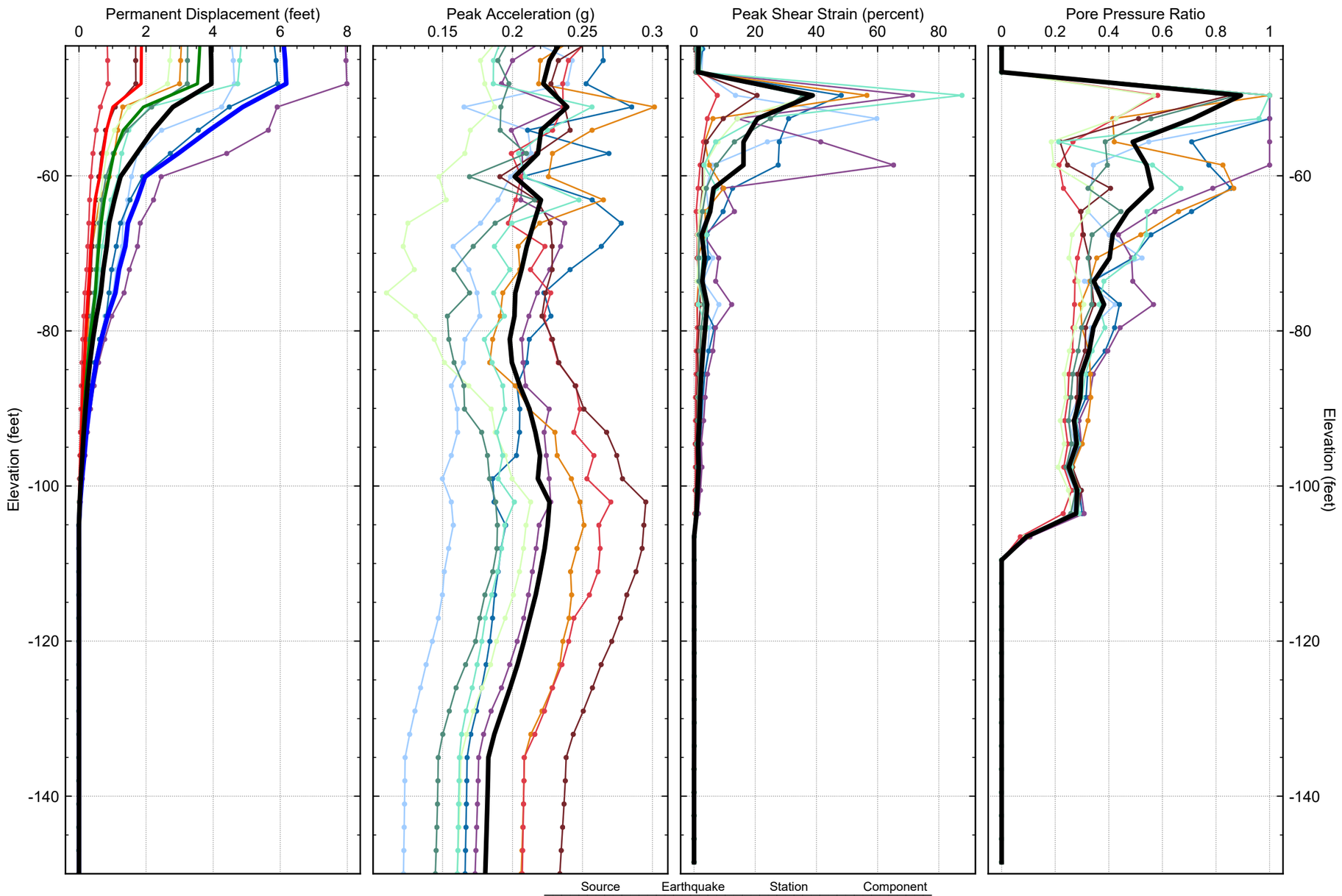
Bent 7
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
1,000-YEAR PROBABILISTIC
BENT 7

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FIG. H-74

C:_FLACPROCESS\Burnside

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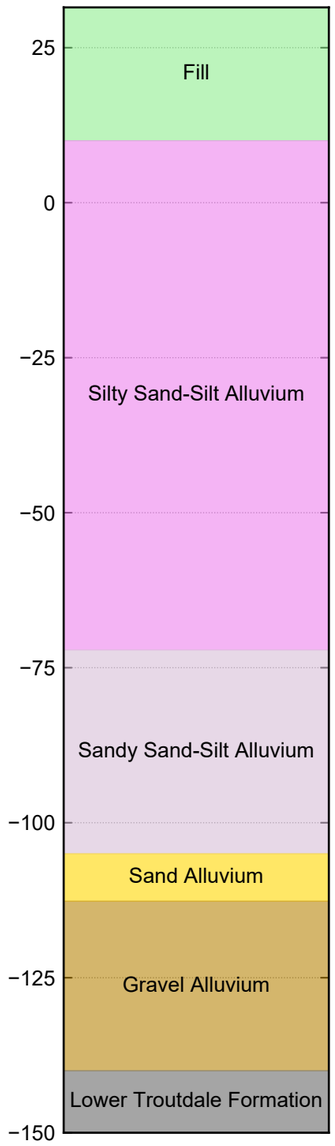

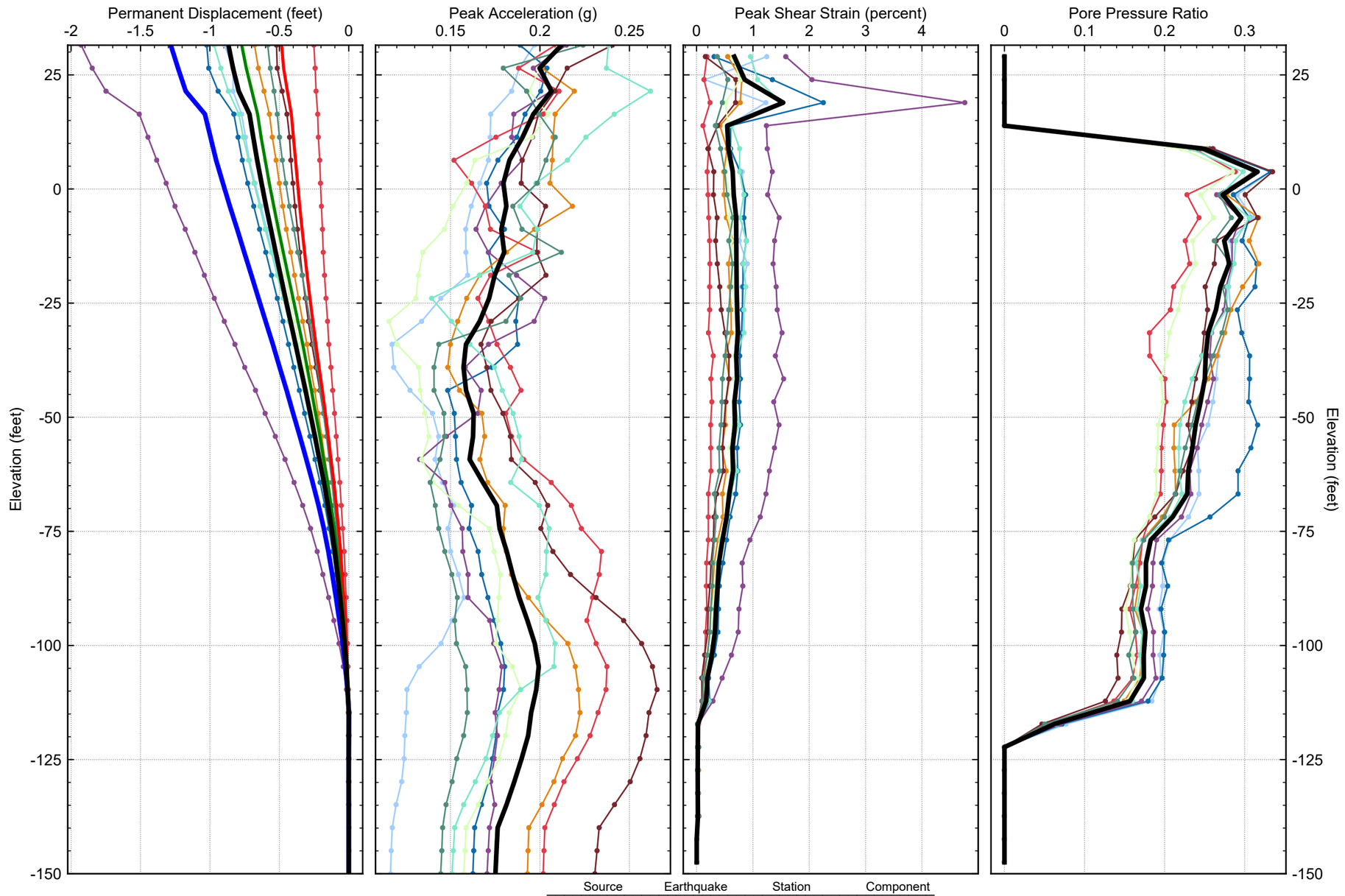

Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
1,000-YEAR PROBABILISTIC
BENT 8 CABLE-STAYED TOWER

April 2022 102636-009

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FIG. H-75

C:_FLACPROCESS\Burnside

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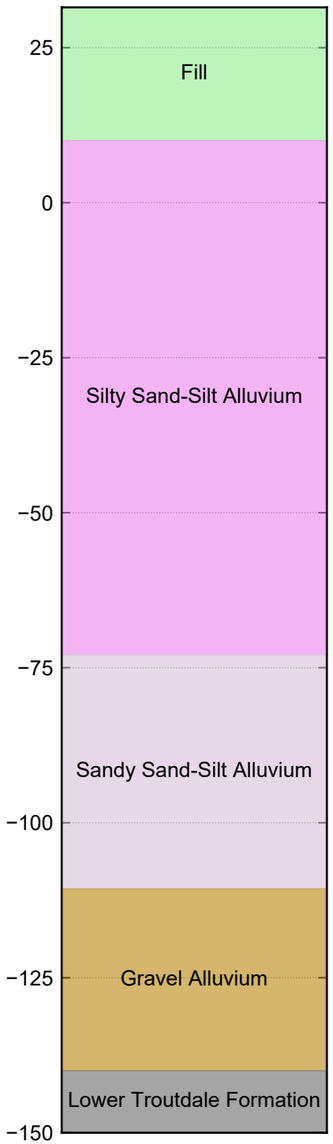
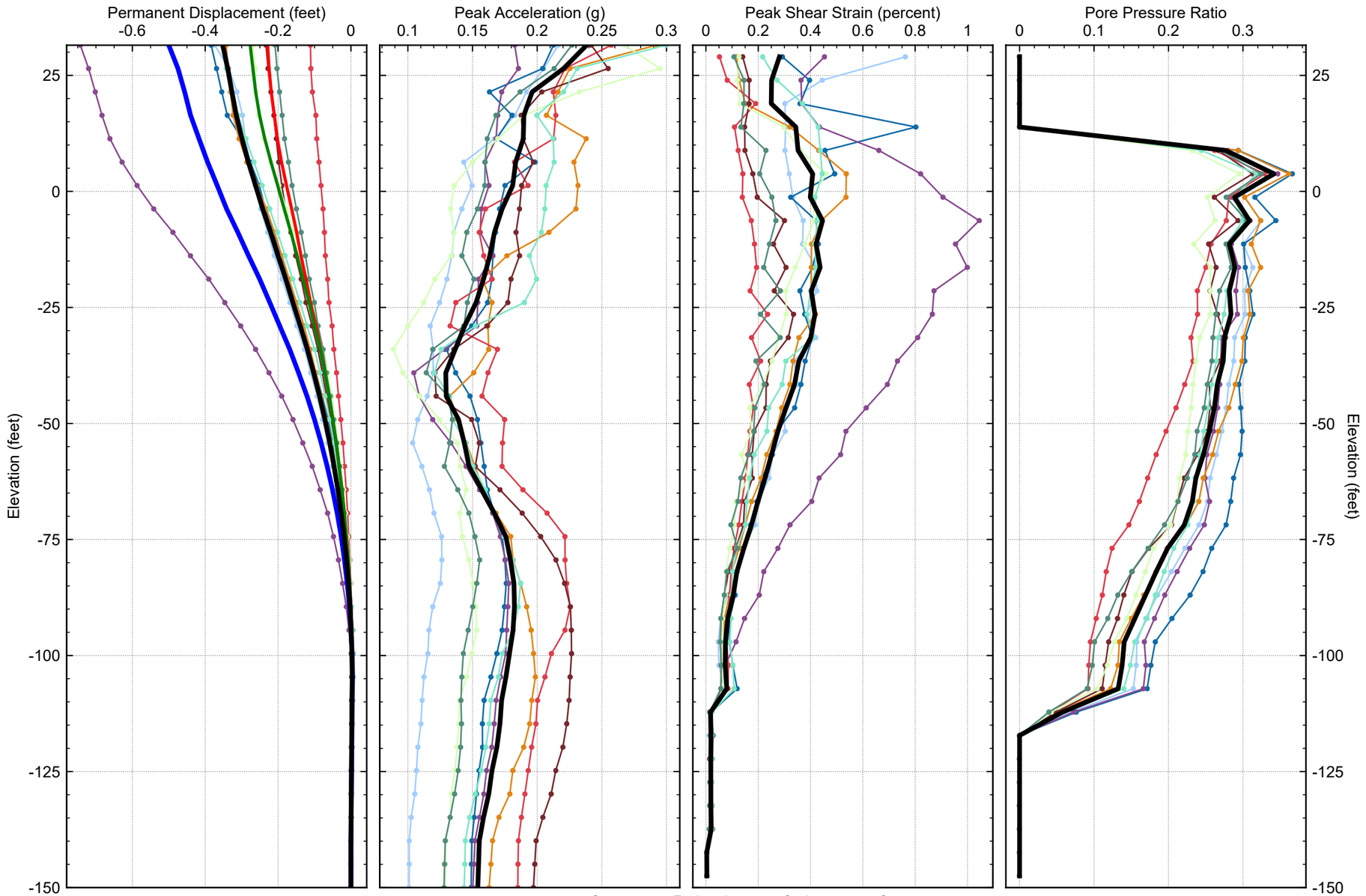
Bent 8 Tied-Arch FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
1,000-YEAR PROBABILISTIC
BENT 8 TIED-ARCH

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FIG. H-76

C:_FLACPROCESS\Burnside

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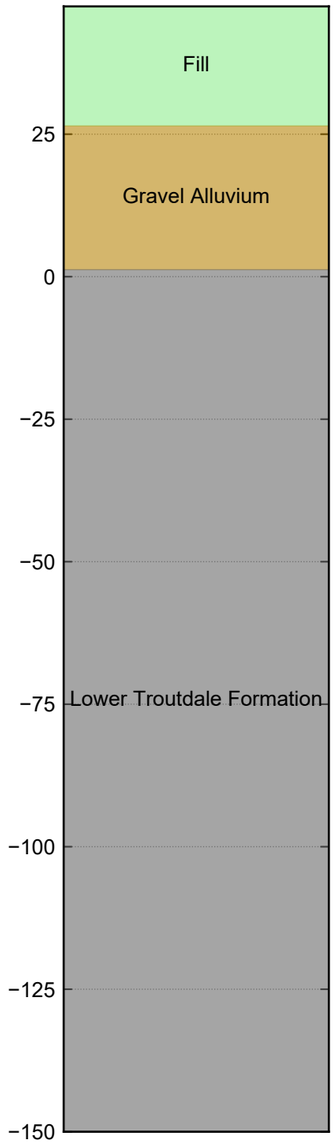
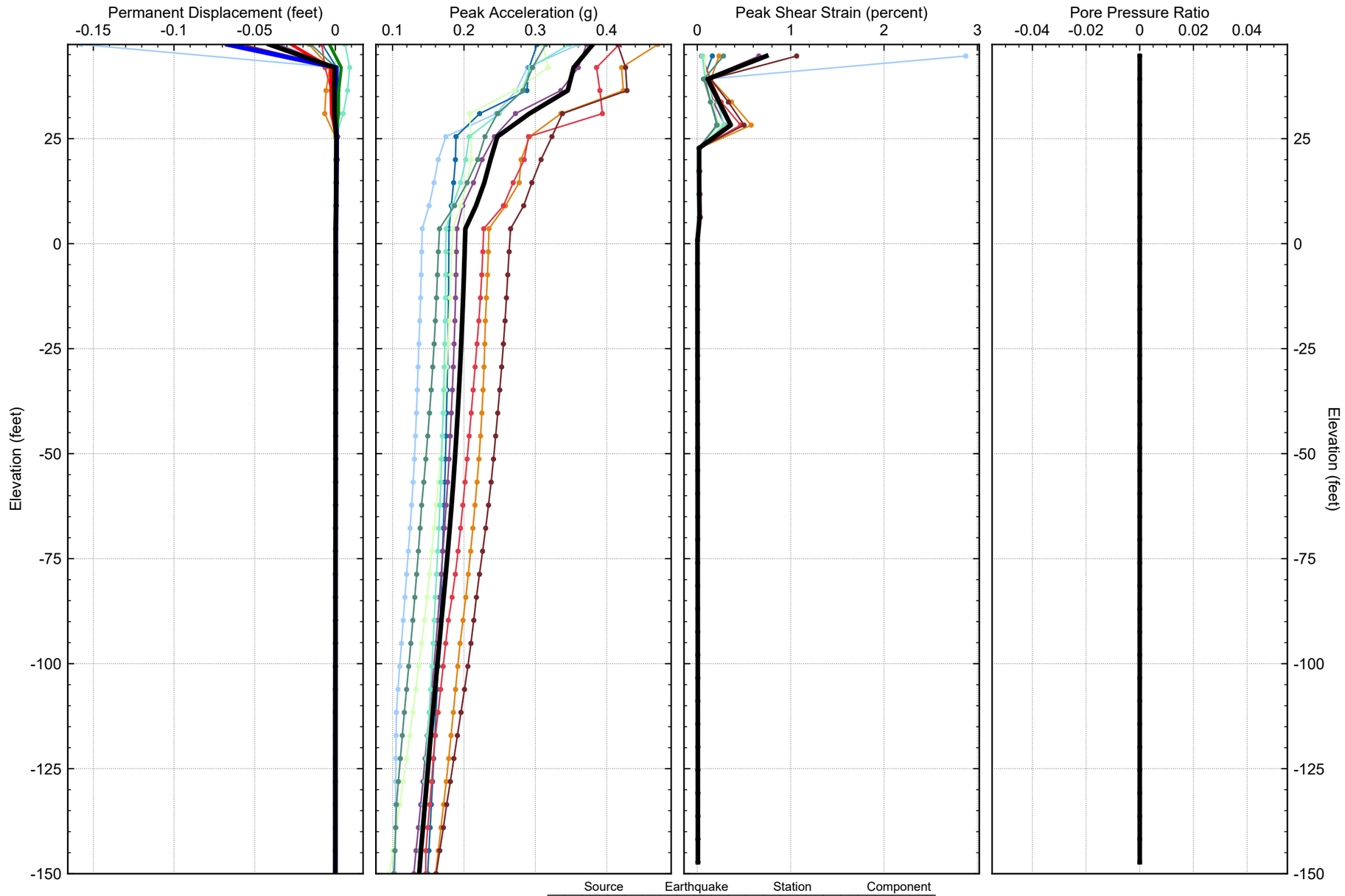
Bent 9
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
1,000-YEAR PROBABILISTIC
BENT 9

April 2022 102636-009

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FIG. H-77

C:_FLACPROCESS\Burnside

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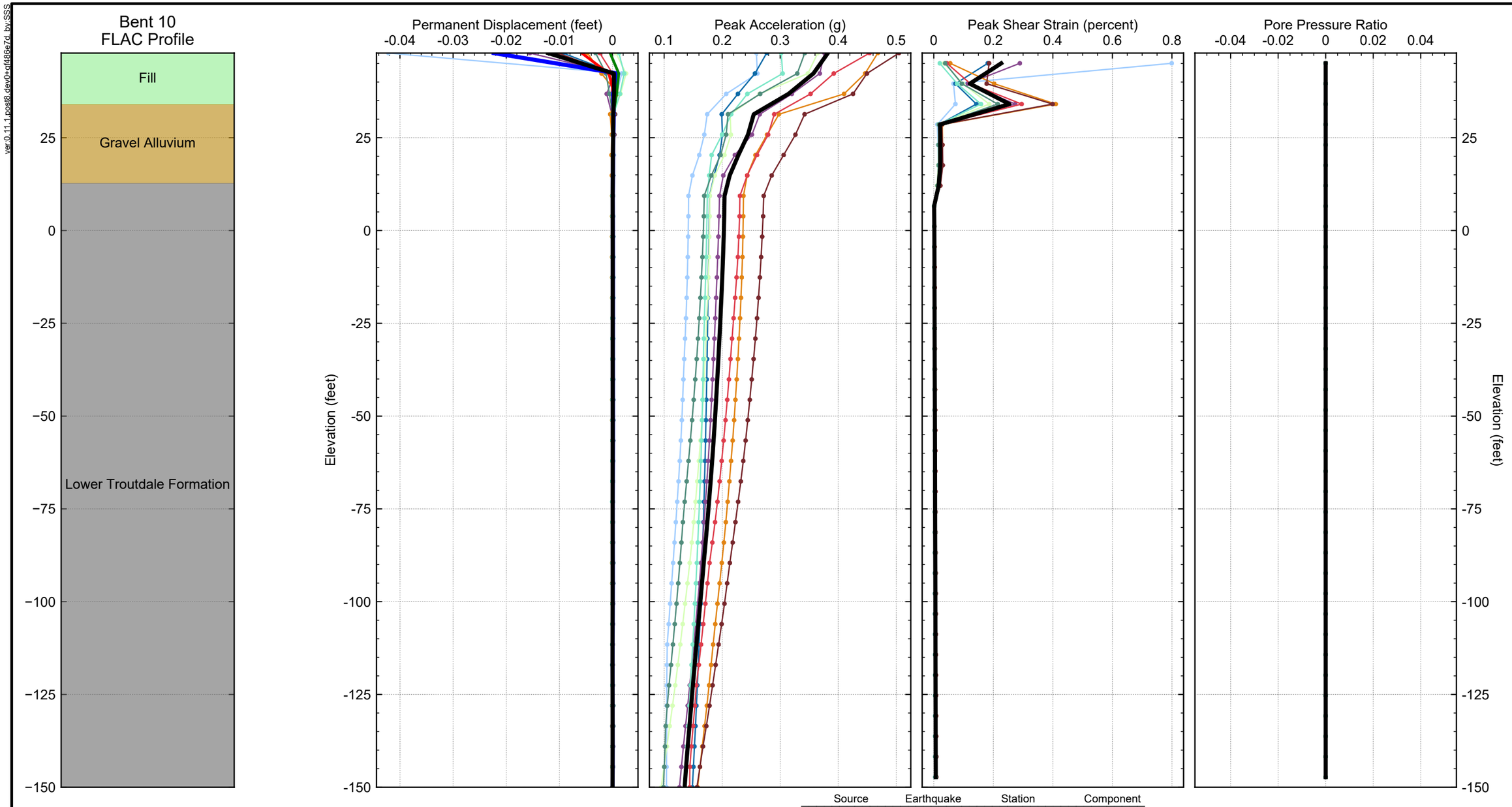

Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
1,000-YEAR PROBABILISTIC
BENT 10

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FIG. H-78

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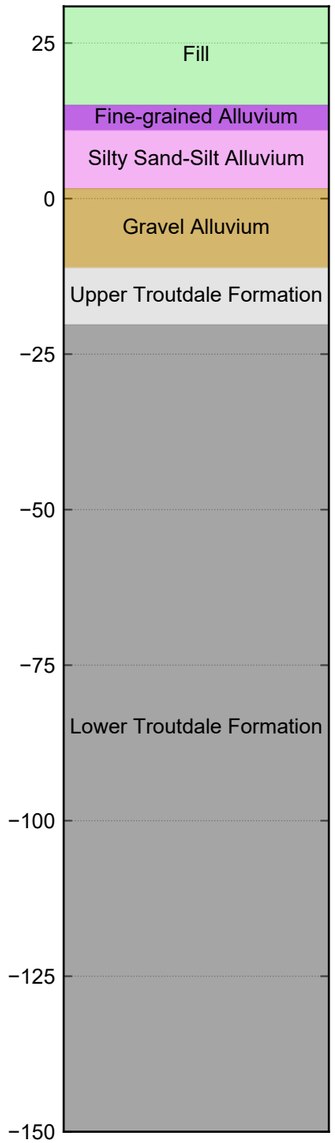
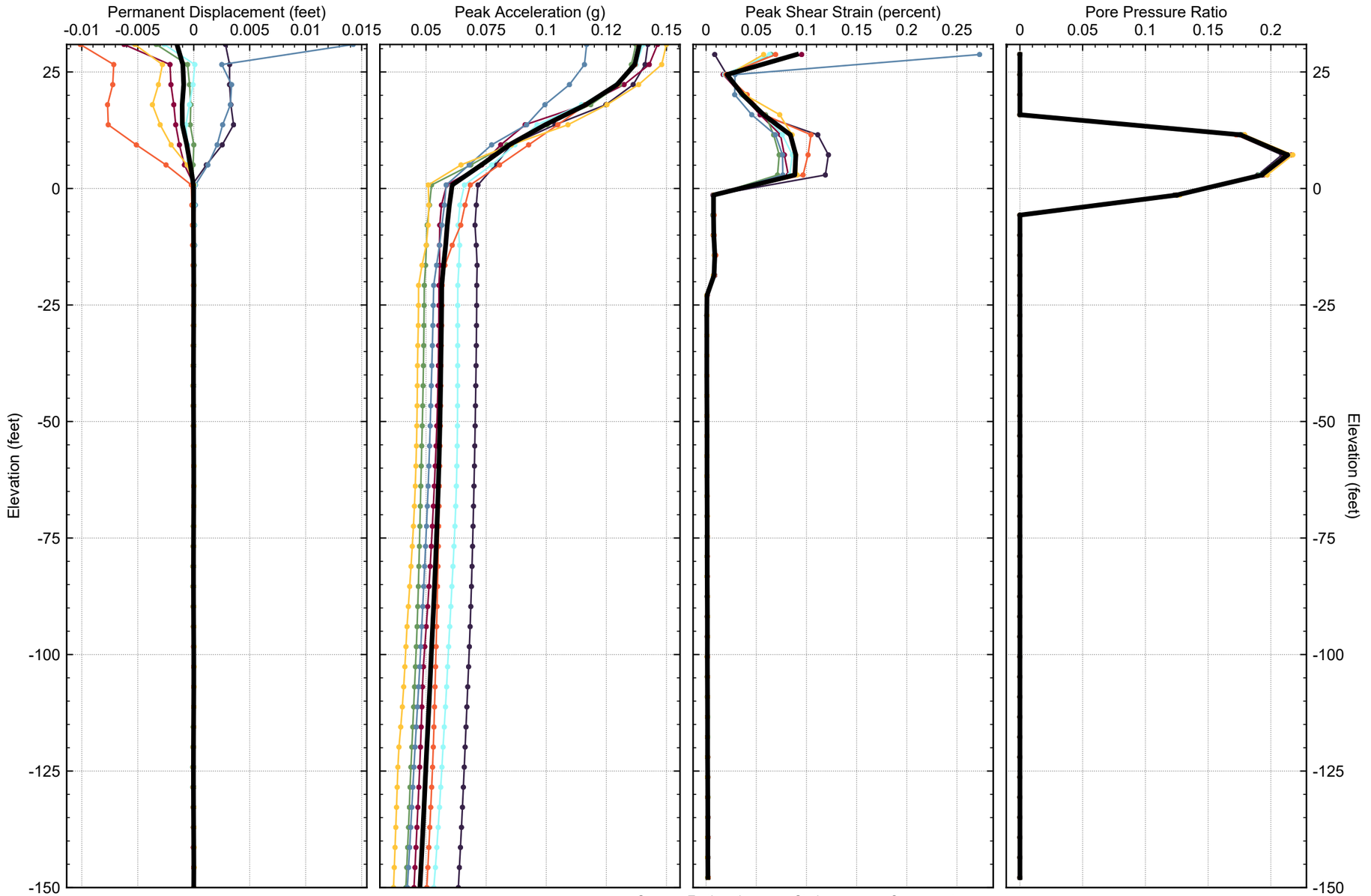
Bent 1
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
DETERMINISTIC CSZ
BENT 1

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FIG. H-79

C:_FLAC\PROCESS\Burnside

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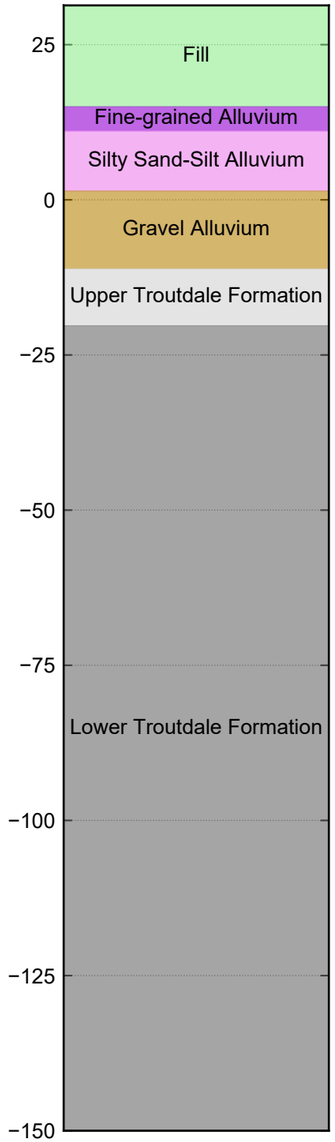
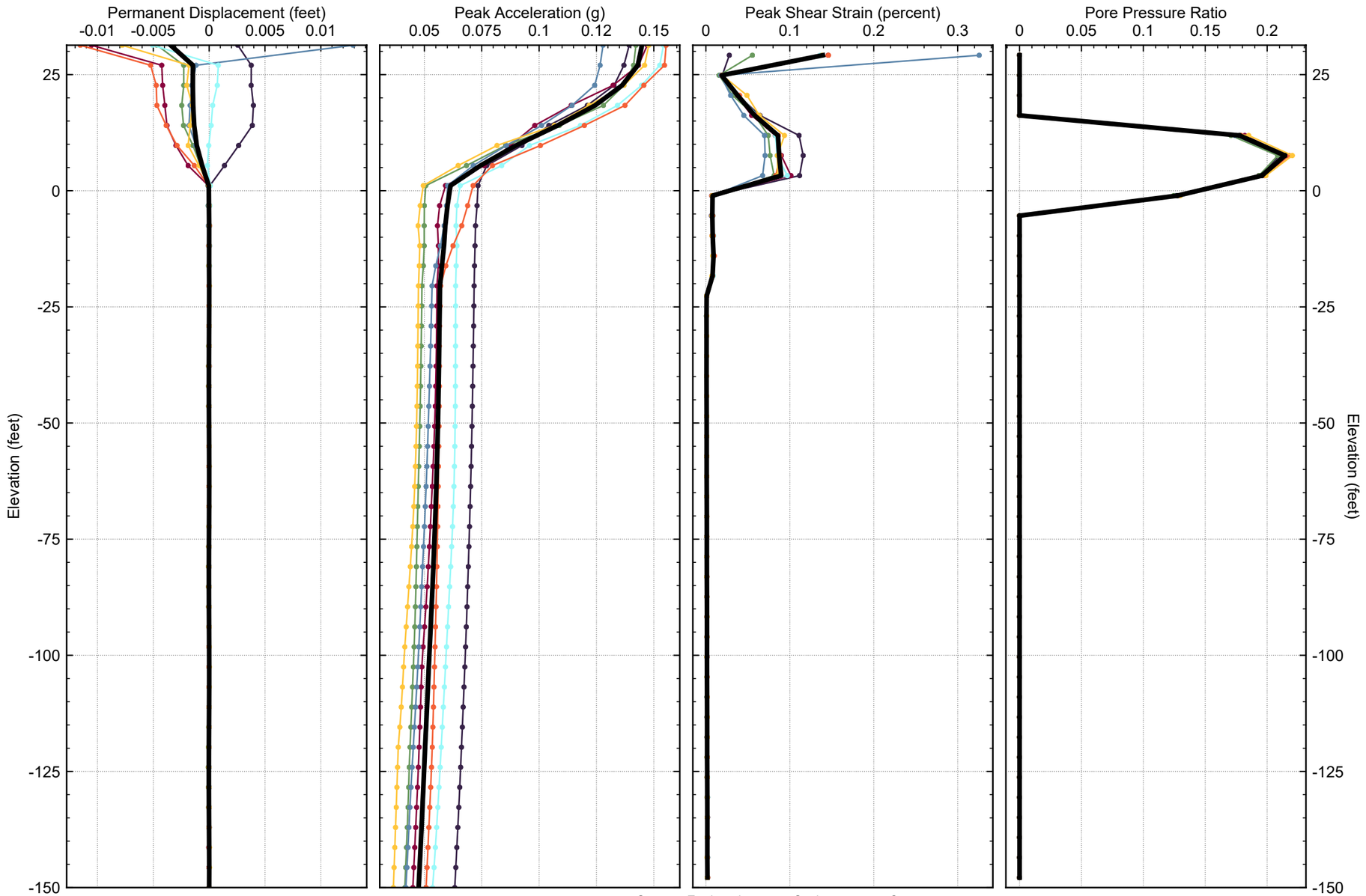
Bent 2
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
DETERMINISTIC CSZ
BENT 2

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FIG. H-80

C:_FLACPROCESS\Burnside

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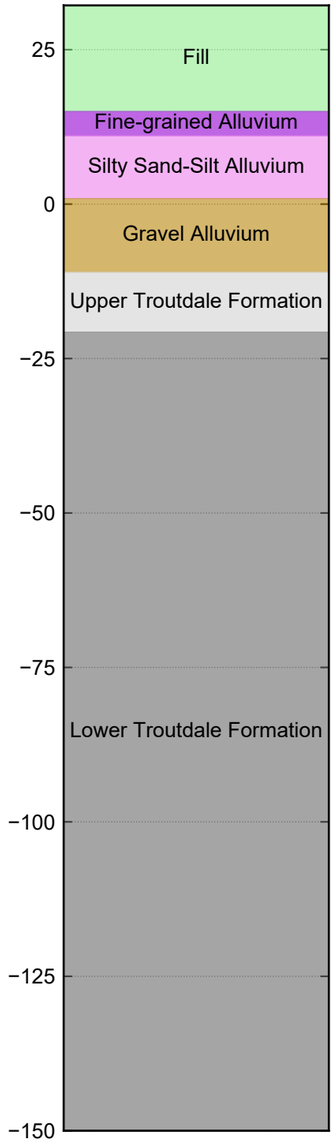
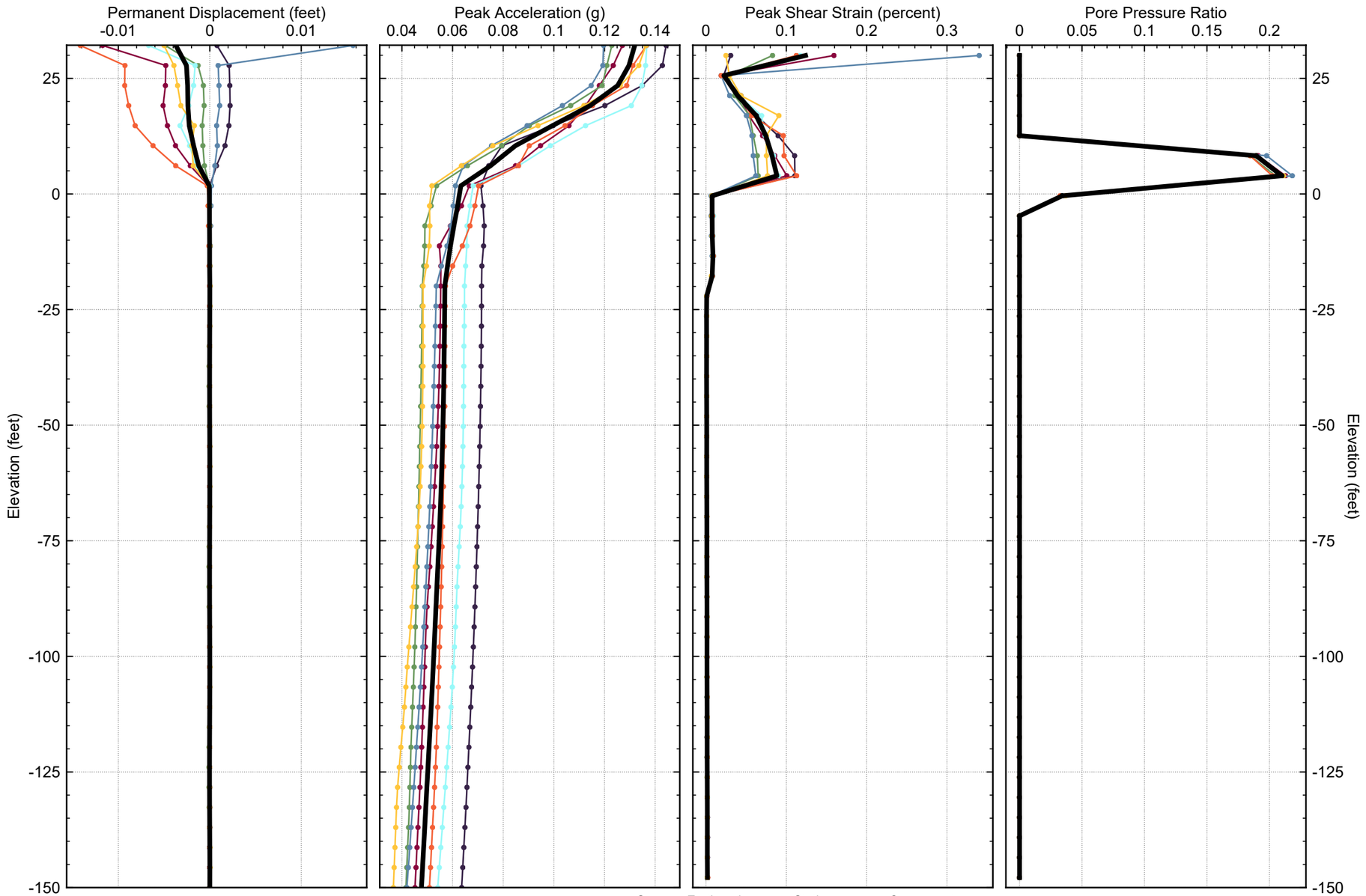
Bent 3
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
DETERMINISTIC CSZ
BENT 3

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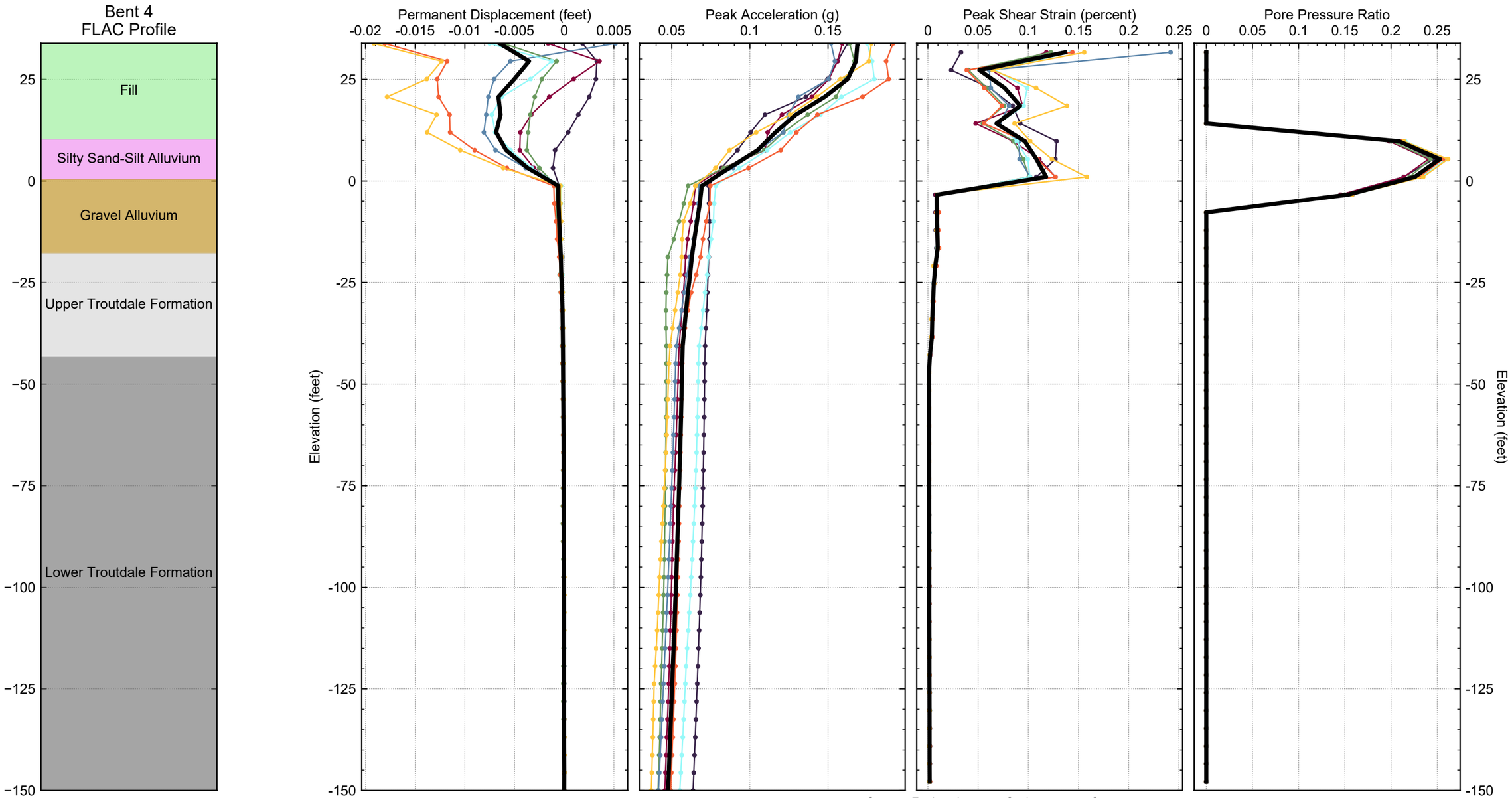
FIG. H-81

C:_FLAGPROCESS\Burnside



Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
DETERMINISTIC CSZ
BENT 4

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FIG. H-82

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C:_FLACPROCESS\Burnside

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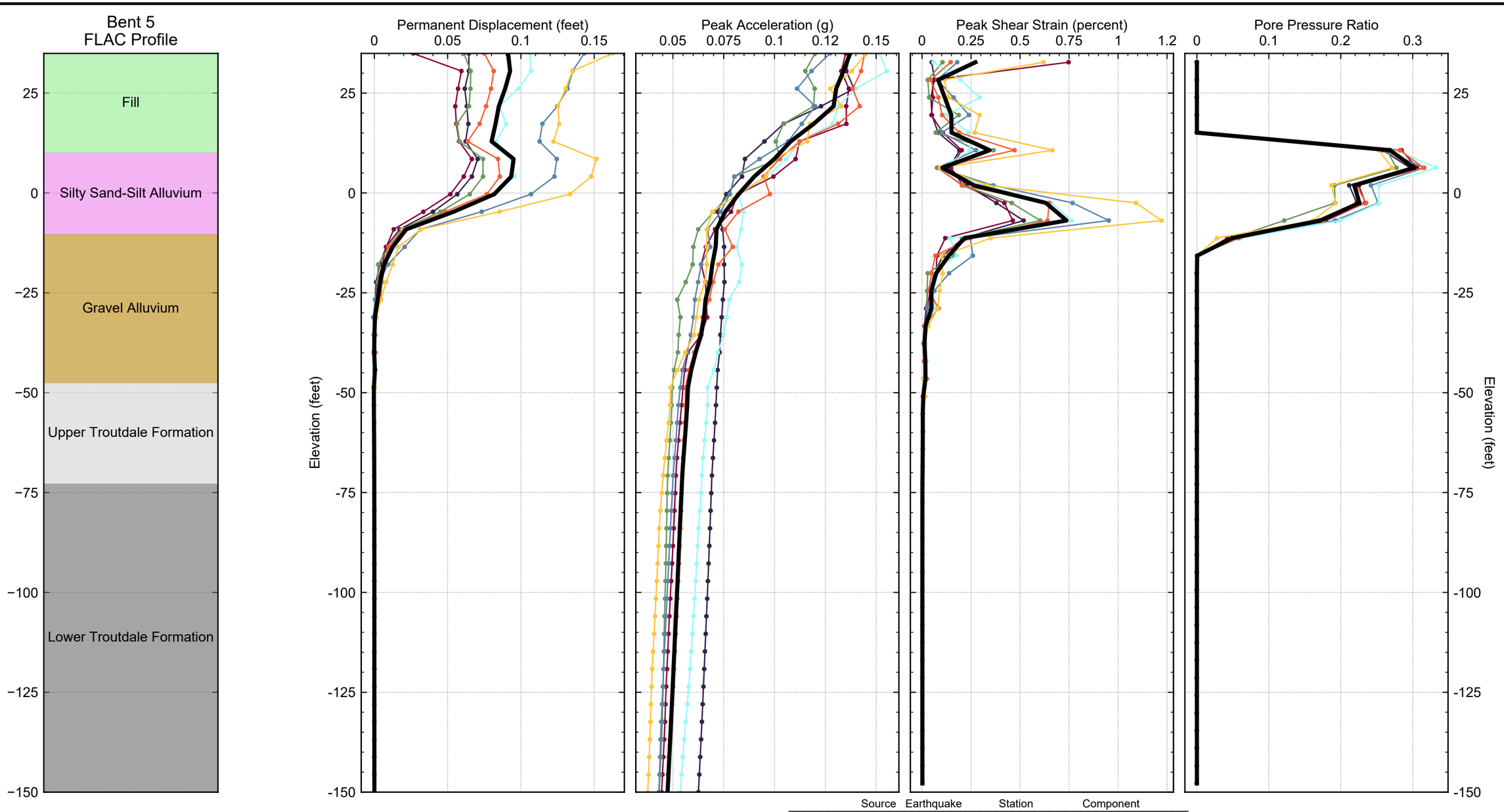

Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
DETERMINISTIC CSZ
BENT 5

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FIG. H-83

C:_FLACPROCESS\Burnside

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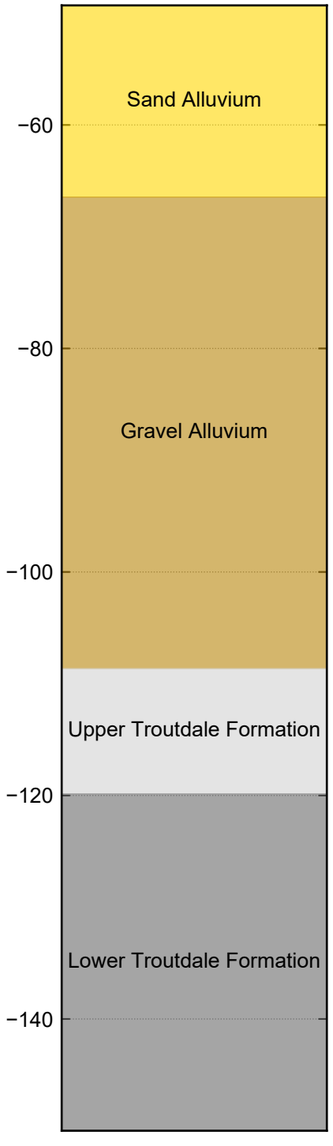
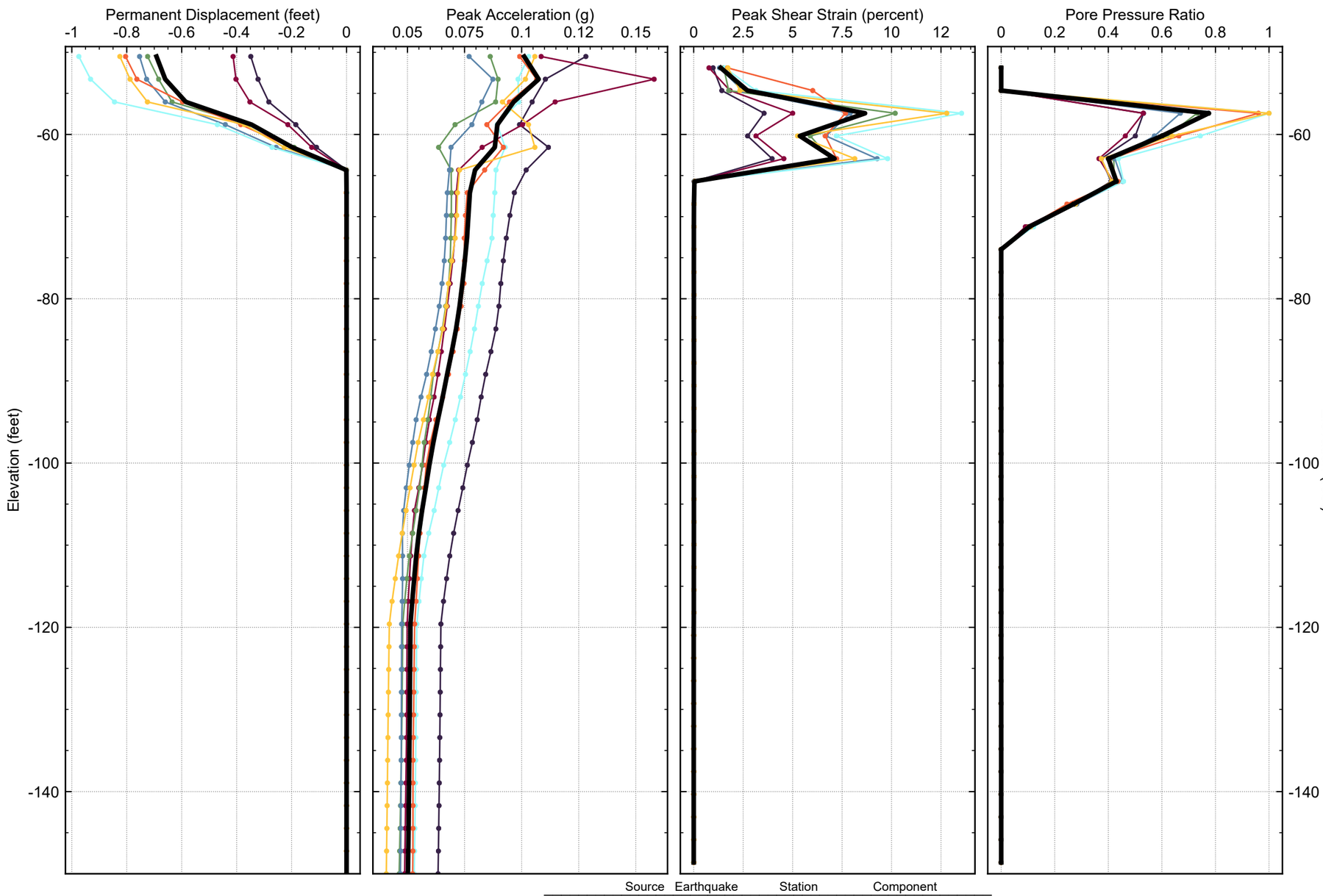
Bent 6
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
DETERMINISTIC CSZ
BENT 6

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FIG. H-84

C:_FLACPROCESS\Burnside

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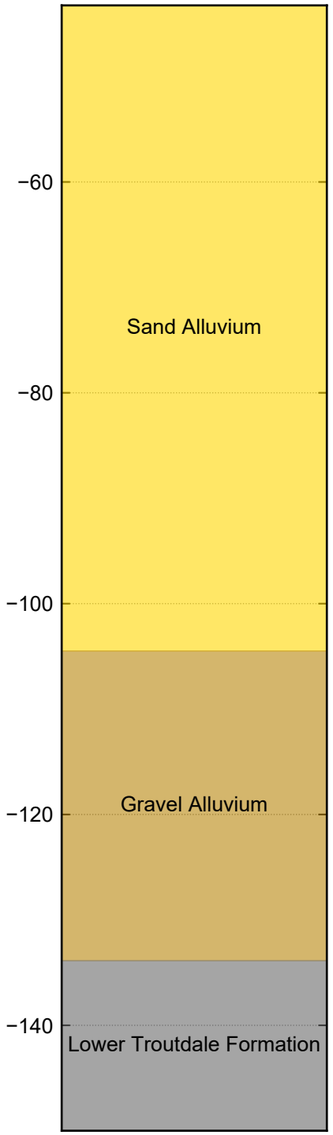
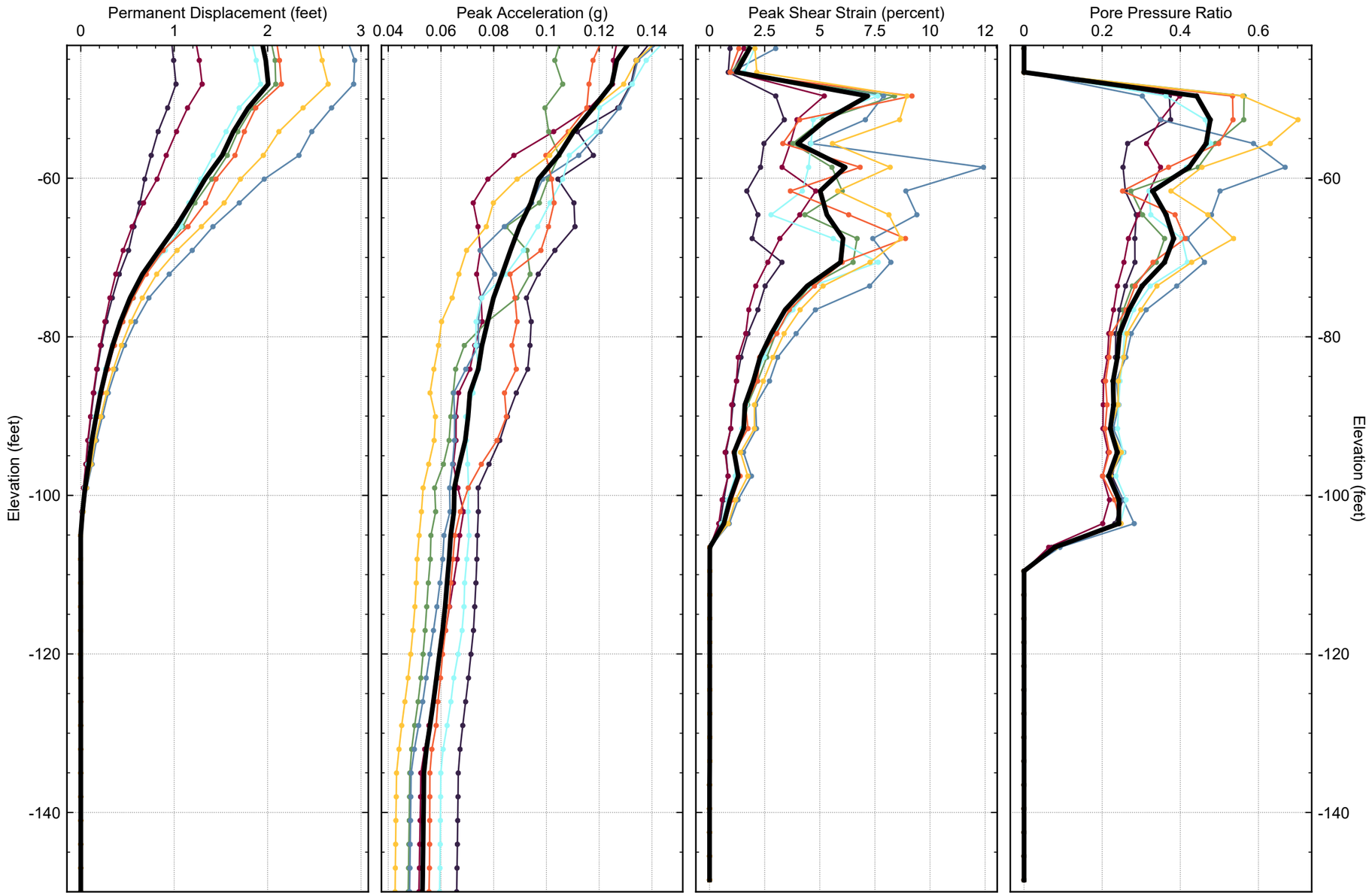
Bent 7
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

C:_FLAC\PROCESS\Burnside

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
DETERMINISTIC CSZ
BENT 7

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FIG. H-85

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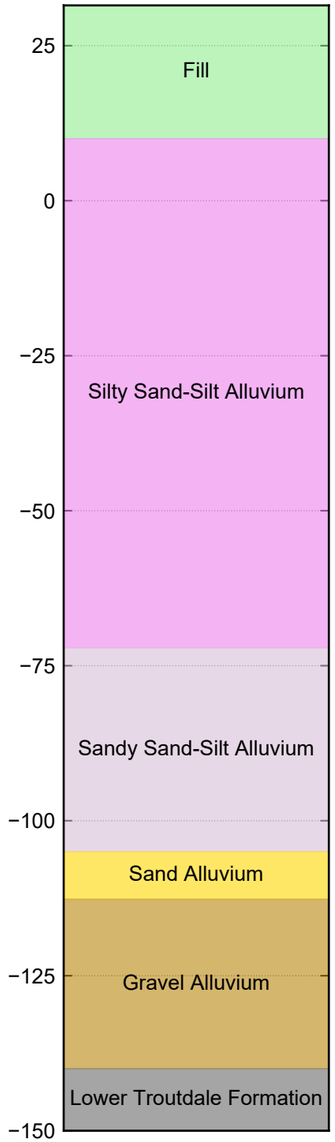
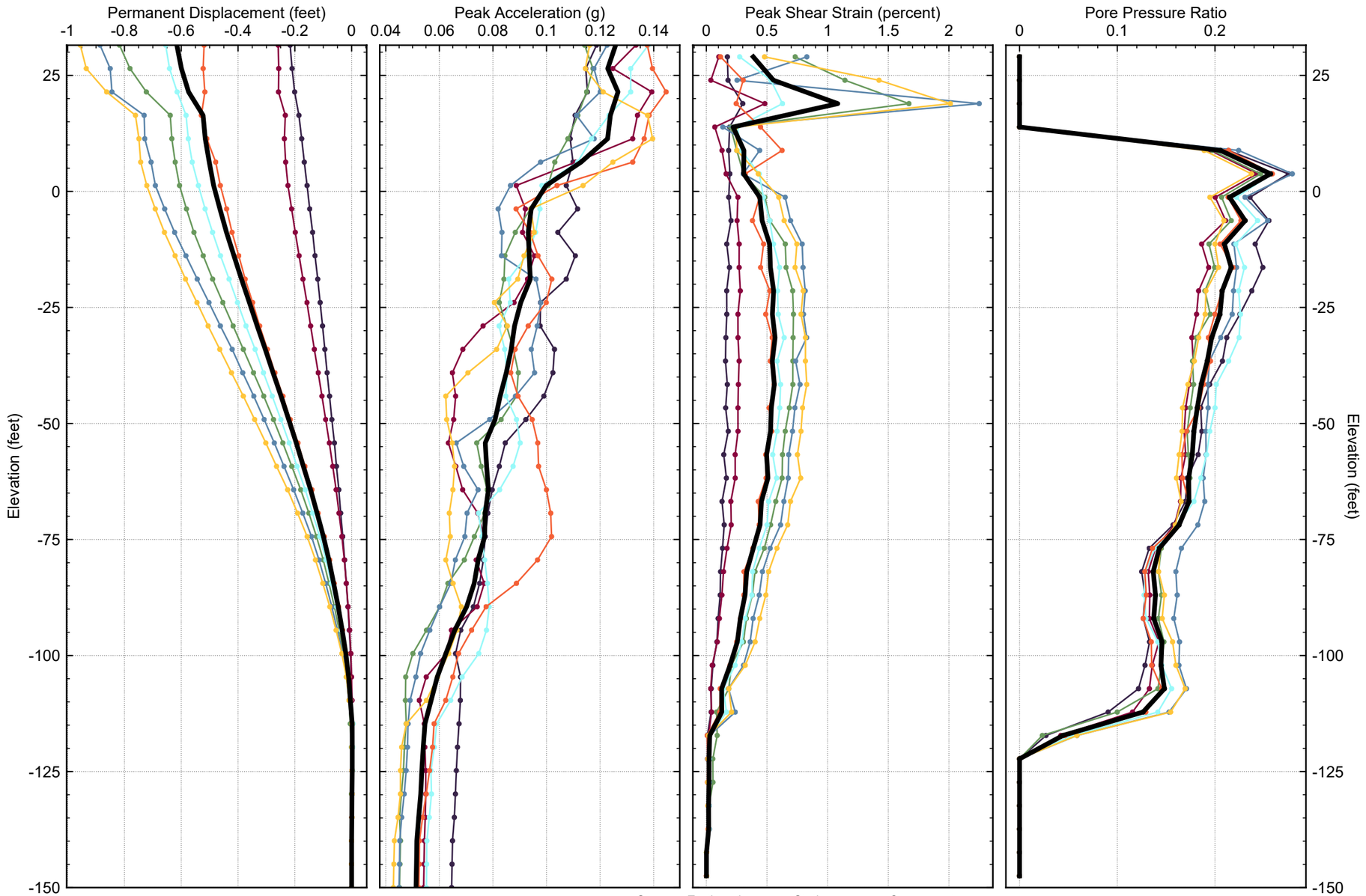
Bent 8 Cable-Stayed Tower
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
DETERMINISTIC CSZ
BENT 8 CABLE-STAYED TOWER

April 2022 102636-009

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FIG. H-86

C:_FLAGPROCESS\Burnside

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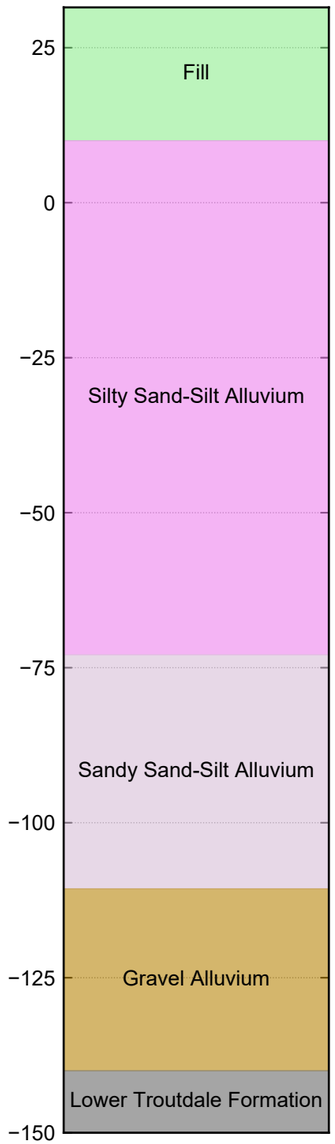
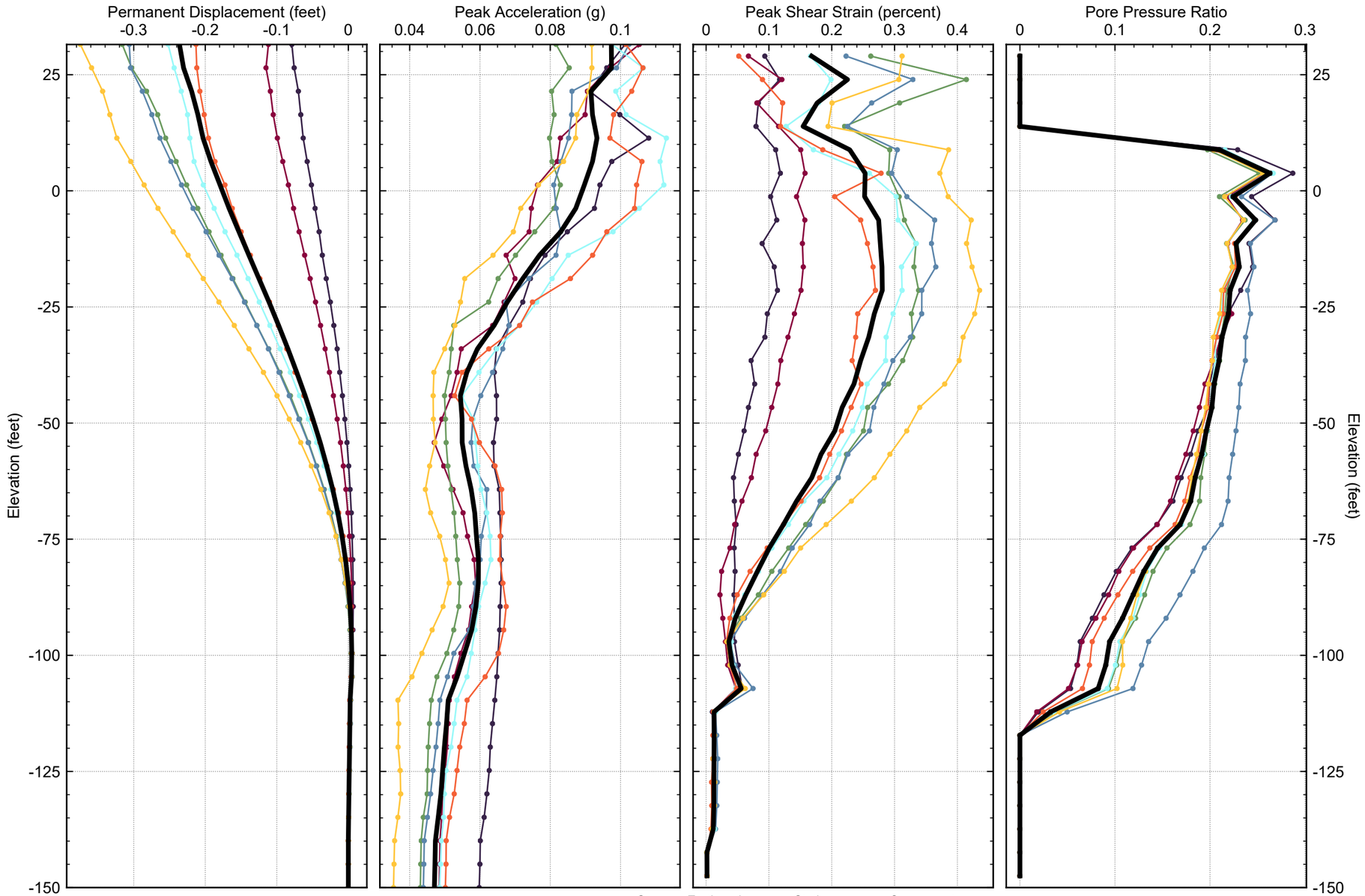
Bent 8 Tied-Arch FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
DETERMINISTIC CSZ
BENT 8 TIED-ARCH

April 2022 102636-009

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FIG. H-87

C:_FLACPROCESS\Burnside

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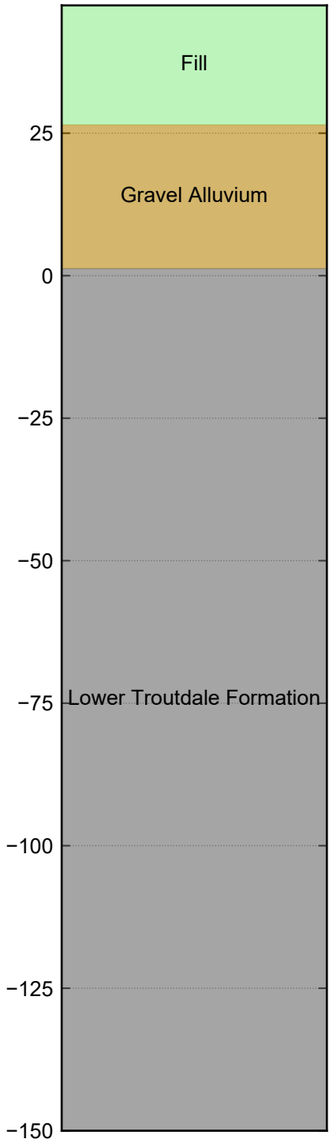
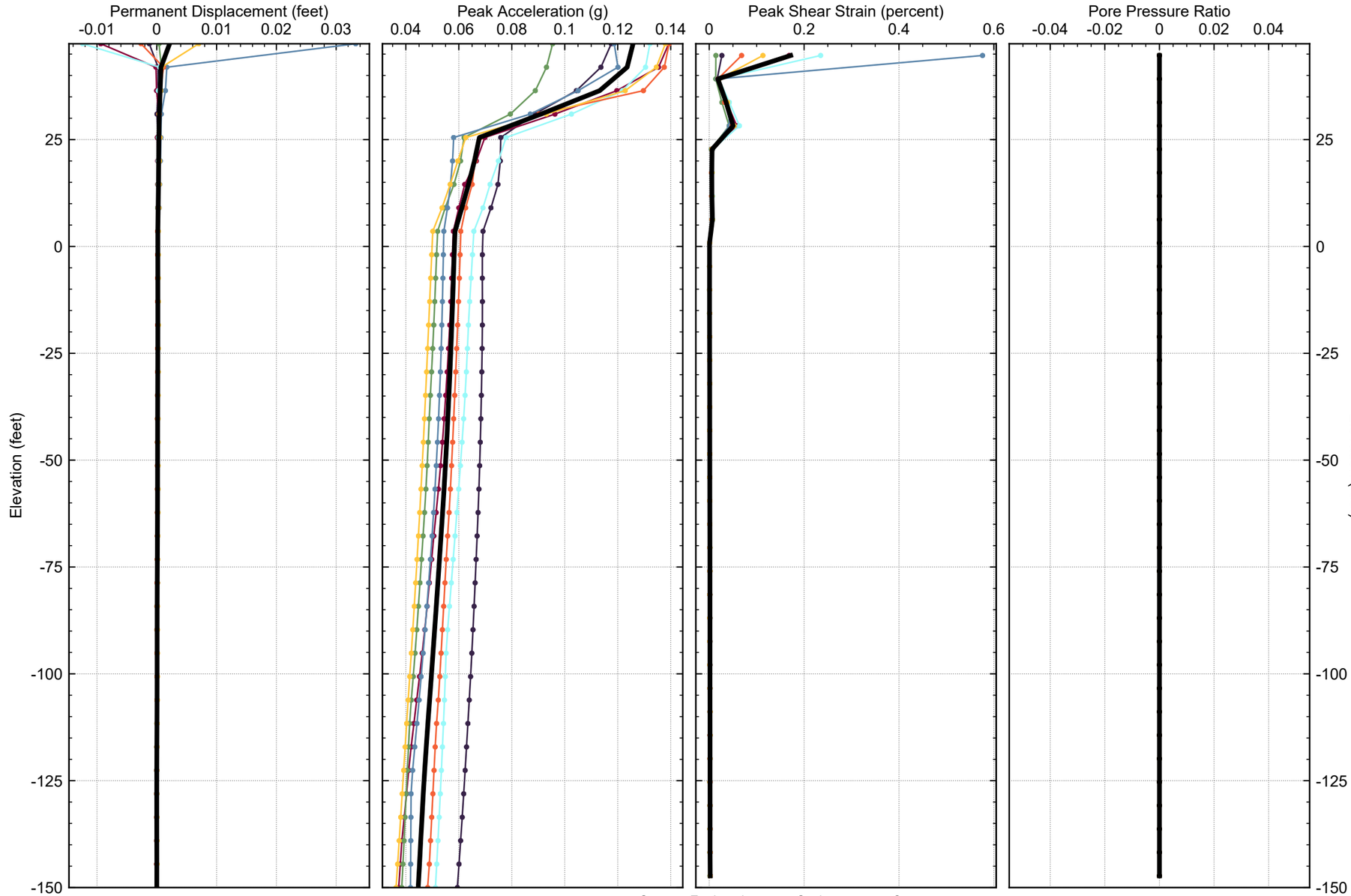
Bent 9
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
DETERMINISTIC CSZ
BENT 9

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FIG. H-88

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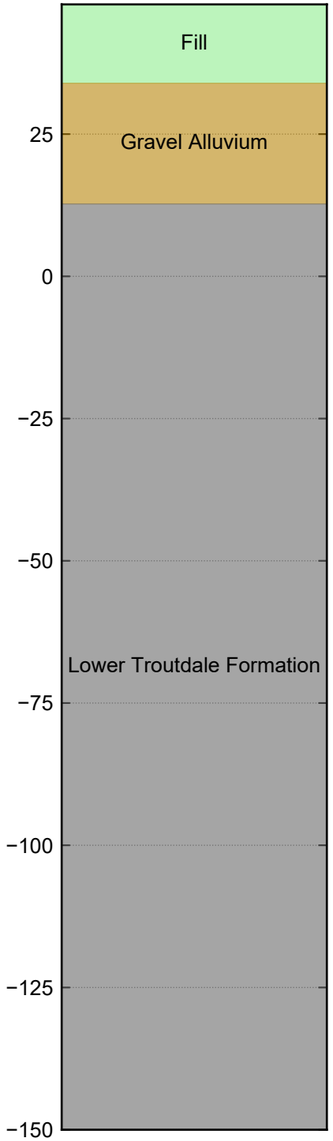
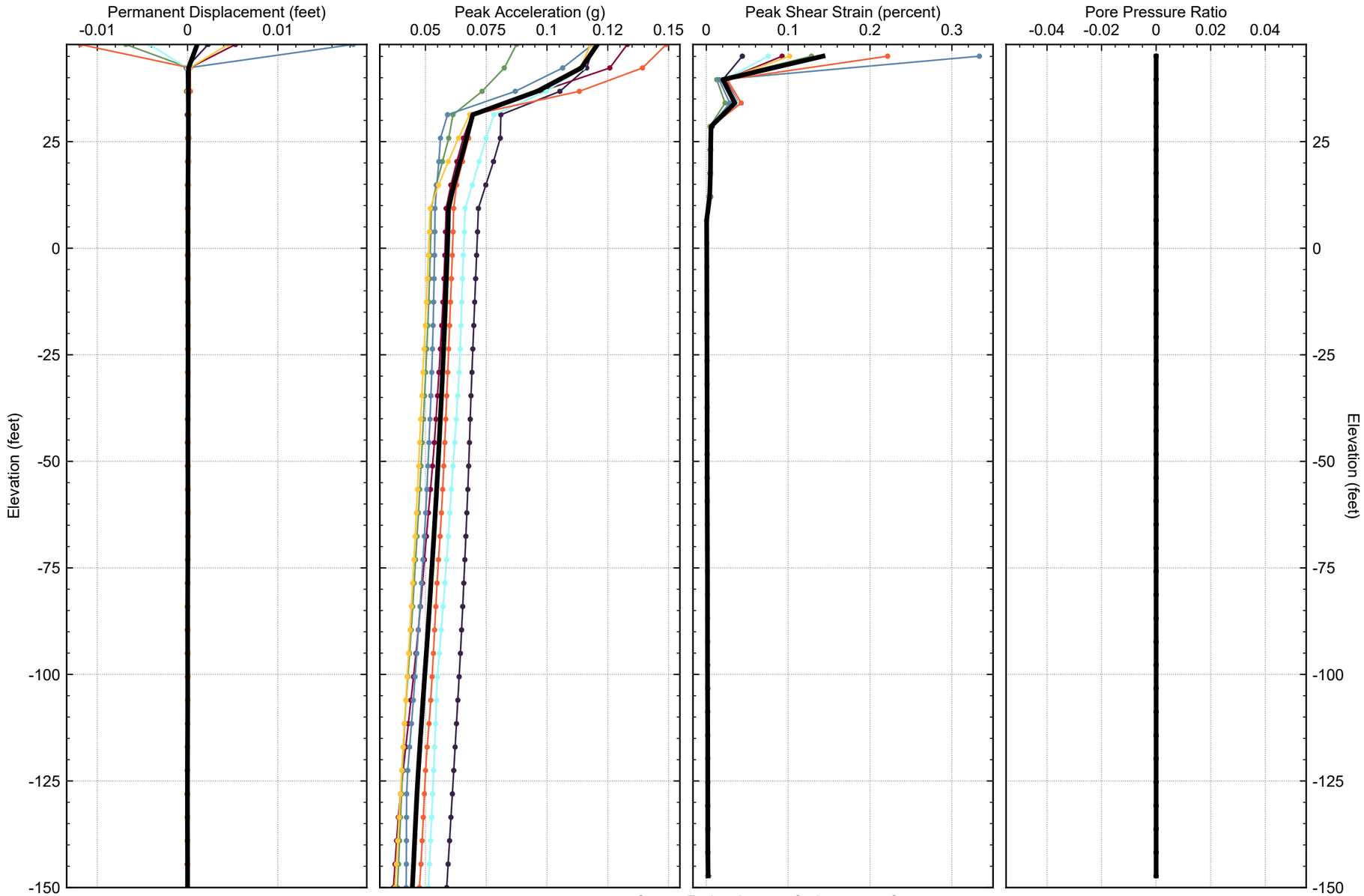
Bent 10
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
All Motion Average (see notes)			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS
DETERMINISTIC CSZ
BENT 10

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FIG. H-89

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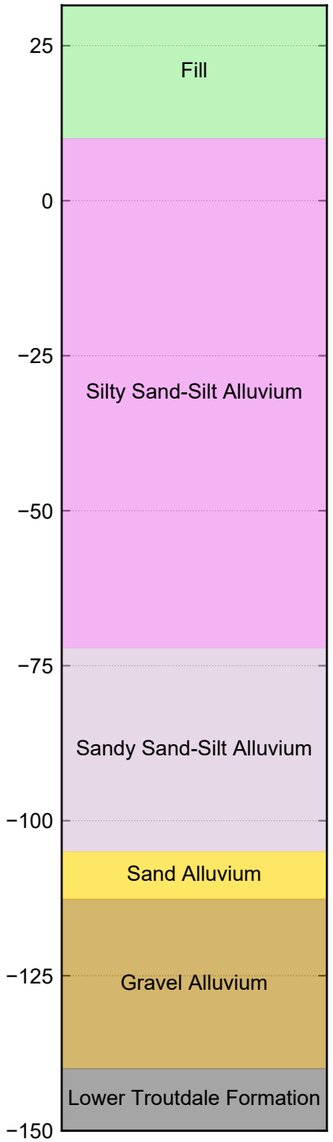
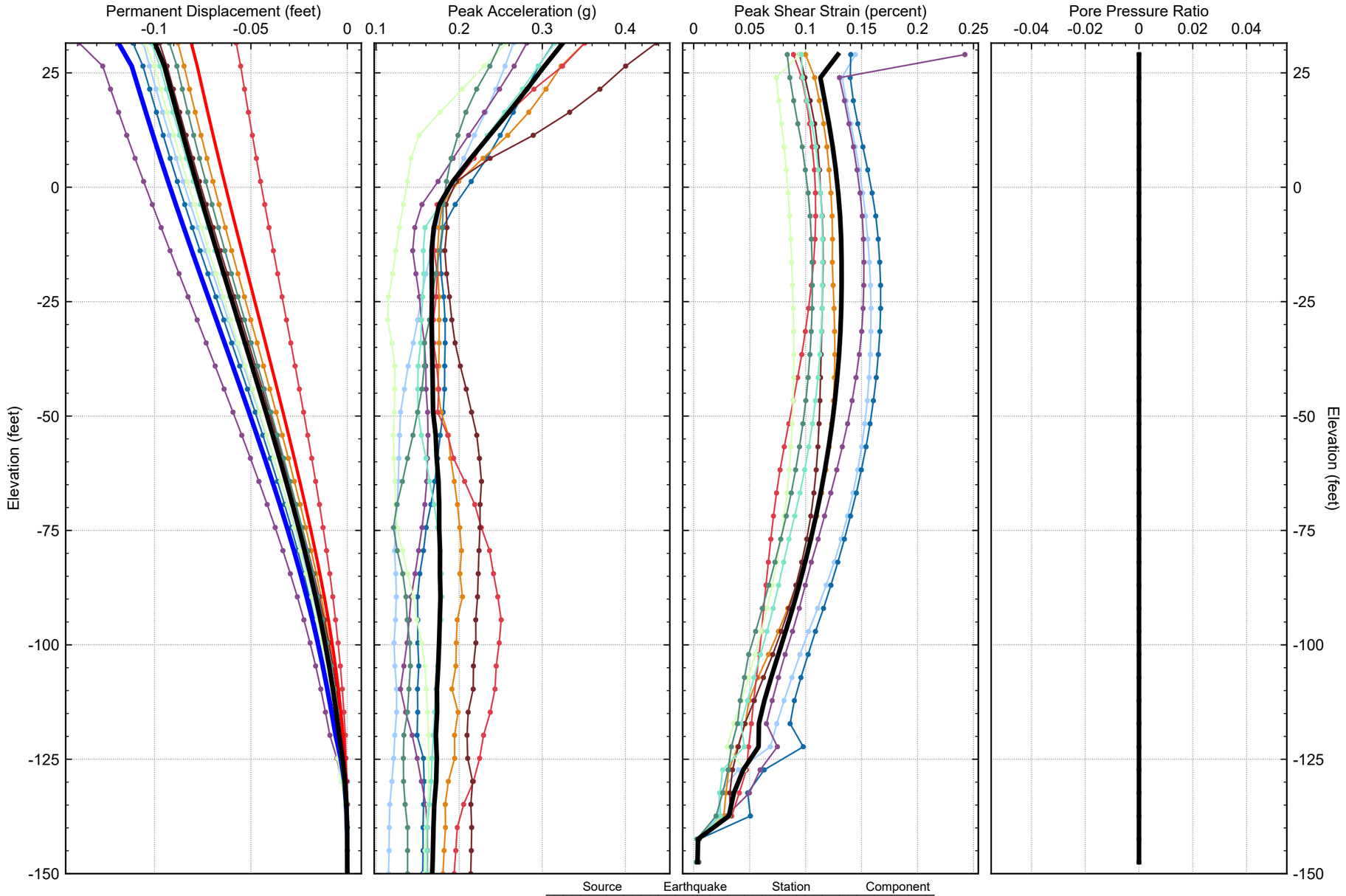
Bent 8 Cable-Stayed Tower FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.

CSZ Motion Average
CRUSTAL Motion Average
SLAB Motion Average
All Motion Average (see notes)

Notes:
1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; SLAB = Cascadia Subduction Zone intraslab event.
2. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
3. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

2D SITE RESPONSE PROFILES
EFFECTIVE STRESS WITH GI
1,000-YEAR PROBABILISTIC
BENT 8 CABLE-STAYED TOWER

April 2022 102636-009

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FIG. H-90

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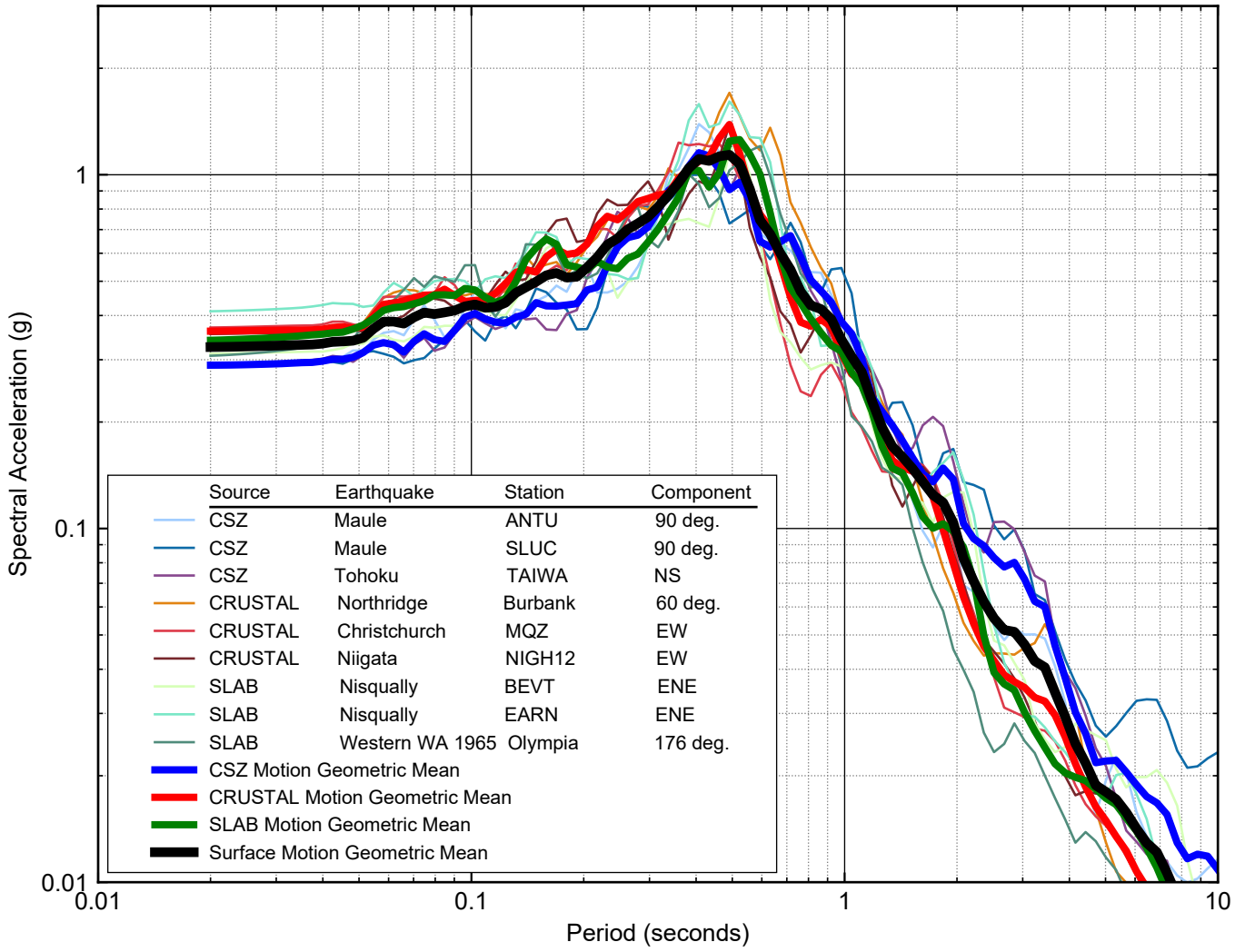

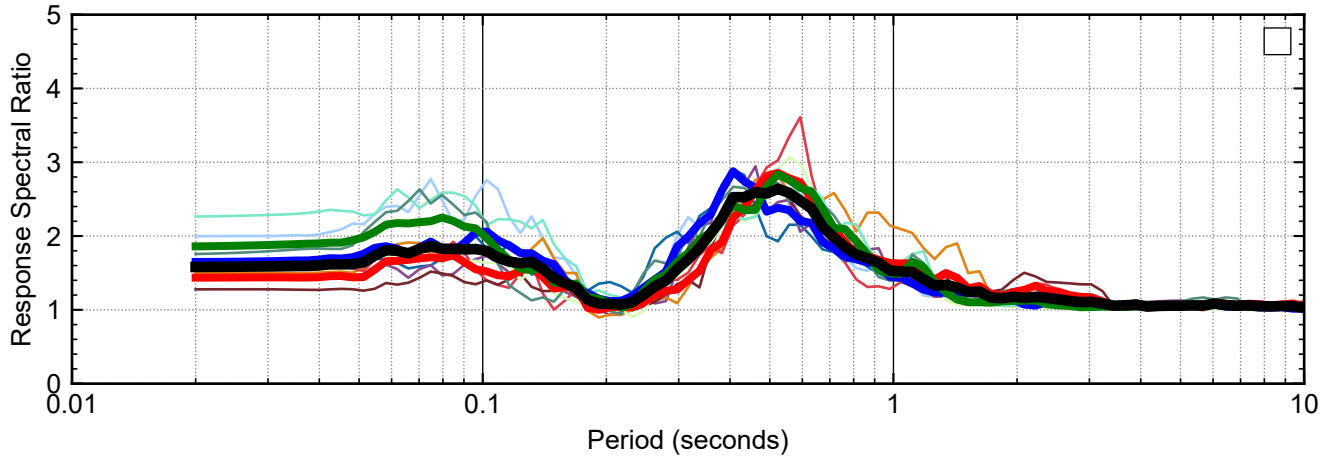

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 1
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

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FIG. H-91

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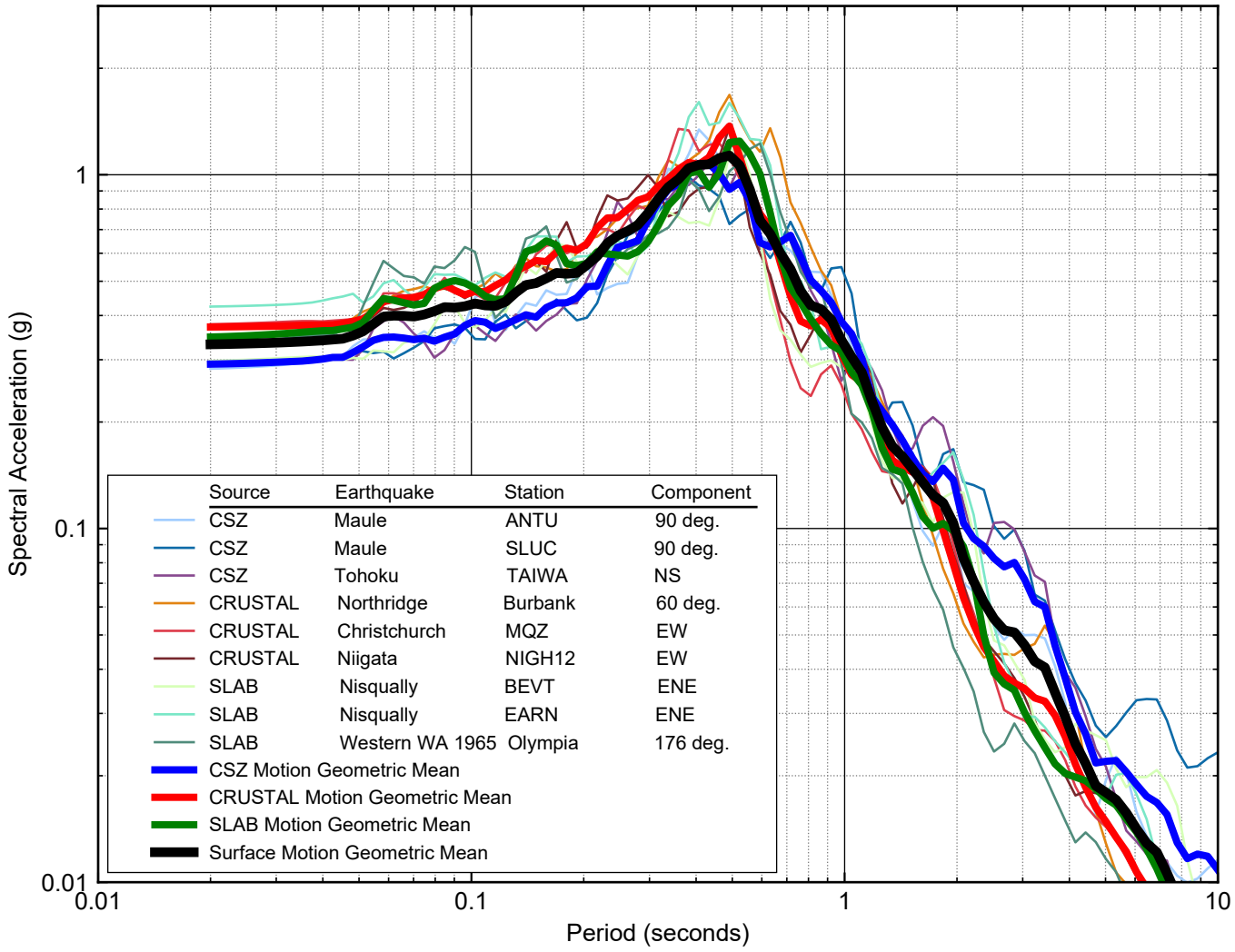

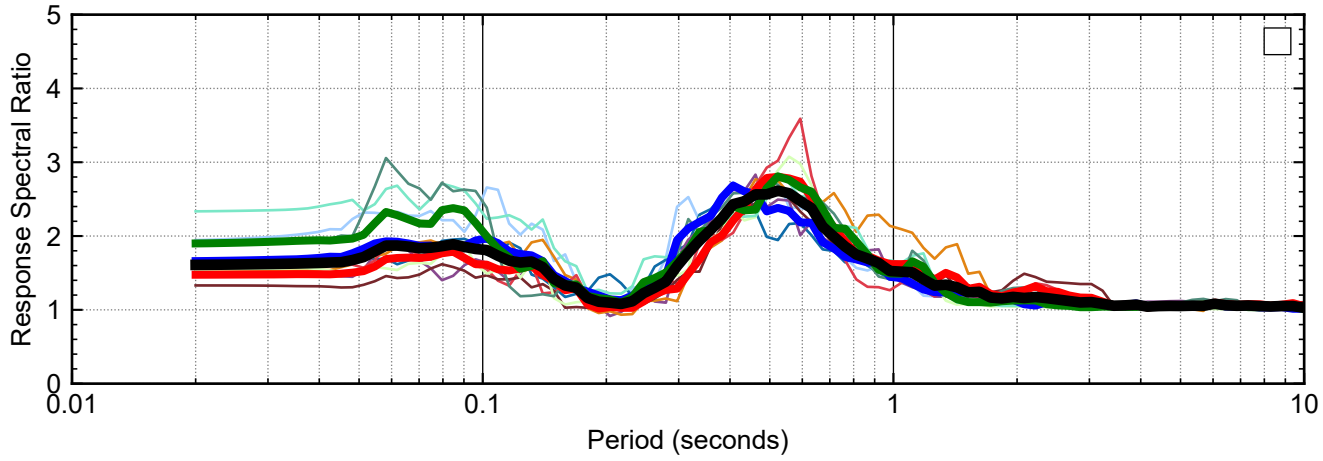

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 2
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

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FIG. H-92

C:_FLACPROCESS\Burnside

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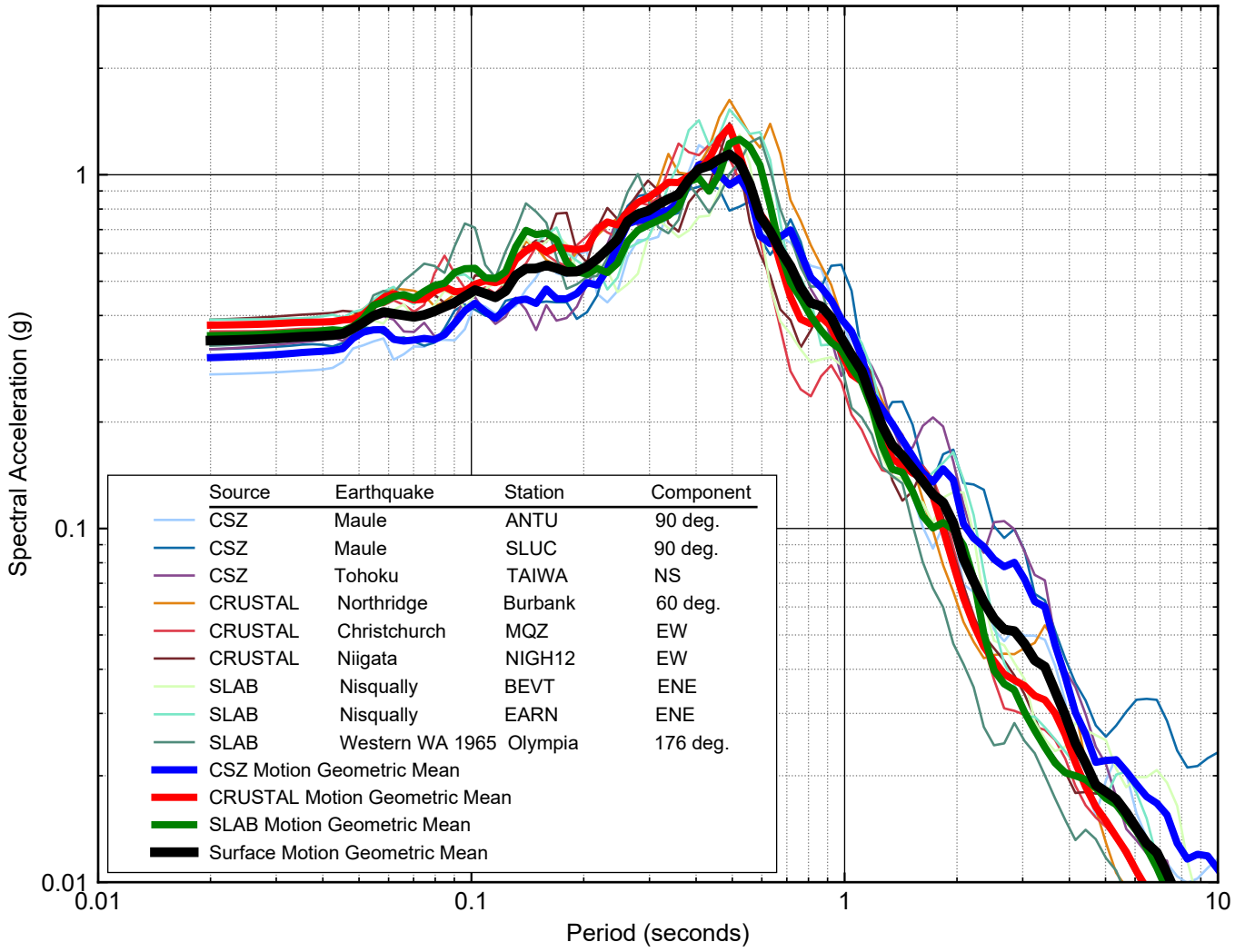

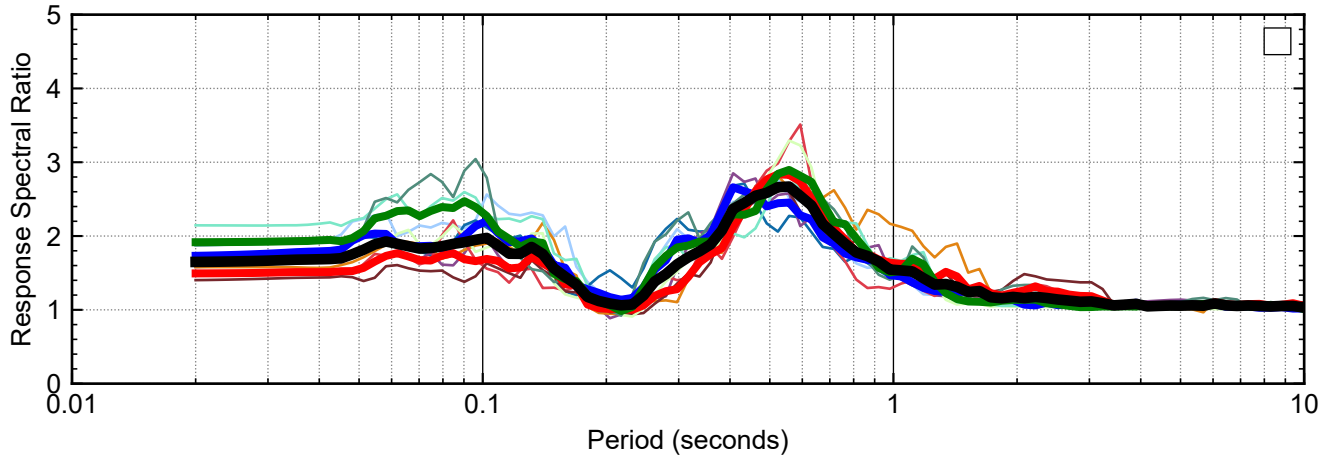

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 3
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-93

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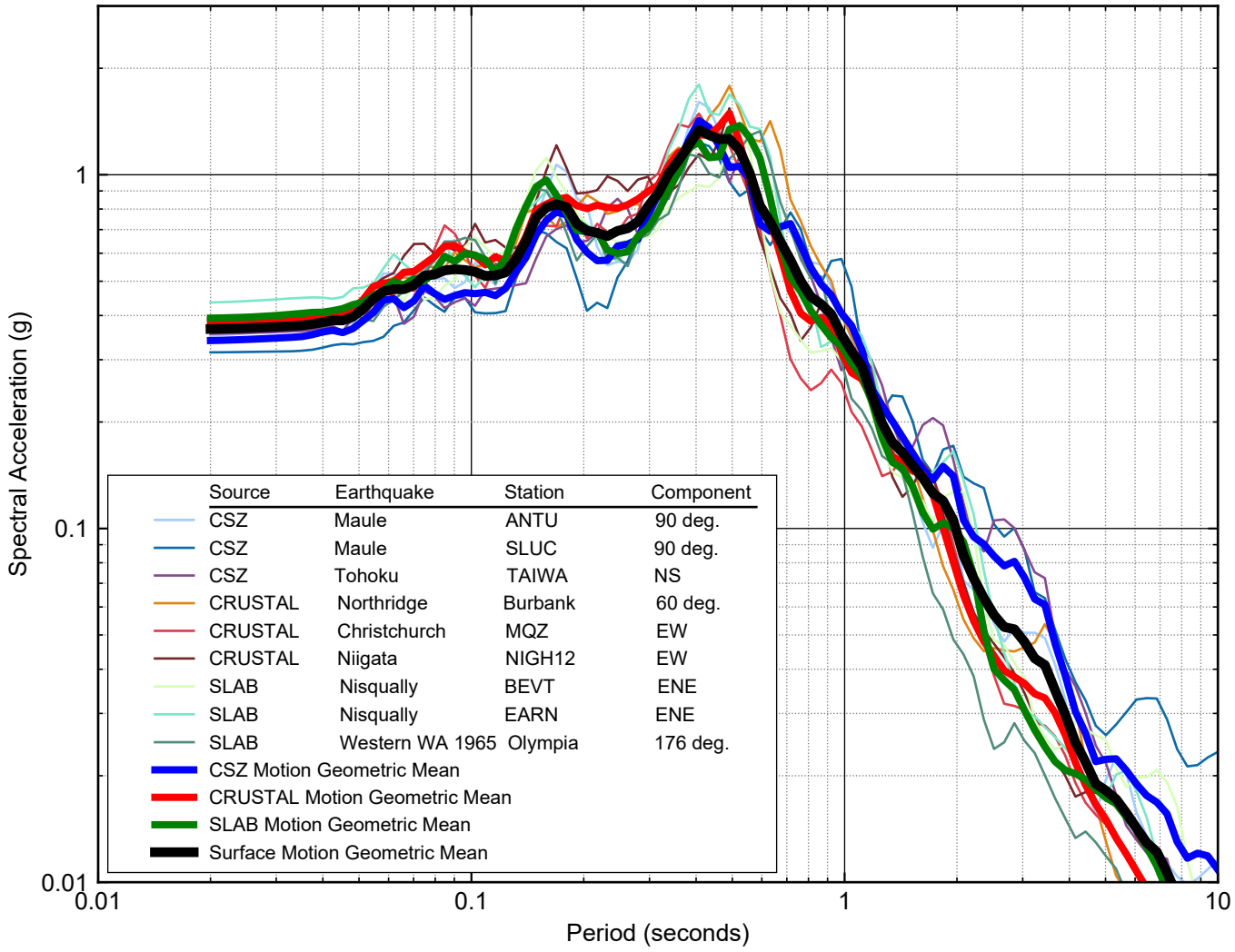

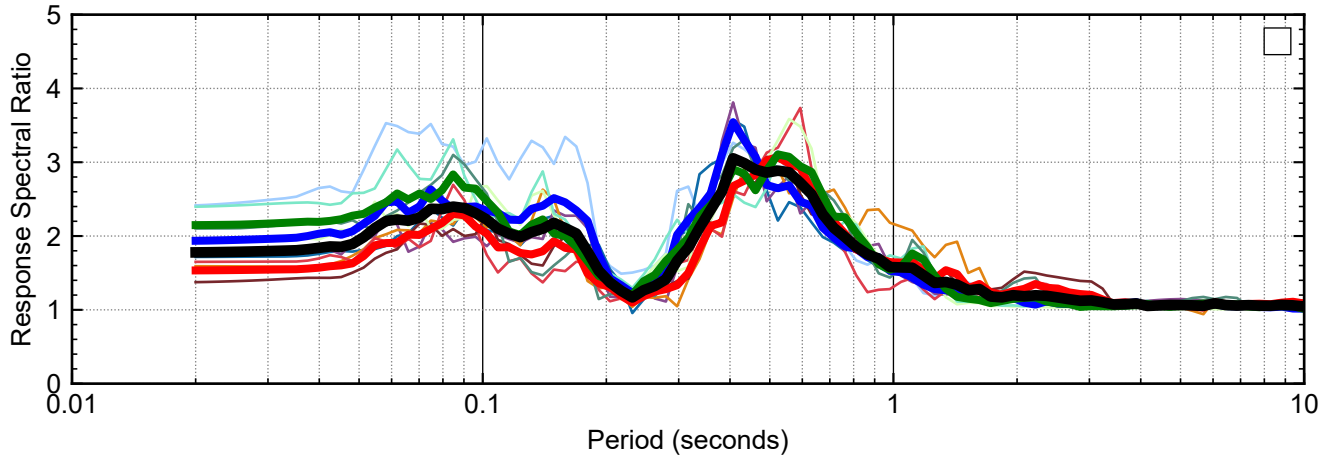

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 4
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-94

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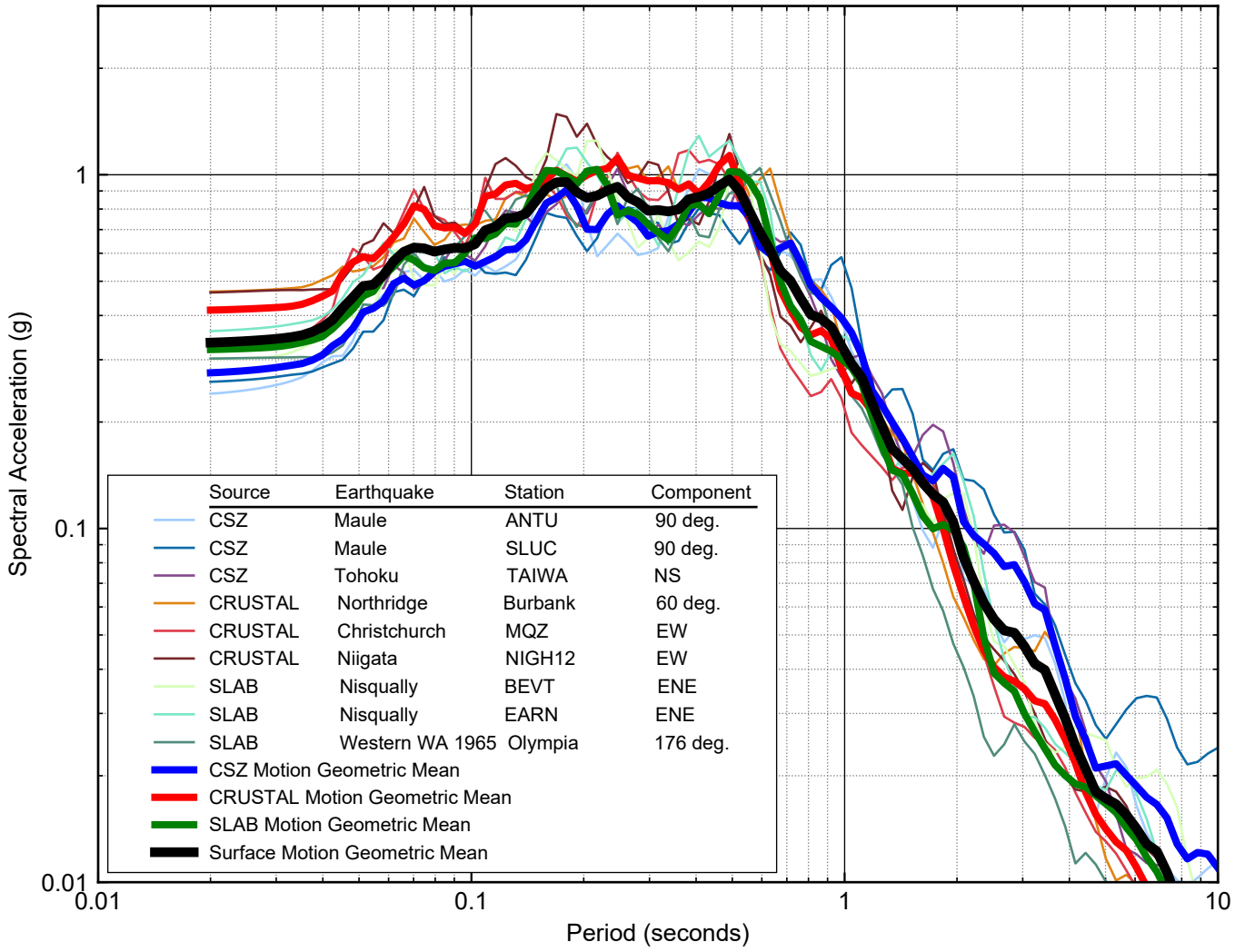

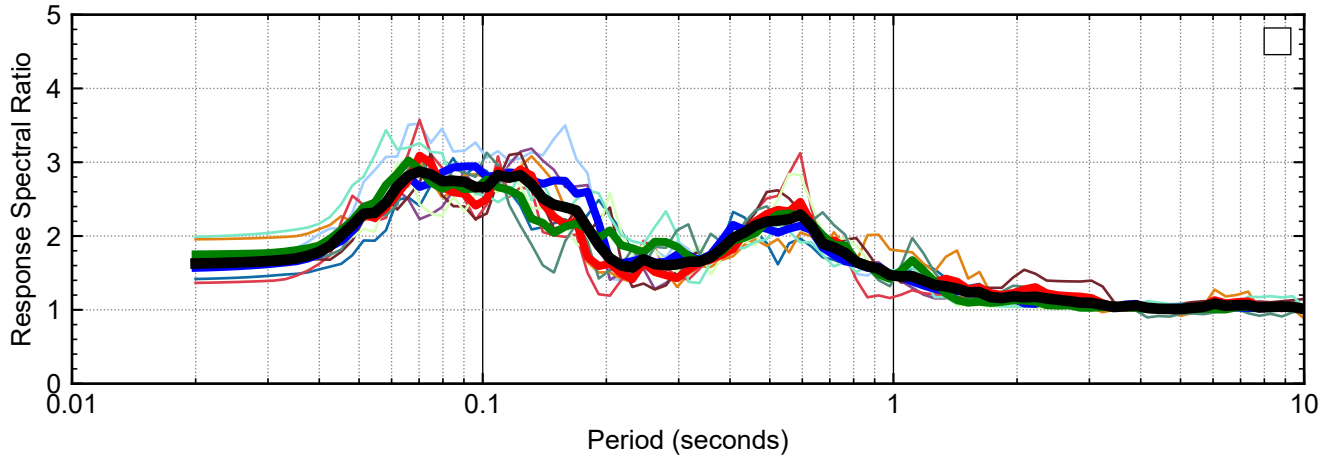

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 5
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
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FIG. H-95

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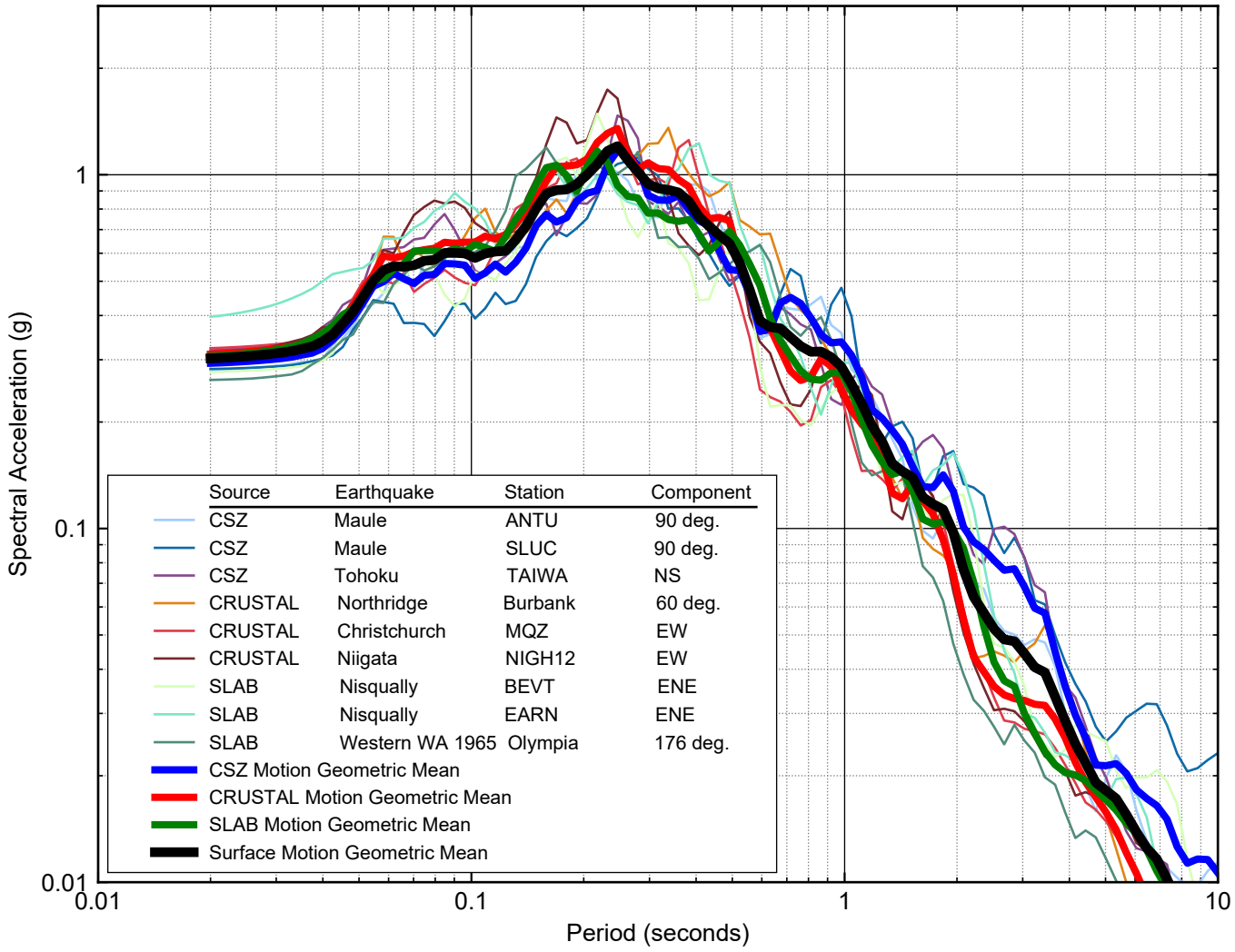

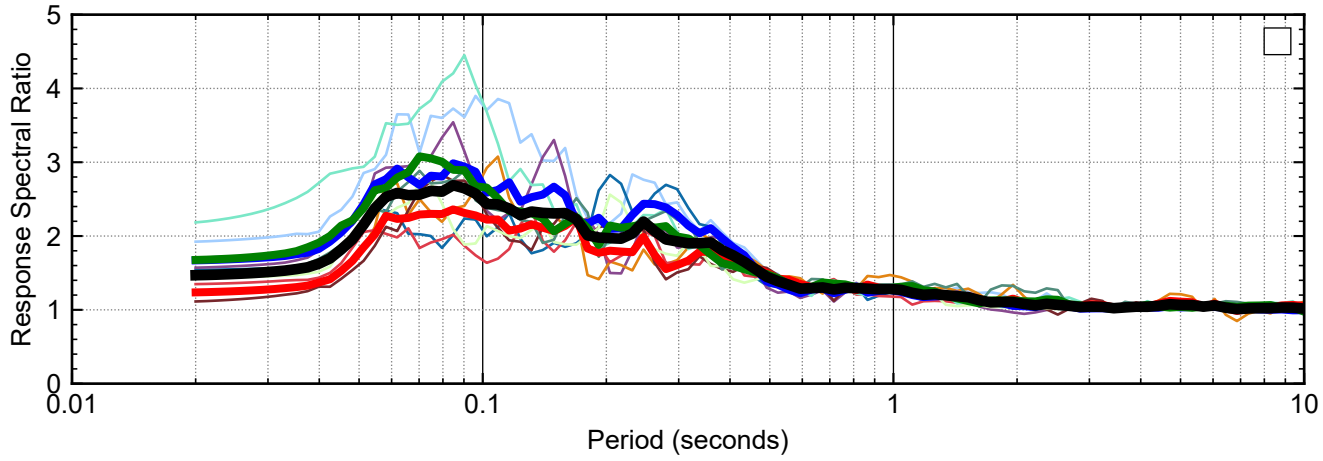

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 6
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
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FIG. H-96

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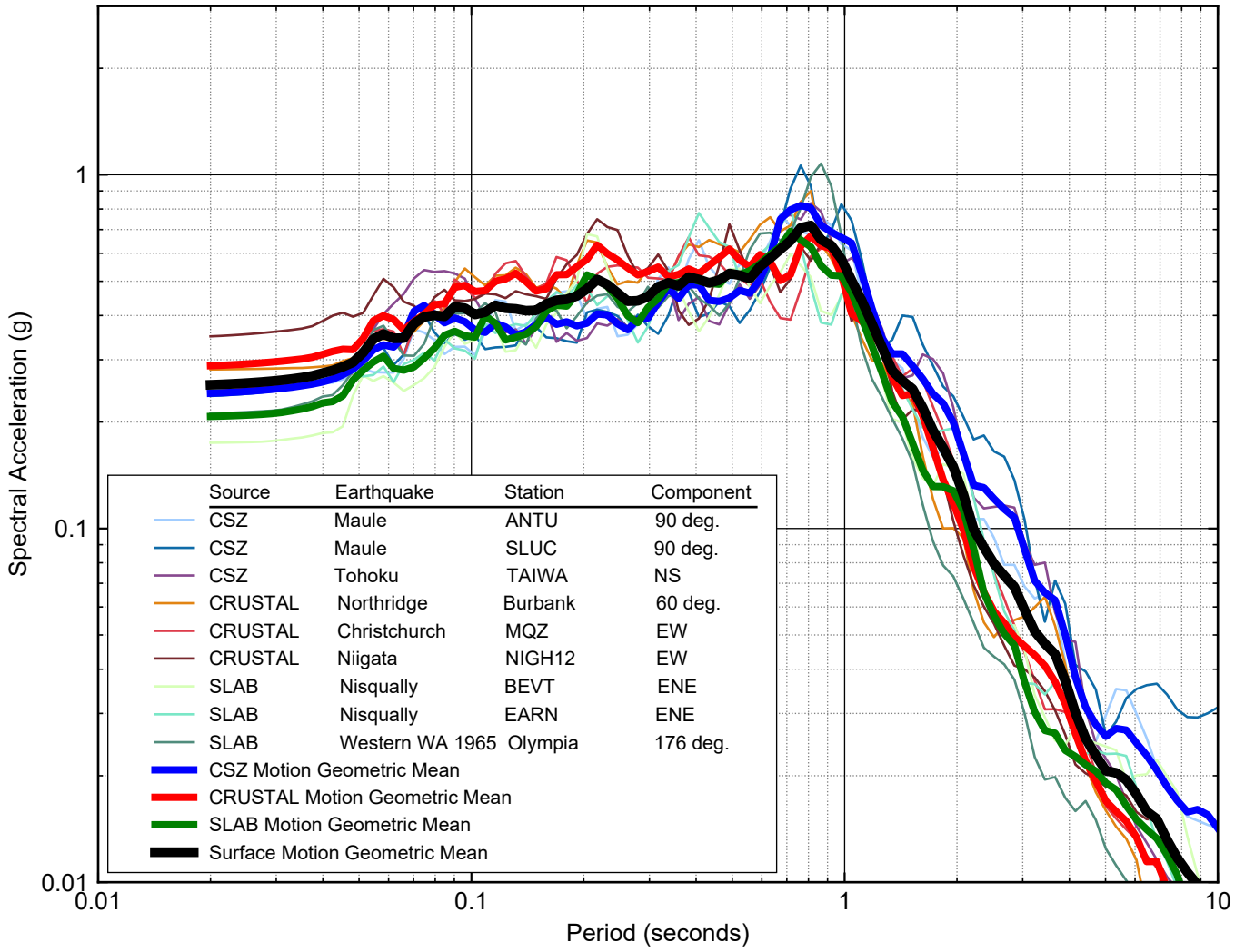

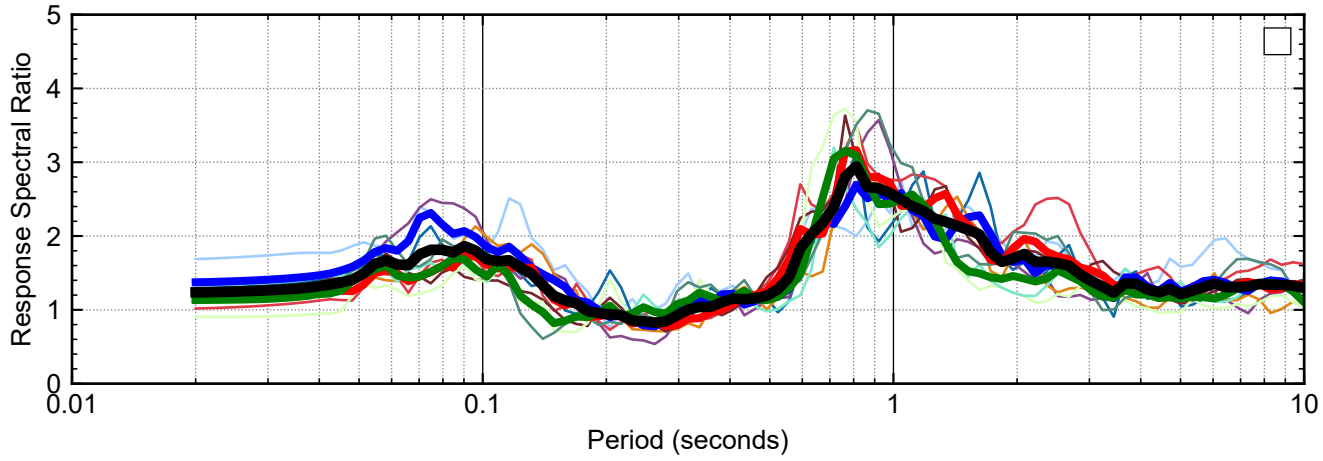

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 7
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-97

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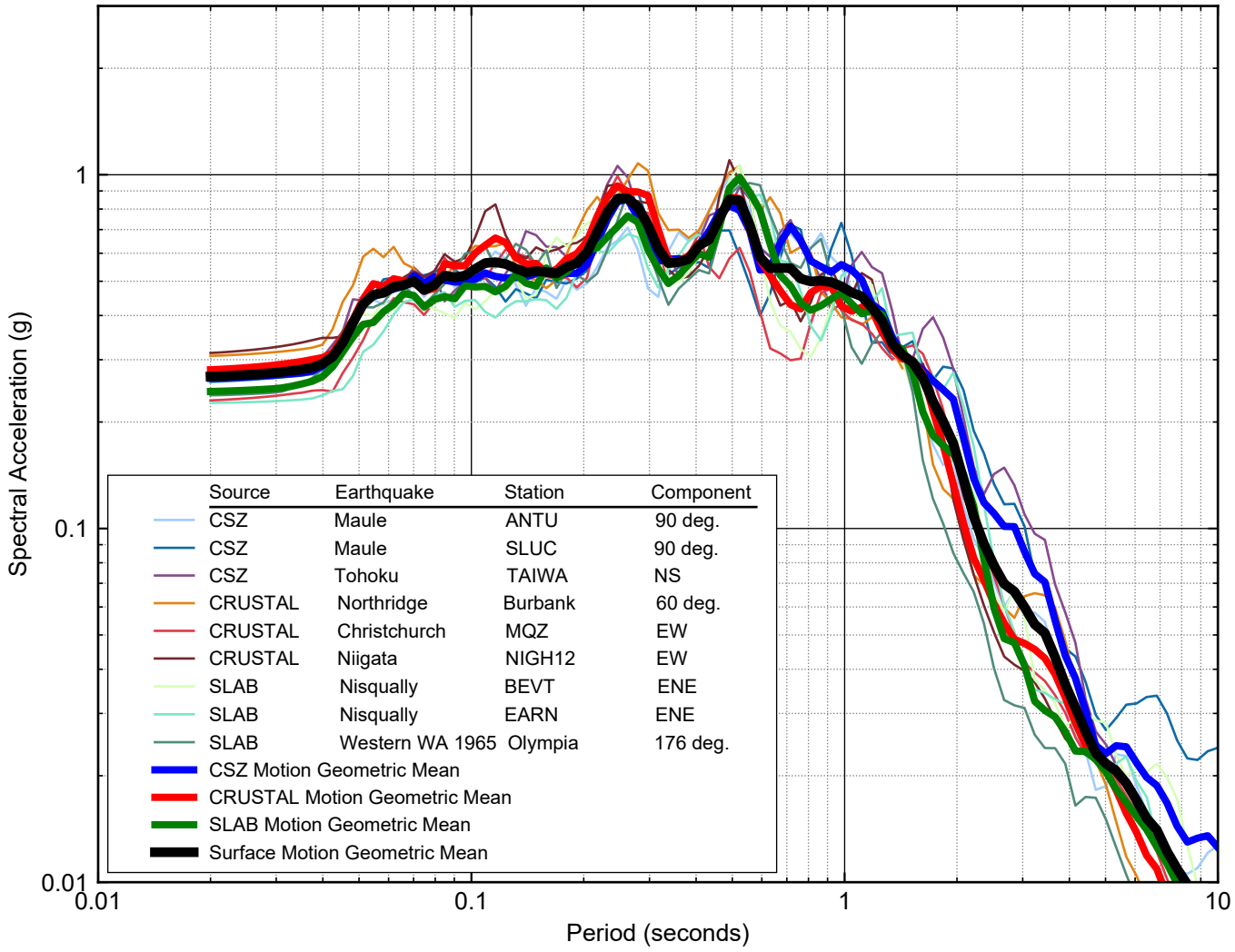

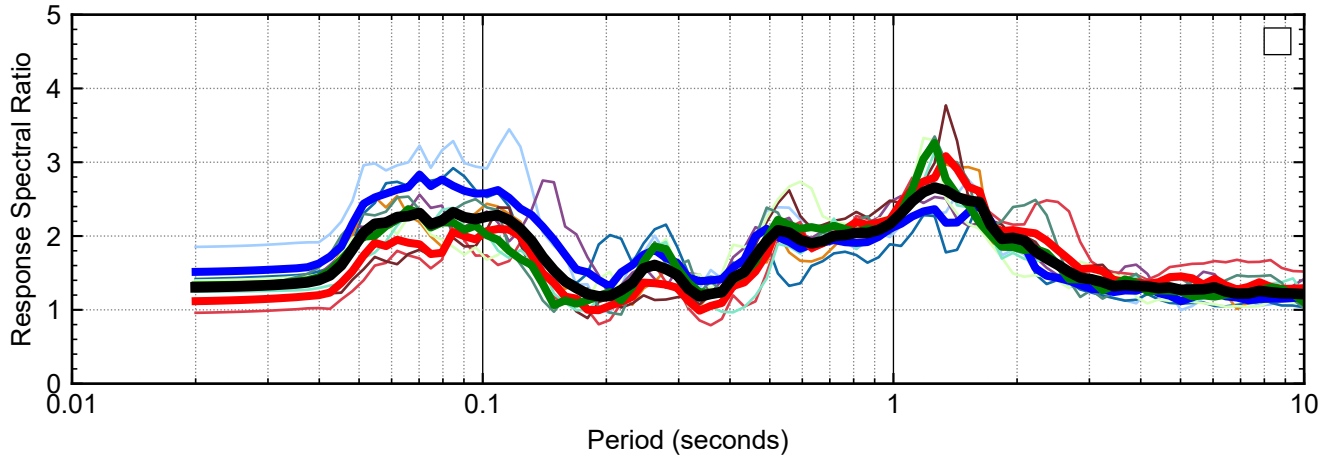

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 8 CABLE-STAYED TOWER
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

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FIG. H-98

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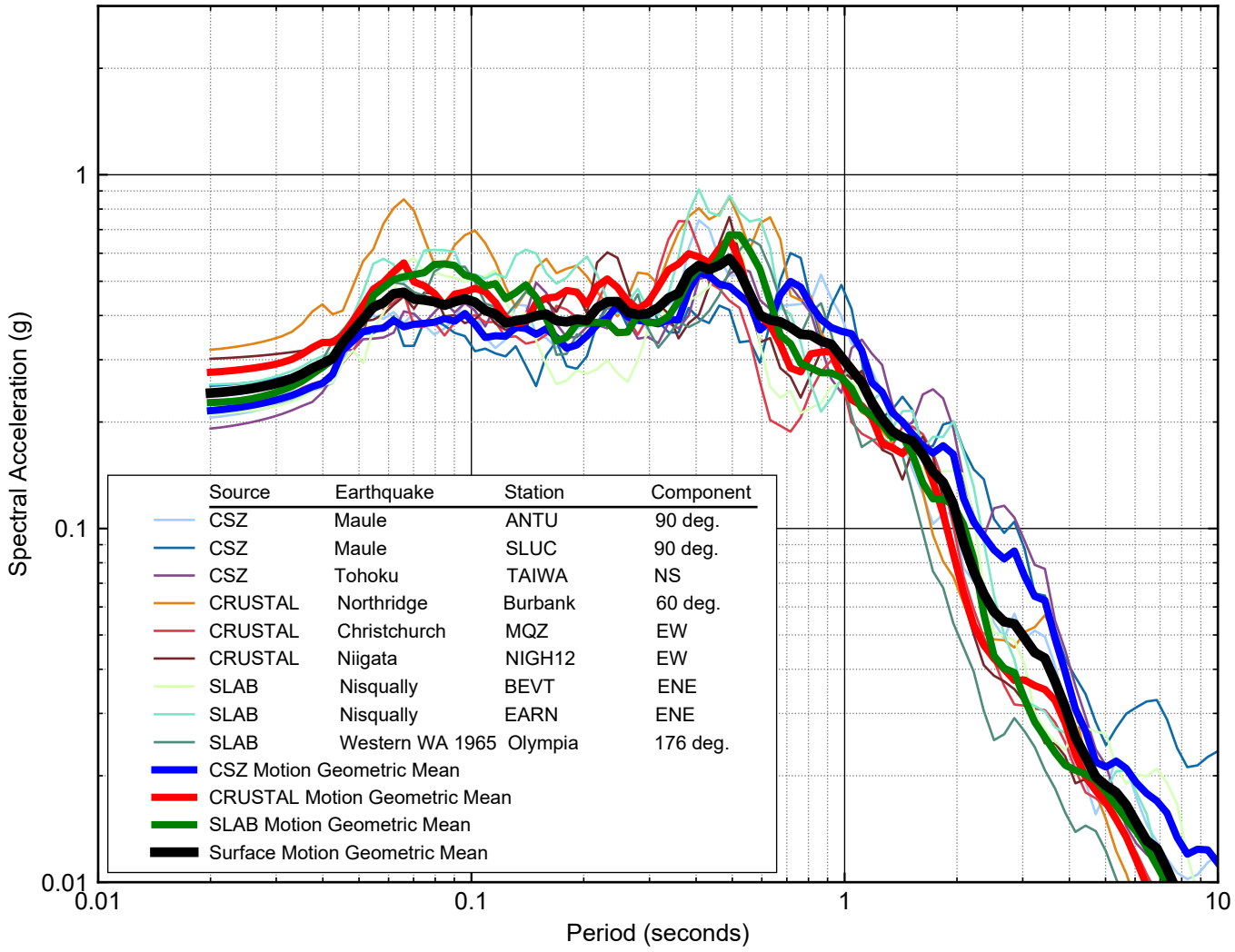

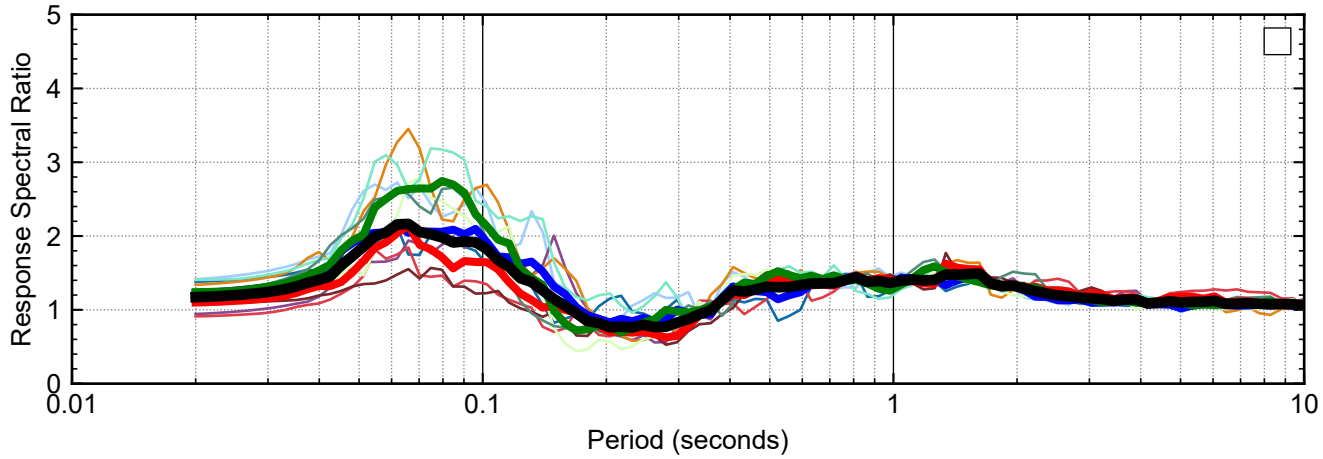

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 8 TIED-ARCH
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

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FIG. H-99

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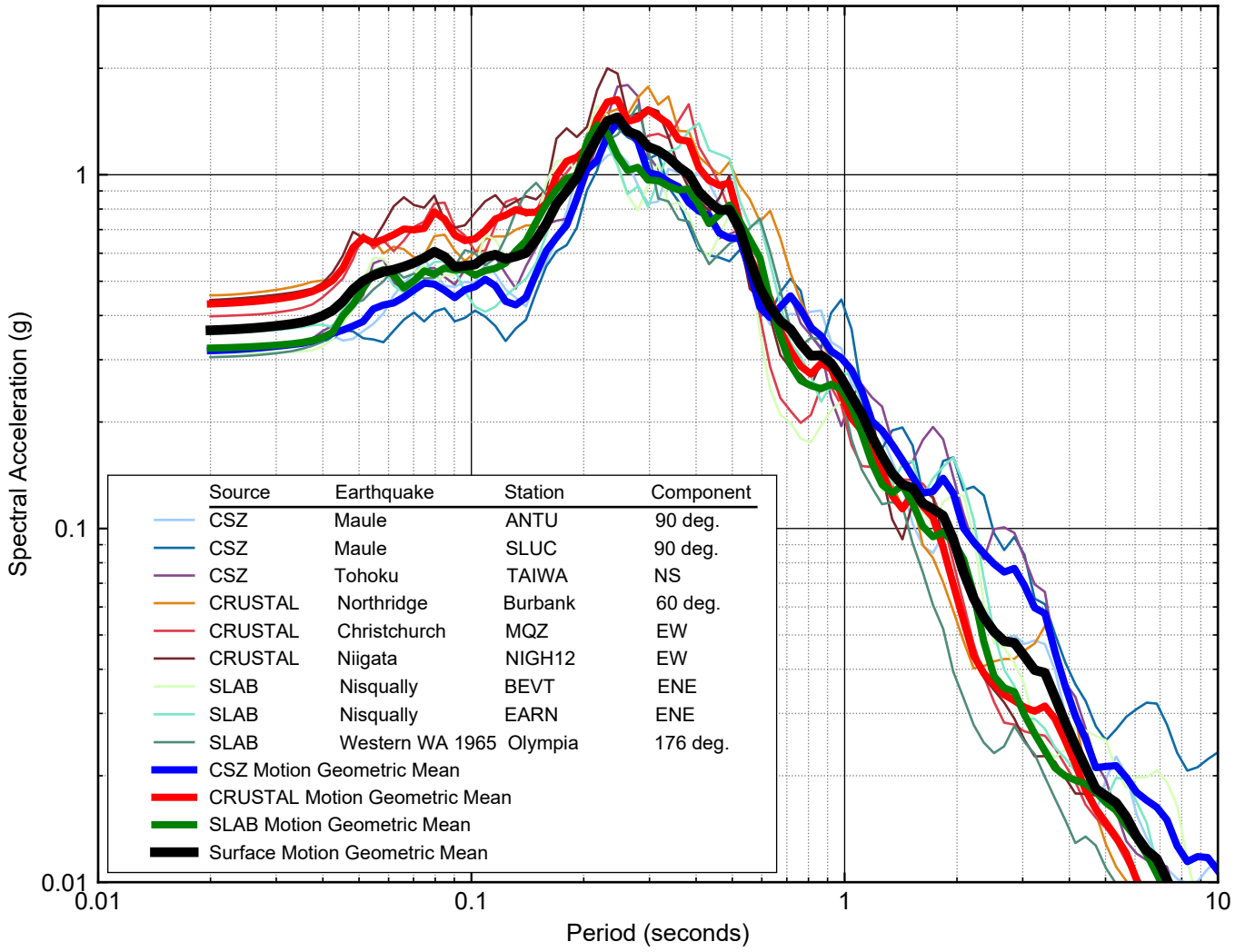

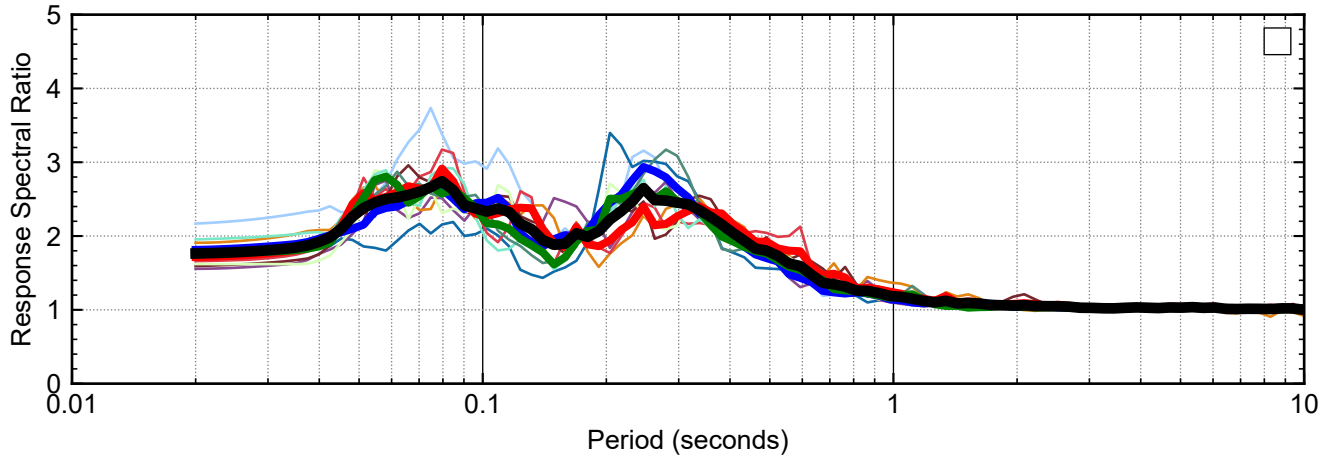

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 9
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

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FIG. H-100

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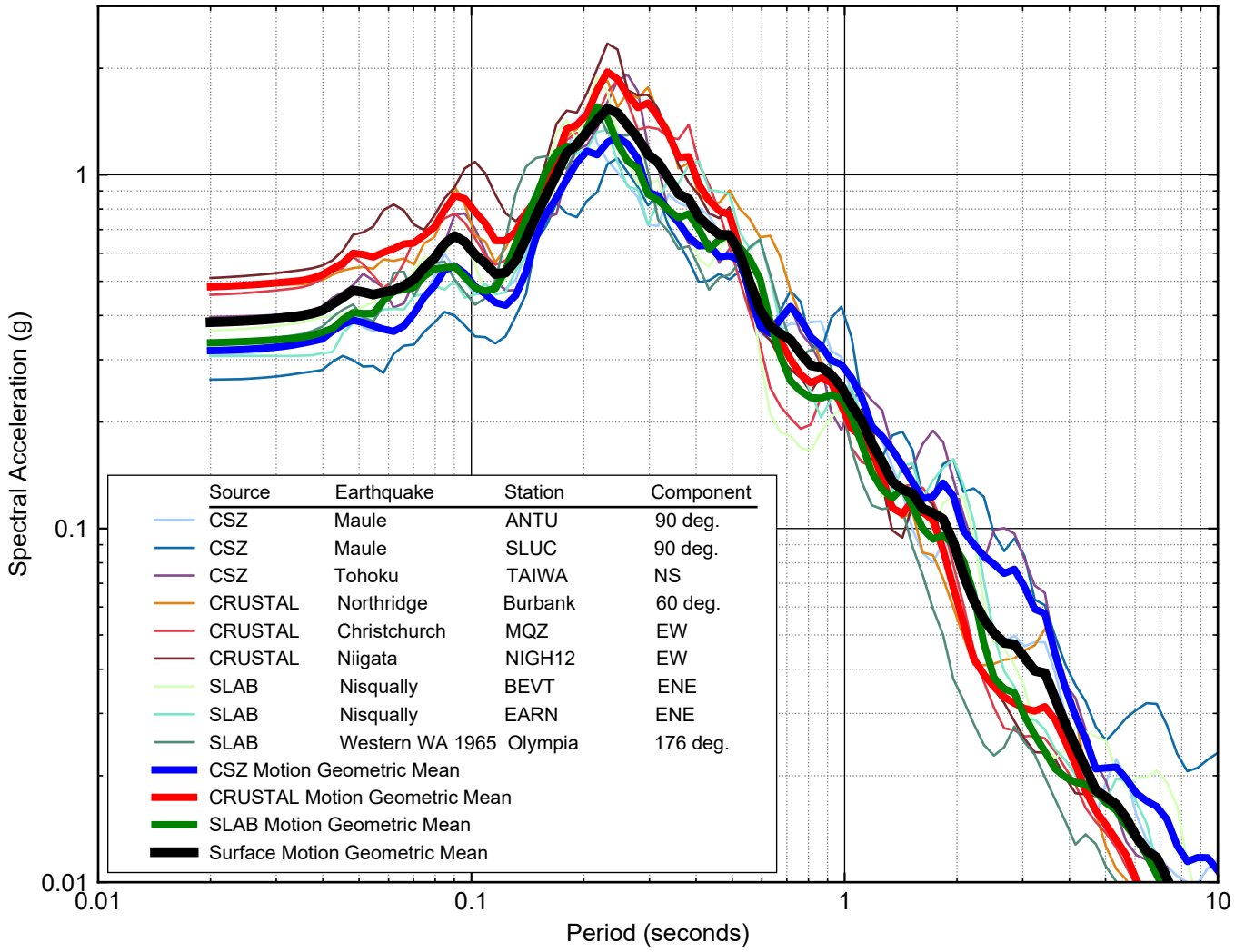

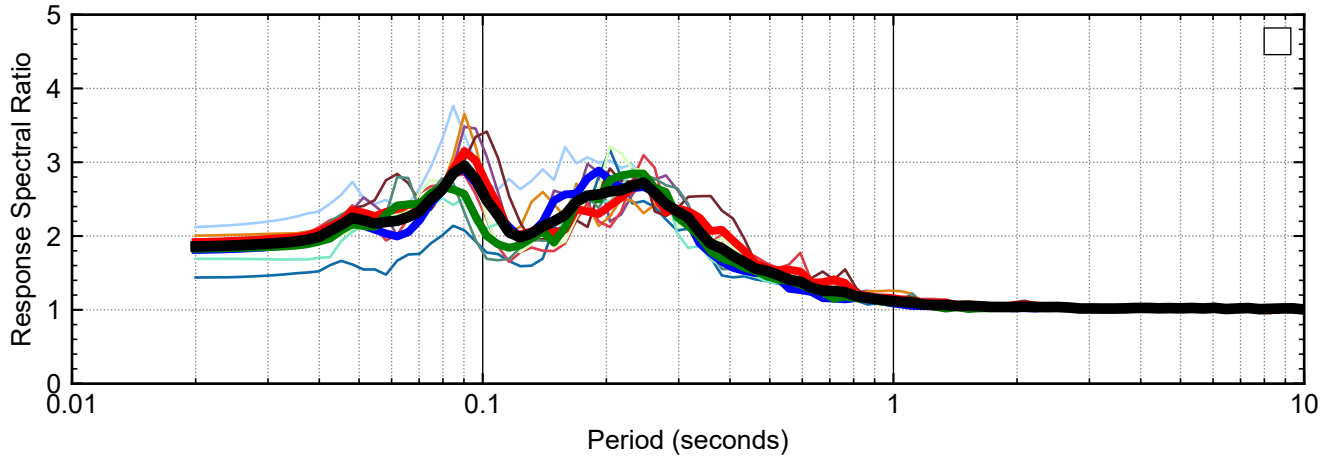

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 10
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC RESPONSE SPECTRA SUMMARY

April 2022 102636-009

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FIG. H-101

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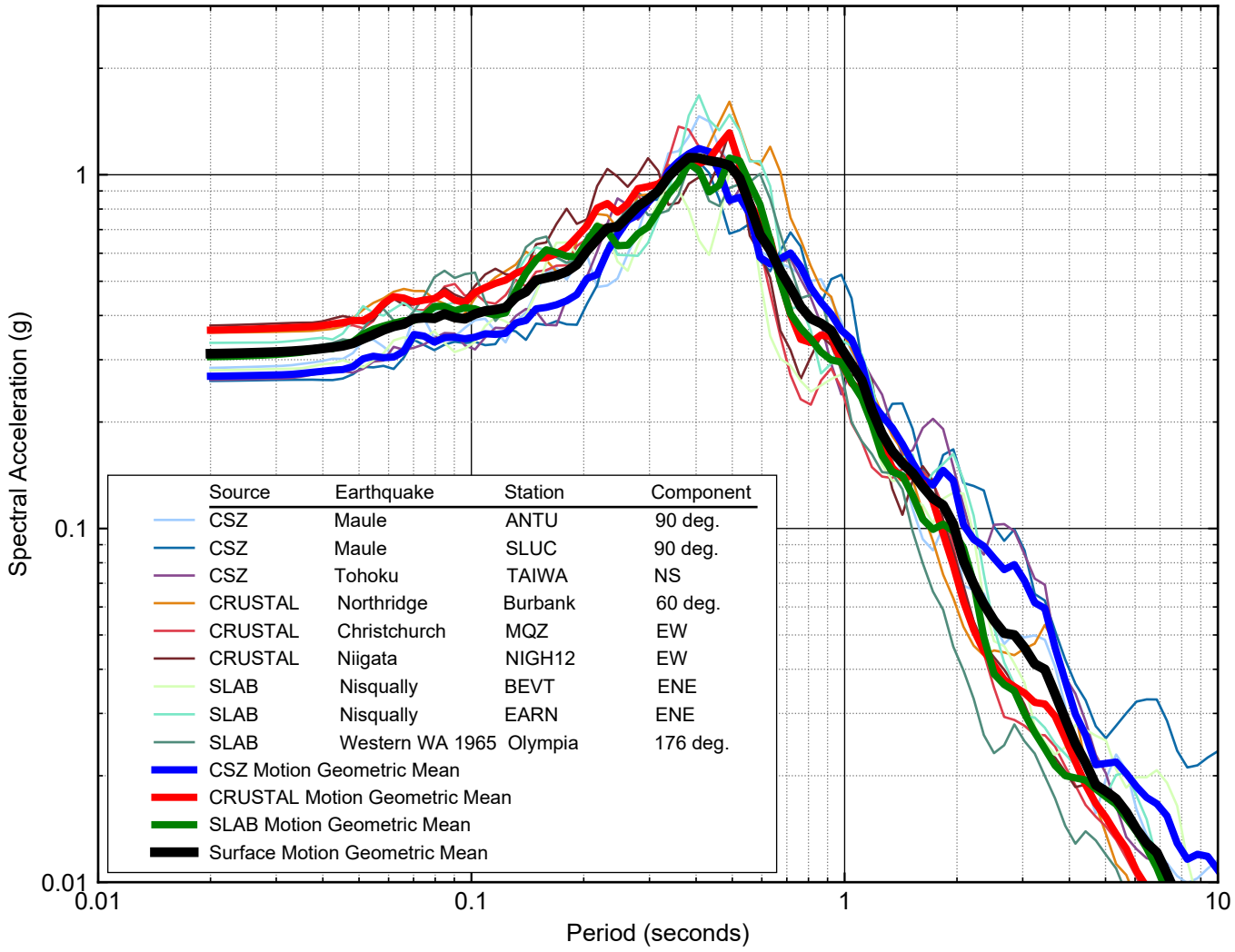

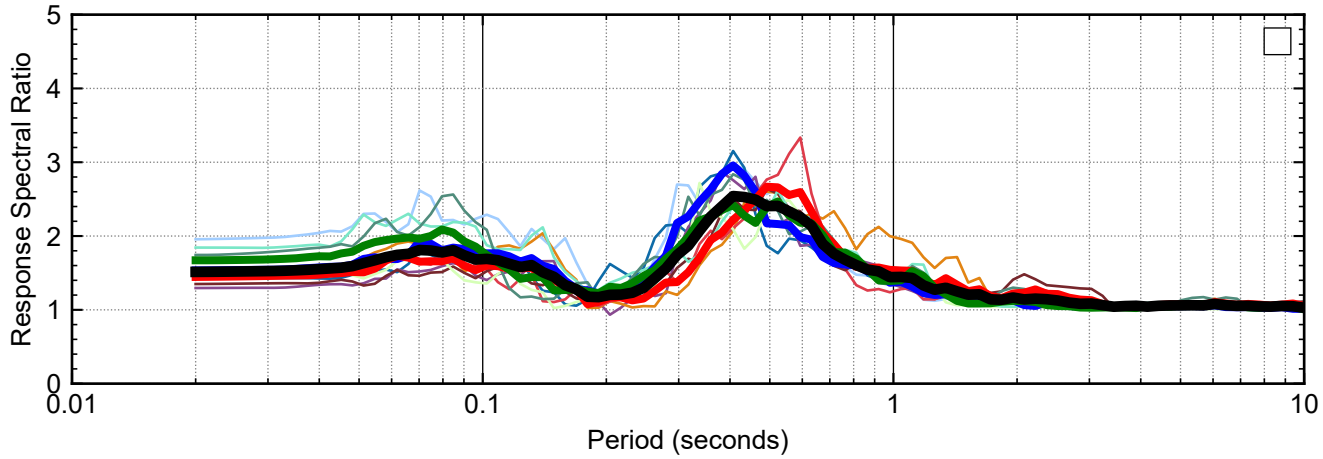

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 1
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

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FIG. H-102

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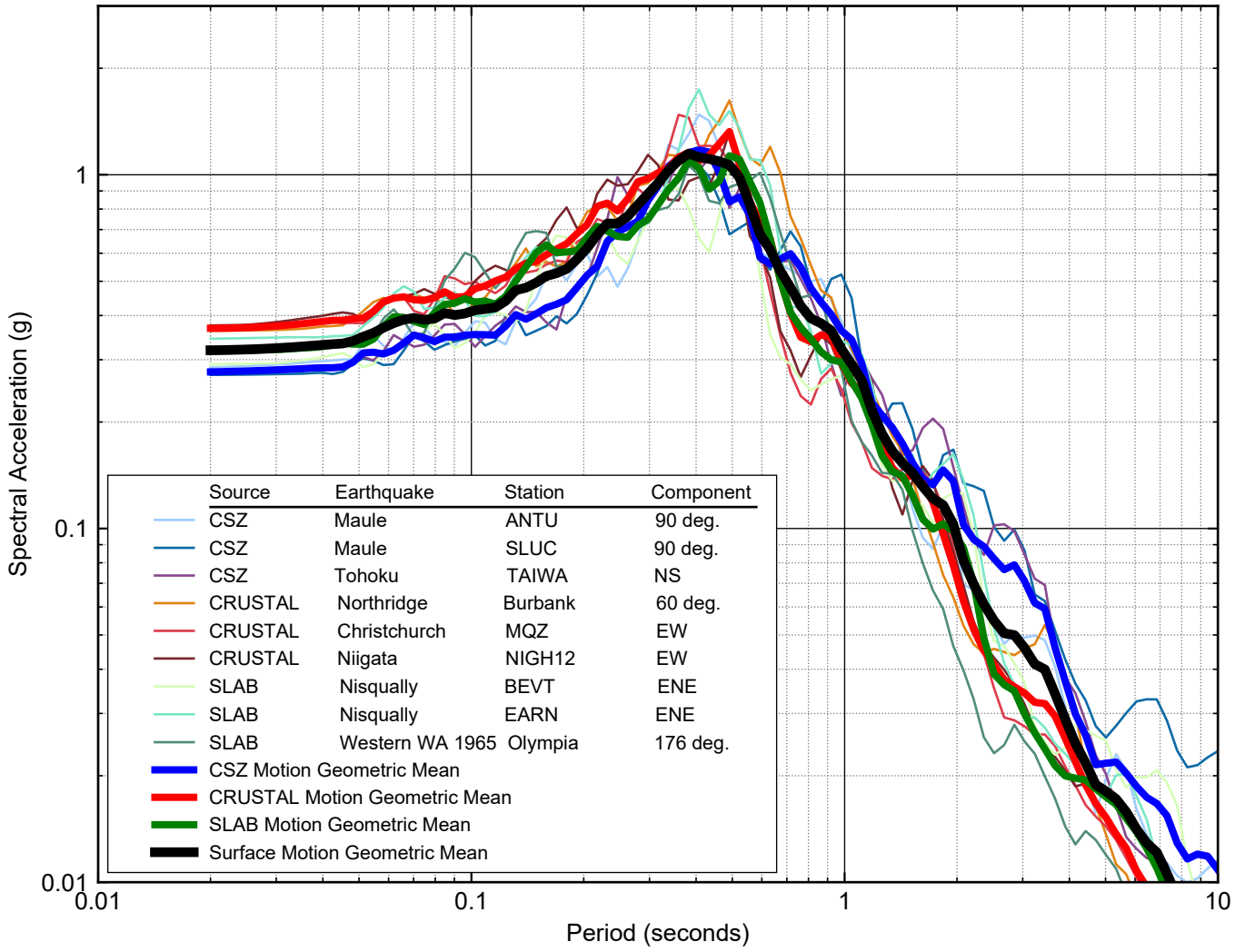

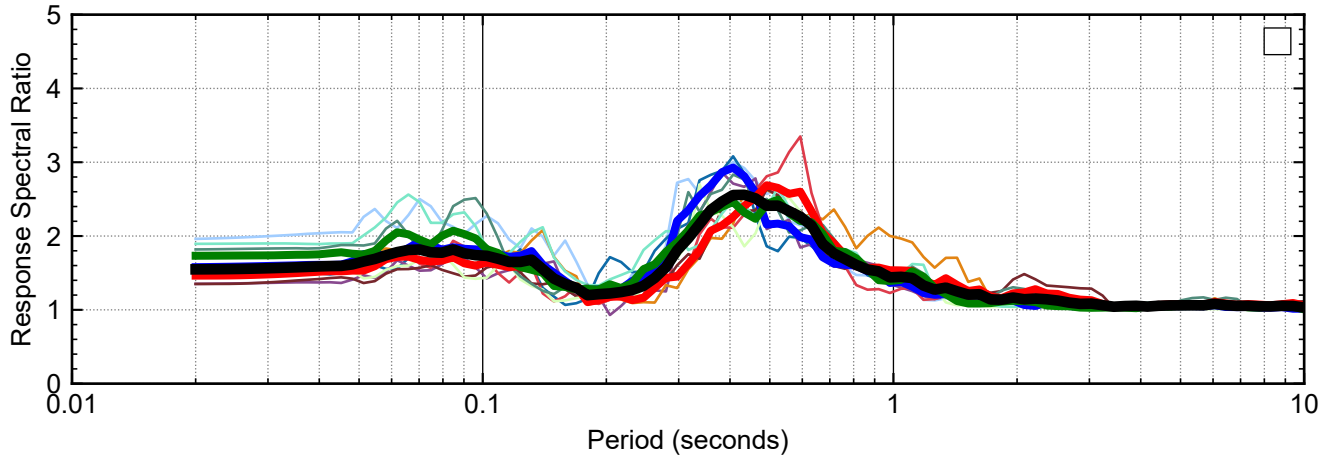

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 2
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-103

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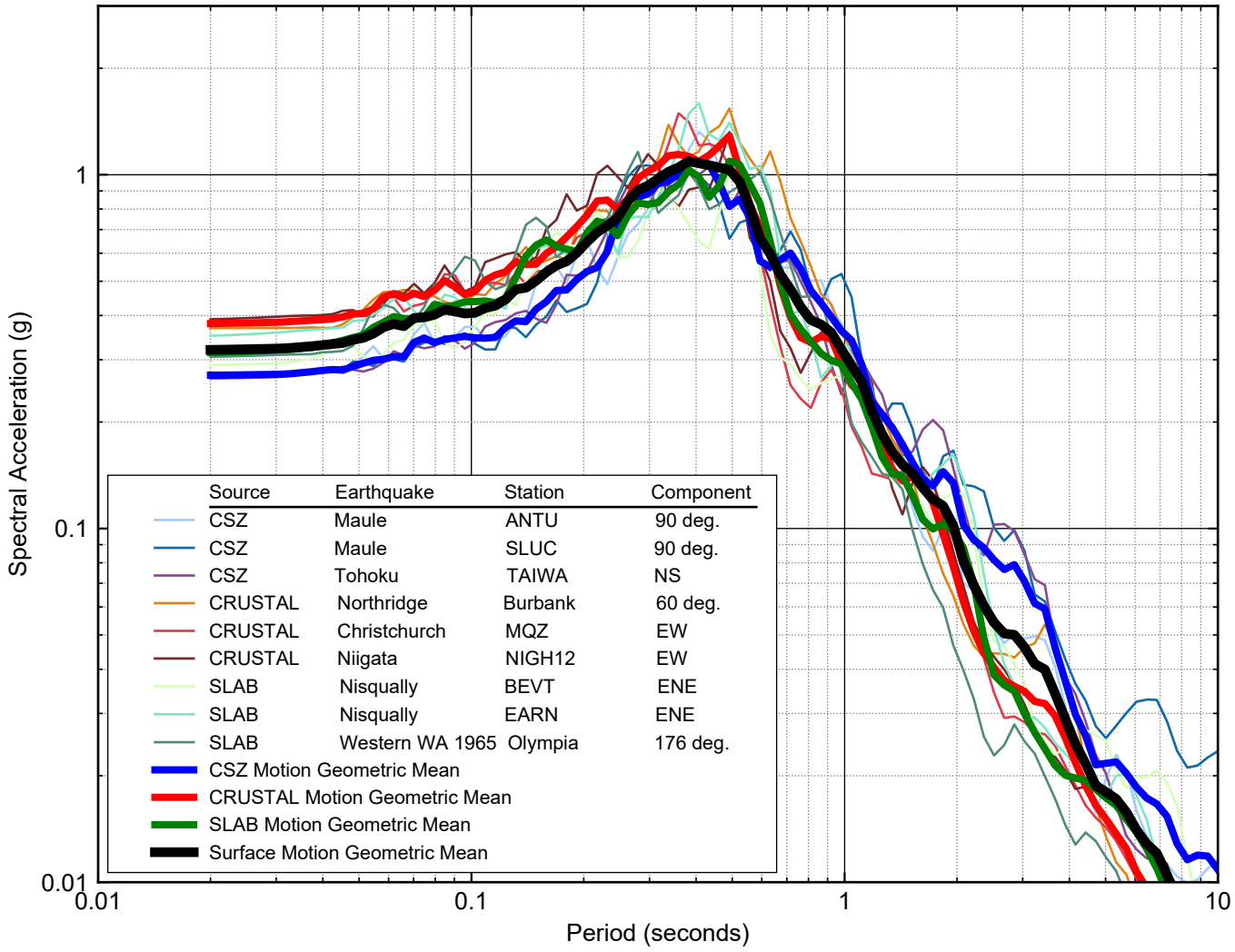

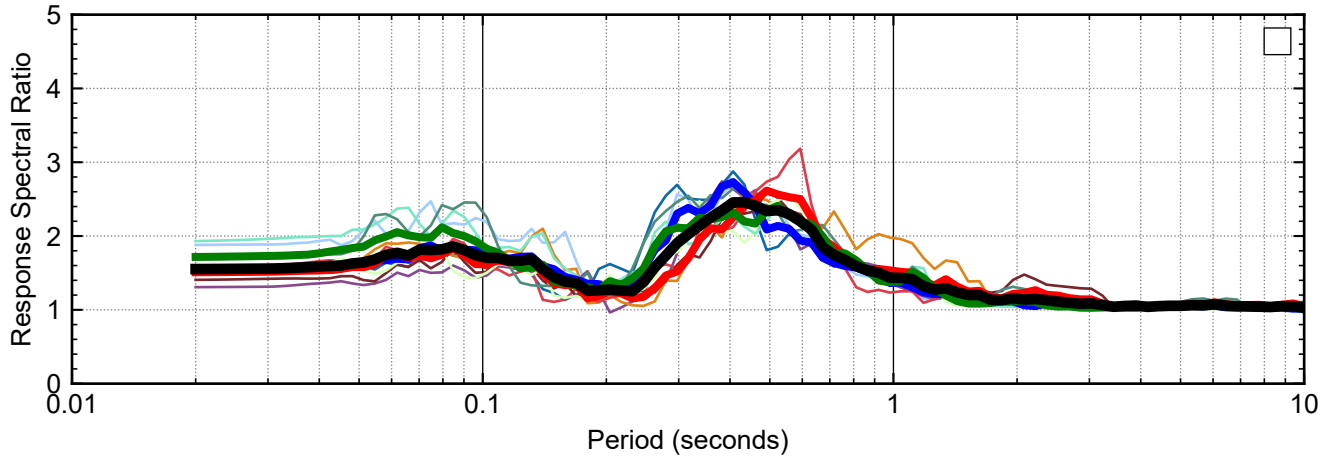

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 3
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-104

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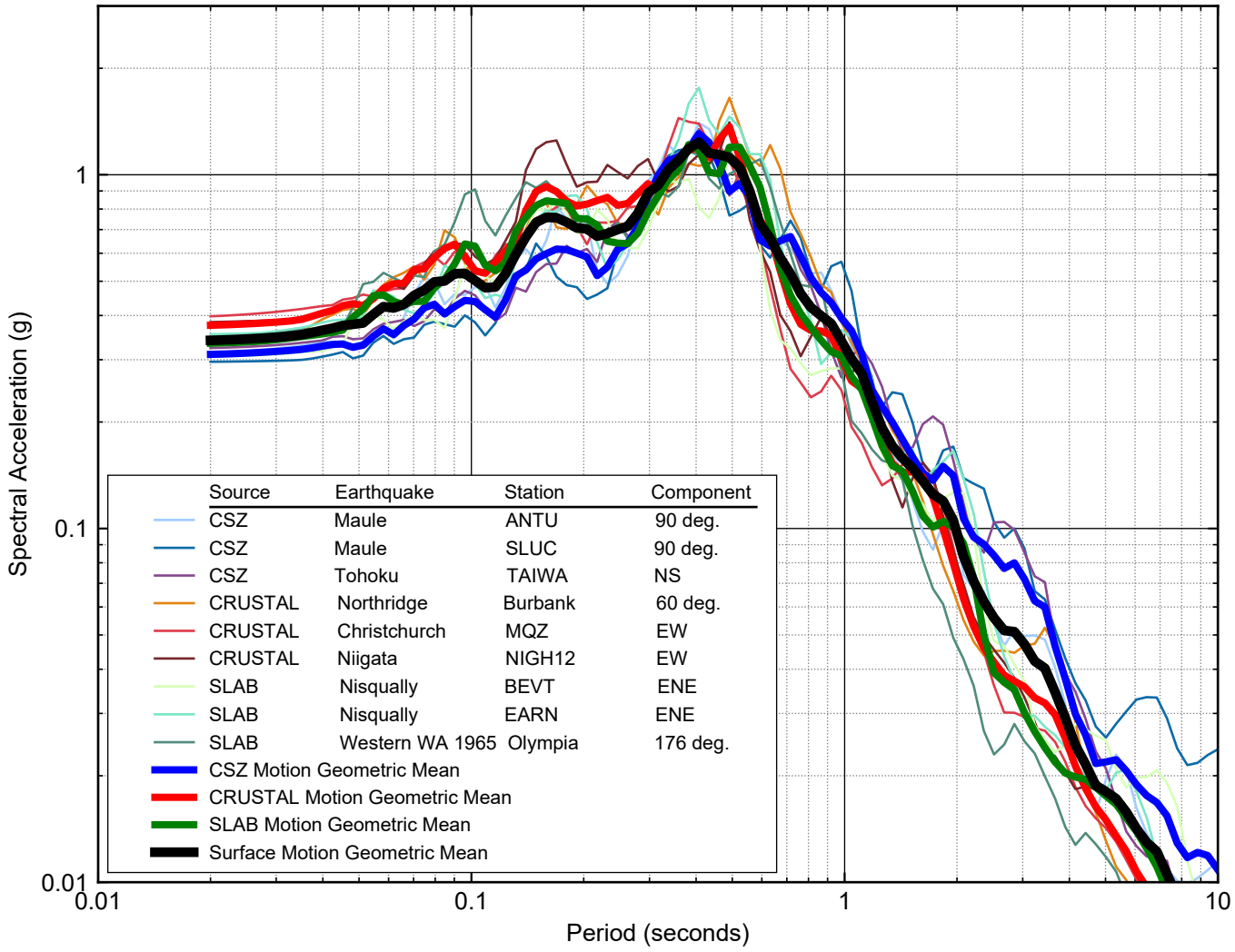

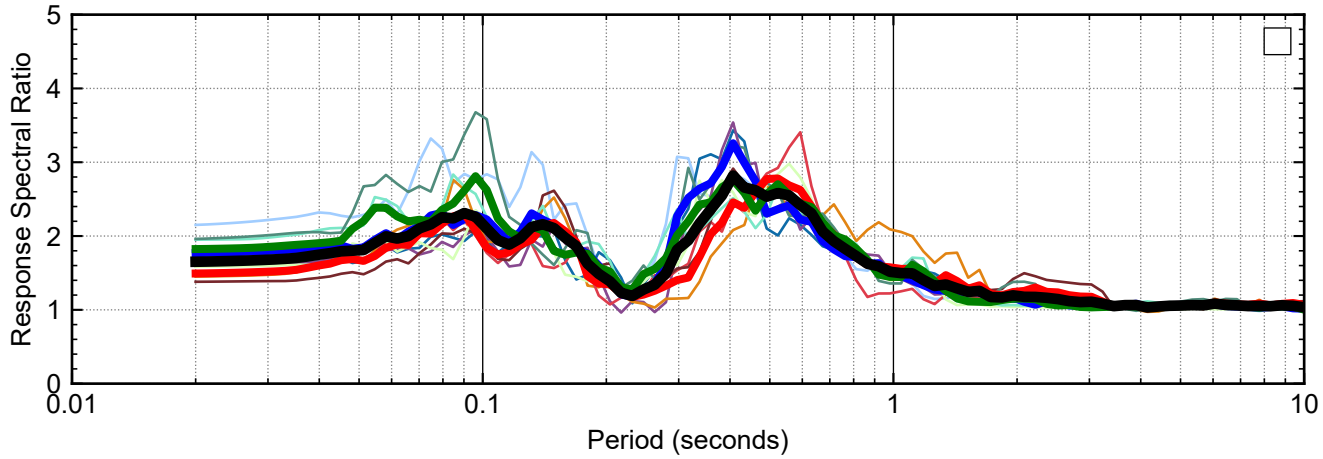

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 4
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-105

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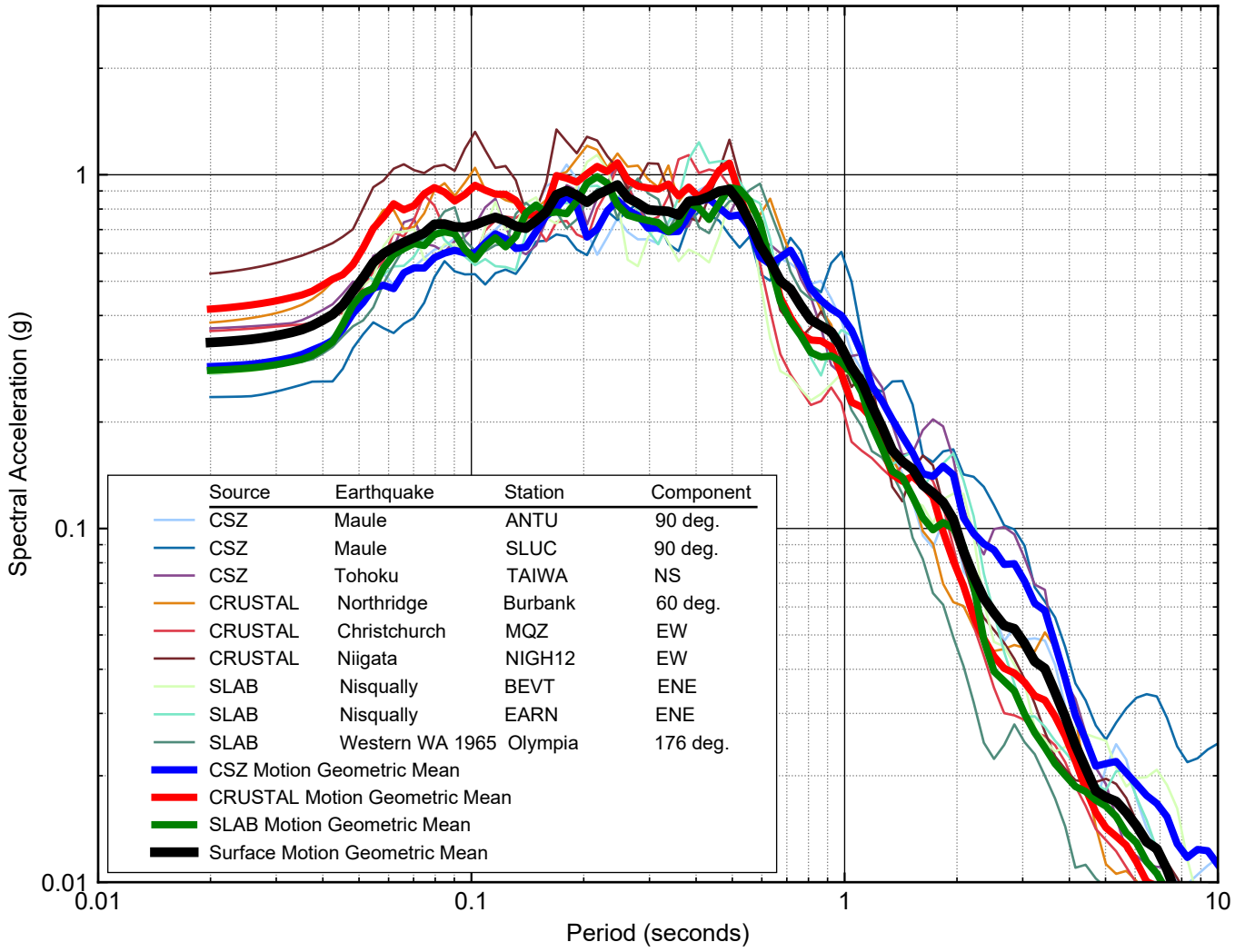

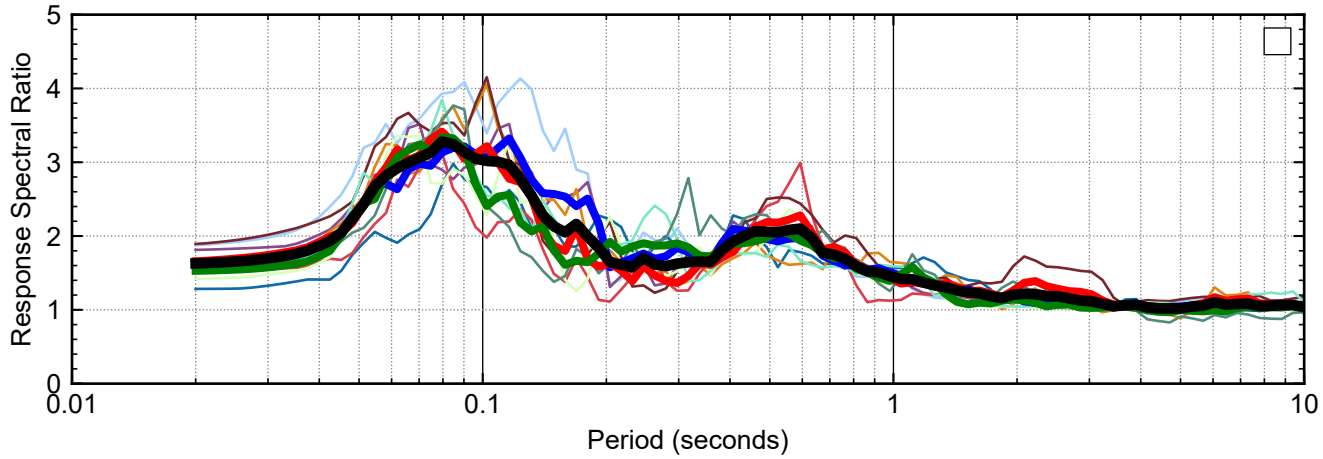

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 5
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-106

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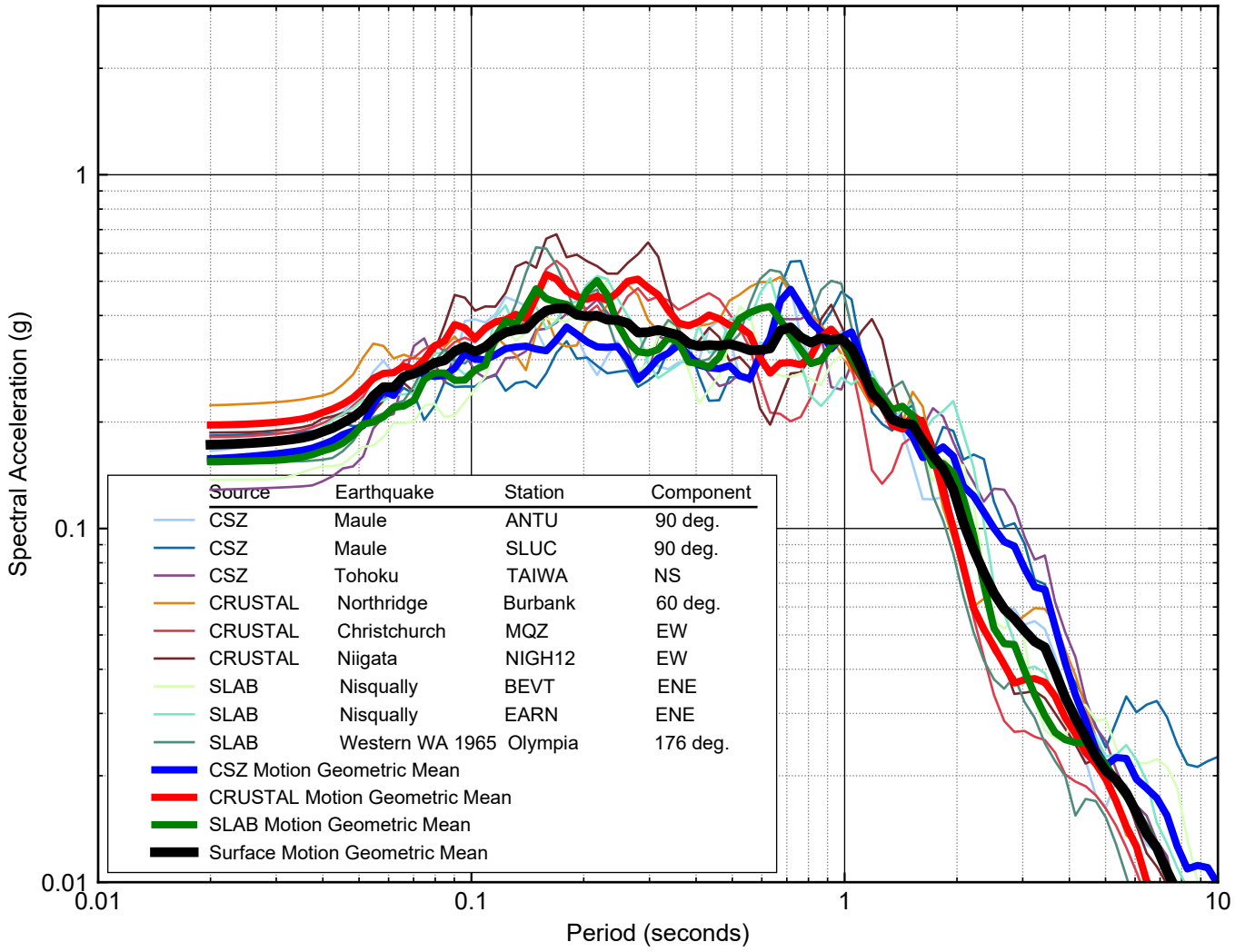

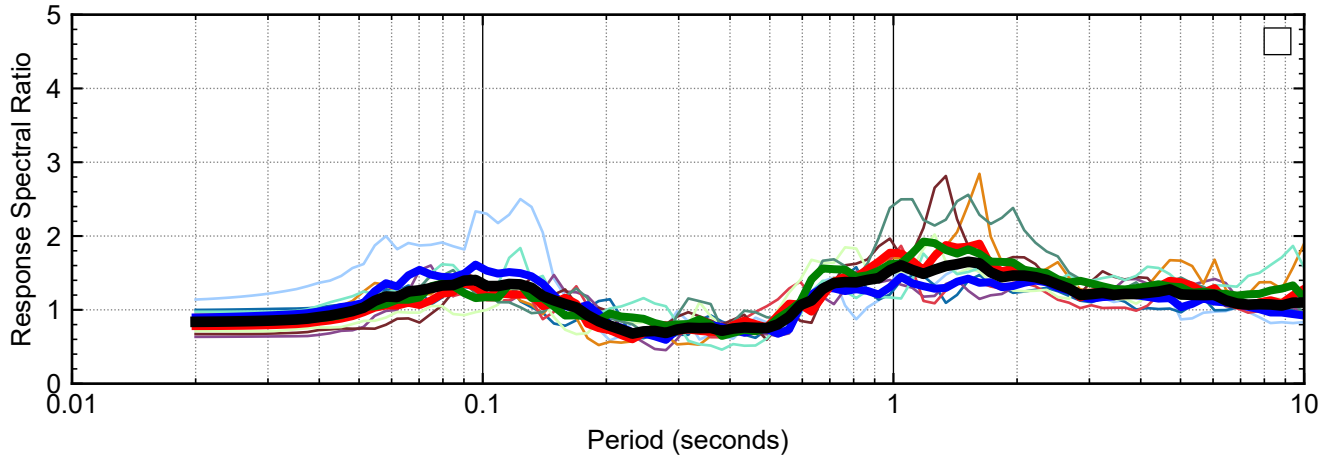

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 6
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-107

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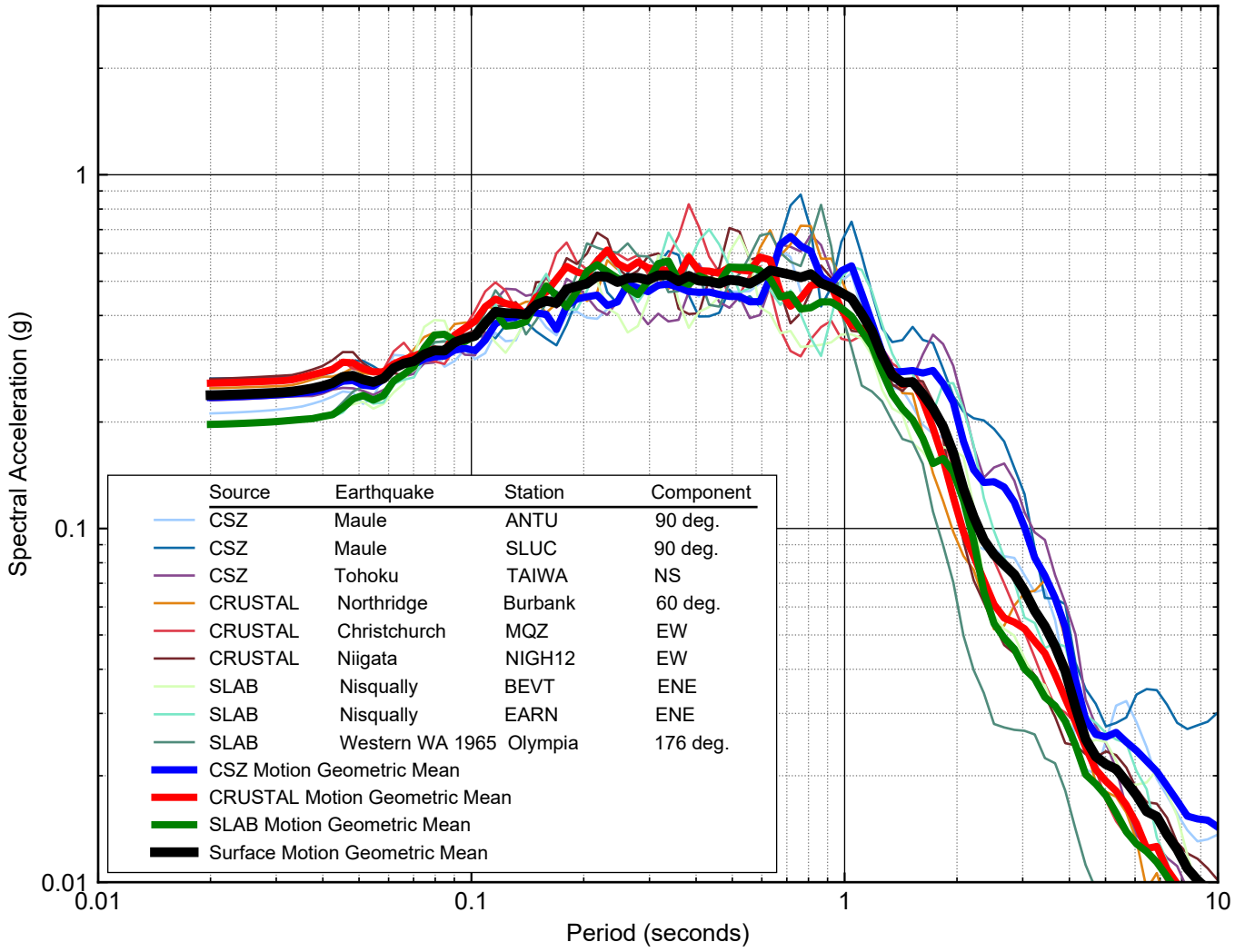

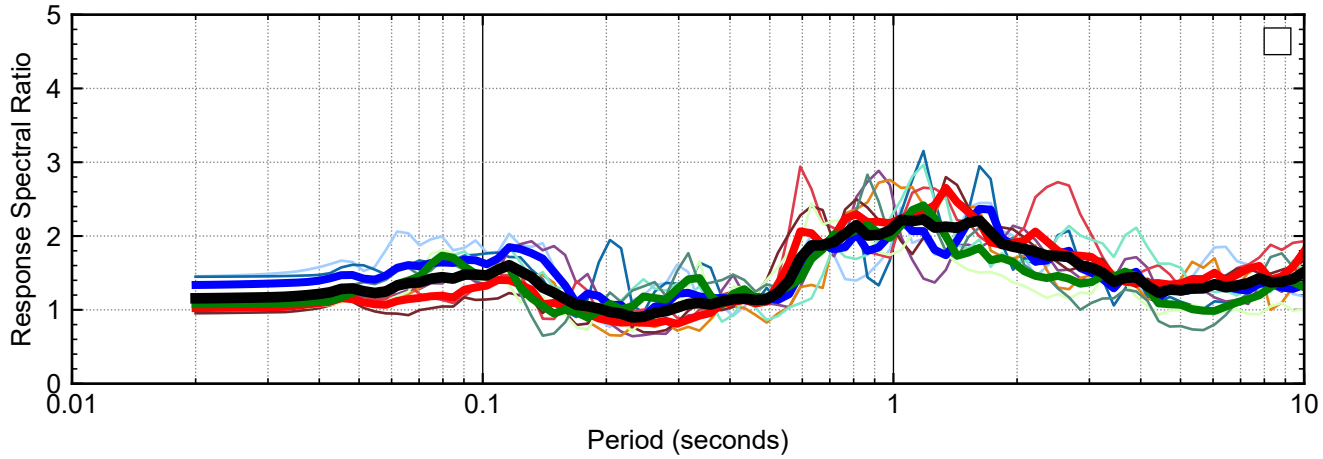

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 7
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-108

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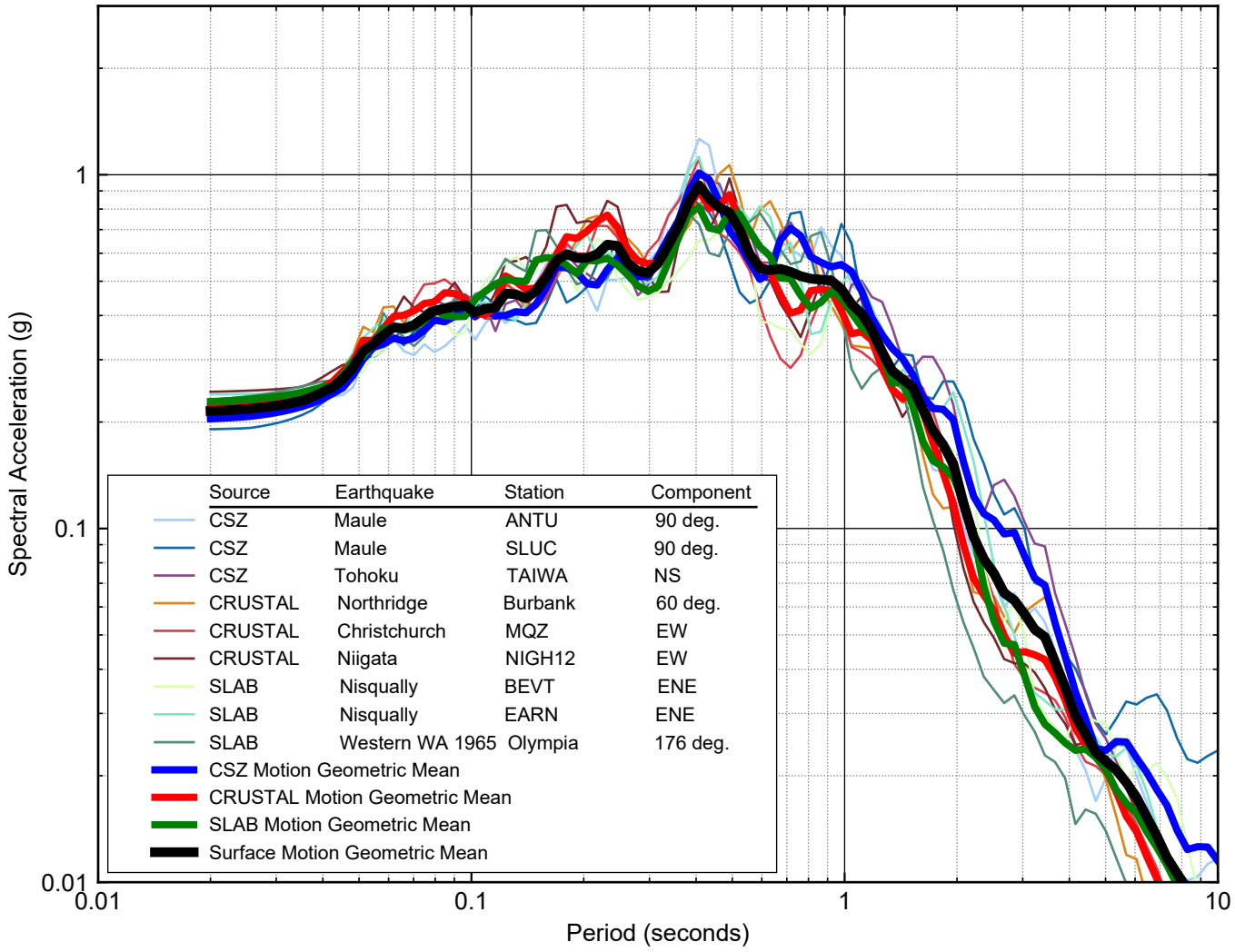

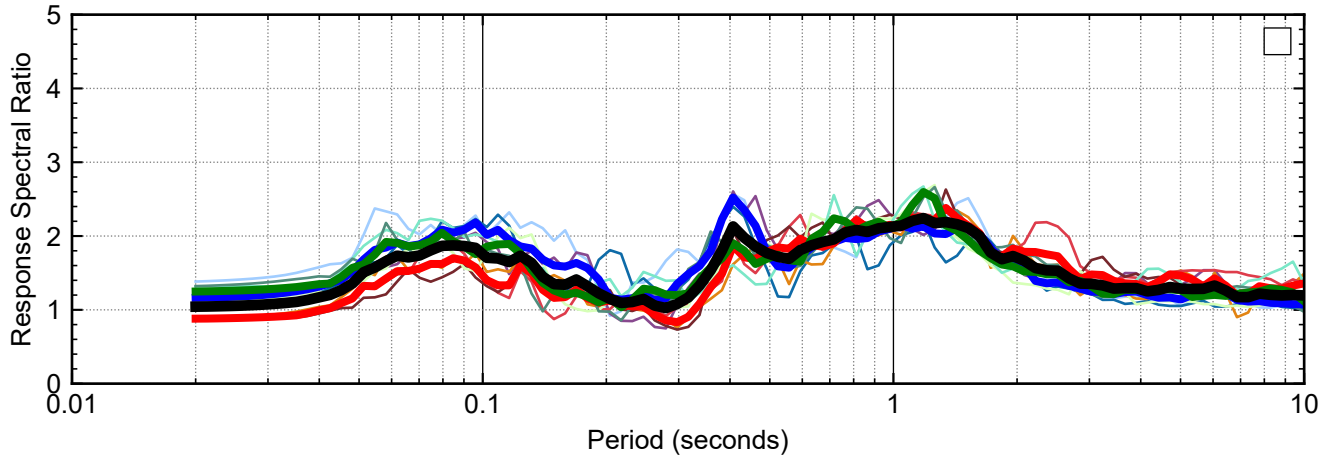

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 8 CABLE-STAYED TOWER EFFECTIVE STRESS ANALYSIS 1,000-YEAR PROBABILISTIC RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-109

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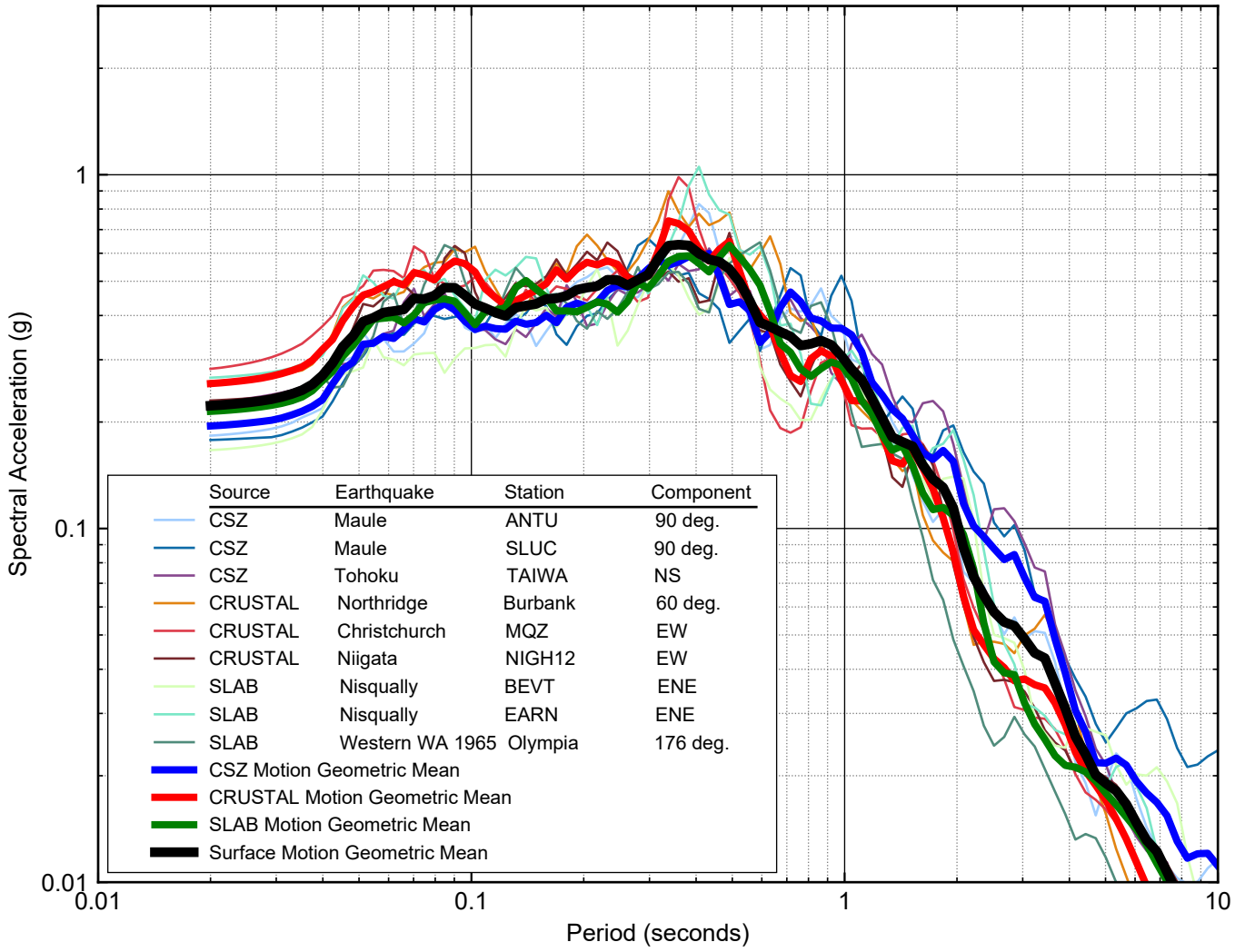

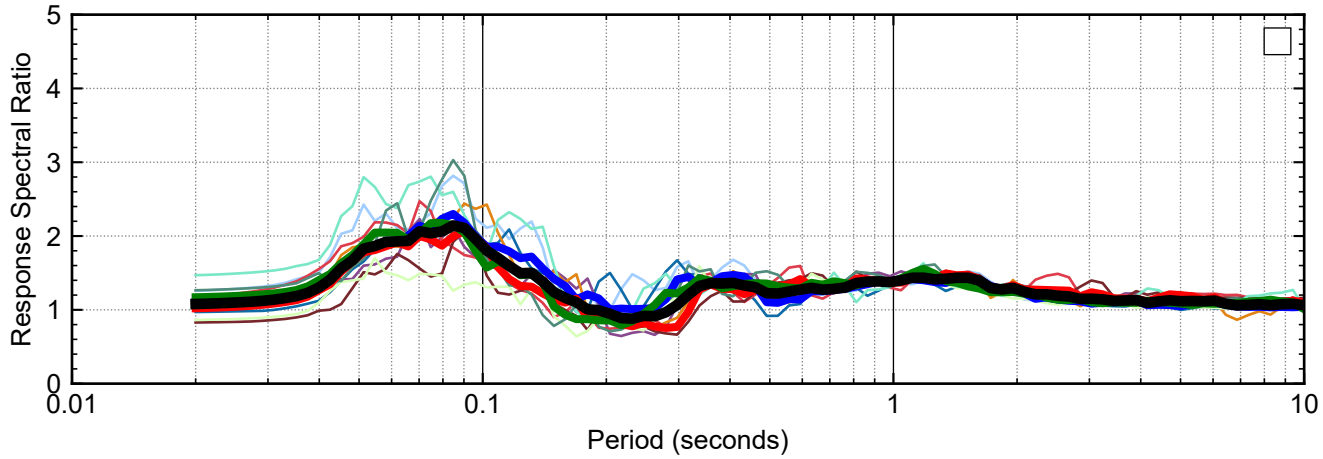

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 8 TIED-ARCH EFFECTIVE STRESS ANALYSIS 1,000-YEAR PROBABILISTIC RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-110

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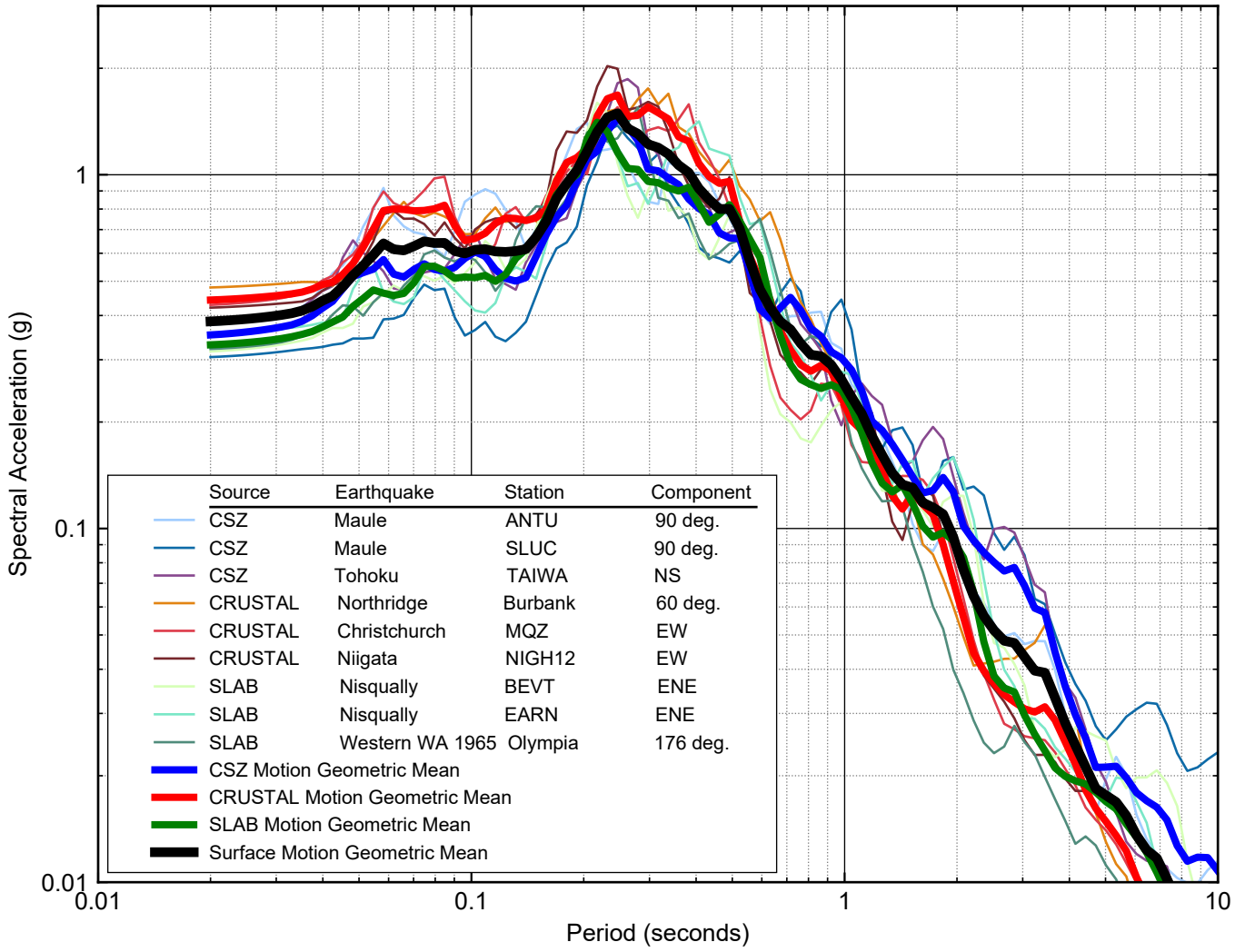

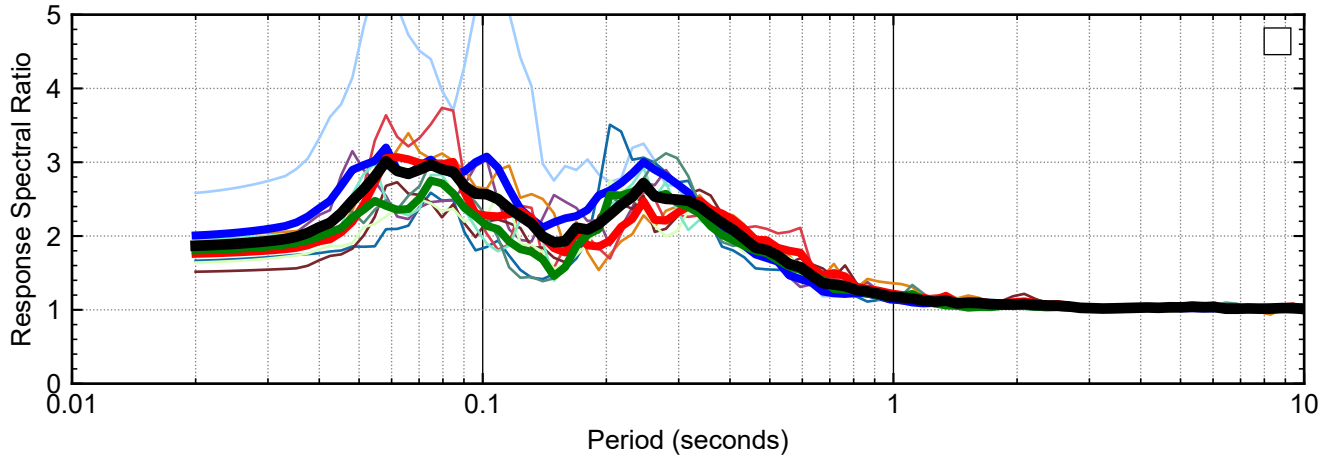

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 9
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-111

C:\ FLACPROCESS\Burnside

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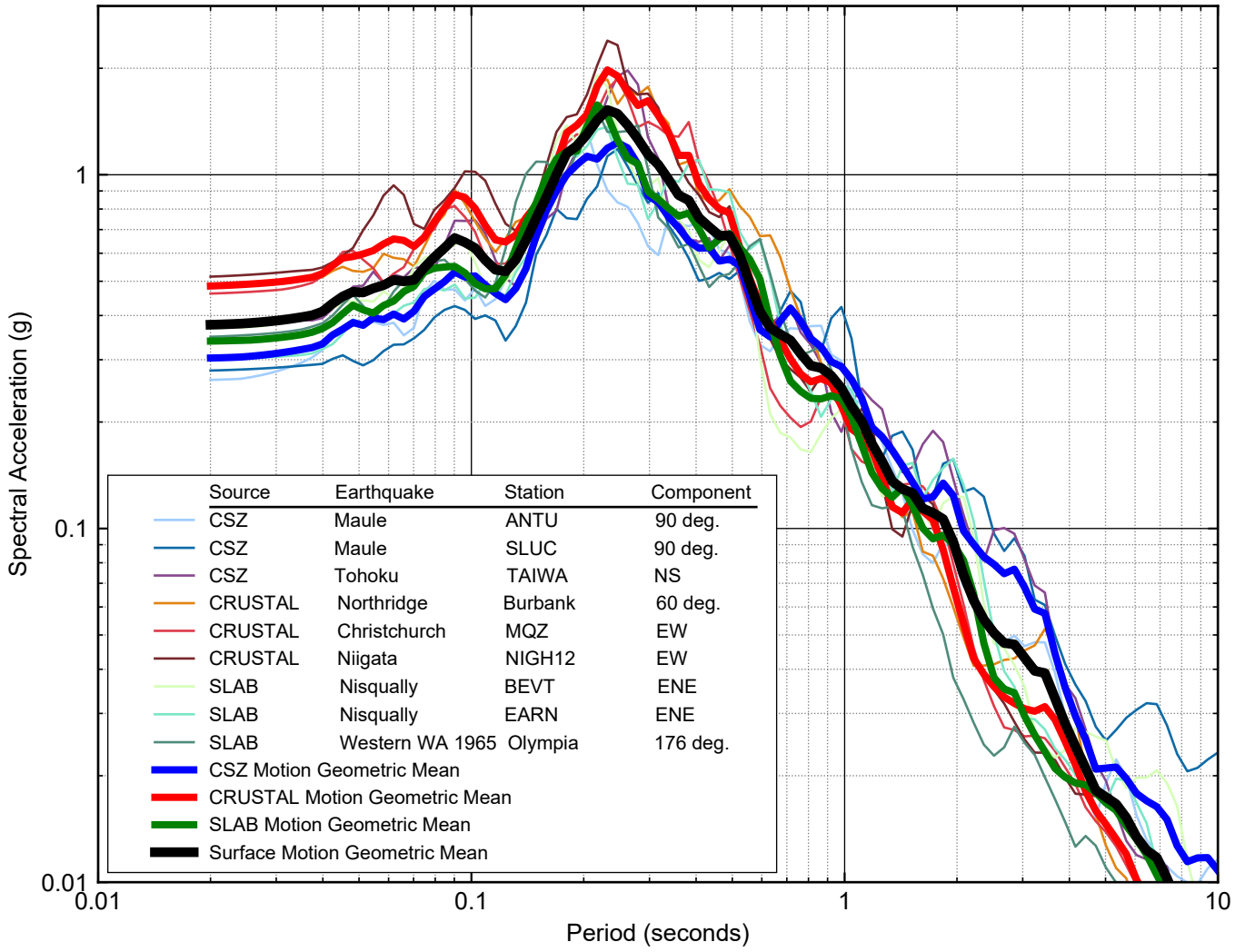

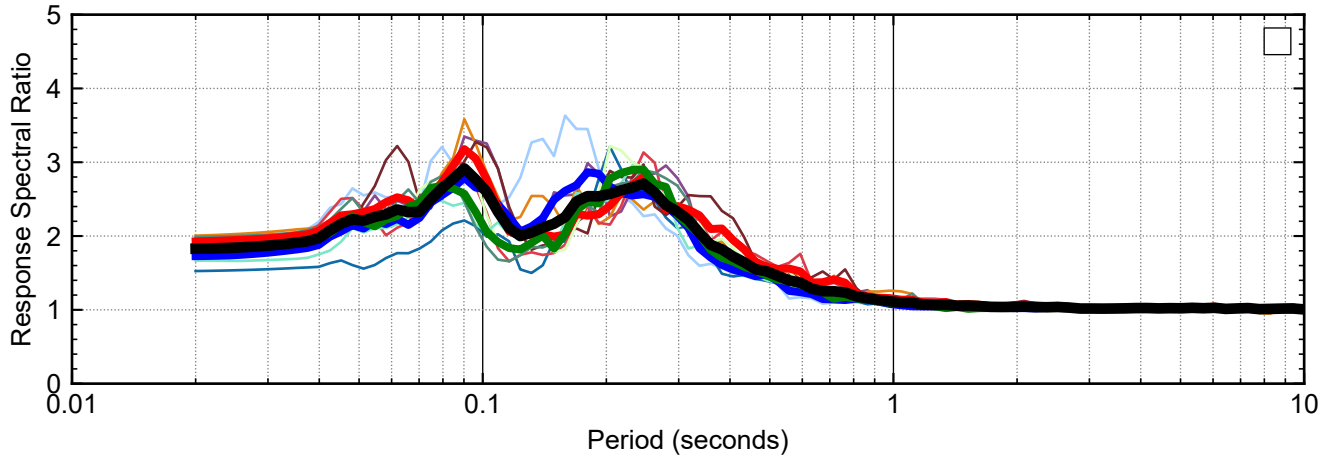

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 10
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-112

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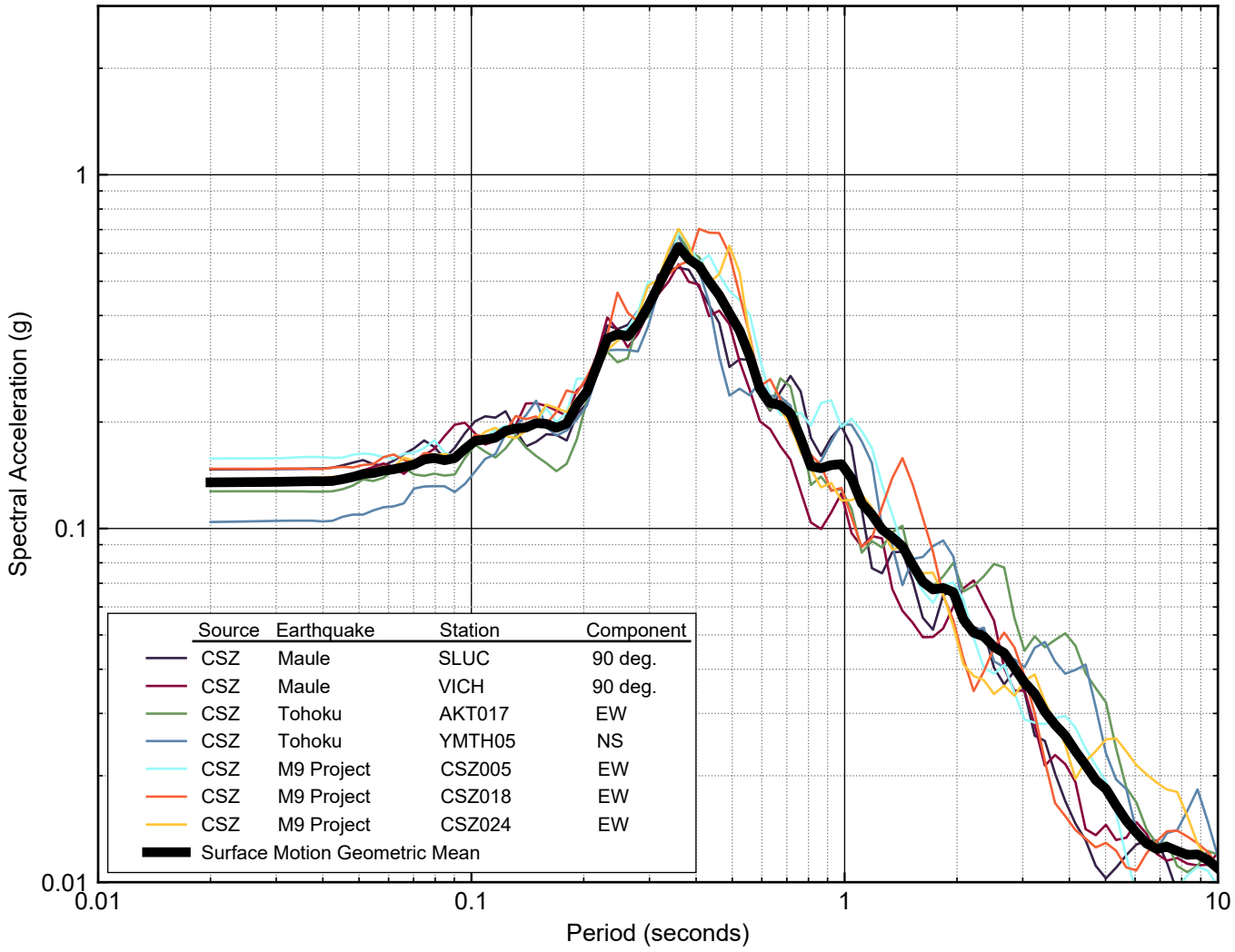

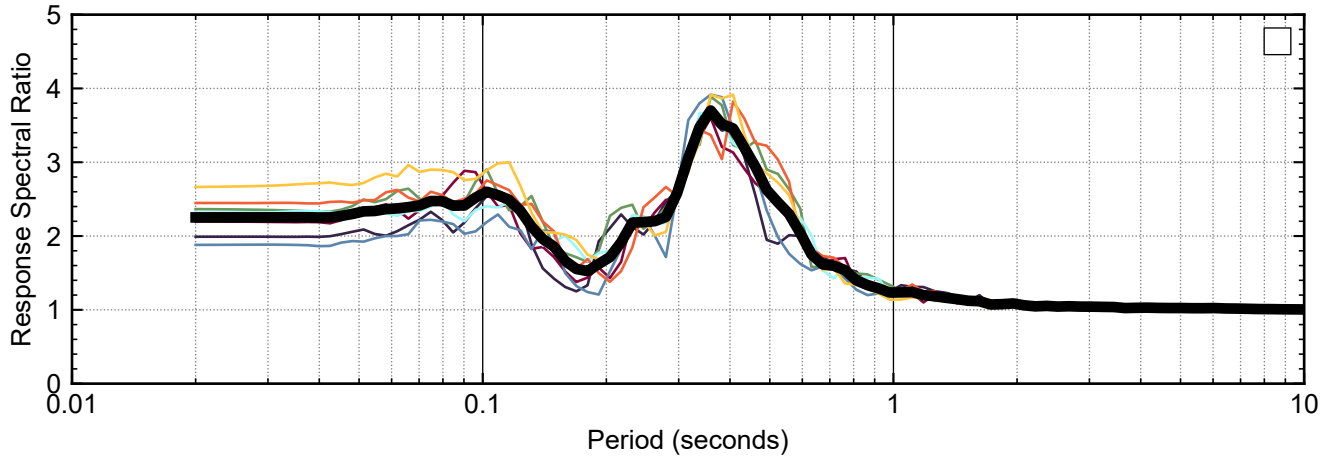

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 1
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-113

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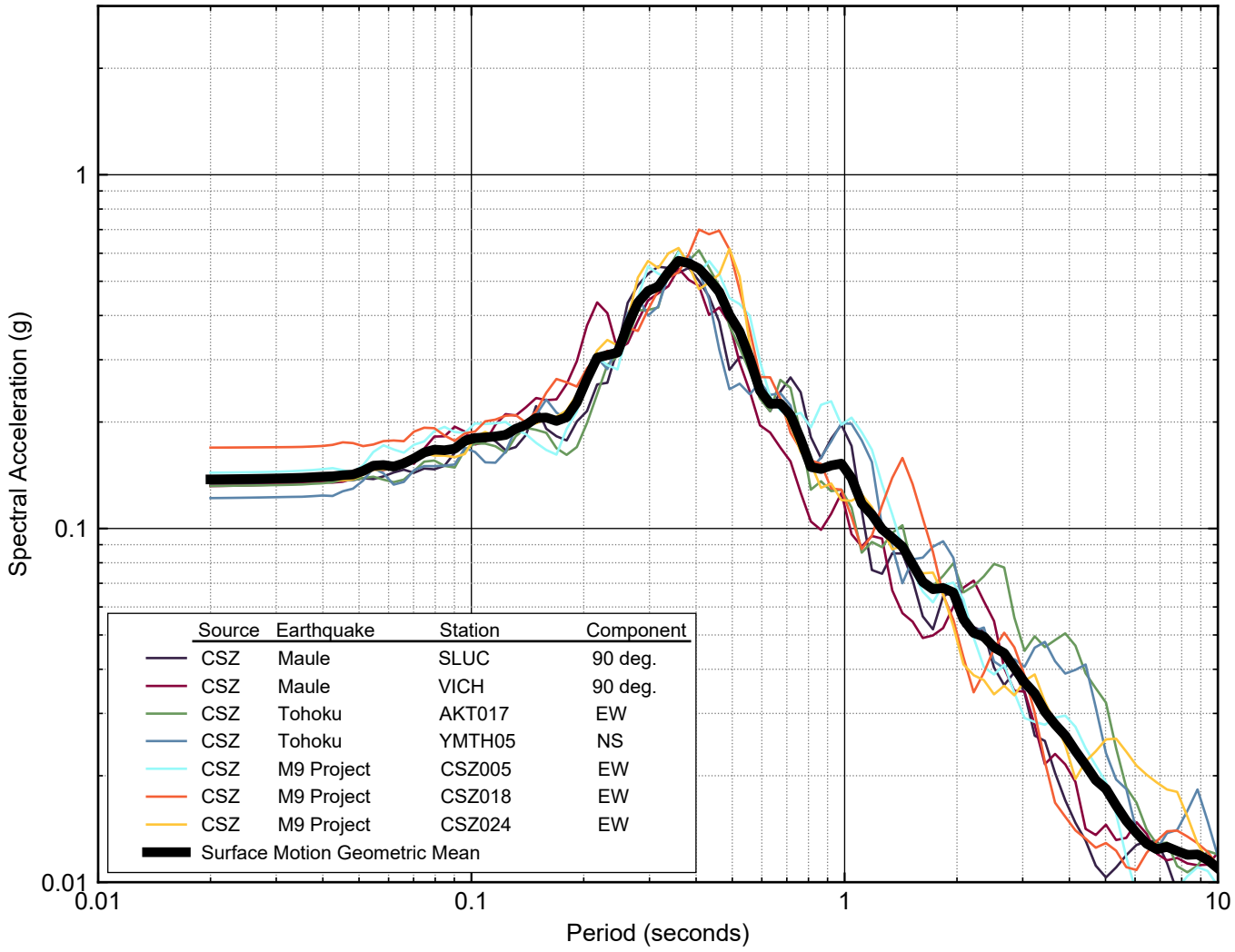

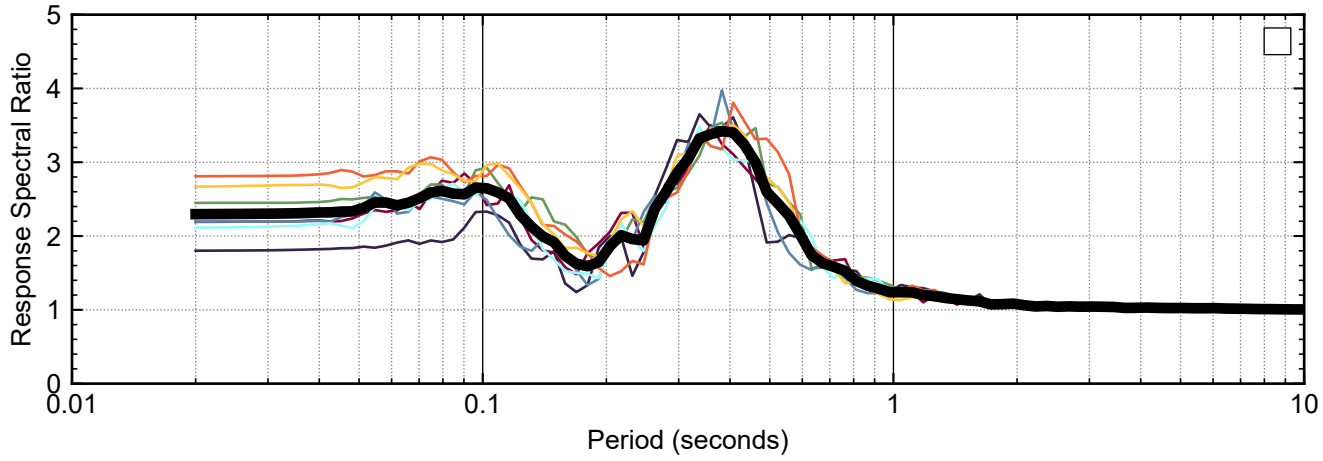

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 2
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-114

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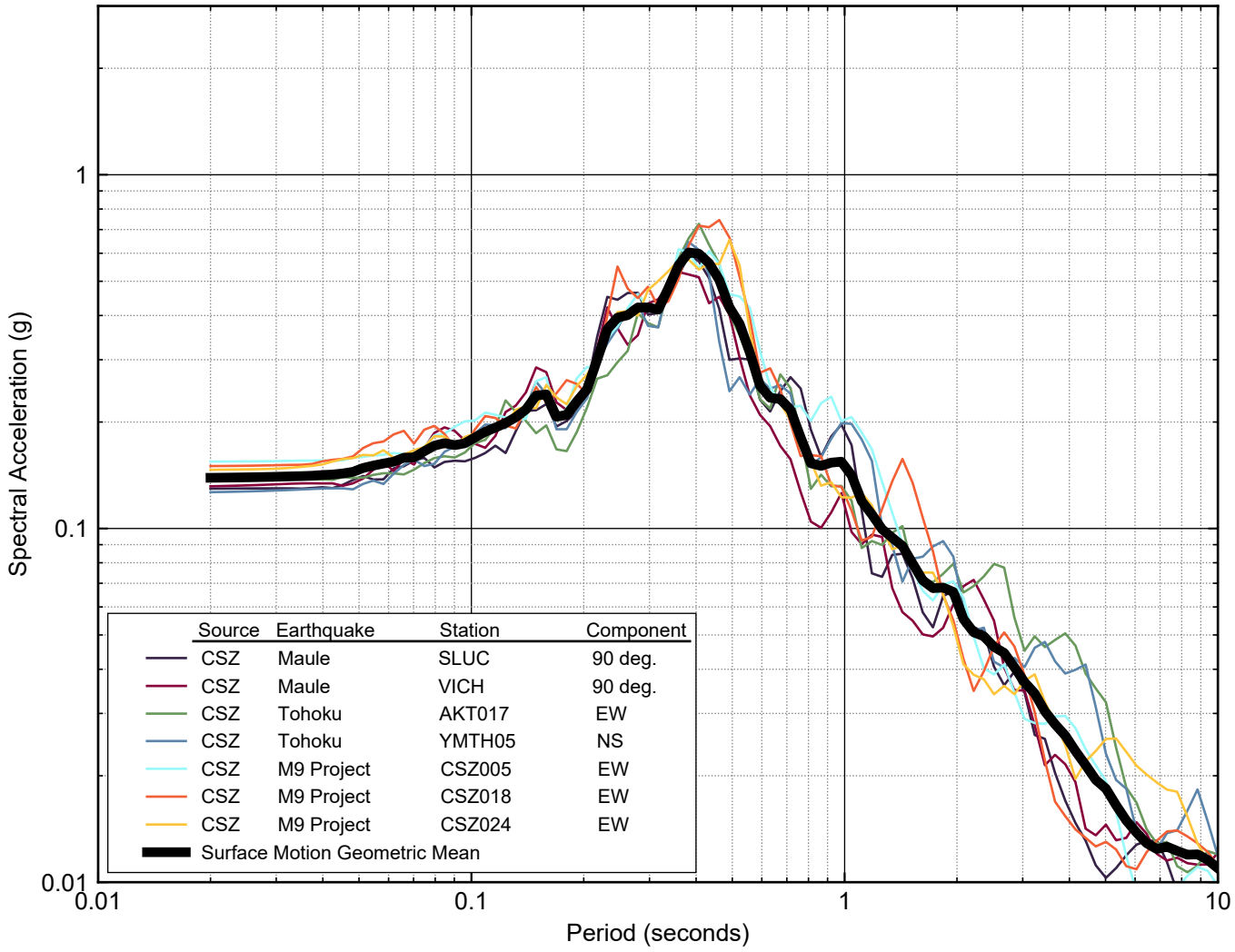

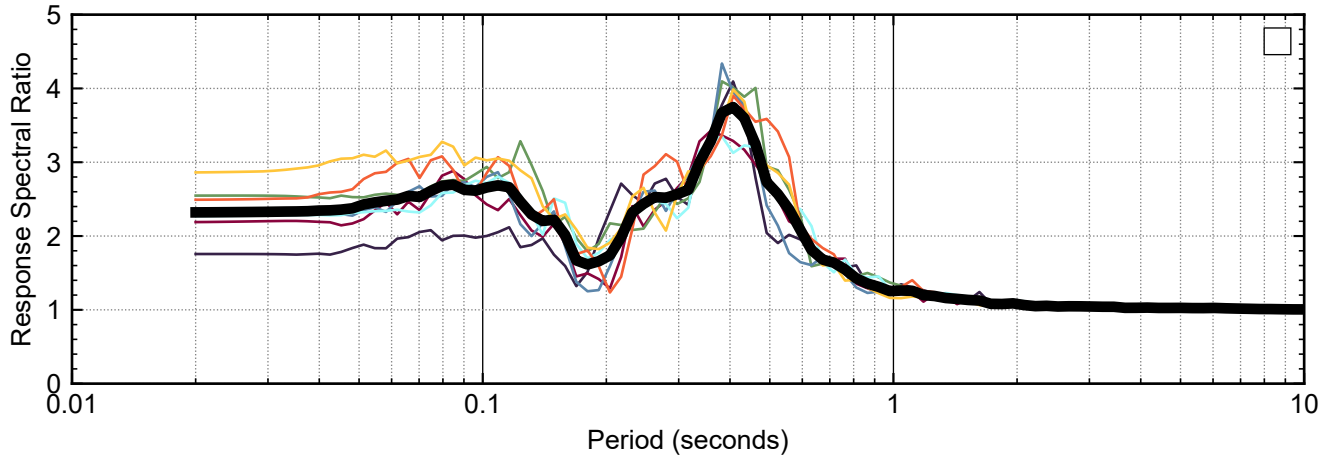

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 3
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-115

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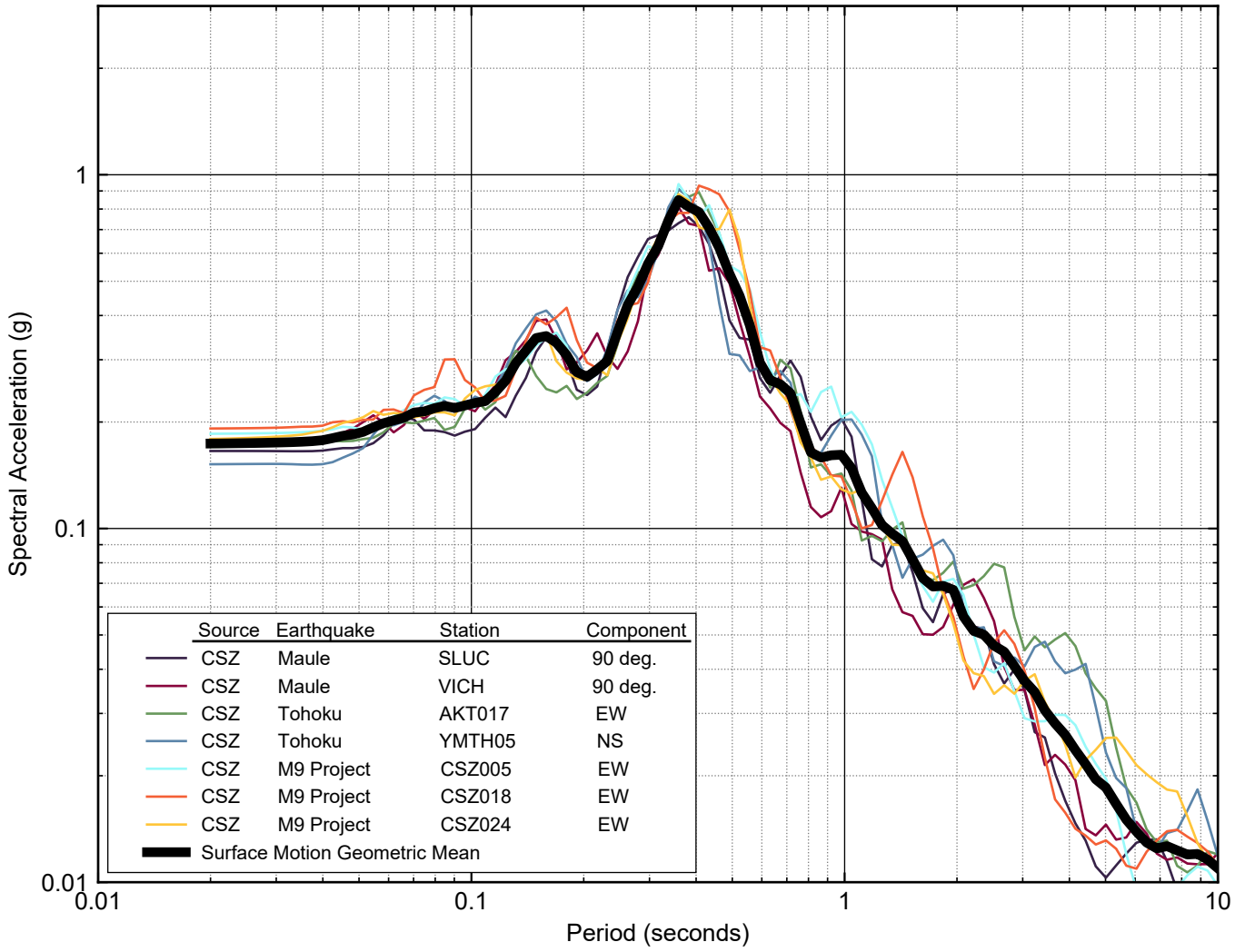

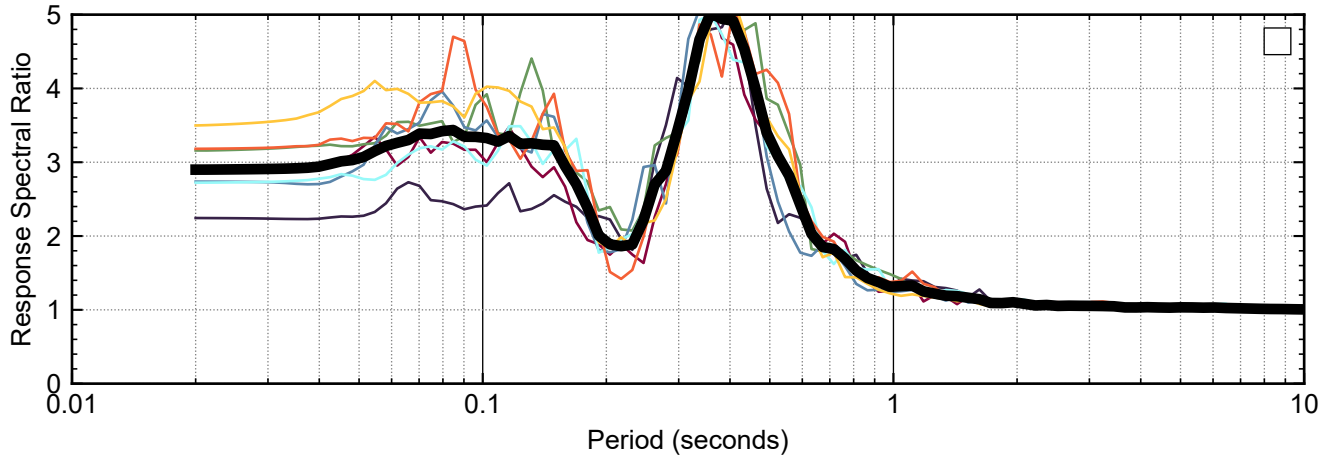

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 4
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-116

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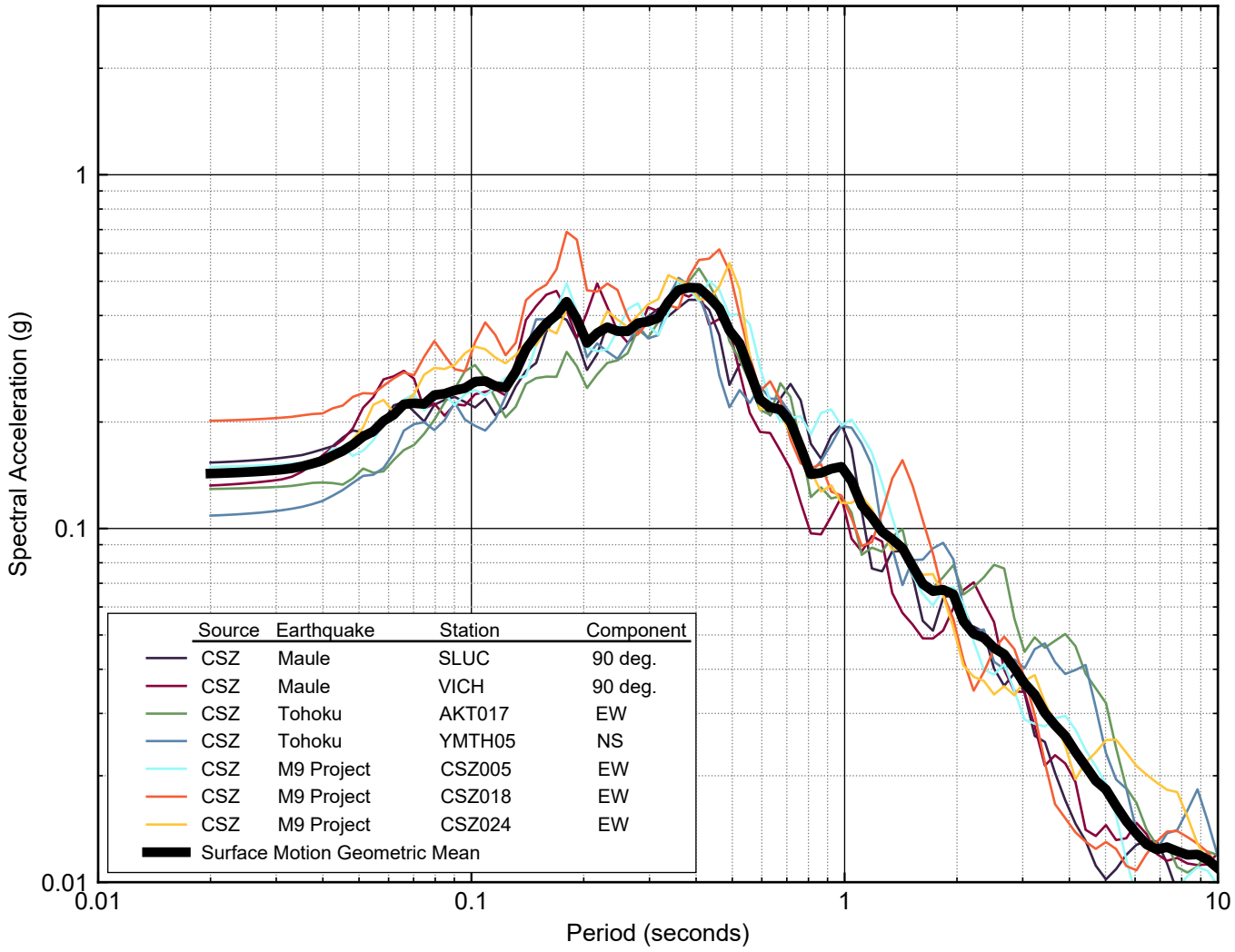

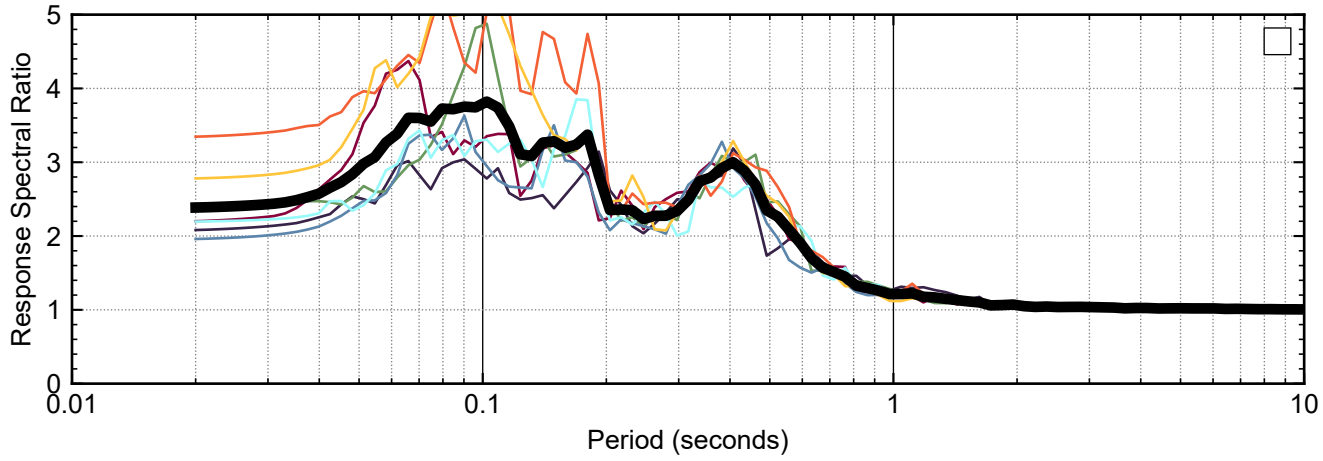

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 5
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-117

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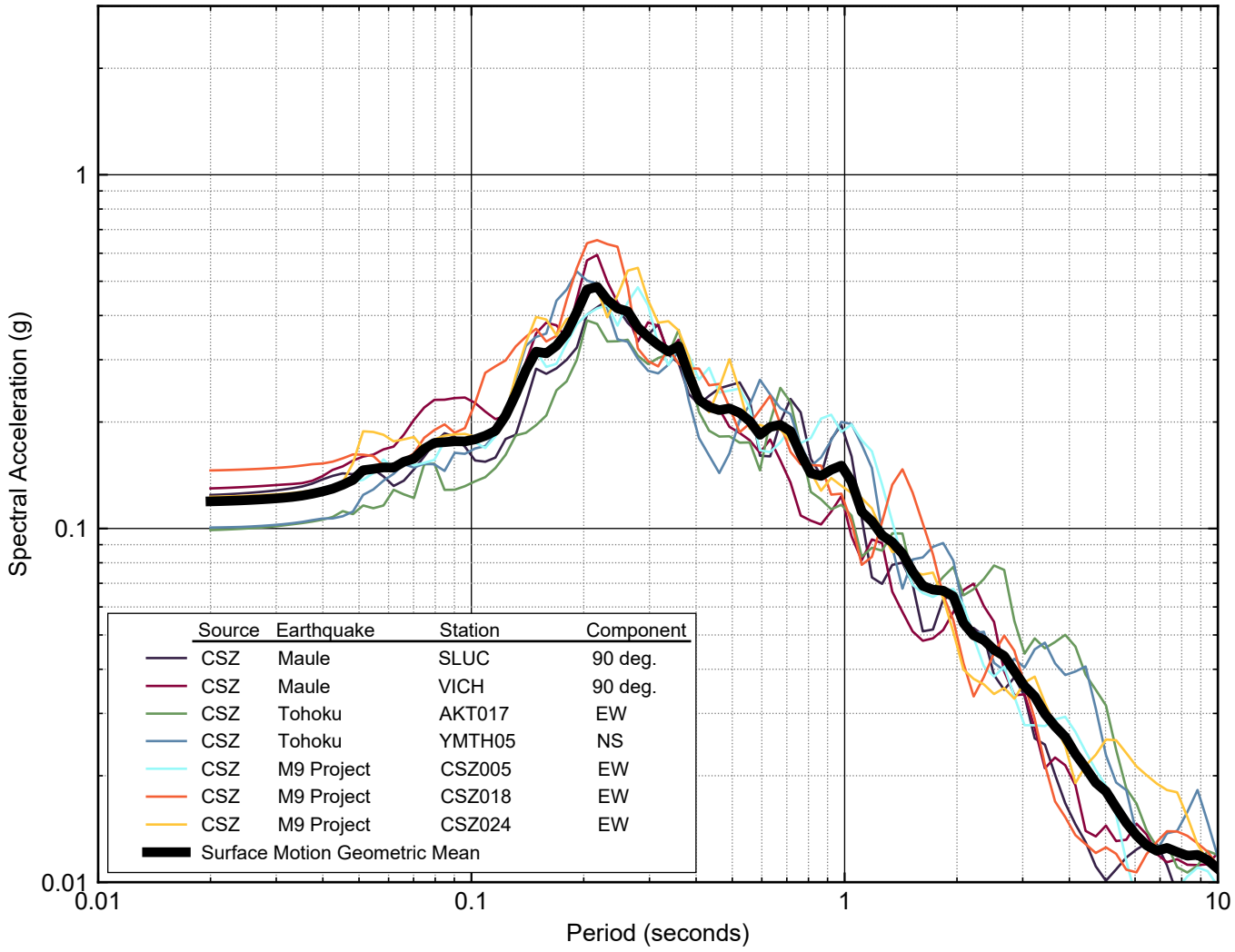

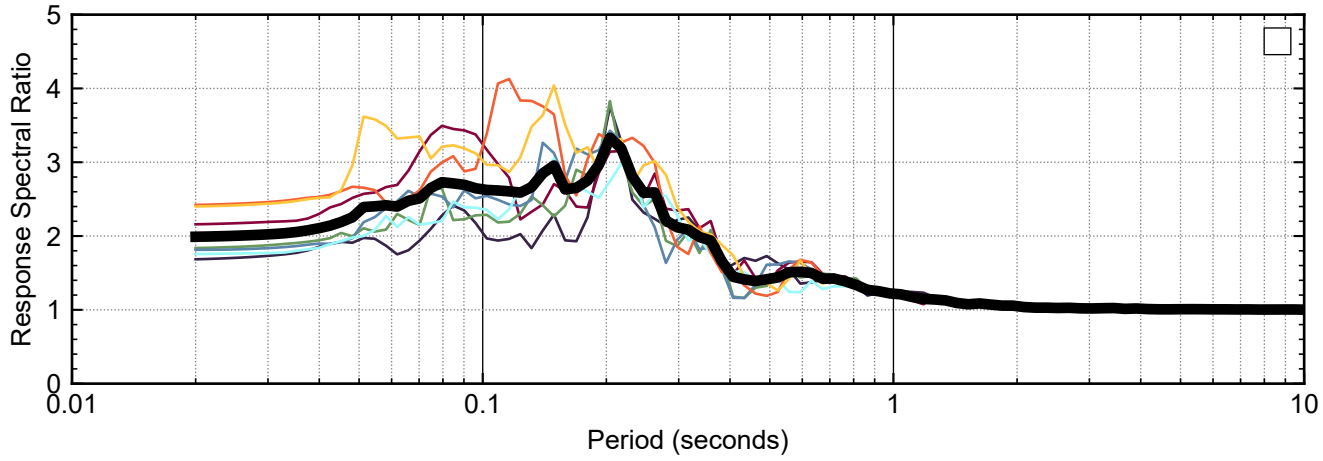

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 6
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-118

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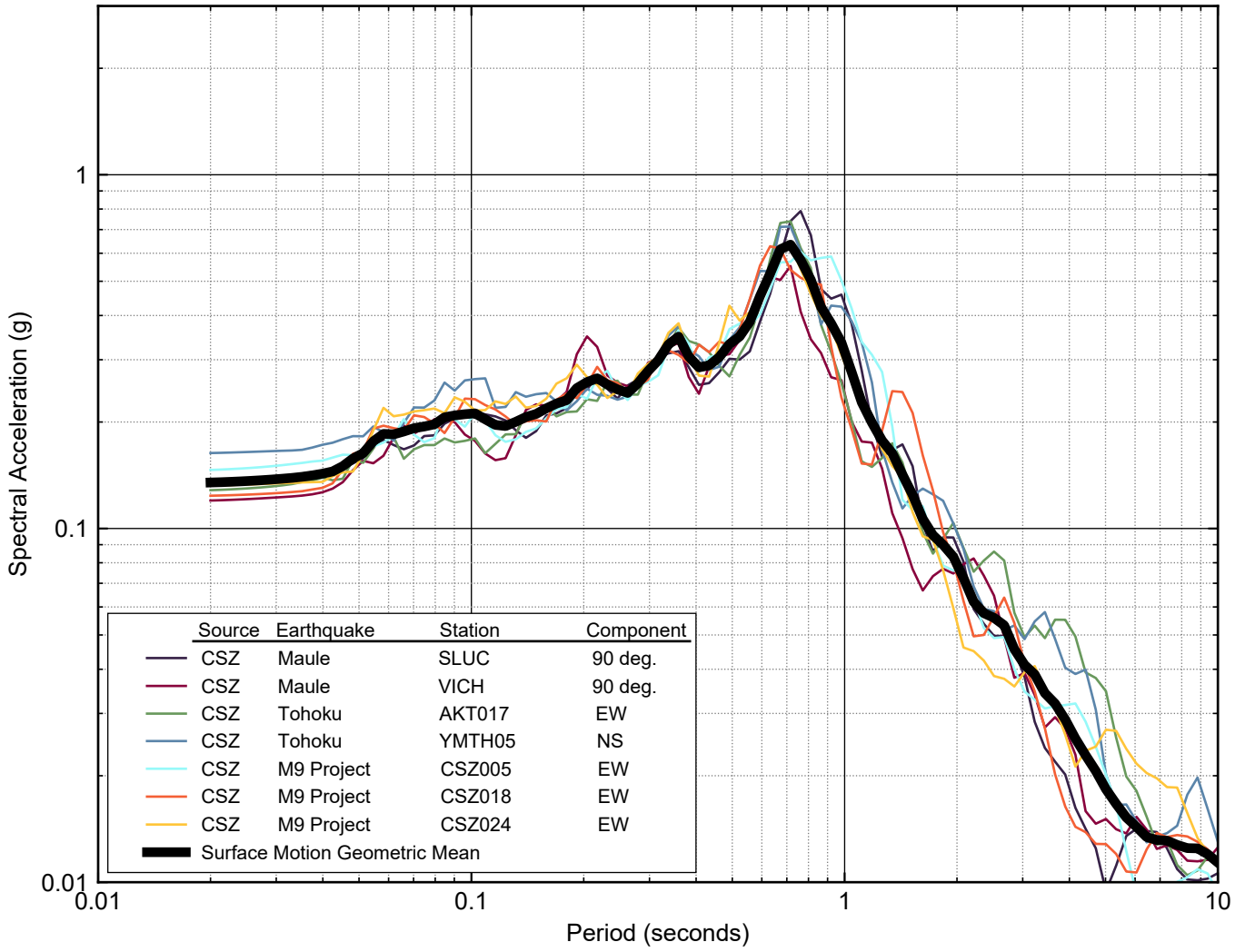

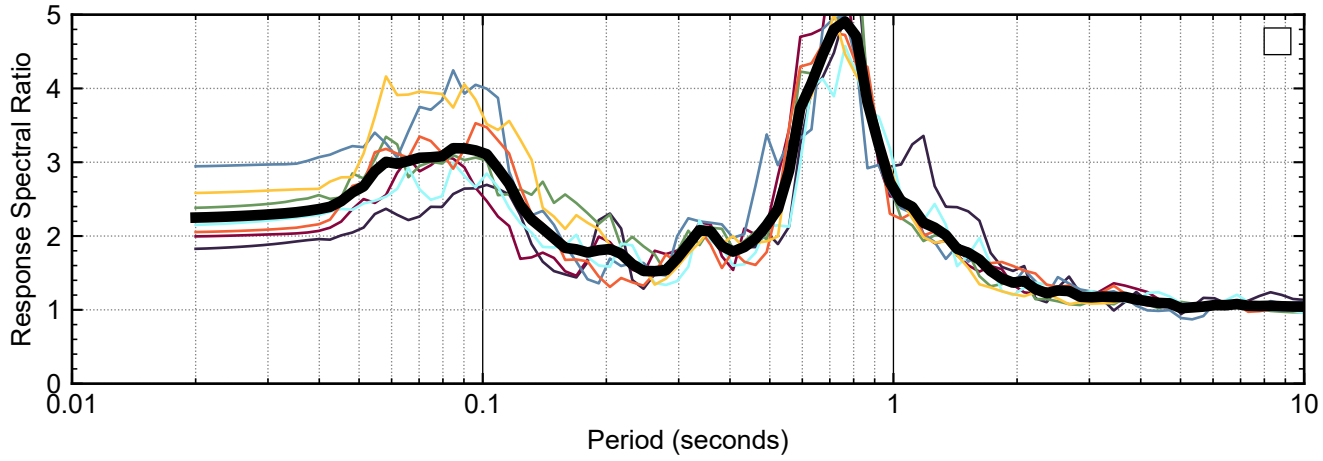

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 7
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-119

C:_FLACPROCESS\Burnside

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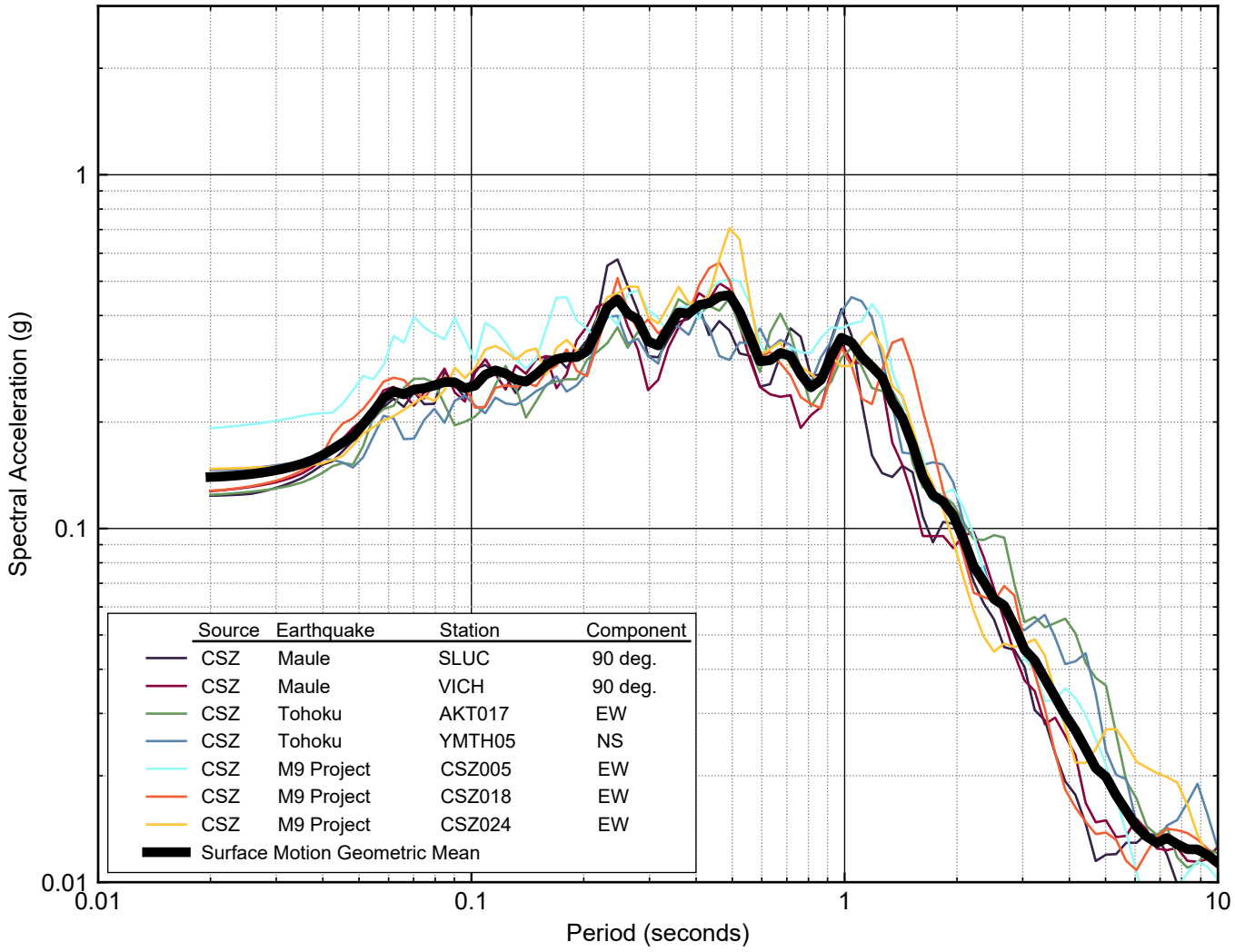

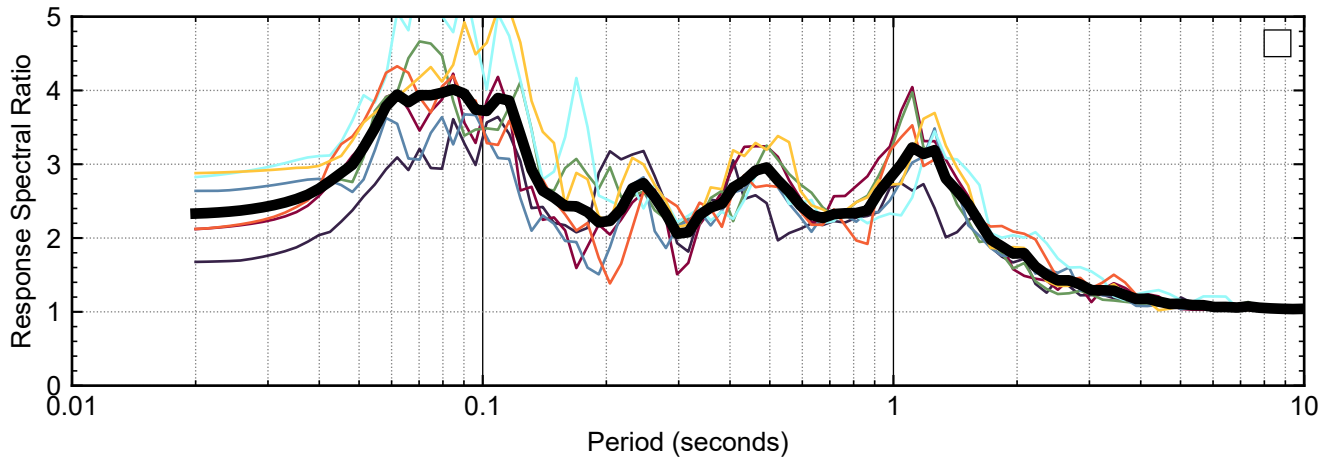

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 8 CABLE-STAYED TOWER
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-120

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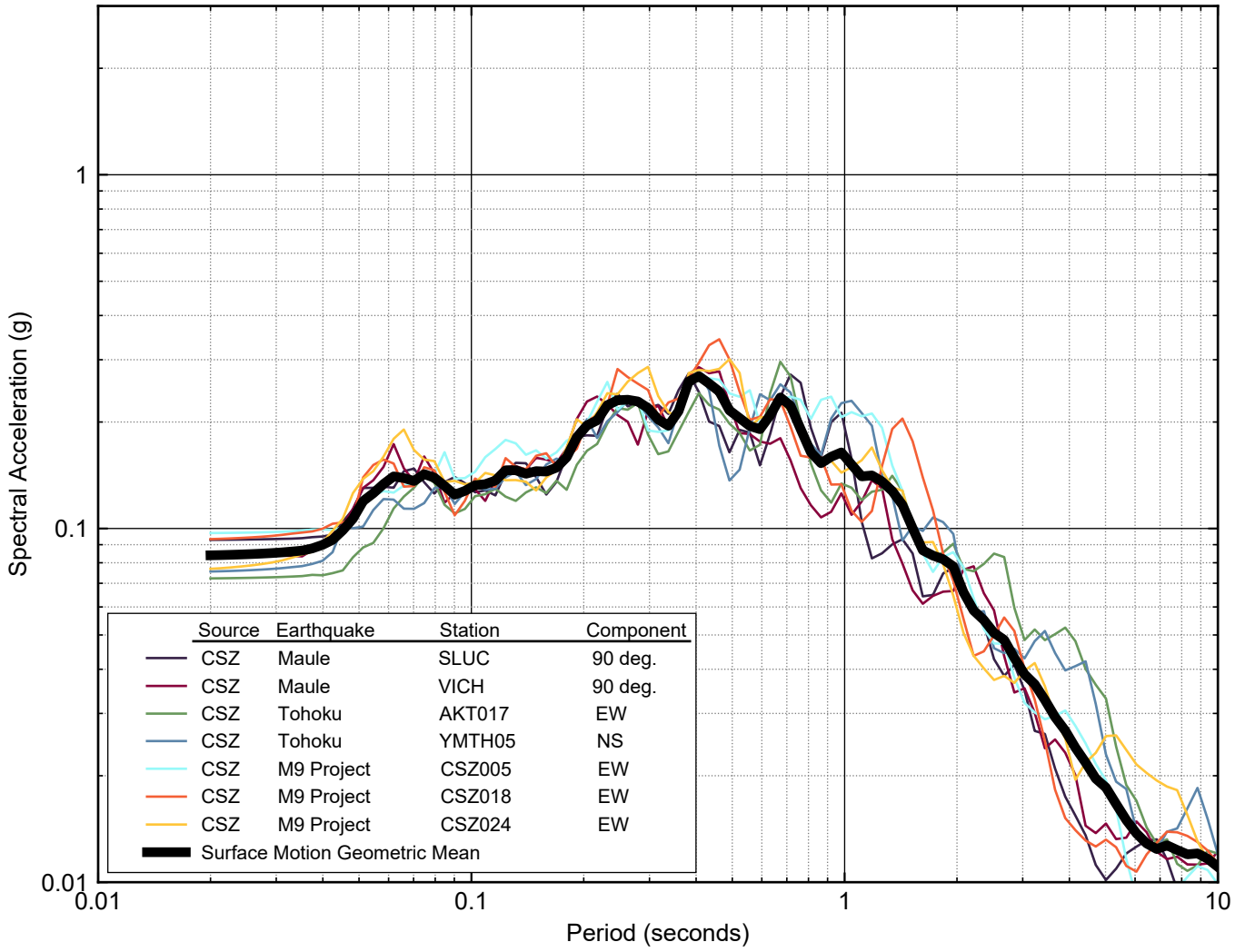

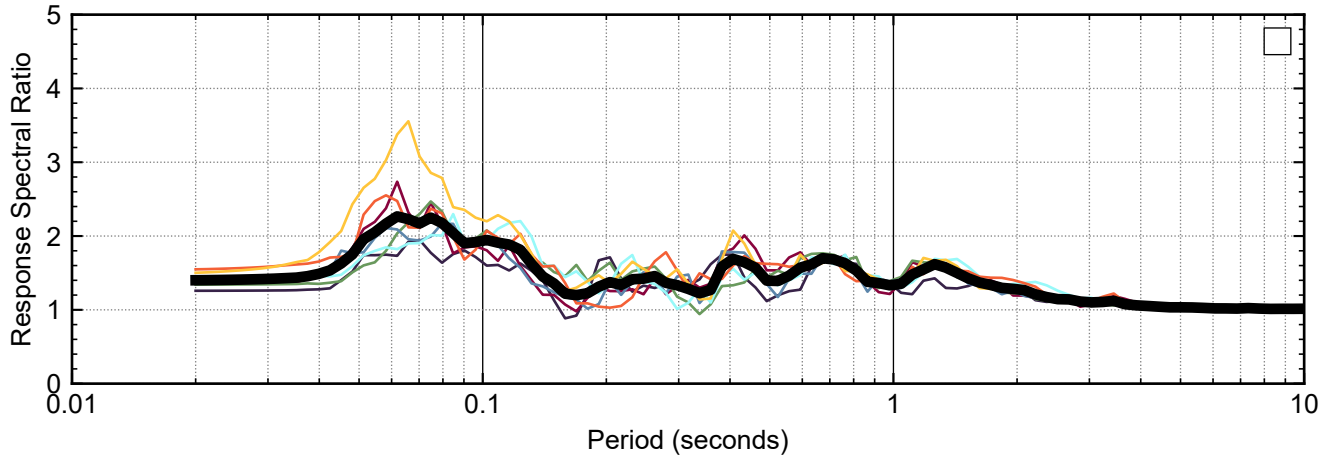

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 8 TIED-ARCH
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-121

C:\ FLACPROCESS\Burnside

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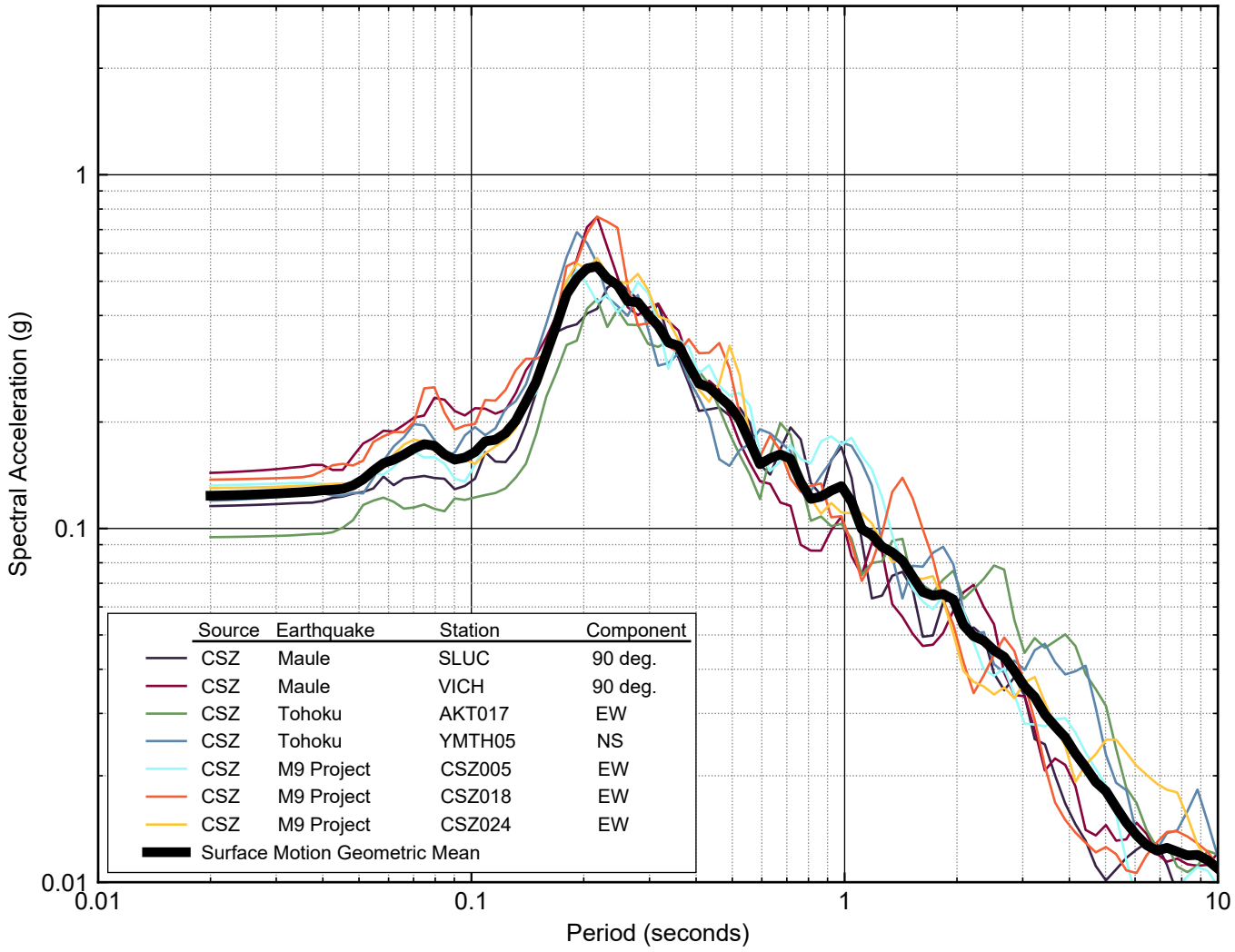

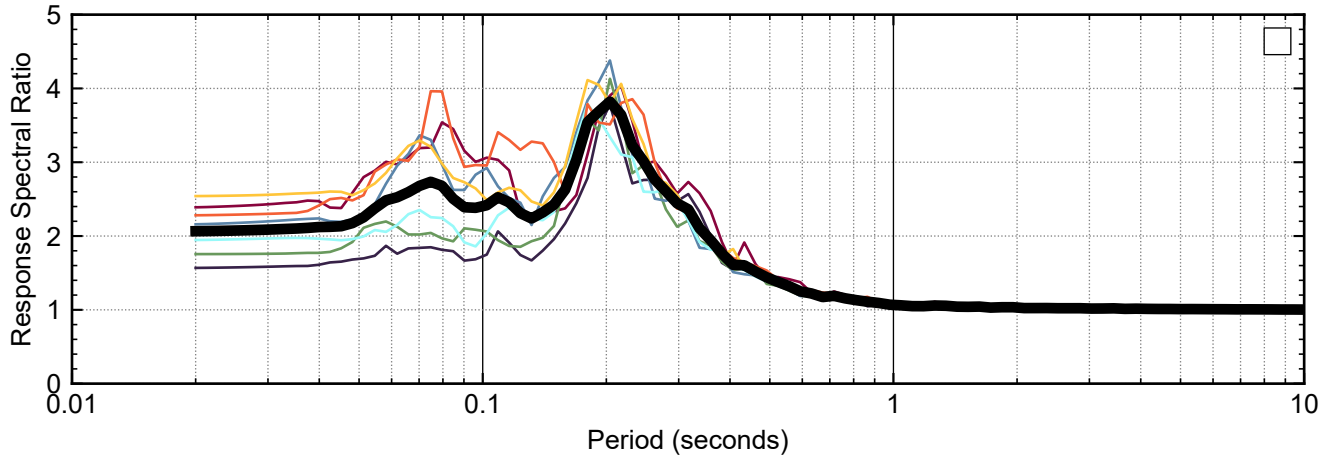

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 9
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-122

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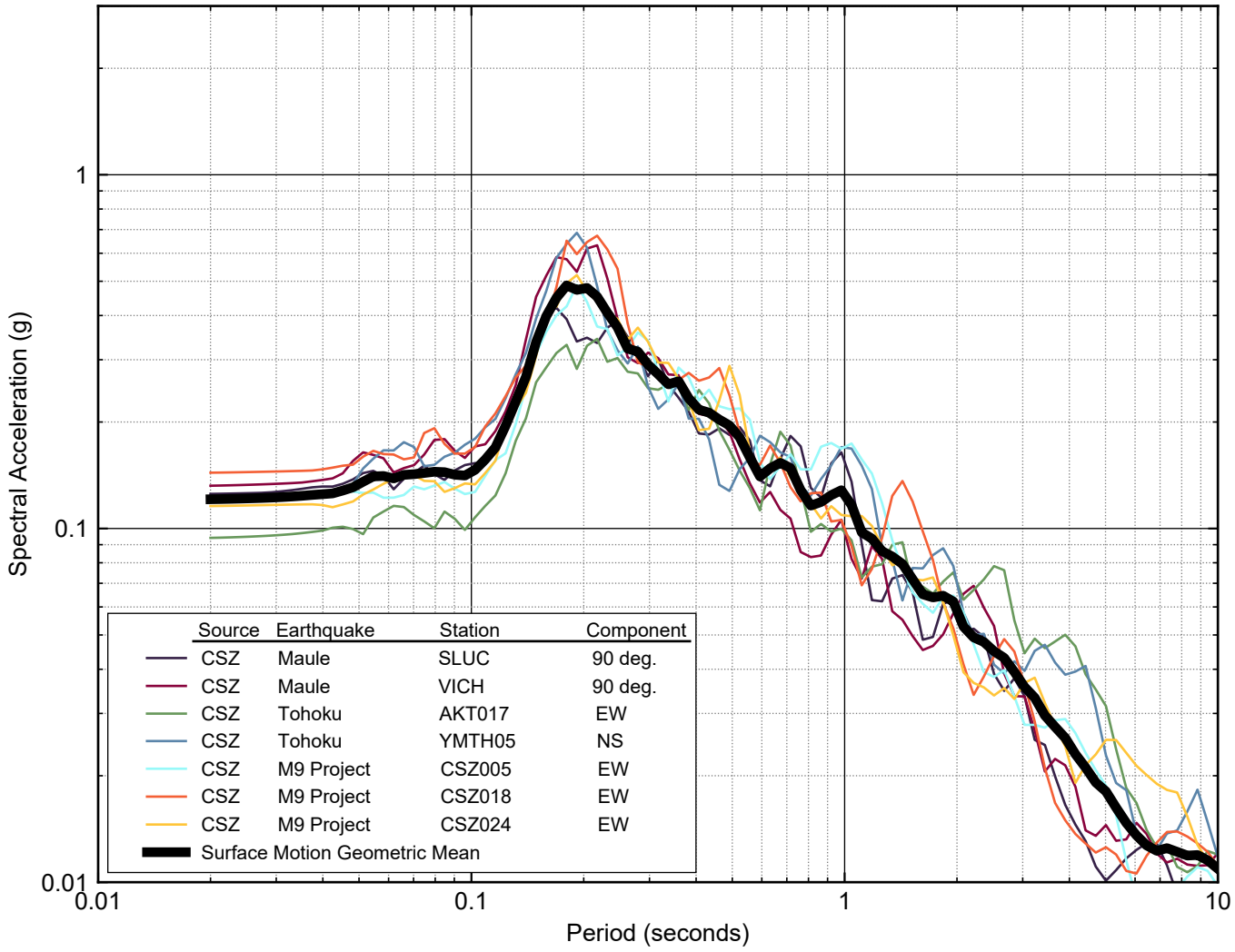

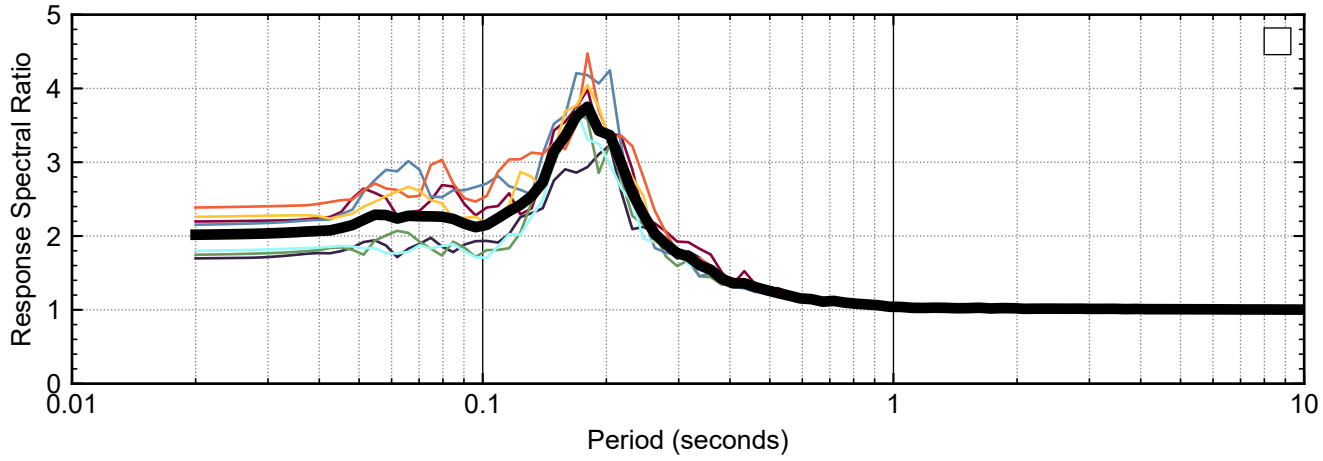

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 10
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-123

C:\ FLACPROCESS\Burnside

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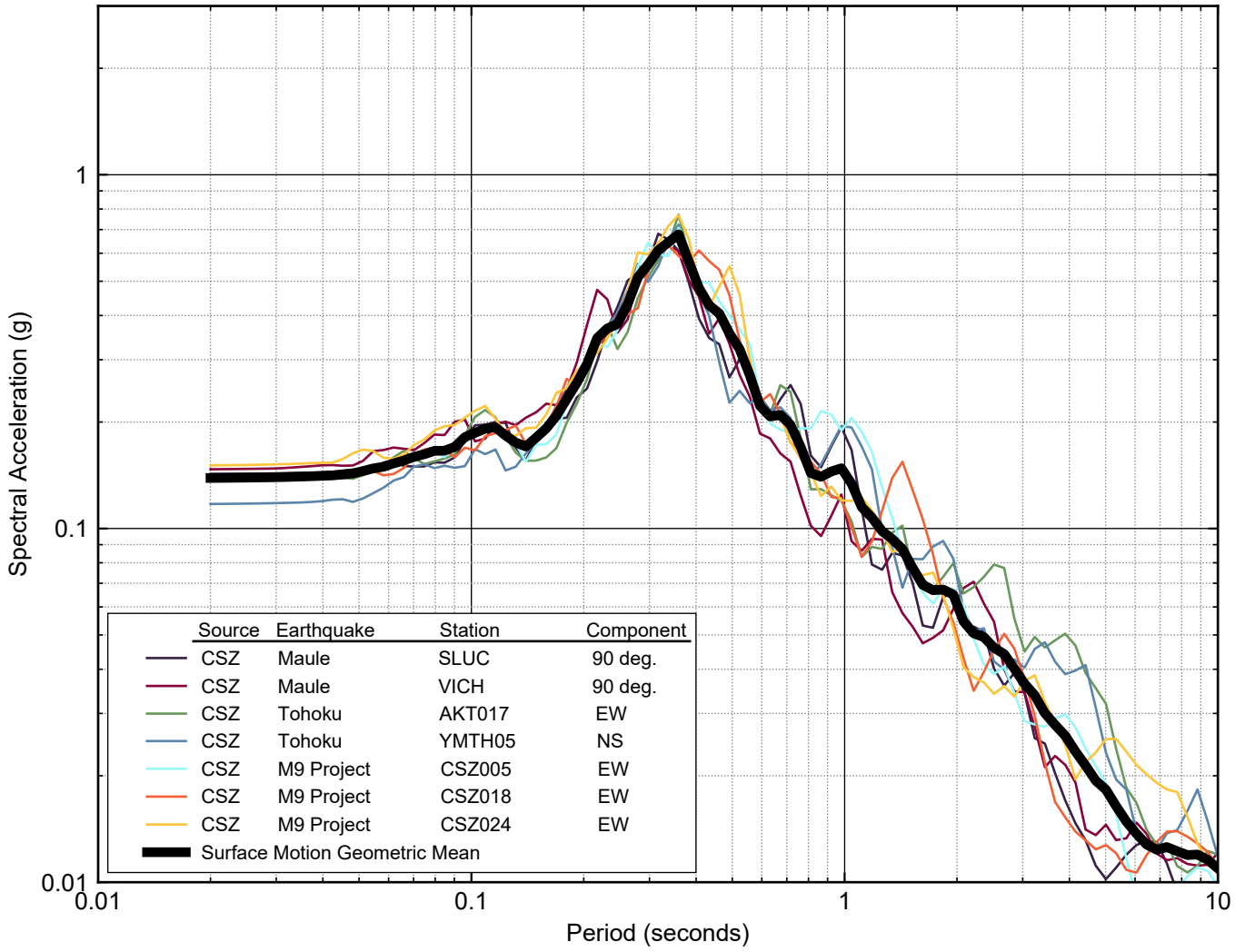

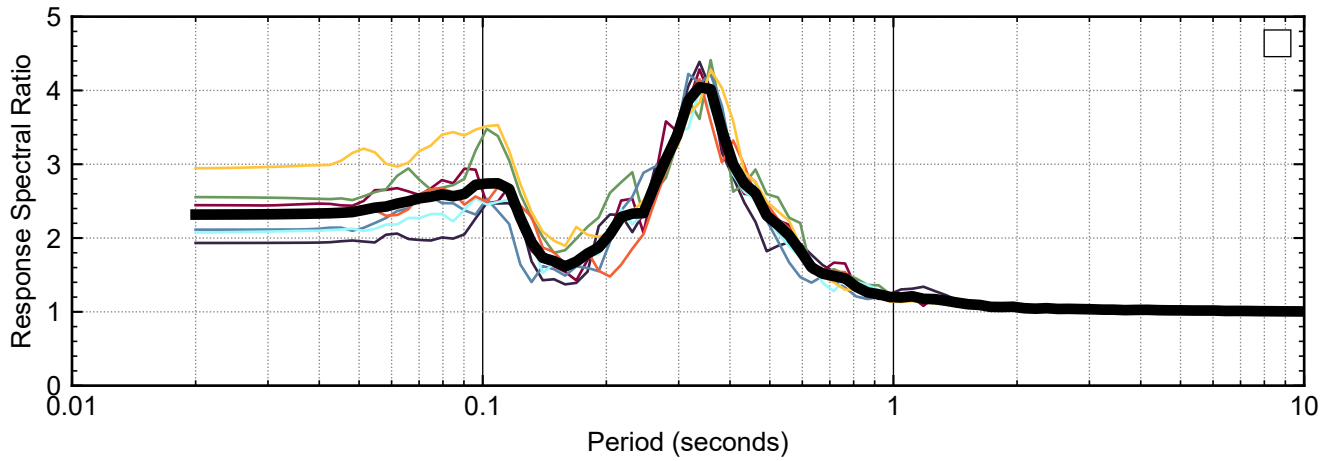

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 1
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-124

C:\ FLACPROCESS\Burnside

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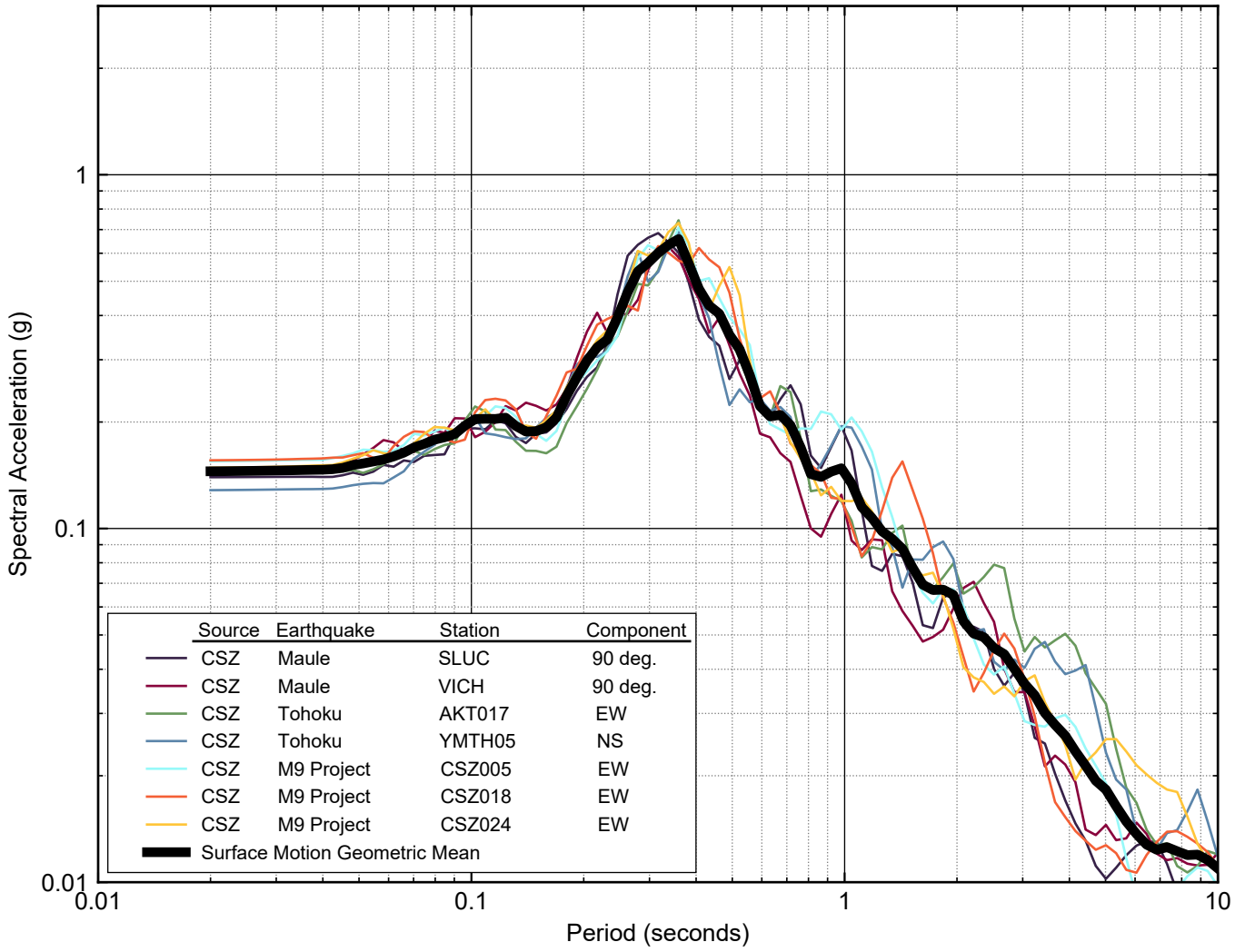

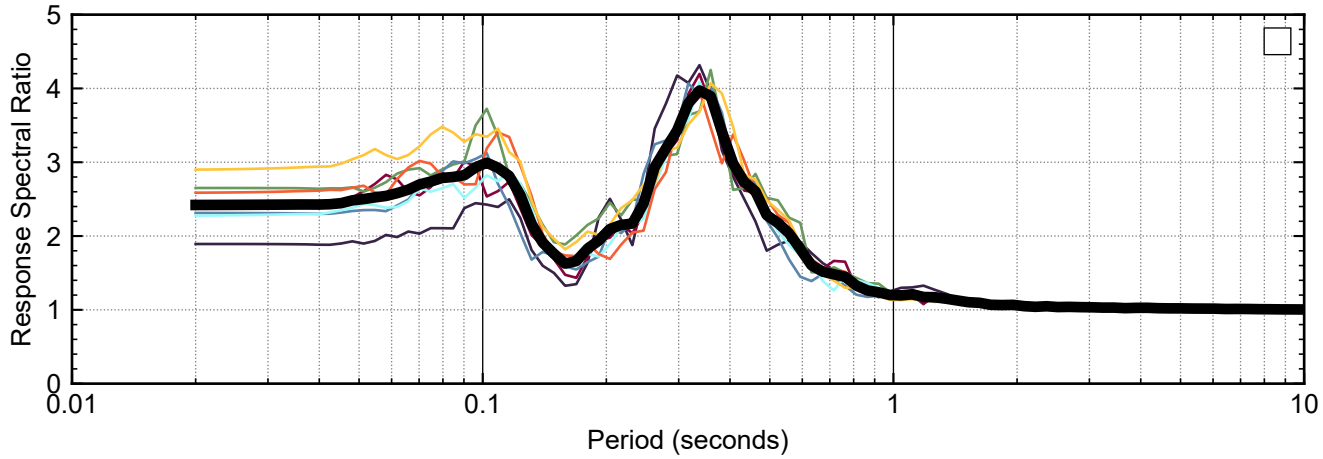

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 2
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-125

C:\ FLACPROCESS\Burnside

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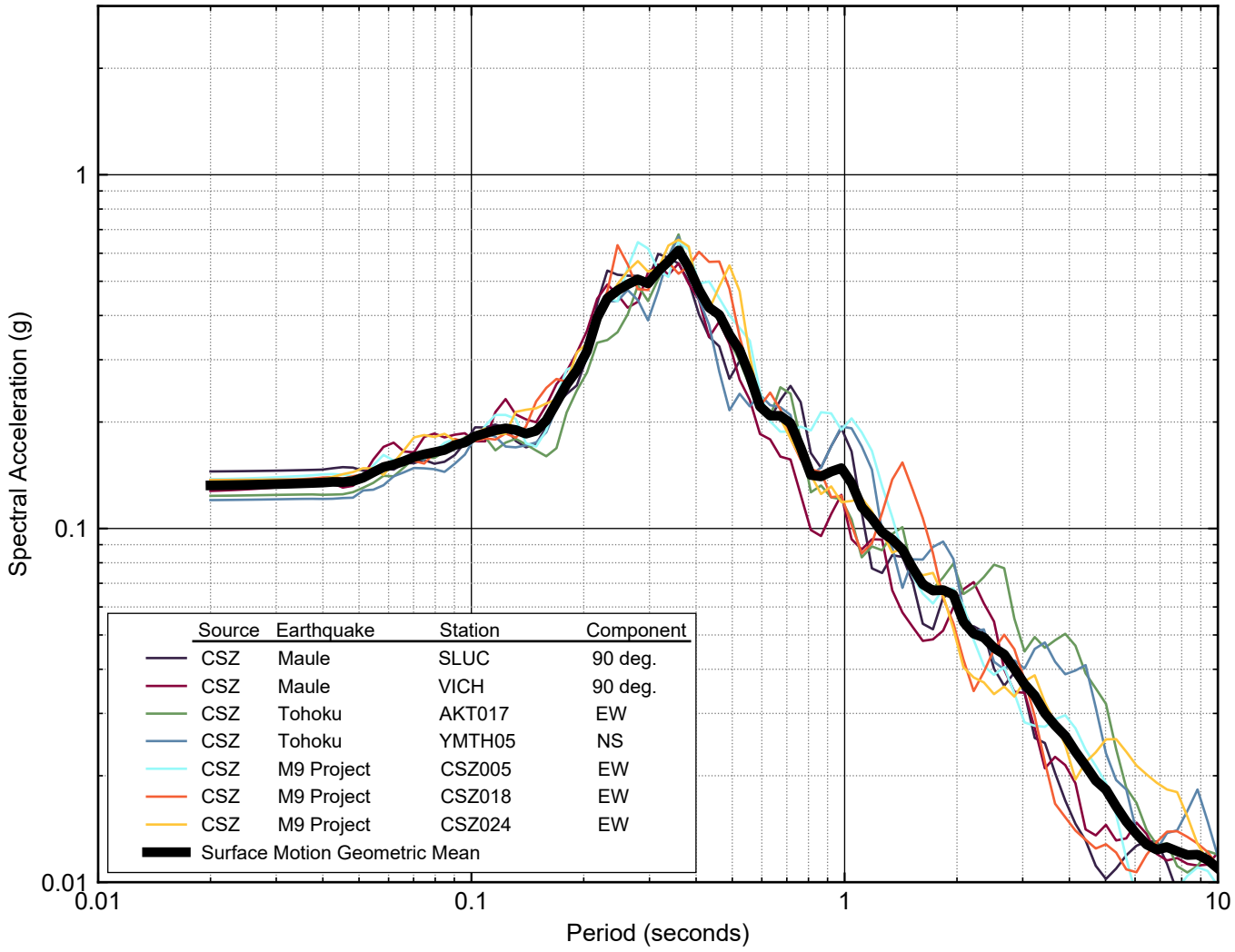
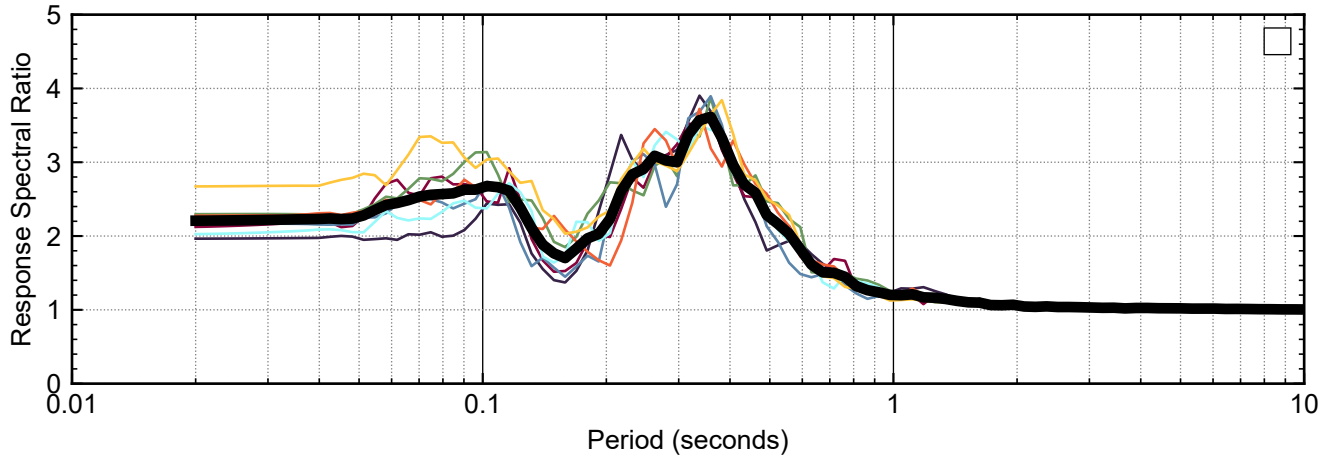




Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 3
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

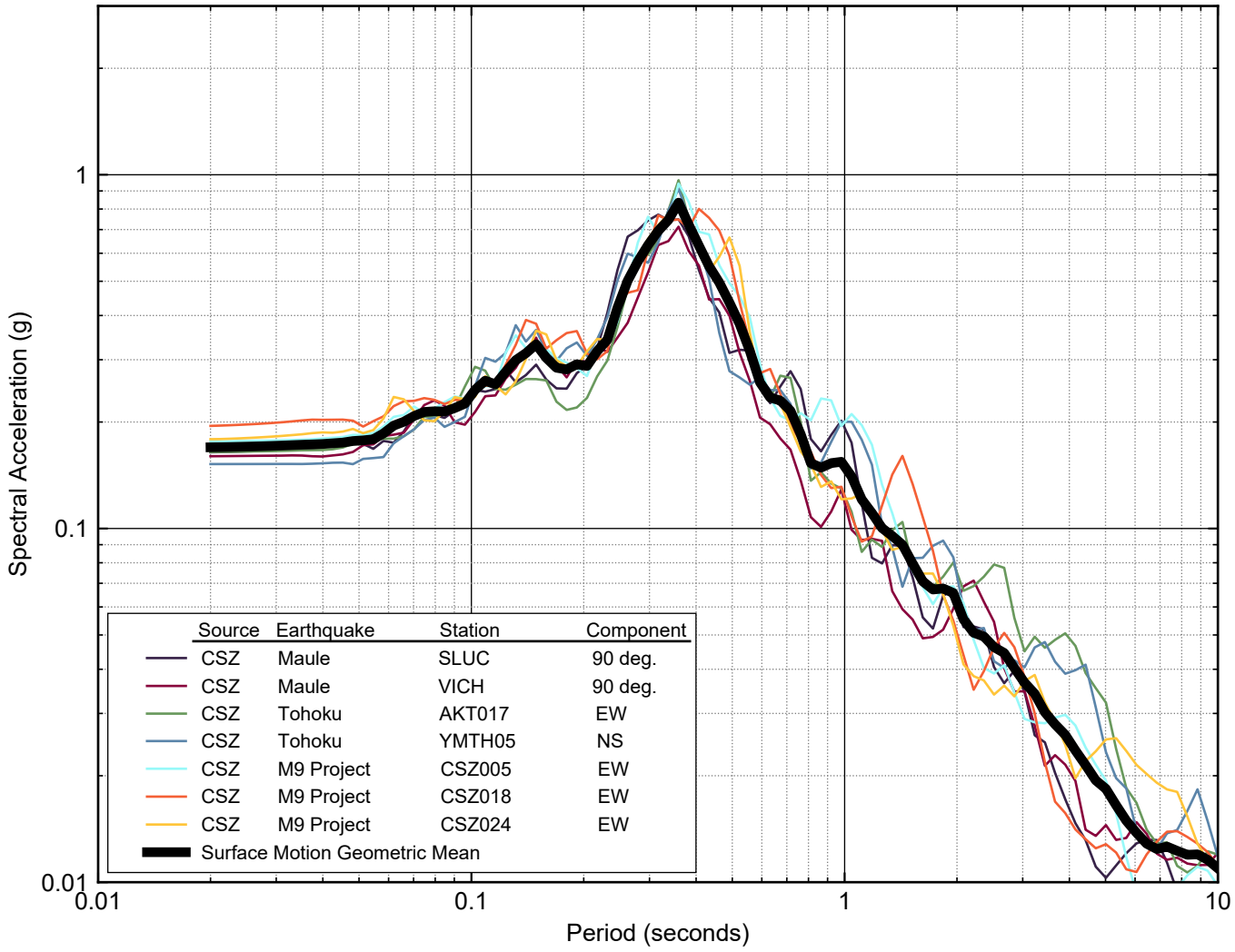
April 2022 102636-009

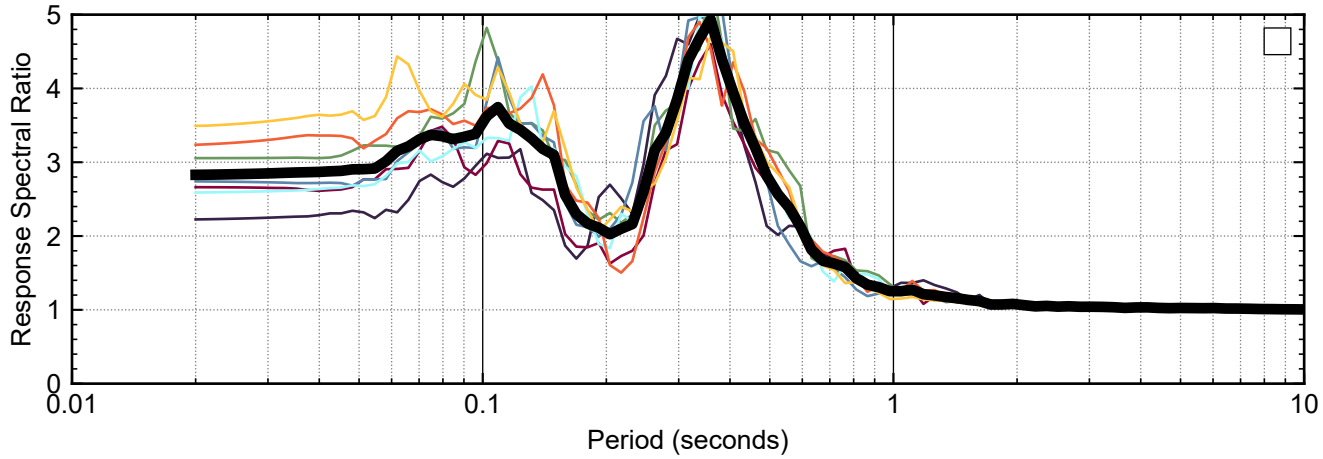
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-126

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d_by:SSS





Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 4
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-127

C:\ FLACPROCESS\Burnside

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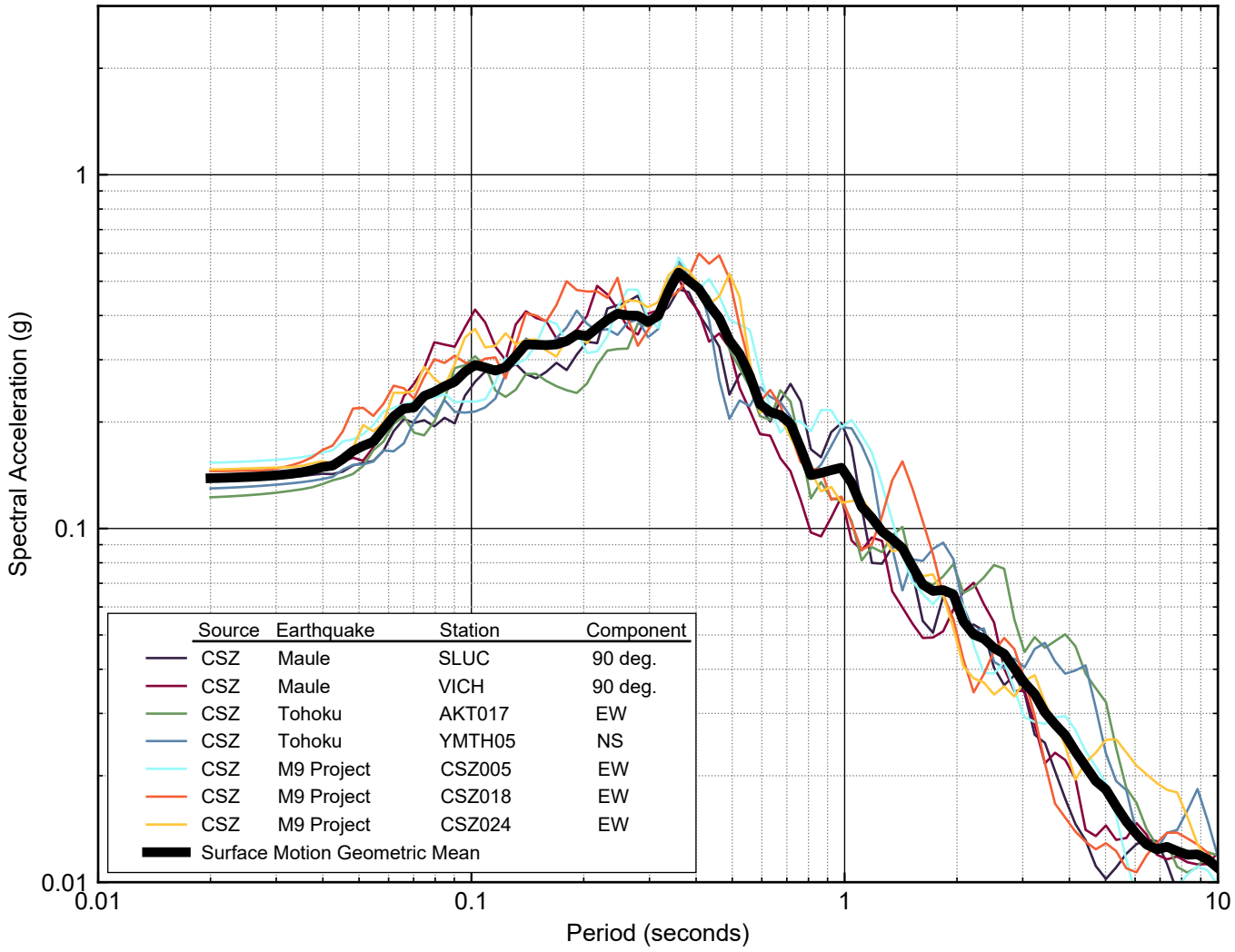

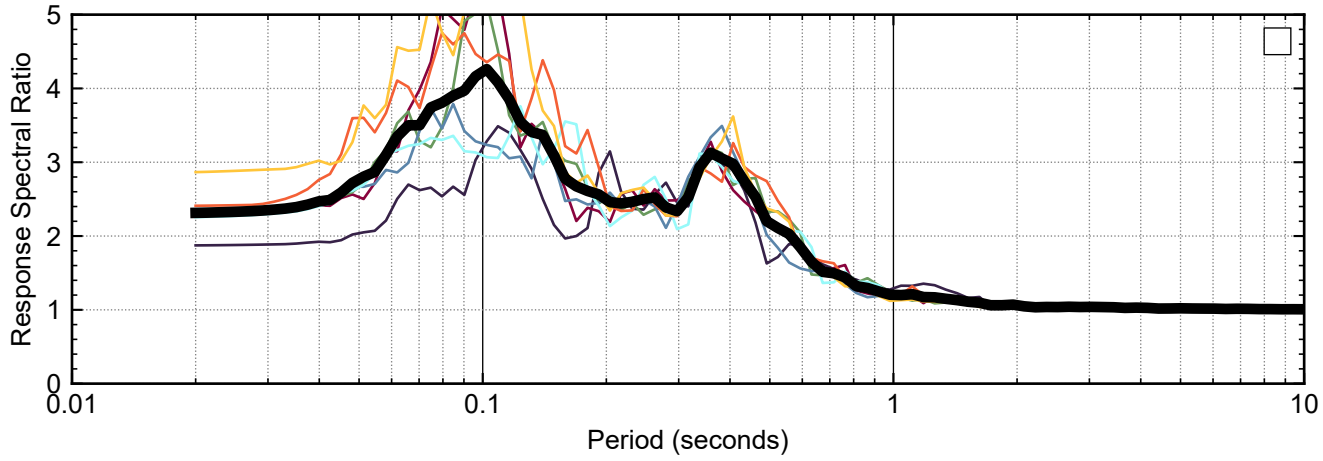

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 5
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-128

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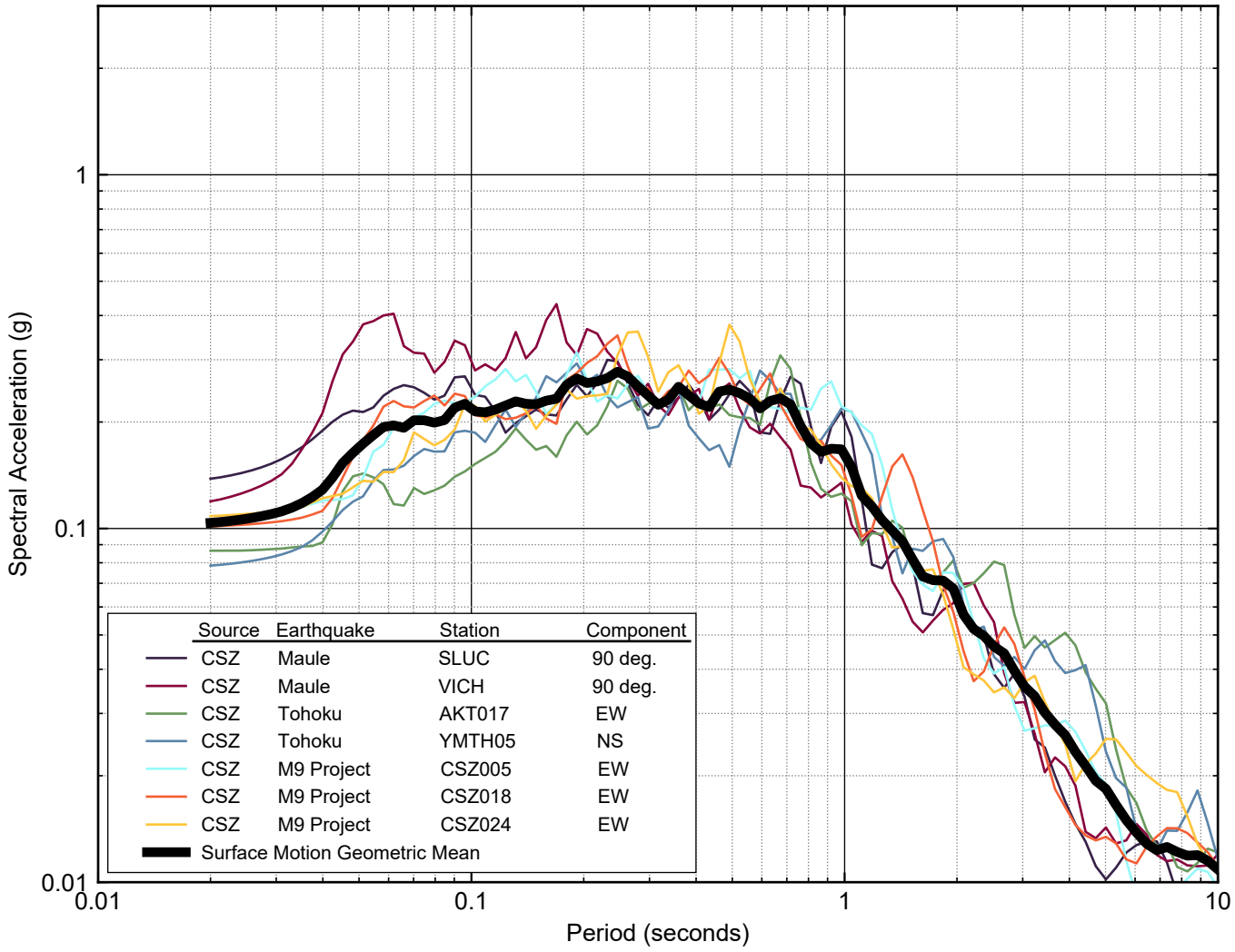

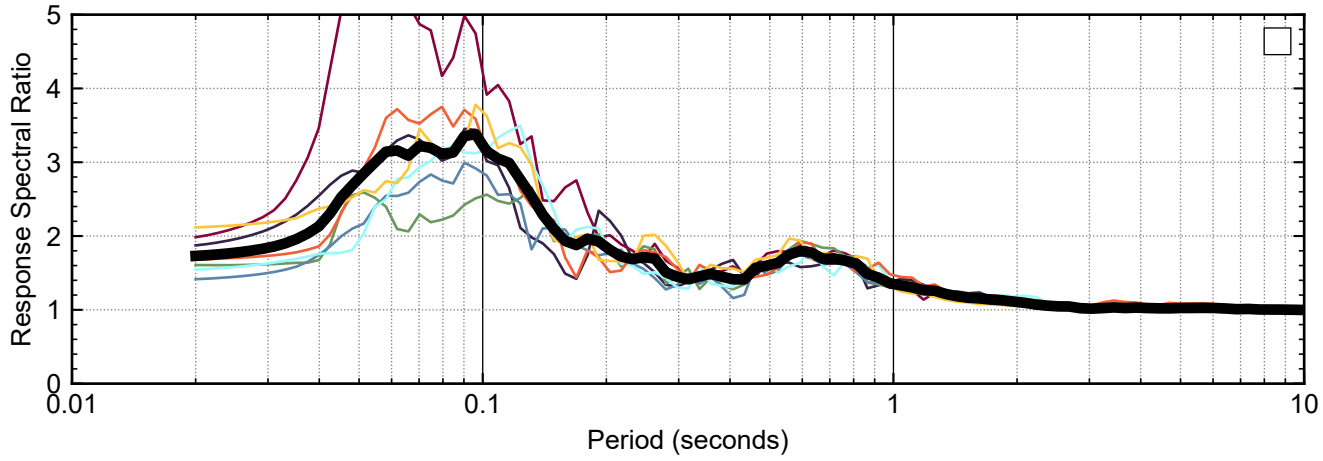

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 6
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-129

C:\ FLACPROCESS\Burnside

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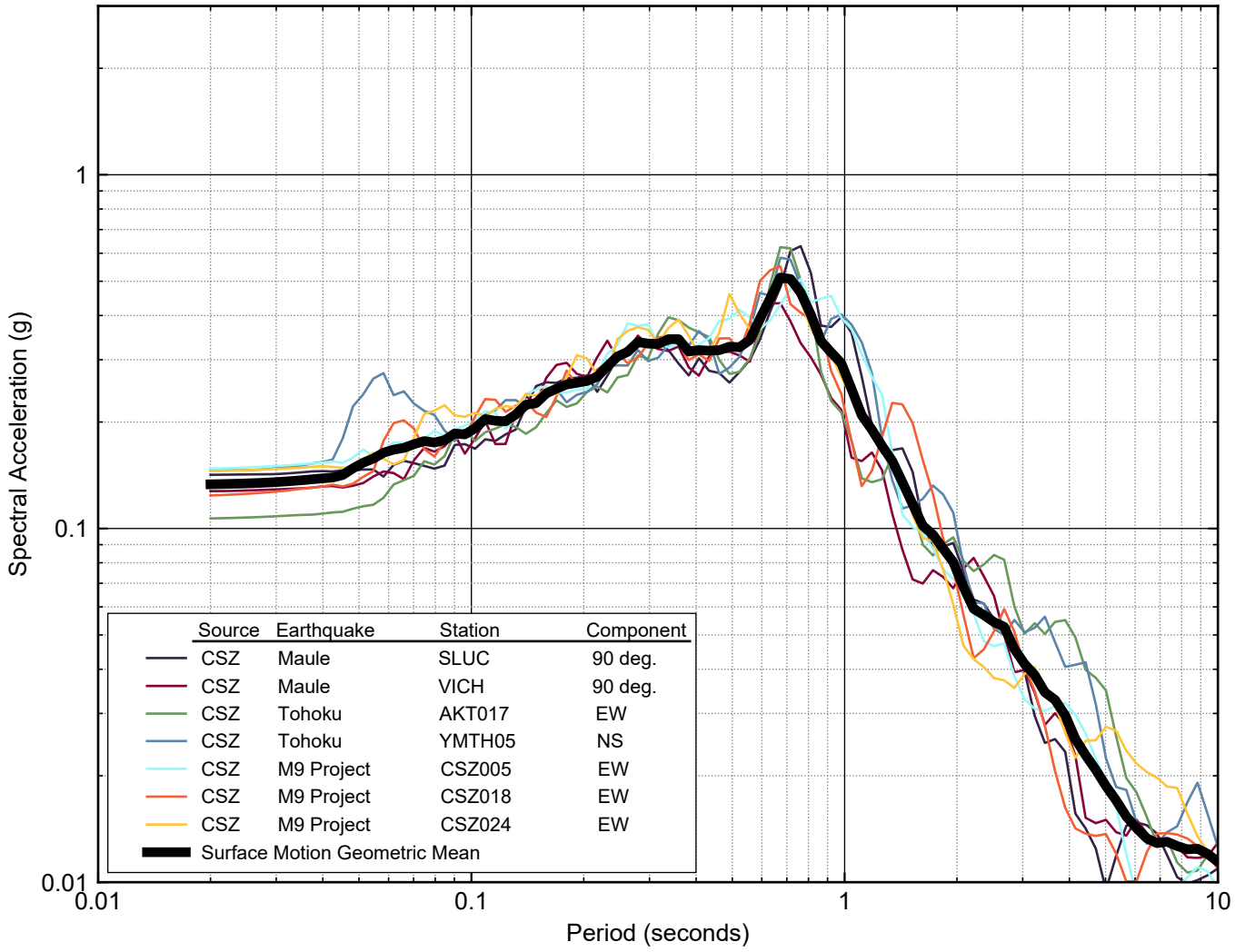

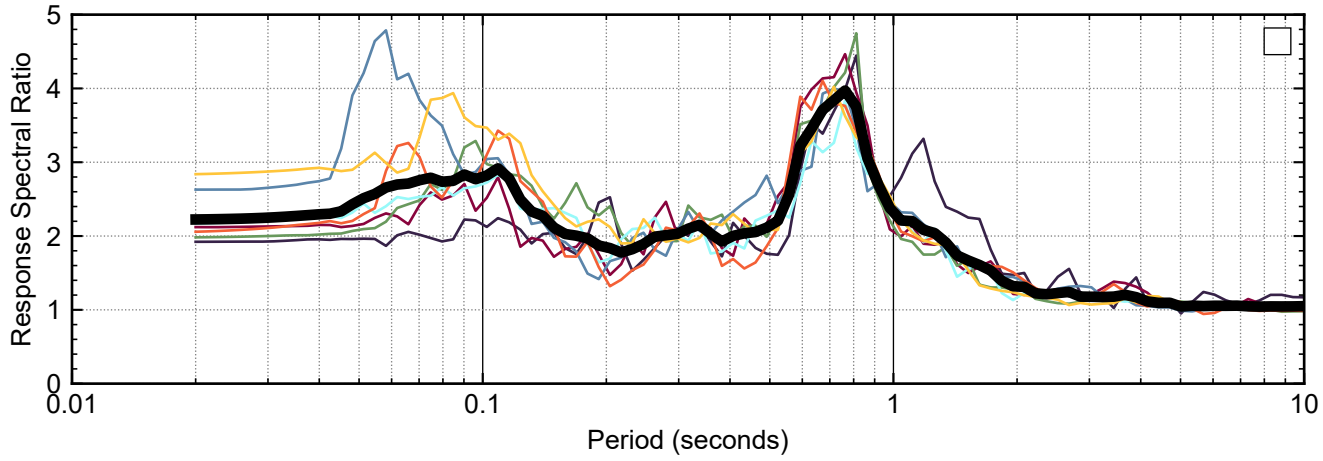

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 7
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-130

C:\ FLACPROCESS\Burnside

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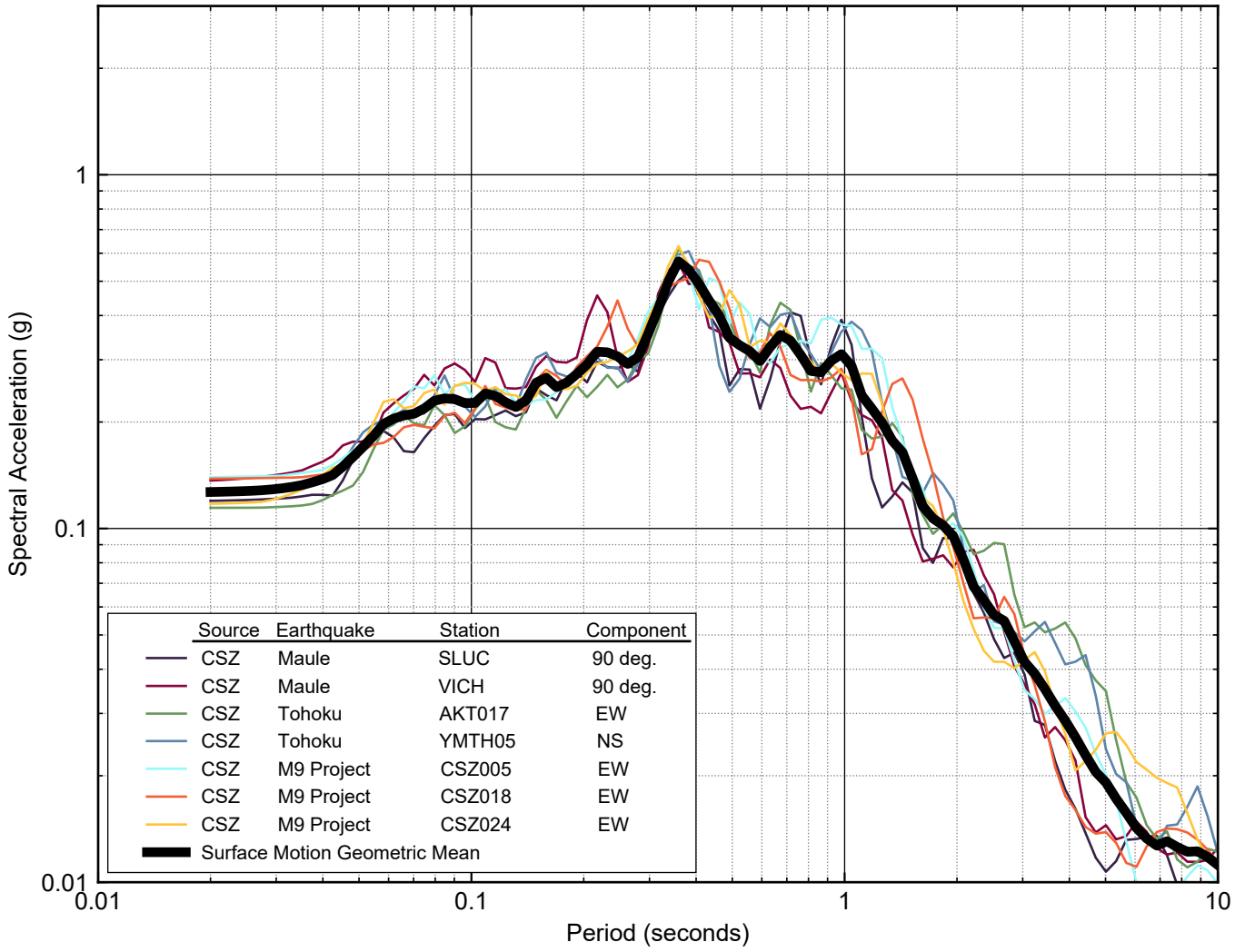

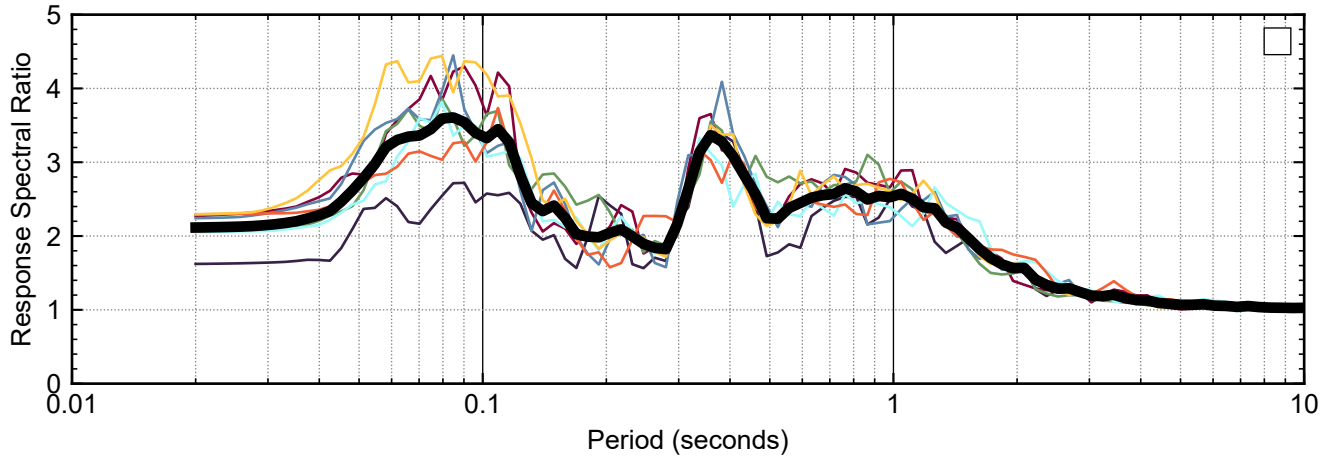

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 8 CABLE-STAYED TOWER EFFECTIVE STRESS ANALYSIS DETERMINISTIC CSZ RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-131

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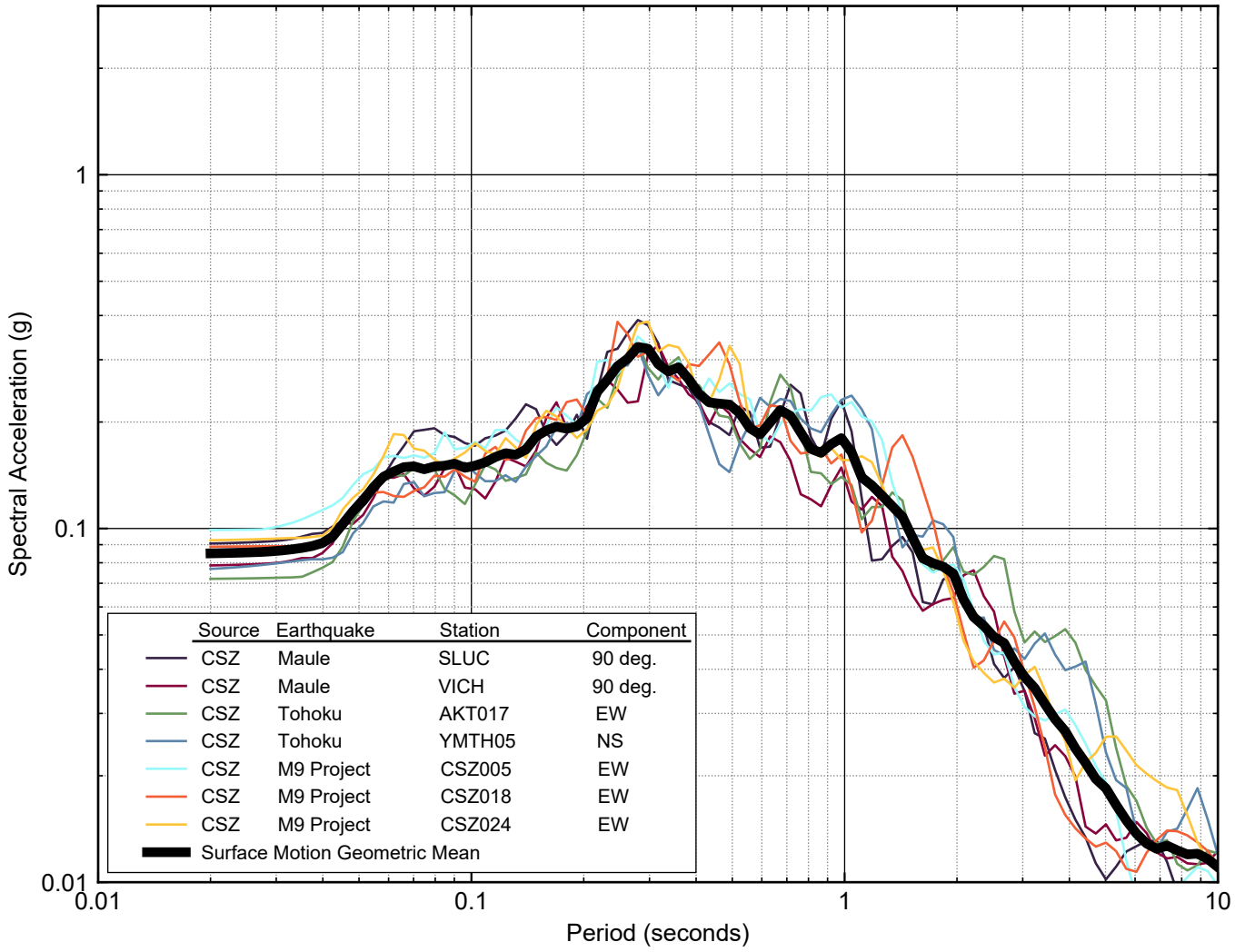

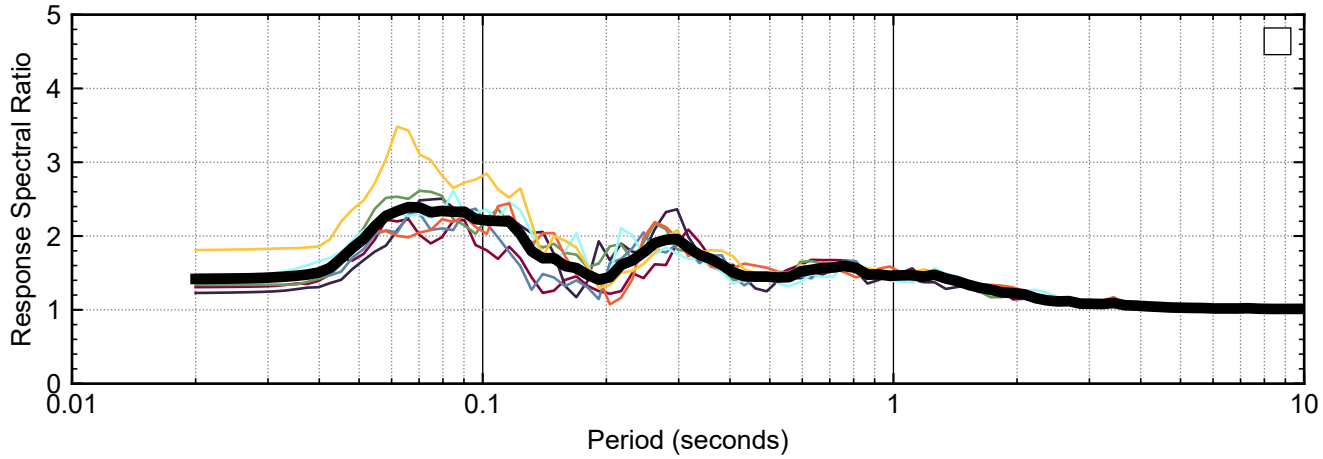

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 8 TIED-ARCH EFFECTIVE STRESS ANALYSIS DETERMINISTIC CSZ RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-132

C:\ FLACPROCESS\Burnside

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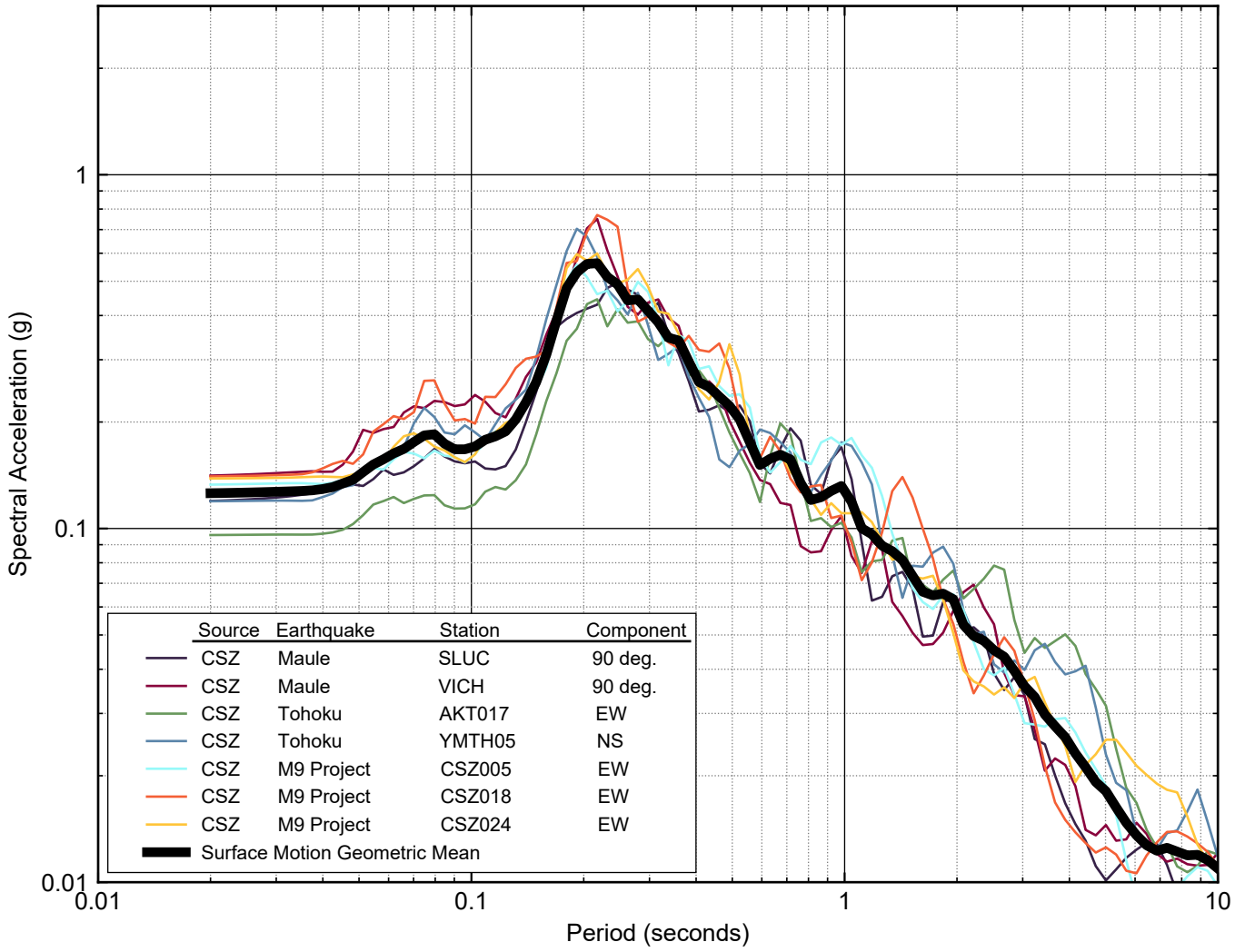

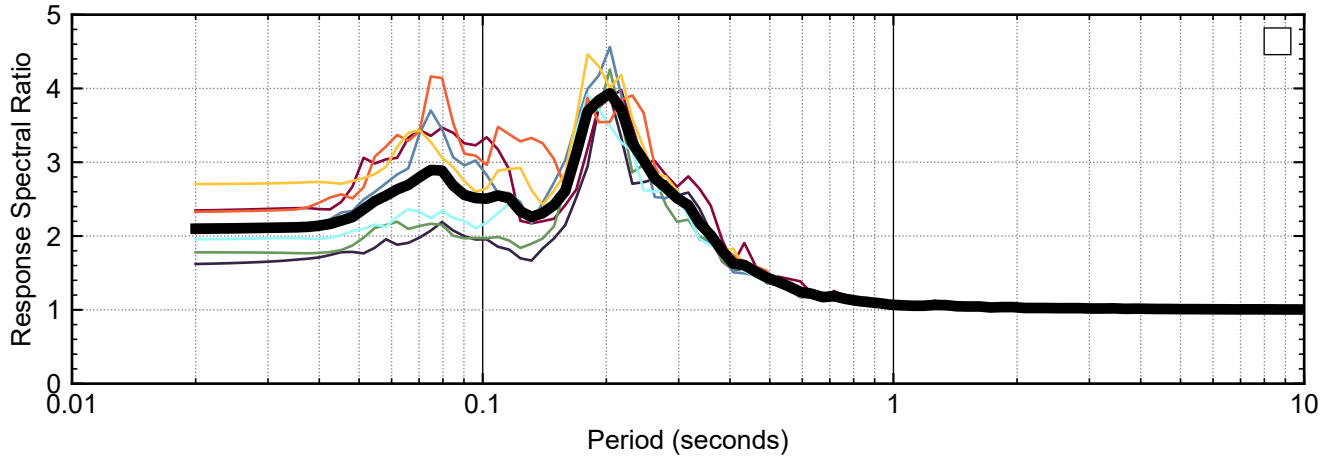

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 9
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-133

C:_FLACPROCESS\Burnside

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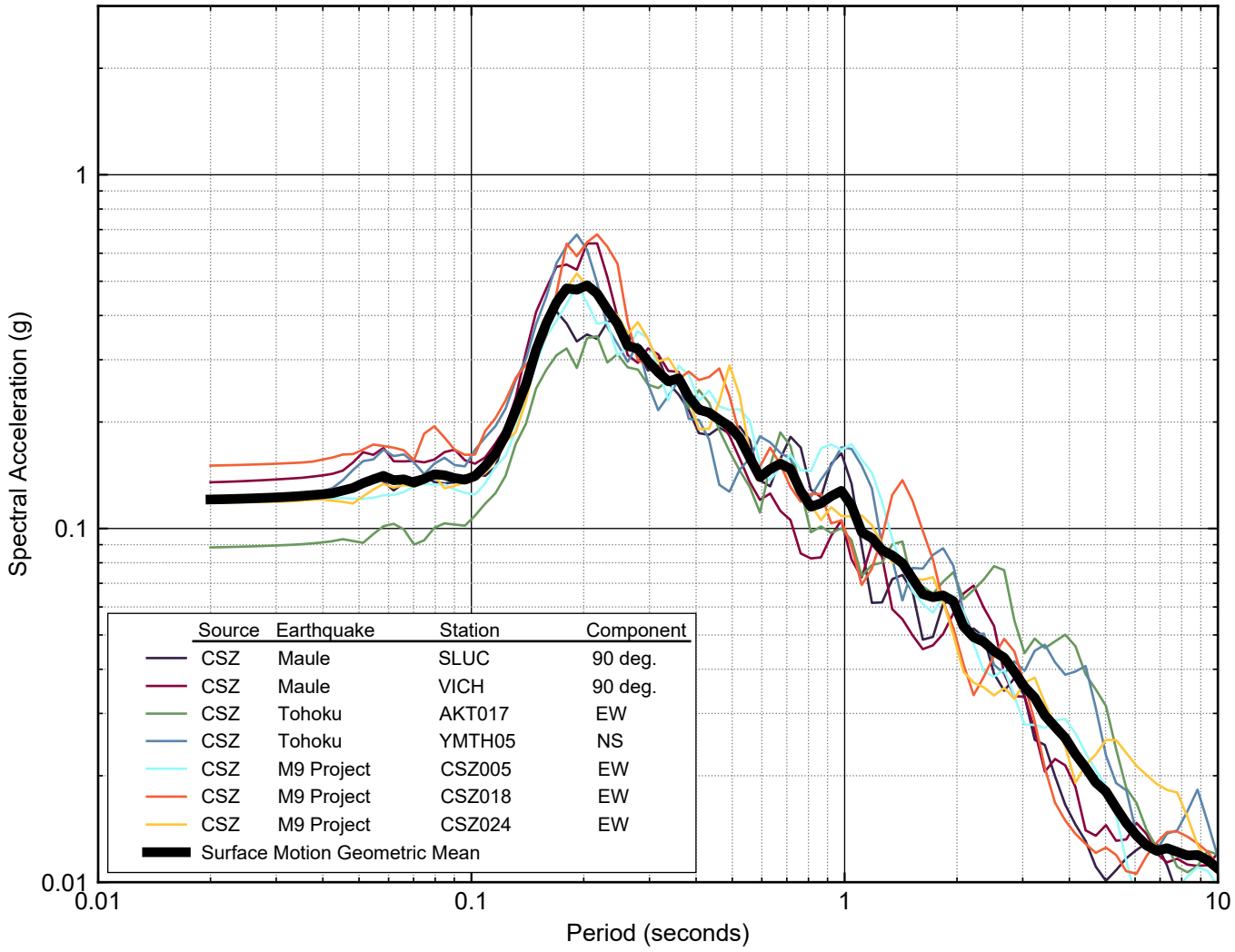

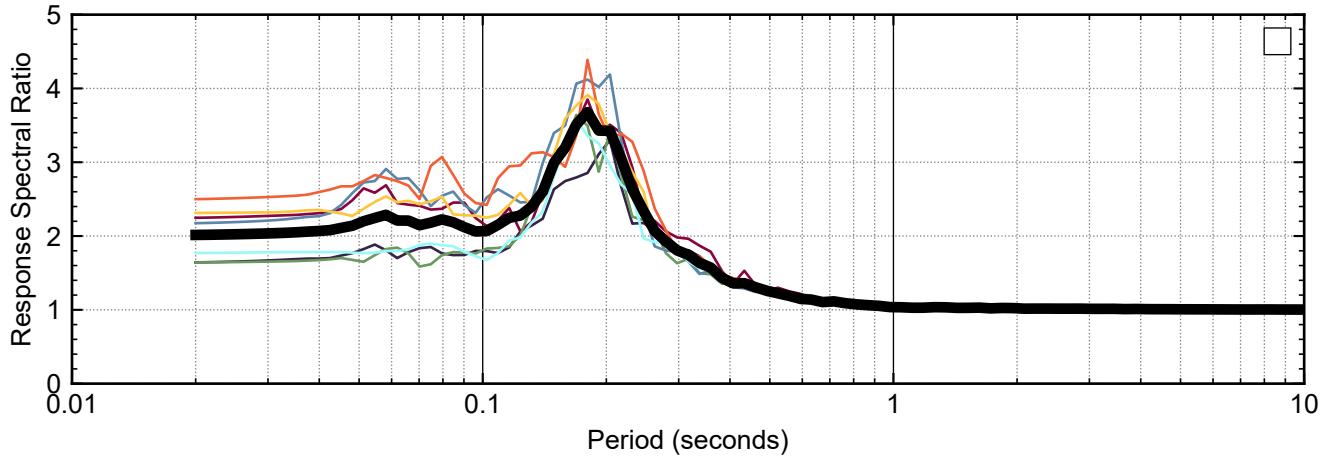

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 10
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-134

C:\ FLACPROCESS\Burnside

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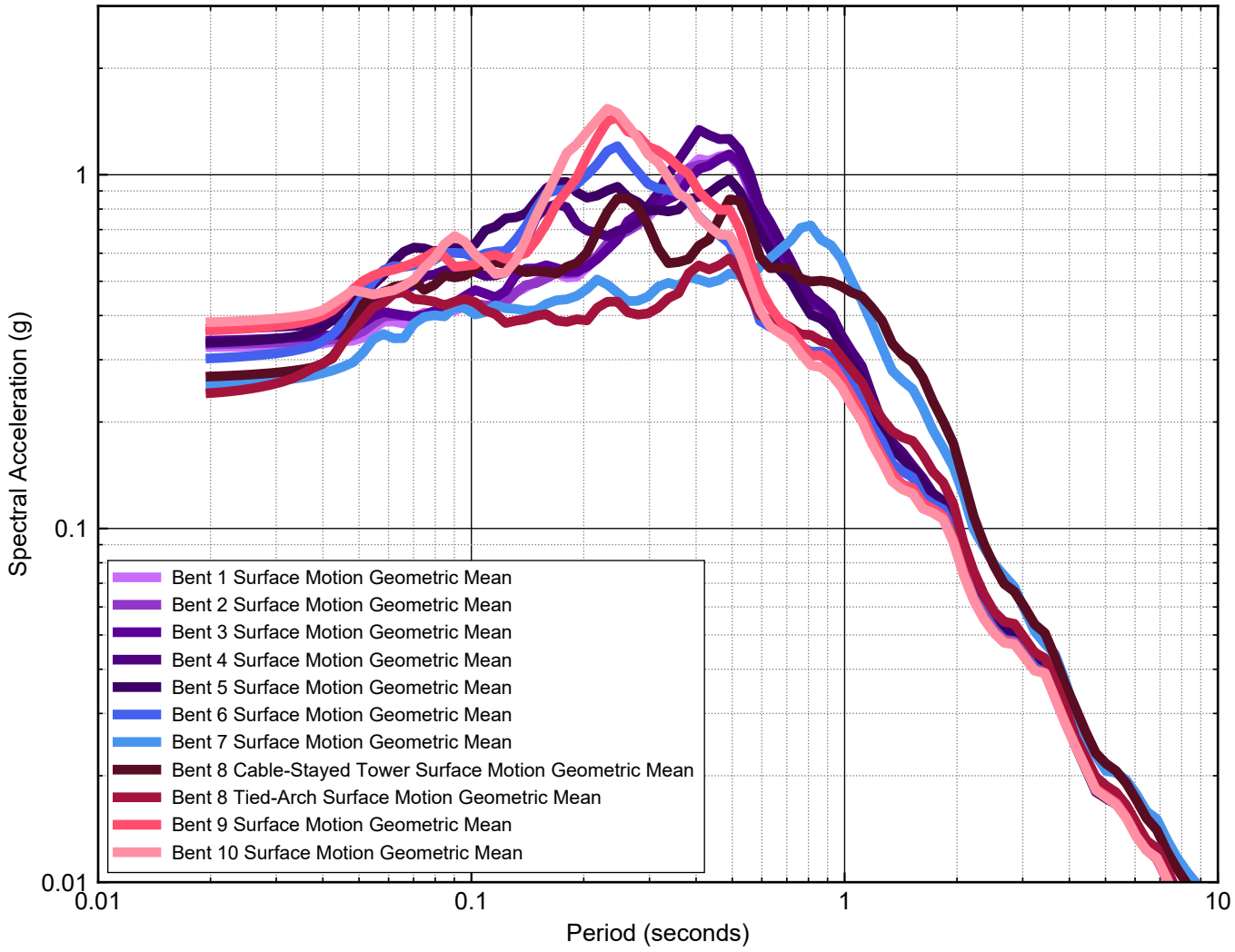

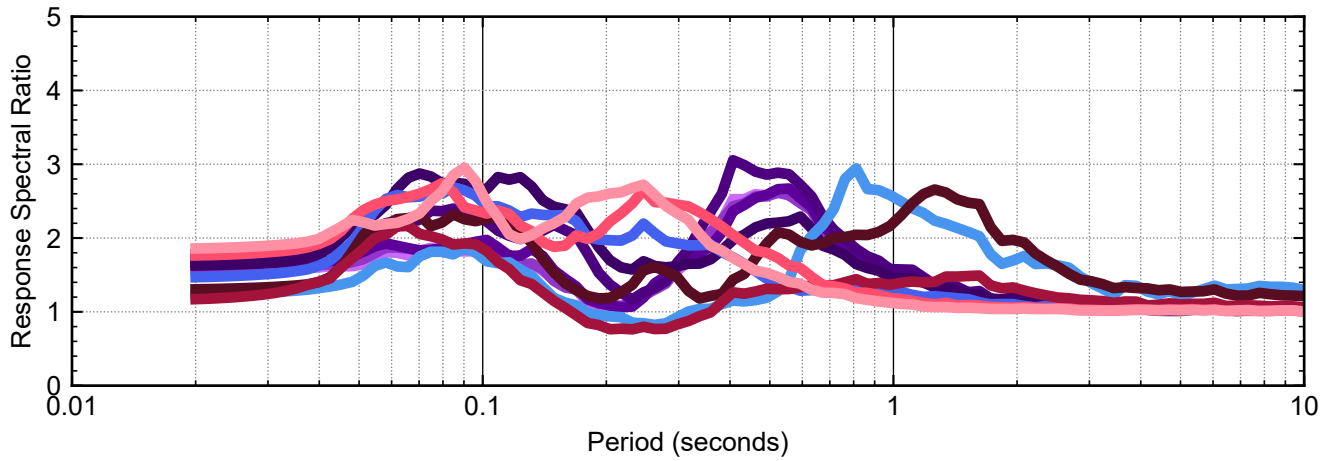

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

ALL PIERS
TOTAL STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-135

C:\ FLACPROCESS\Burnside

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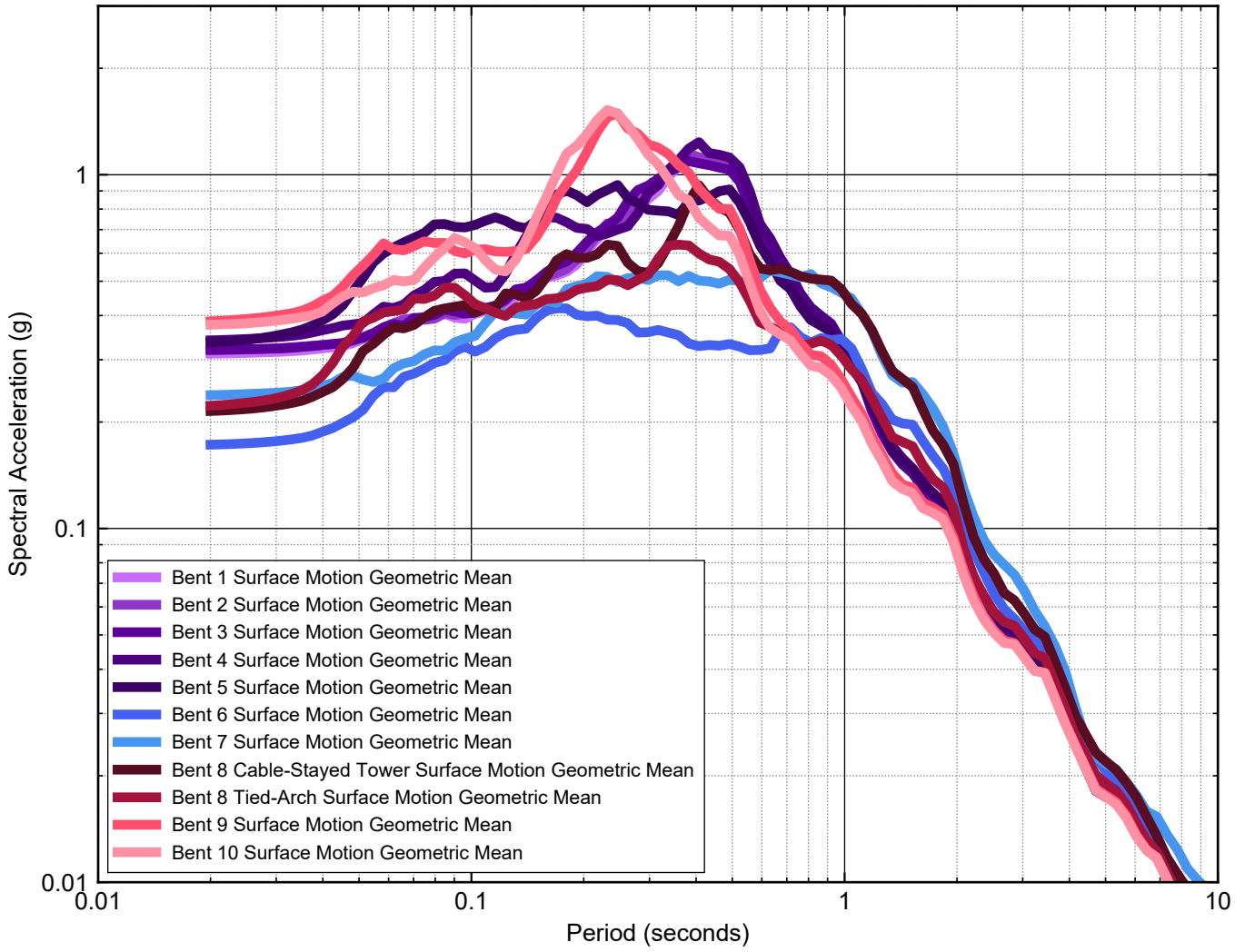

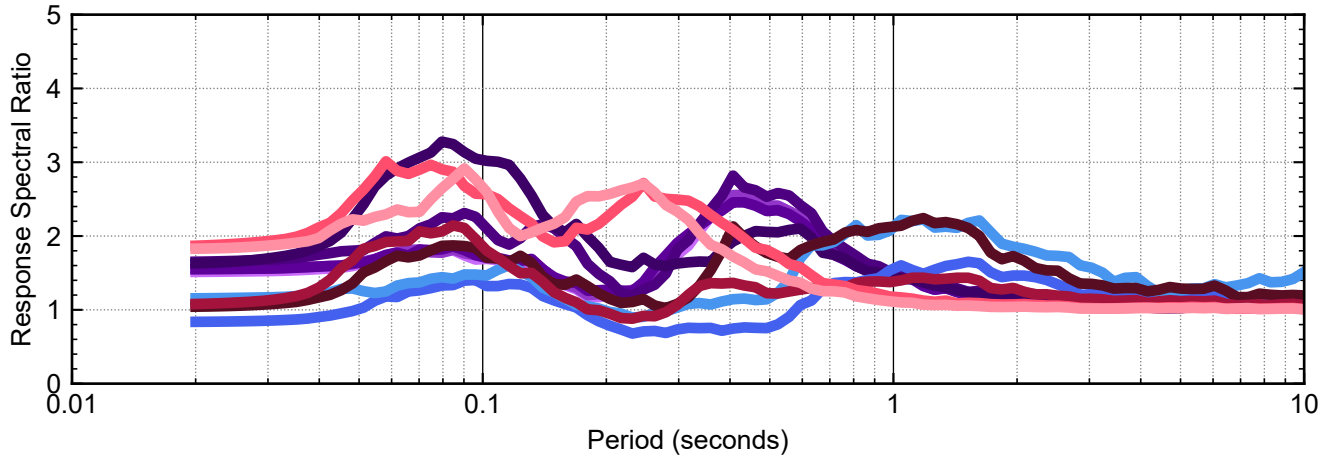

Notes:

1. CSZ = Cascadia Subduction Zone interface event; CRUSTAL = crustal event; g = acceleration of gravity; SLAB = Cascadia Subduction Zone intraslab event.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. Based on the seismic hazard deaggregation, the total, all motion average, was evaluated by fully weighting the three CSZ and CRUSTAL input motions and using a weighting factor of one-third for each of the three SLAB input motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

ALL PIERS
EFFECTIVE STRESS ANALYSIS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-136

C:\ FLACPROCESS\Burnside

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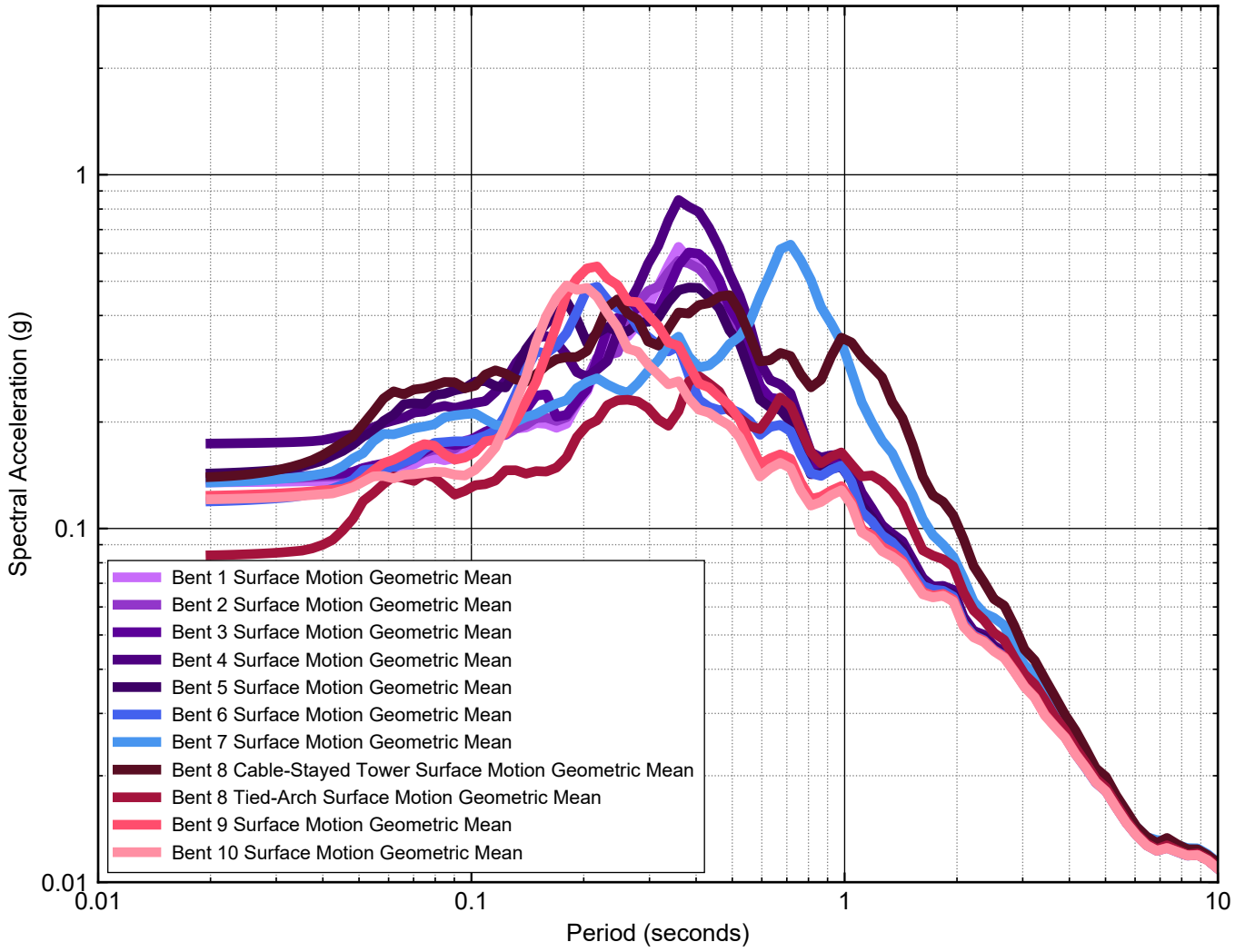

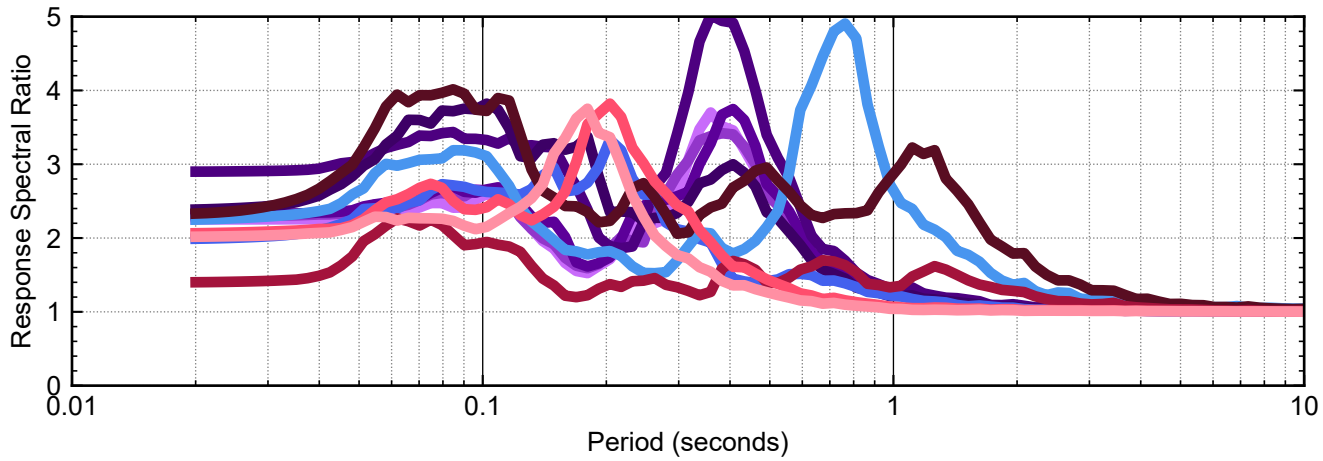

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

ALL PIERS
TOTAL STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-137

C:\ FLACPROCESS\Burnside

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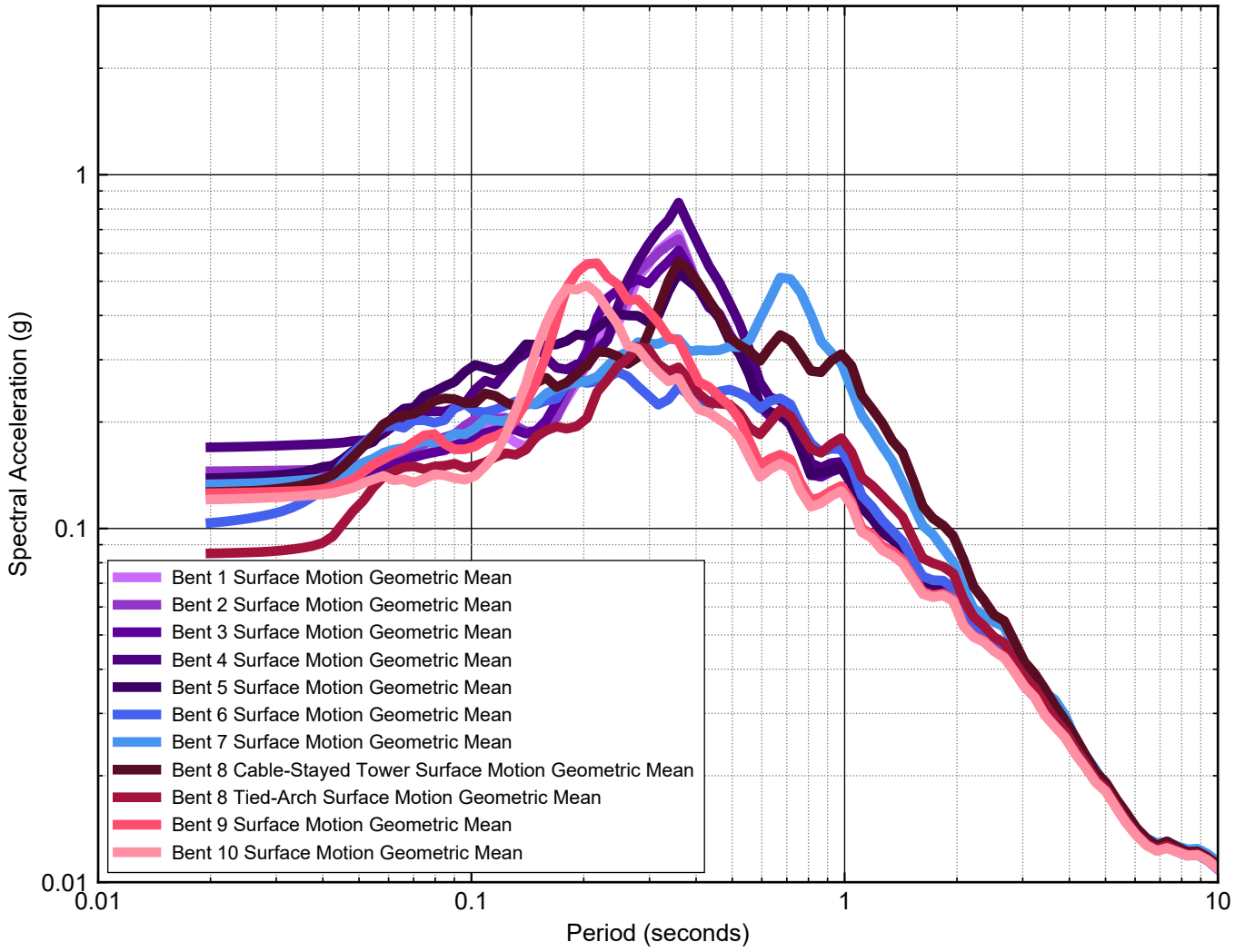

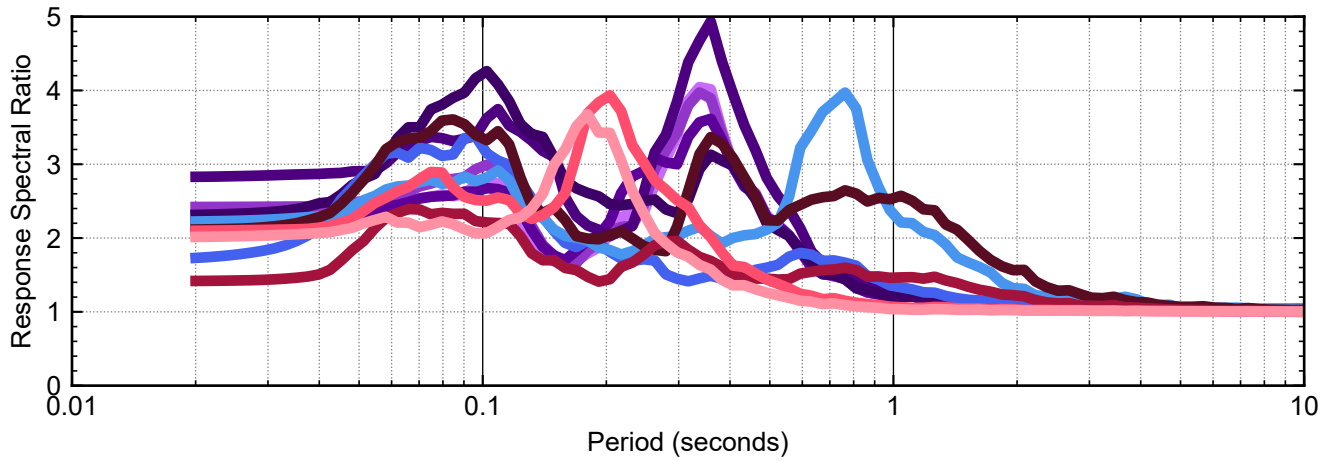

Notes:
1. CSZ = Cascadia Subduction Zone interface event; g = acceleration of gravity.
2. Site response analyses were performed using FLAC v.8 (Itasca, 2018).
3. The response spectral ratio is defined as the ratio of the surface response spectra to the response spectra of the base input motion.
4. The total, all motion average, was evaluated as the arithmetic average of all seven input ground motions.

Earthquake Ready Burnside Bridge
Portland, Oregon

ALL PIERS
EFFECTIVE STRESS ANALYSIS
DETERMINISTIC CSZ
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-138

C:\ FLACPROCESS\Burnside

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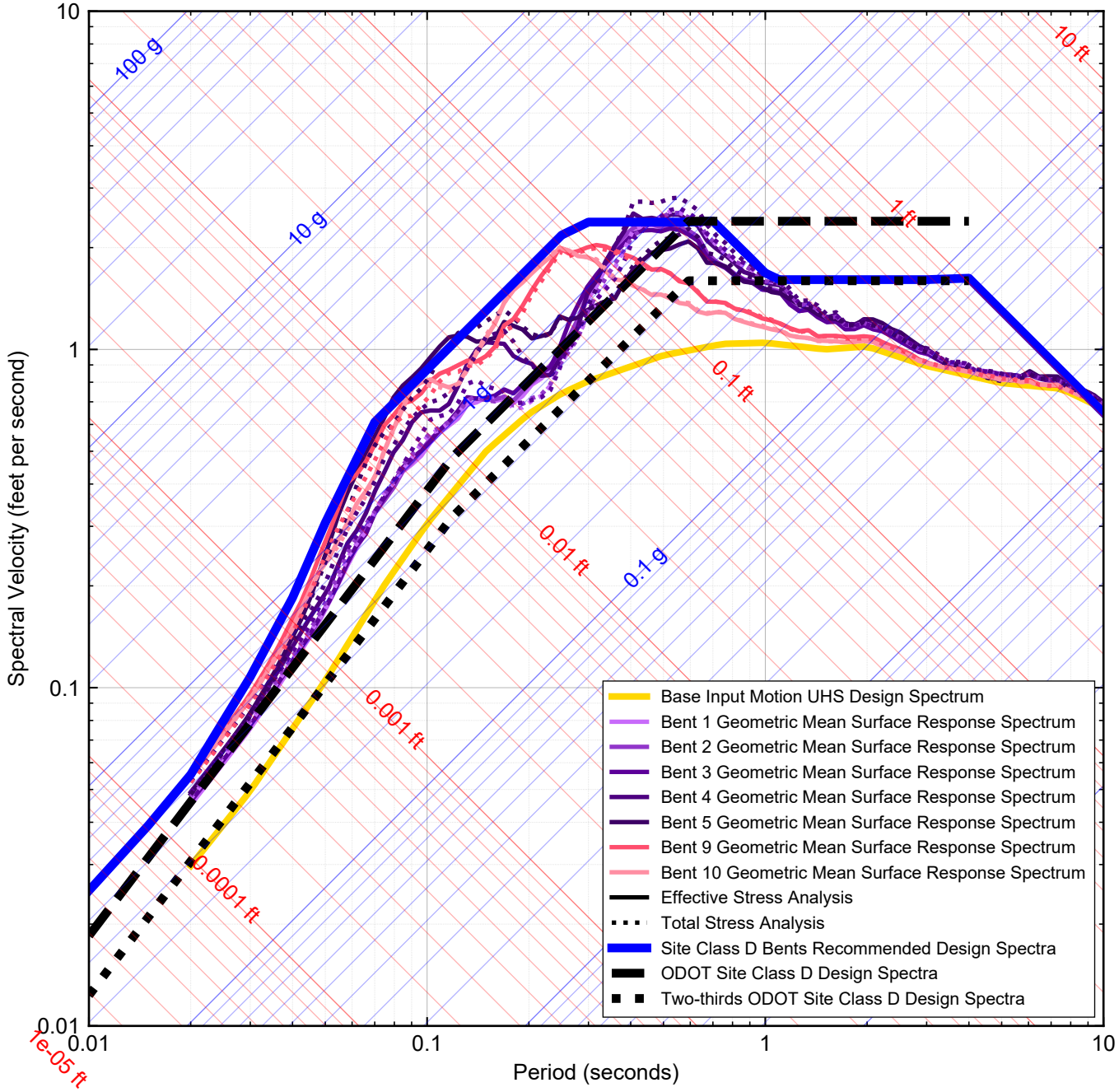

Notes:
1. Per AASHTO and the GDM, the surface response spectrum at each bent location was evaluated for both total and effective stress site response analysis as the average response spectral ratio multiplied by the base input motion design spectrum.
2. The specification-based spectrum were evaluated per the ODOT GDM.

Earthquake Ready Burnside Bridge
Portland, Oregon

SITE CLASS D BENTS 1,000-YEAR PROBABILISTIC RESPONSE SPECTRA SUMMARY

April 2022 102636-009

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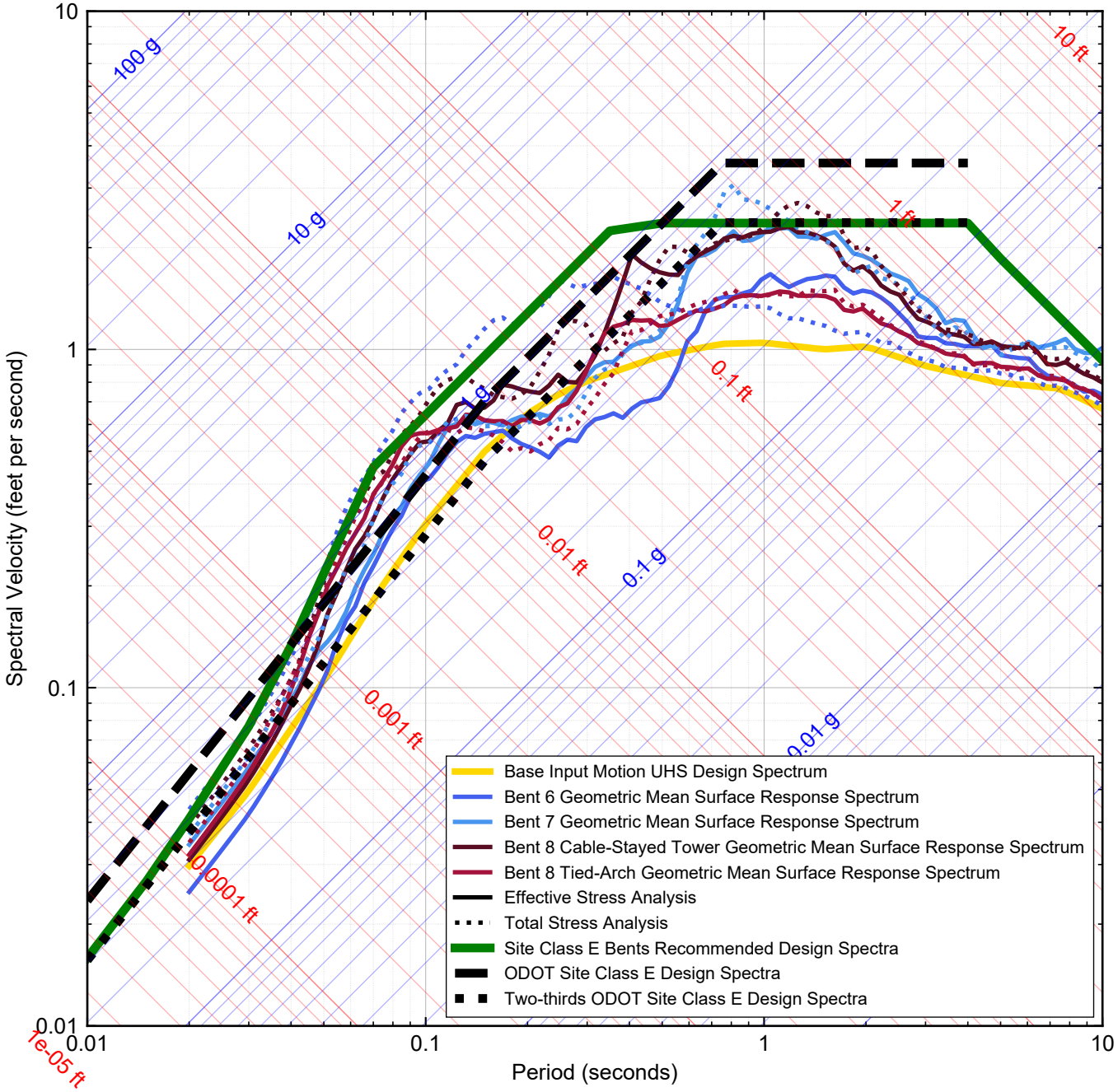
FIG. H-139

C:_FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d. by:SSS



Notes:
1. Per AASHTO and the GDM, the surface response spectrum at each bent location was evaluated for both total and effective stress site response analysis as the average response spectral ratio multiplied by the base input motion design spectrum.
2. The specification-based spectrum were evaluated per the ODOT GDM.

Earthquake Ready Burnside Bridge
Portland, Oregon

SITE CLASS E BENTS
1,000-YEAR PROBABILISTIC
RESPONSE SPECTRA SUMMARY

April 2022 102636-009

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FIG. H-140

C:\ FLACPROCESS\Burnside

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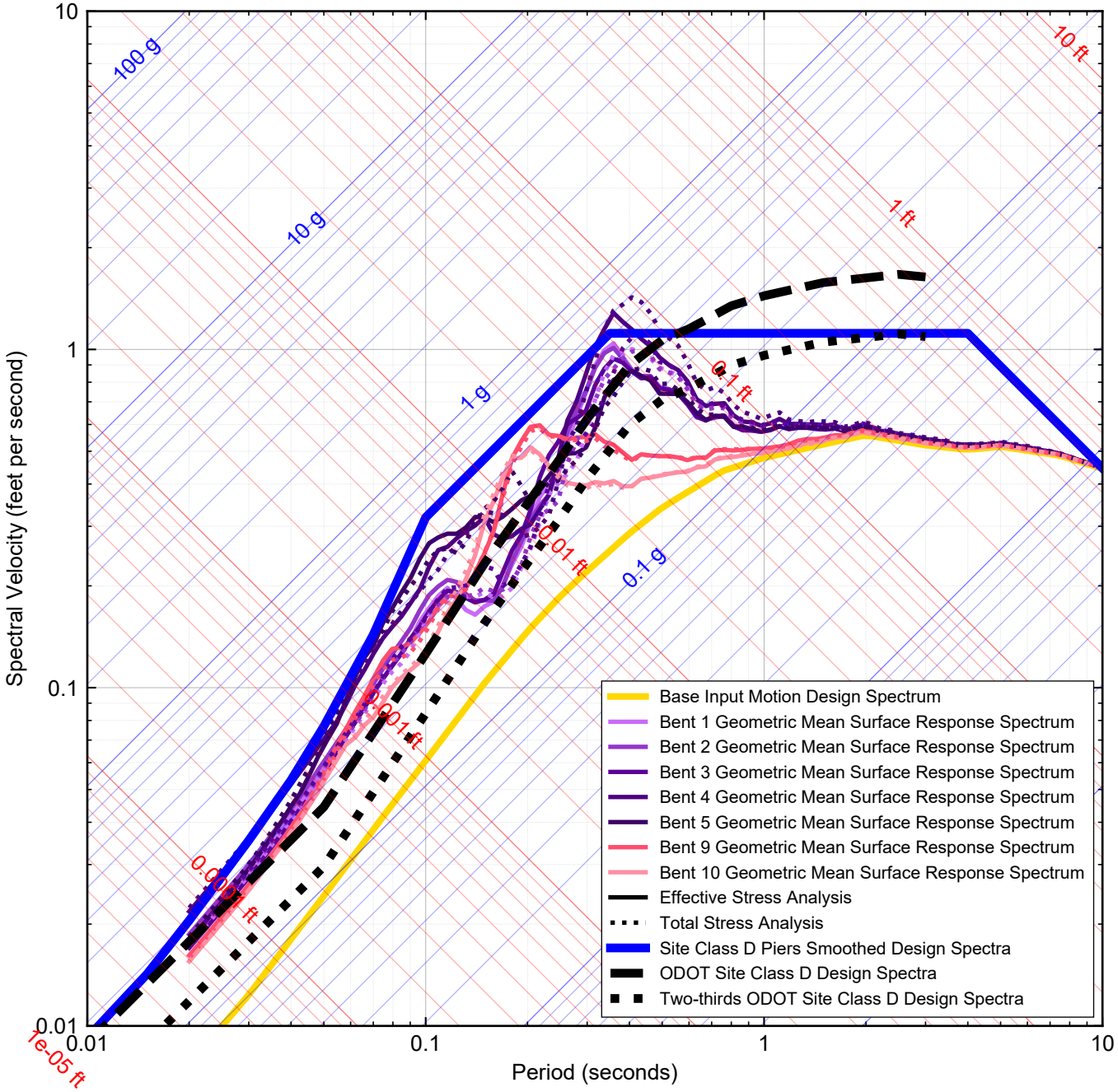

Notes:
1. Per AASHTO and the GDM, the surface response spectrum at each bent location was evaluated for both total and effective stress site response analysis as the average response spectral ratio multiplied by the base input motion design spectrum.
2. The specification-based spectrum were evaluated per the ODOT GDM.

Earthquake Ready Burnside Bridge
Portland, Oregon

SITE CLASS D BENTS DETERMINISTIC CSZ RESPONSE SPECTRA SUMMARY

April 2022 102636-009

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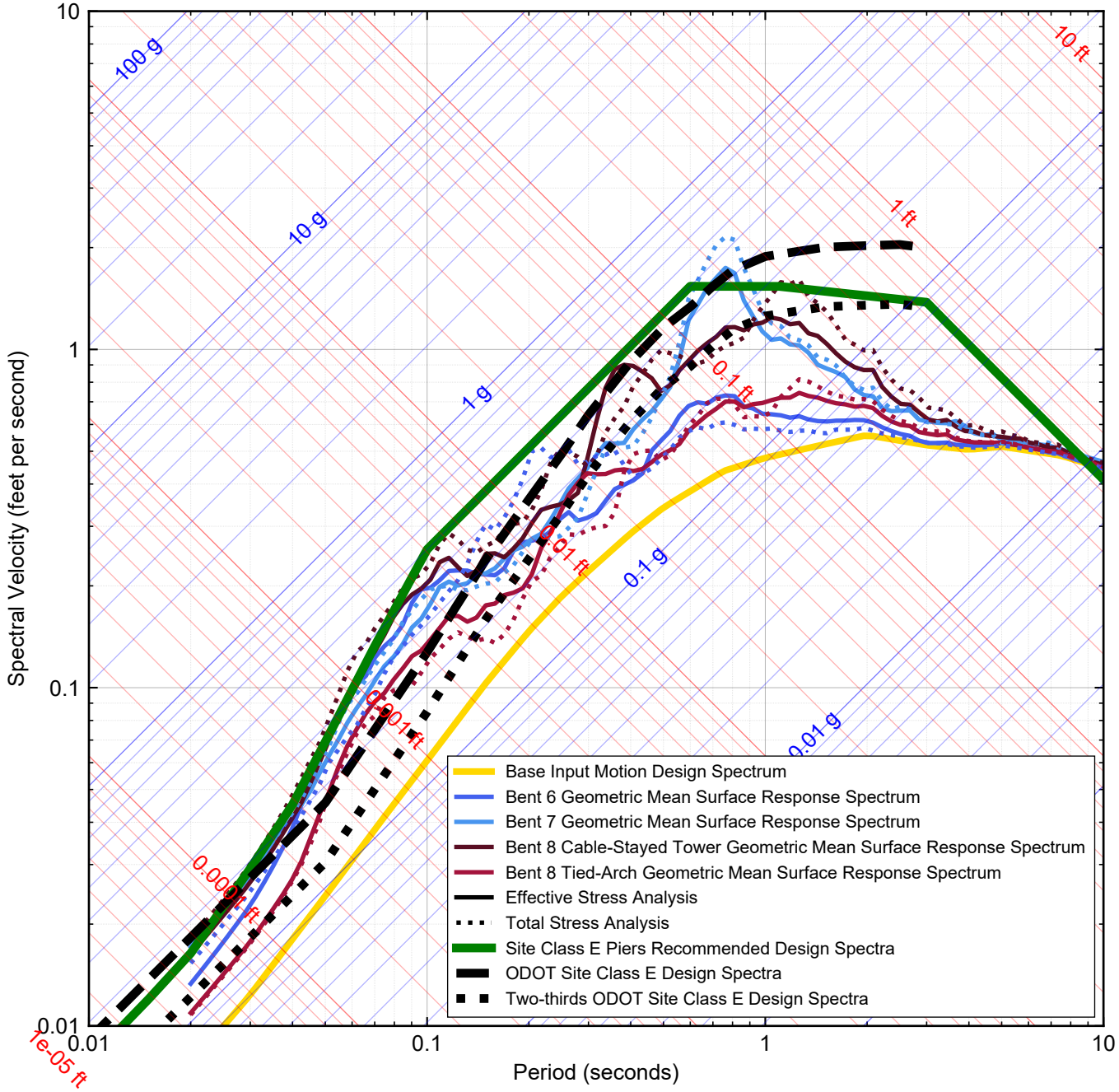
FIG. H-141

C:_FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d. by:SSS



Notes:
1. Per AASHTO and the GDM, the surface response spectrum at each bent location was evaluated for both total and effective stress site response analysis as the average response spectral ratio multiplied by the base input motion design spectrum.
2. The specification-based spectrum were evaluated per the ODOT GDM.

Earthquake Ready Burnside Bridge
Portland, Oregon

SITE CLASS E BENTS DETERMINISTIC CSZ RESPONSE SPECTRA SUMMARY

April 2022 102636-009

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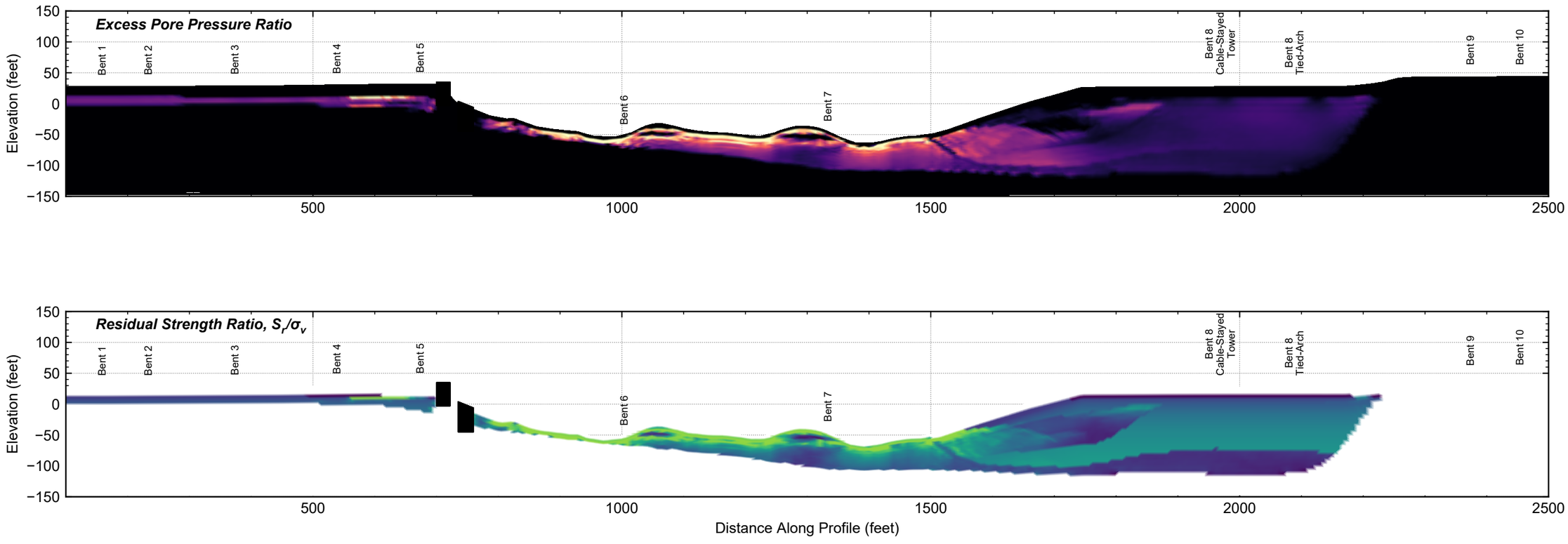
FIG. H-142

C:\ FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Earthquake Ready Burnside Bridge
Portland, Oregon

FLAC MODEL INPUTS
POST-SEISMIC STRENGTH
1,000-YEAR PROBABILISTIC
NORTHRIDGE - BURBANK

April 2022 102636-009

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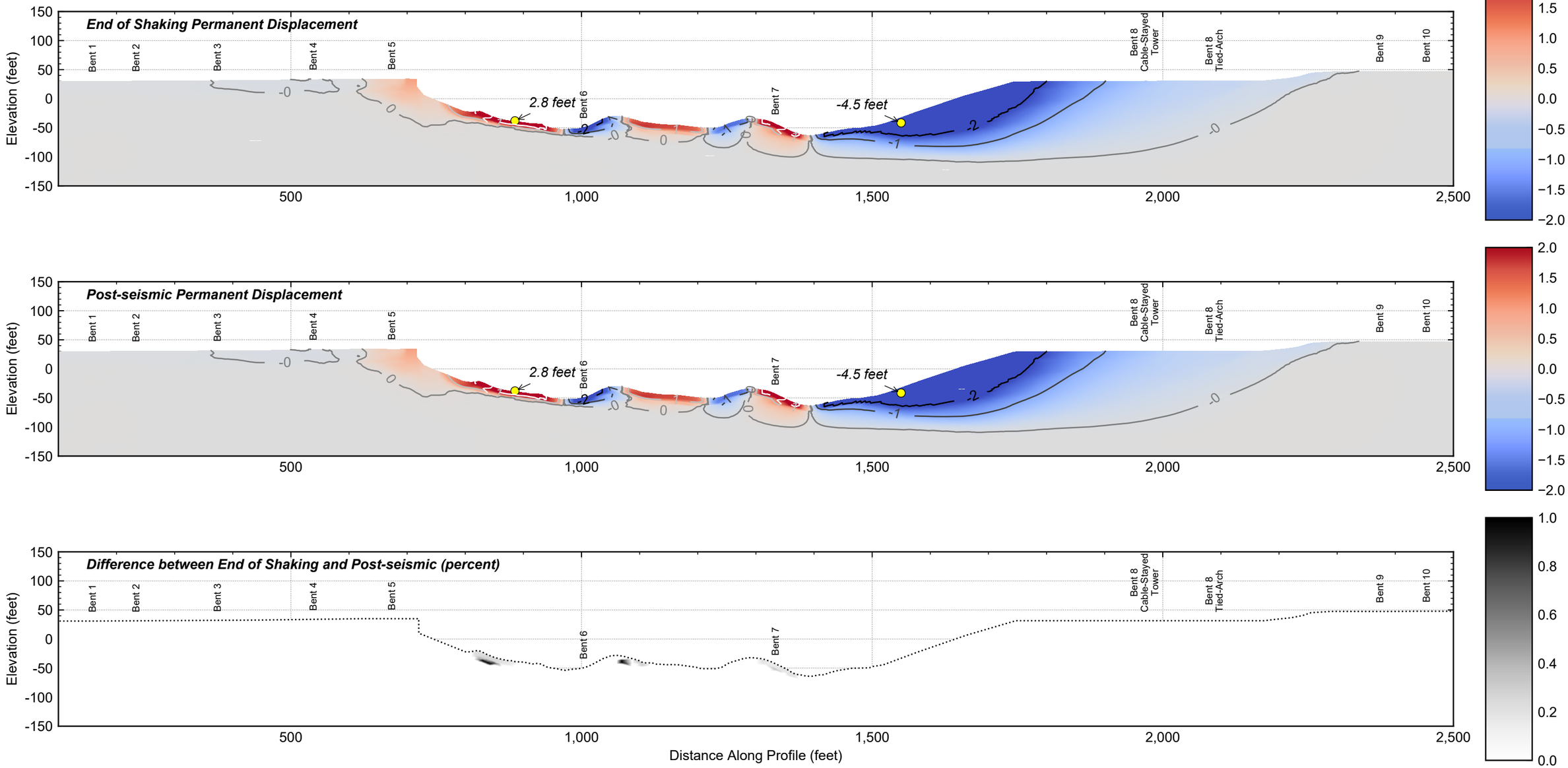
FIG. H-143

C:\...FLAC\PROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Earthquake Ready Burnside Bridge
Portland, Oregon

END OF SHAKING AND POST-SEISMIC DISPLACEMENTS 1,000-YEAR PROBABILISTIC NORTHRIDGE - BURBANK

April 2022 102636-009

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FIG. 144

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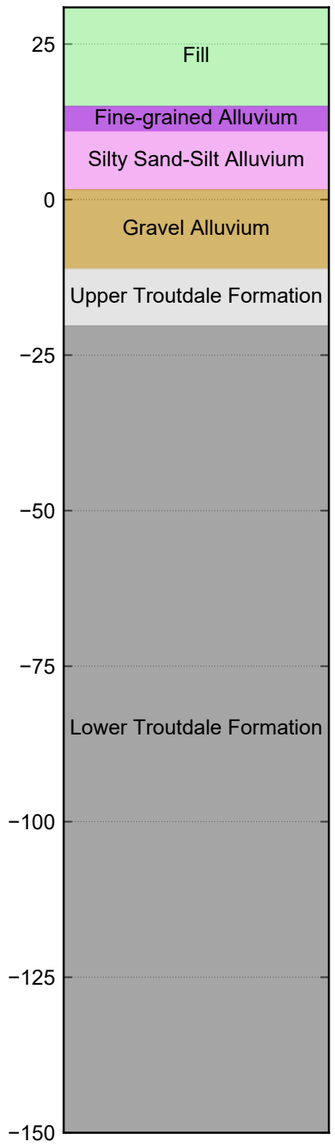
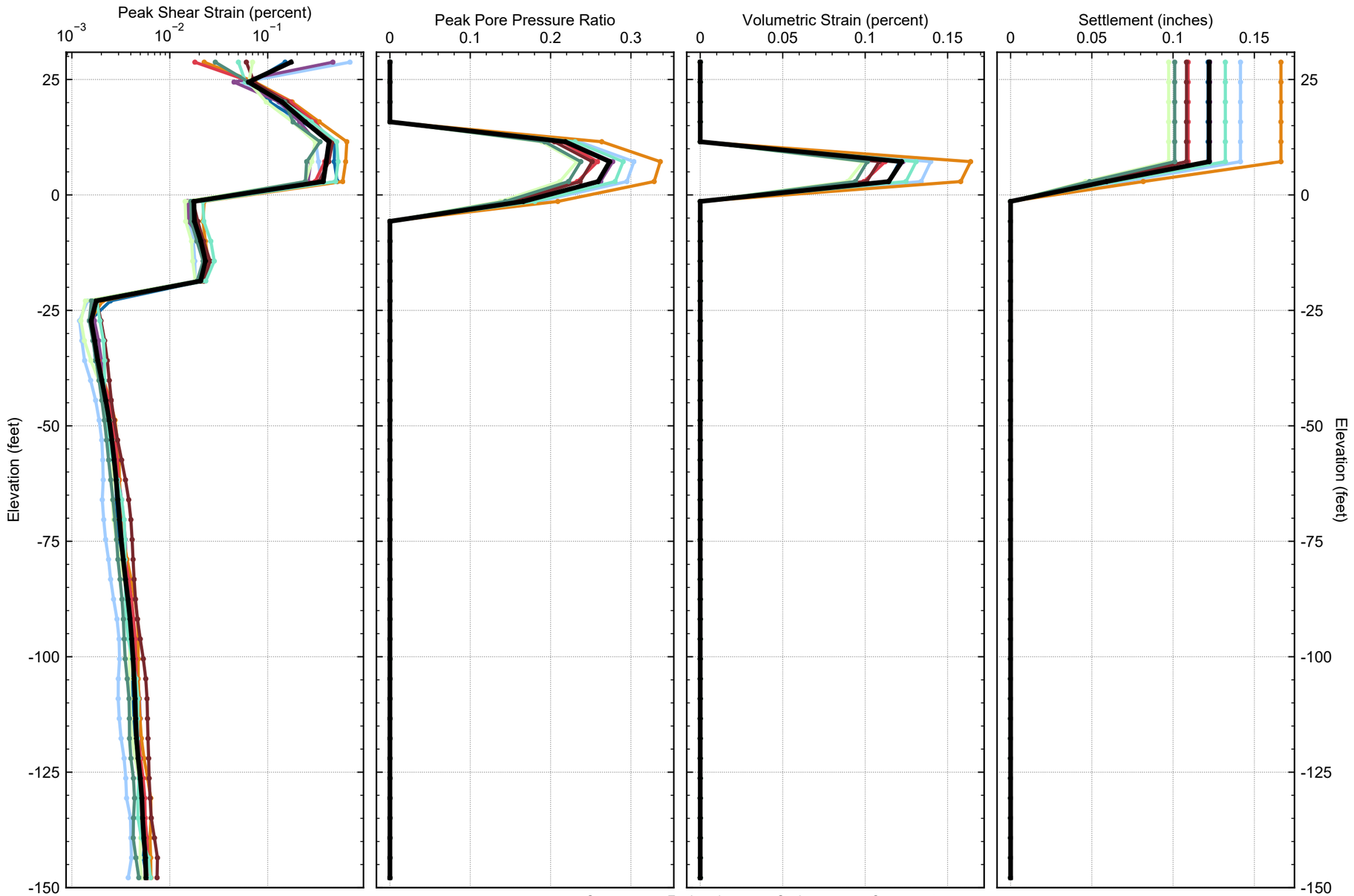
ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 1
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 1
EFFECTIVE STRESS ANALYSES
1,000-YEAR PROBABILISTIC SEISMIC SETTLEMENT

April 2022 102636-009

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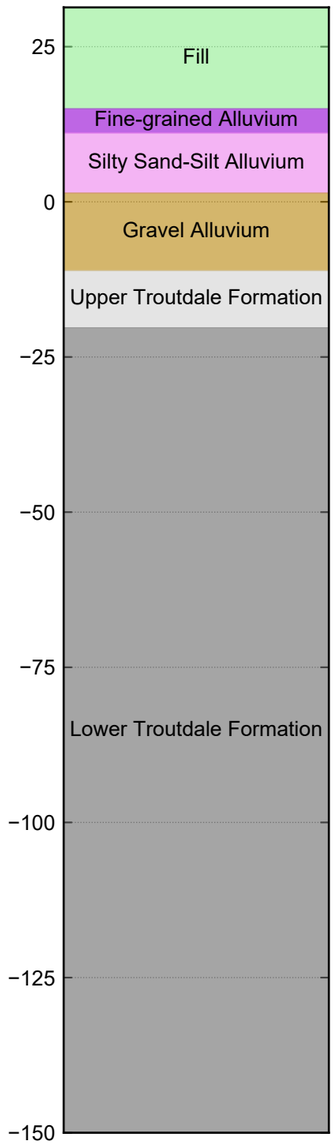
Geotechnical and Environmental Consultants

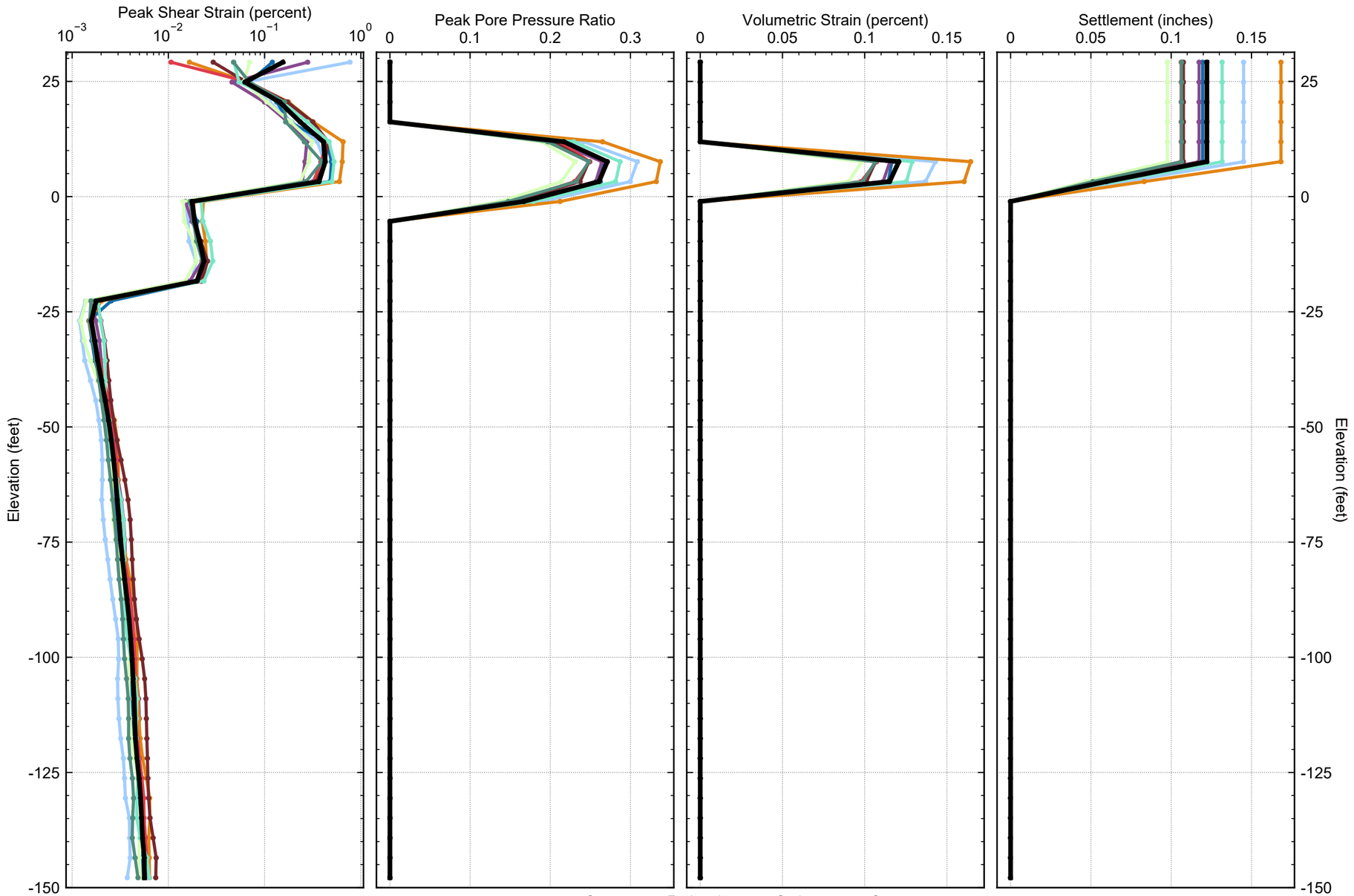
FIG. H-145

C:_FLAC\PROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 2
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 2
EFFECTIVE STRESS ANALYSES
1,000-YEAR PROBABILISTIC SEISMIC SETTLEMENT

April 2022 102636-009

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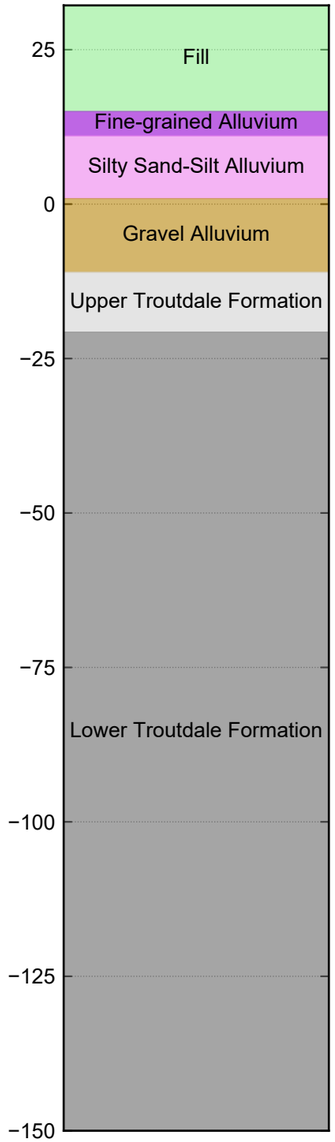
Geotechnical and Environmental Consultants

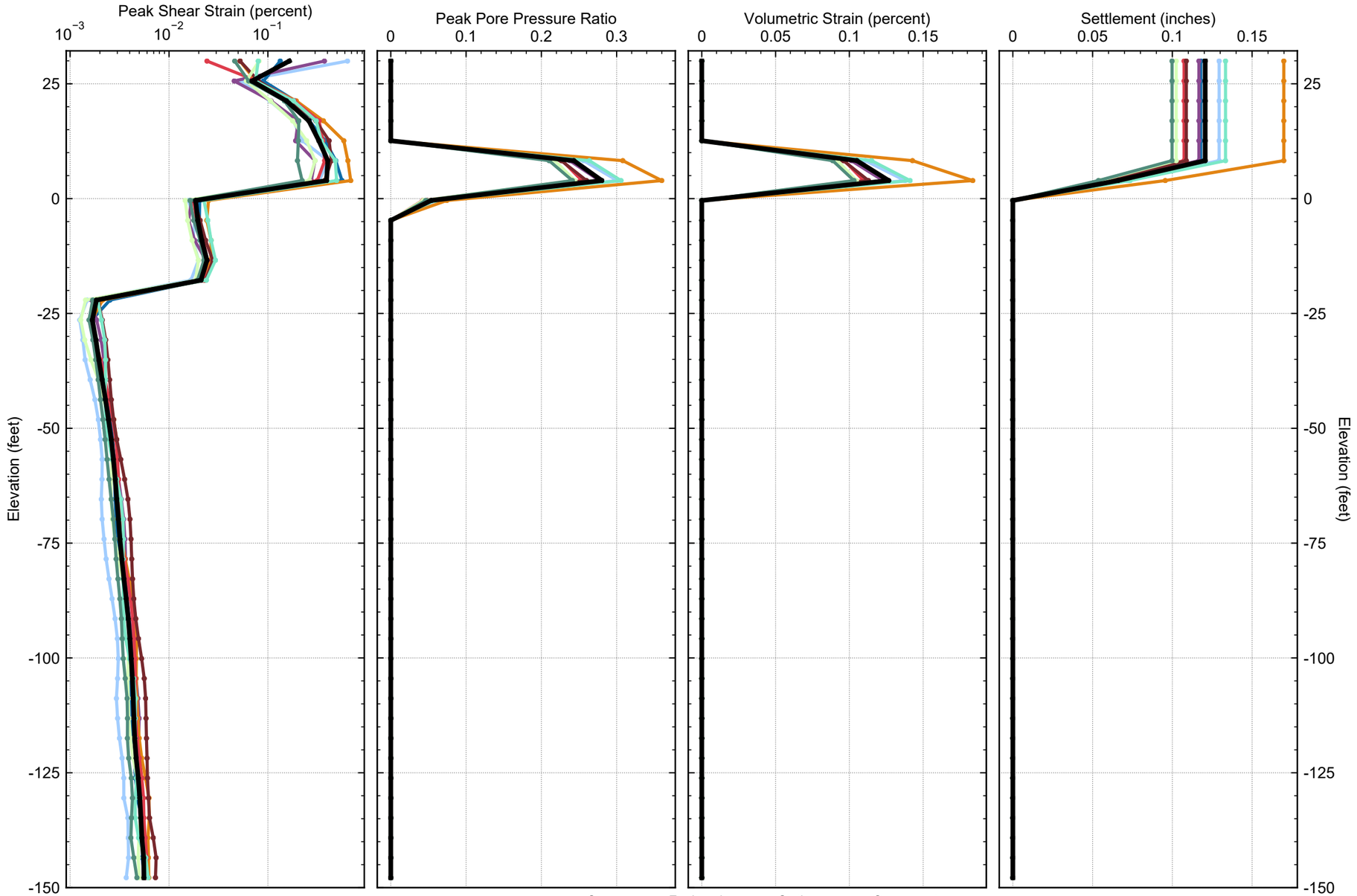
FIG. H-146

C:\...FLAGPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 3
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 3
EFFECTIVE STRESS ANALYSES
1,000-YEAR PROBABILISTIC SEISMIC SETTLEMENT

April 2022 102636-009

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Geotechnical and Environmental Consultants

FIG. H-147

C:_FLAC\PROCESS\Burnside

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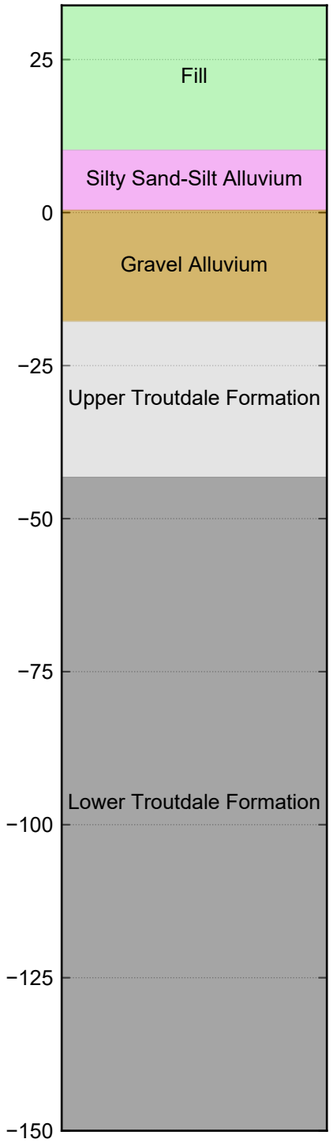
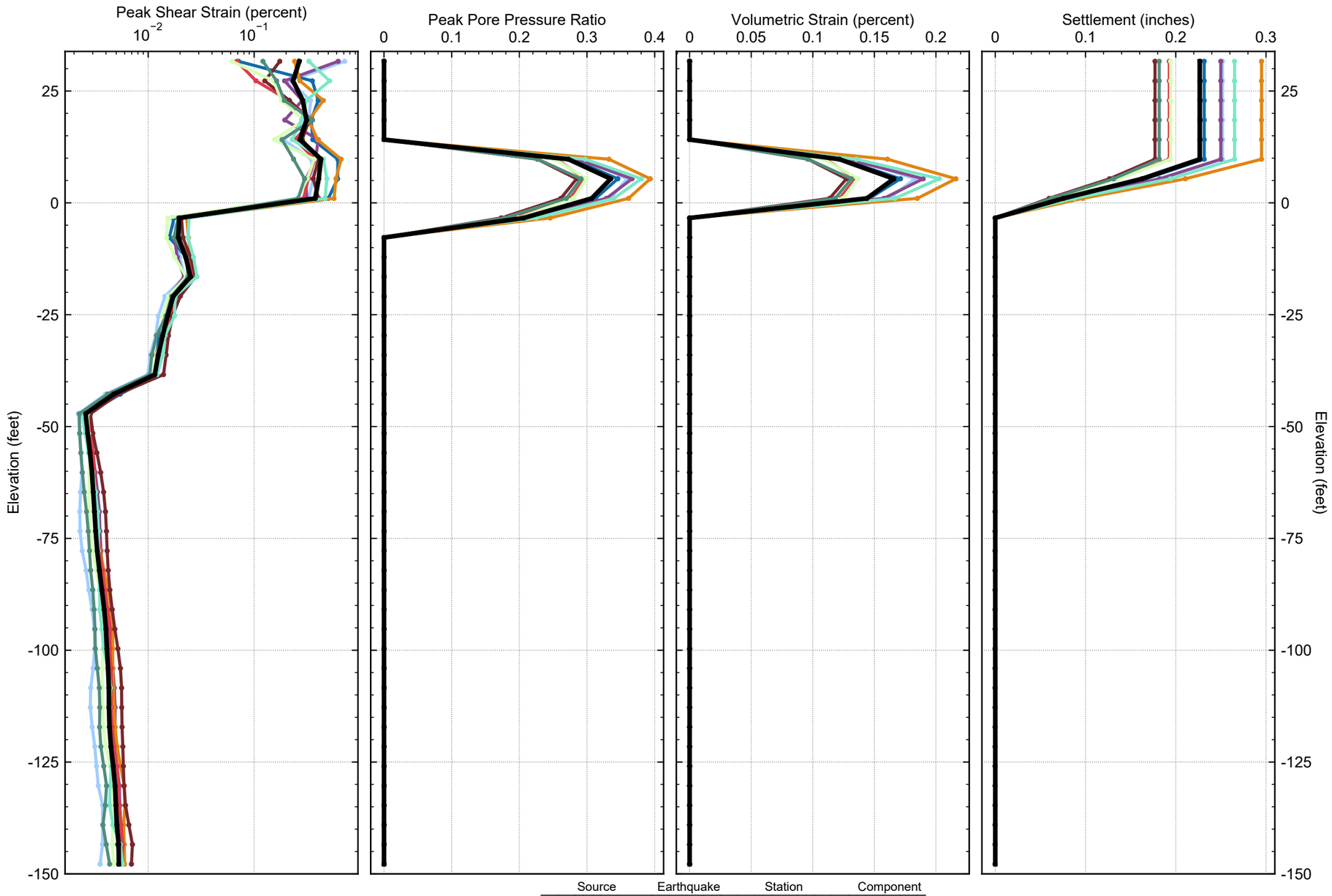
Bent 4
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 4
EFFECTIVE STRESS ANALYSES
1,000-YEAR PROBABILISTIC SEISMIC SETTLEMENT

April 2022 102636-009

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FIG. H-148

C:_FLACPROCESS\Burnside

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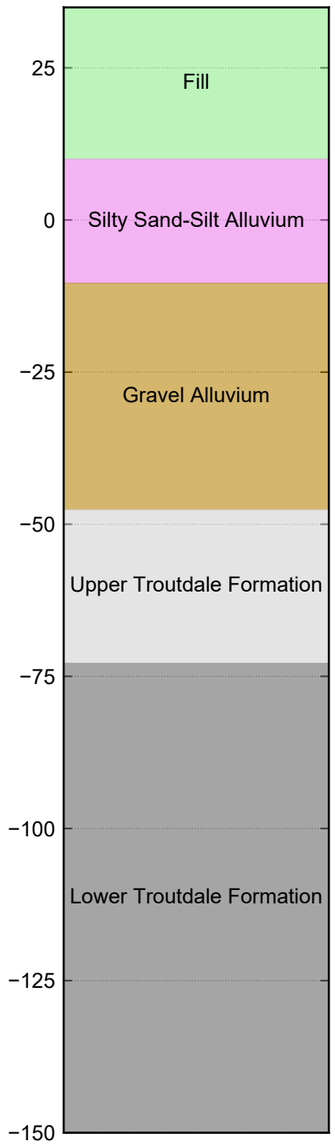
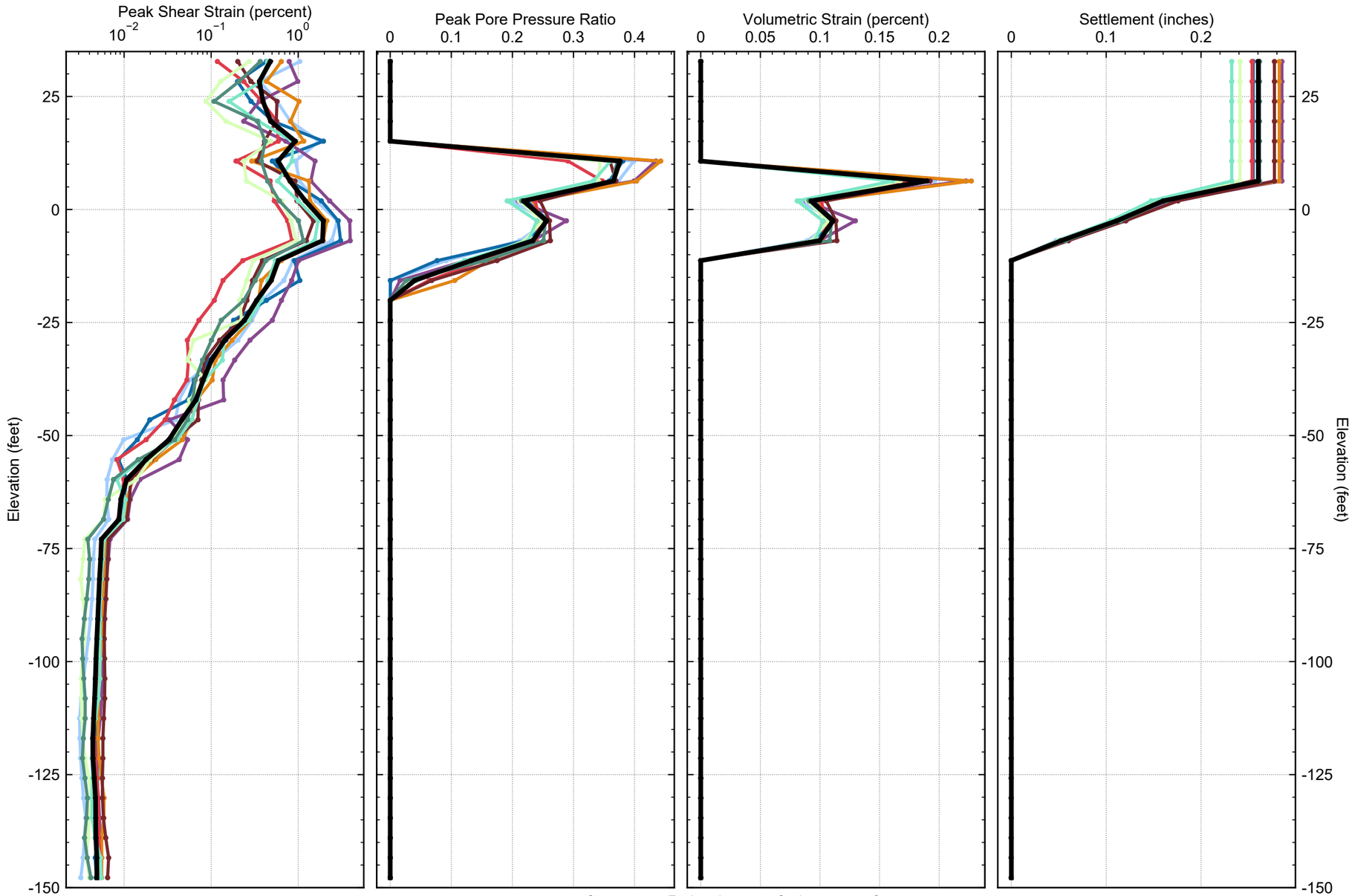
Bent 5
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

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Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 5
EFFECTIVE STRESS ANALYSES
1,000-YEAR PROBABILISTIC SEISMIC SETTLEMENT

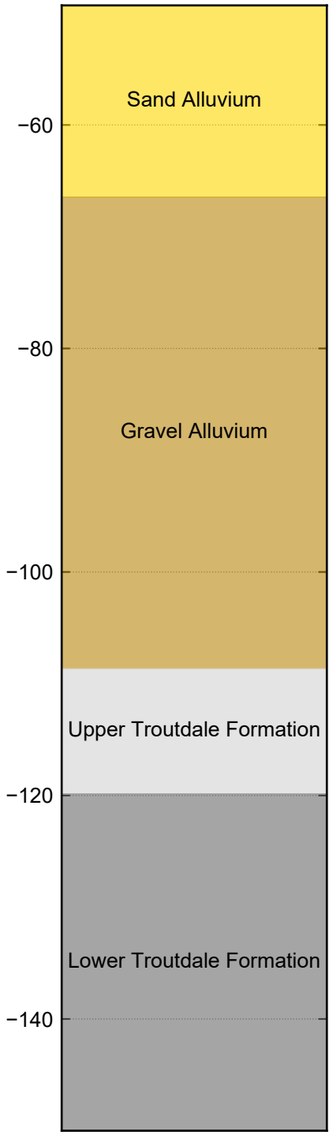
April 2022 102636-009

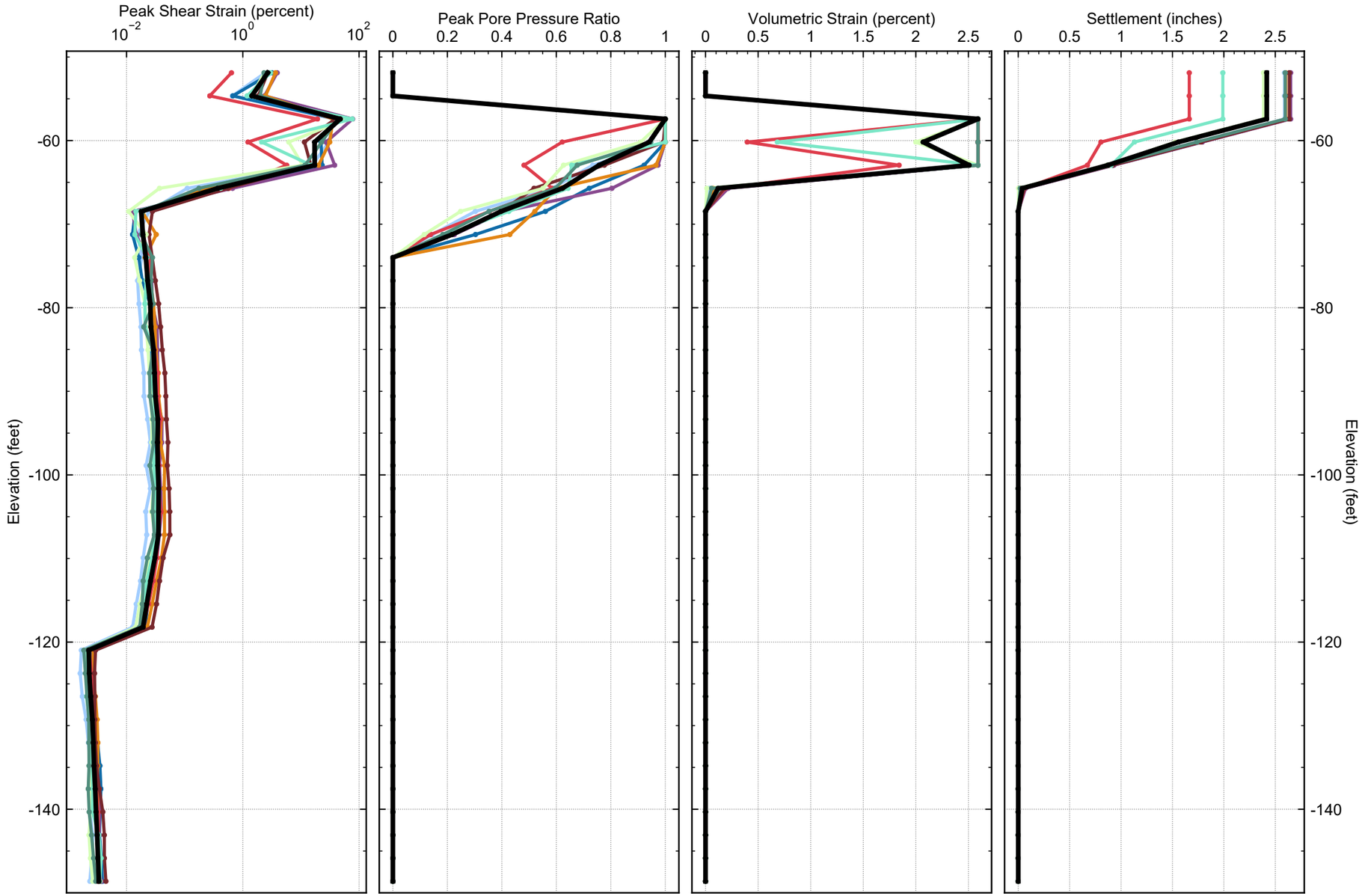
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-149

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 6
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 6
EFFECTIVE STRESS ANALYSES
1,000-YEAR PROBABILISTIC SEISMIC SETTLEMENT

April 2022 102636-009

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FIG. H-150

C:_FLAC\PROCESS\Burnside

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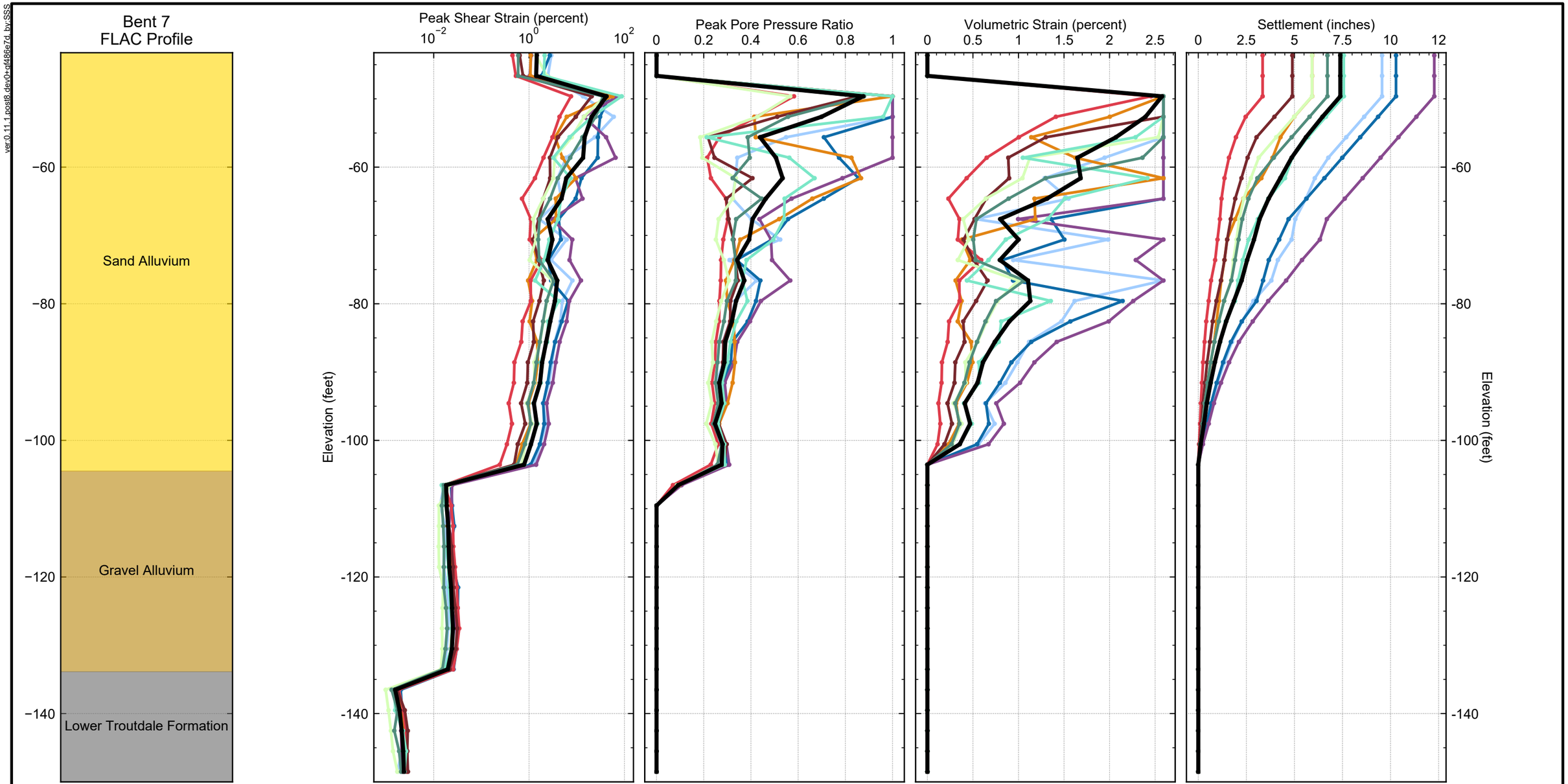

Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 7
EFFECTIVE STRESS ANALYSES
1,000-YEAR PROBABILISTIC SEISMIC SETTLEMENT

April 2022 102636-009

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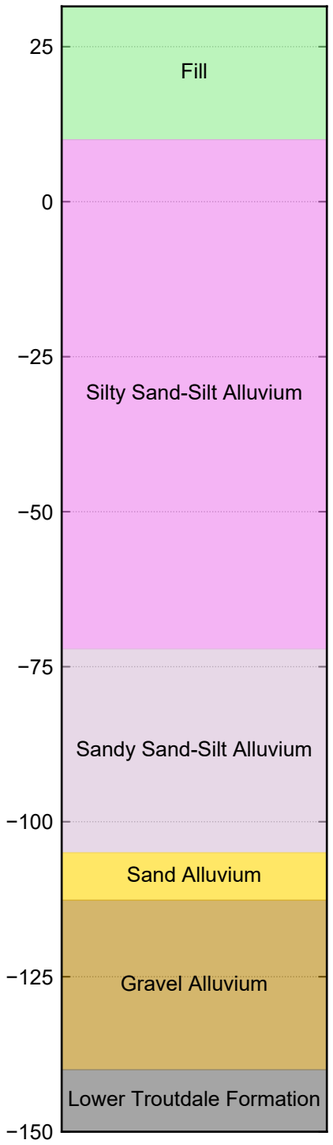
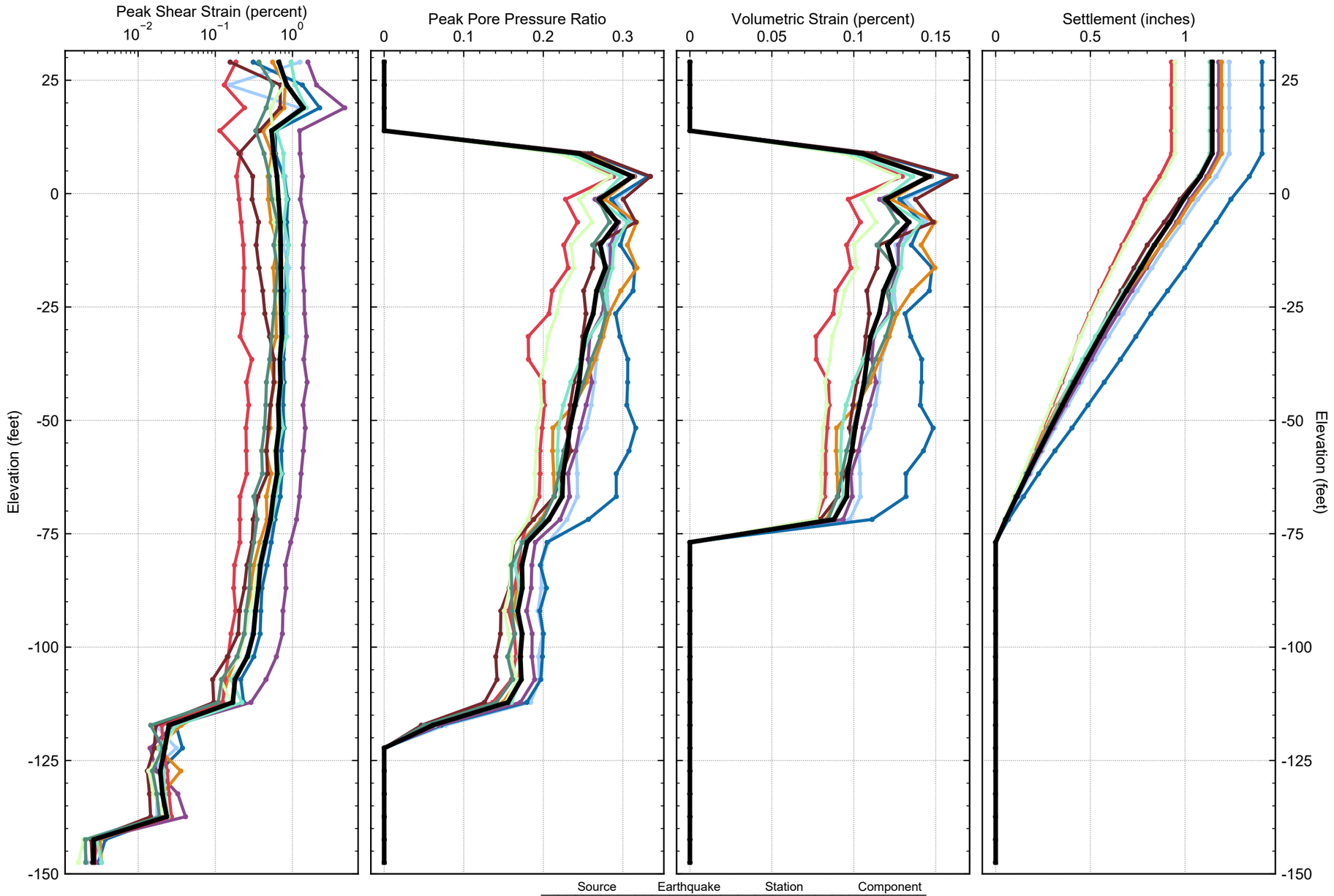
FIG. H-151

C:\...FLAC\PROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by.SSS

Bent 8 Cable-Stayed Tower FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 8 CABLE-STAYED TOWER EFFECTIVE STRESS ANALYSES 1,000-YEAR PROBABILISTIC SEISMIC SETTLEMENT

April 2022 102636-009

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FIG. H-152

C:_FLACPROCESS\Burnside

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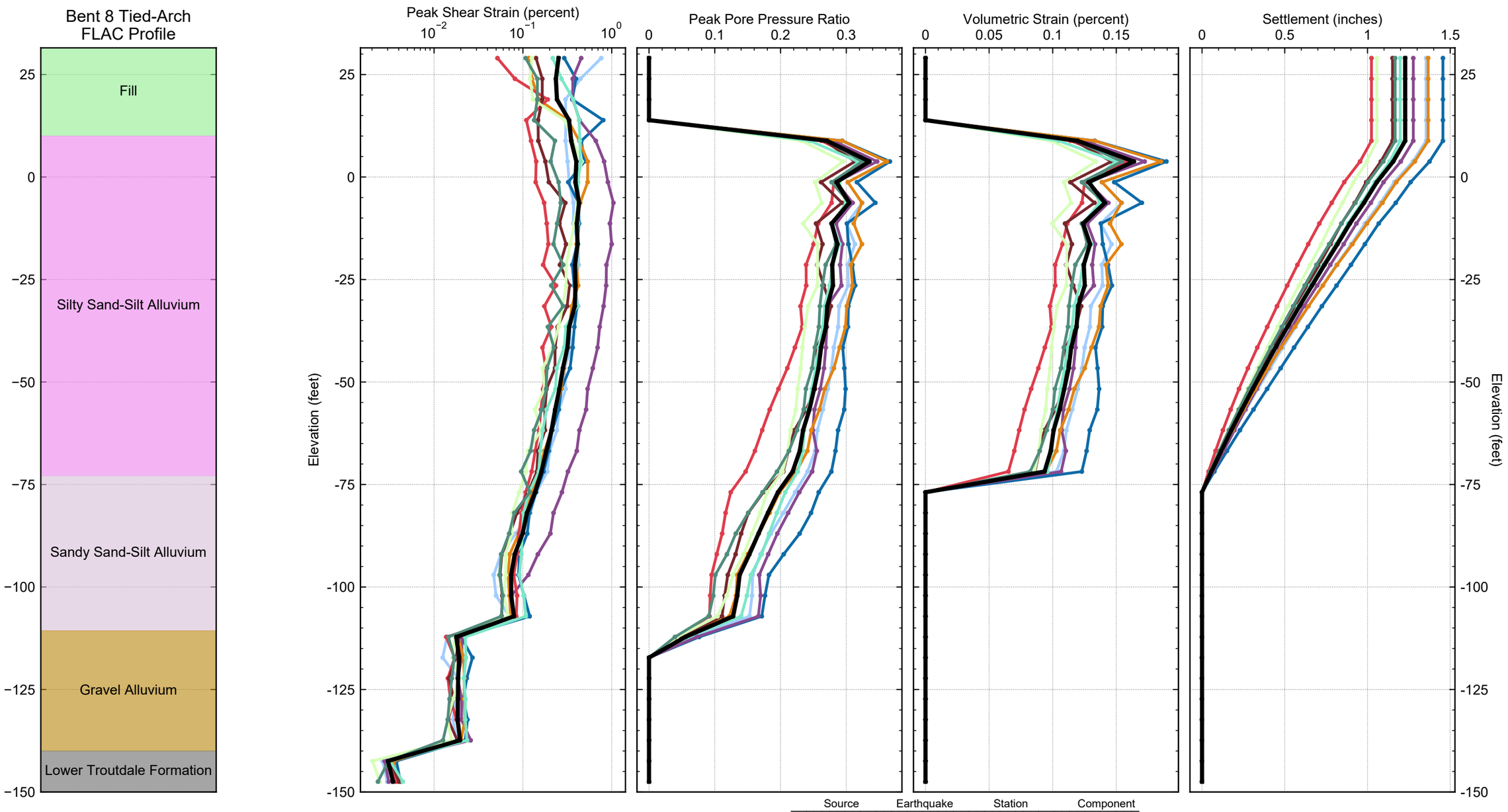


Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

C:_FLACPROCESS\Burnside

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 8 TIED-ARCH
EFFECTIVE STRESS ANALYSES
1,000-YEAR PROBABILISTIC
SEISMIC SETTLEMENT

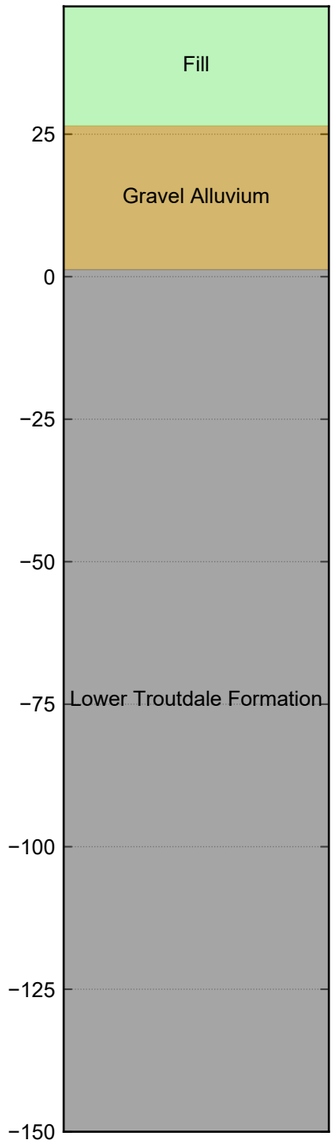
April 2022 102636-009

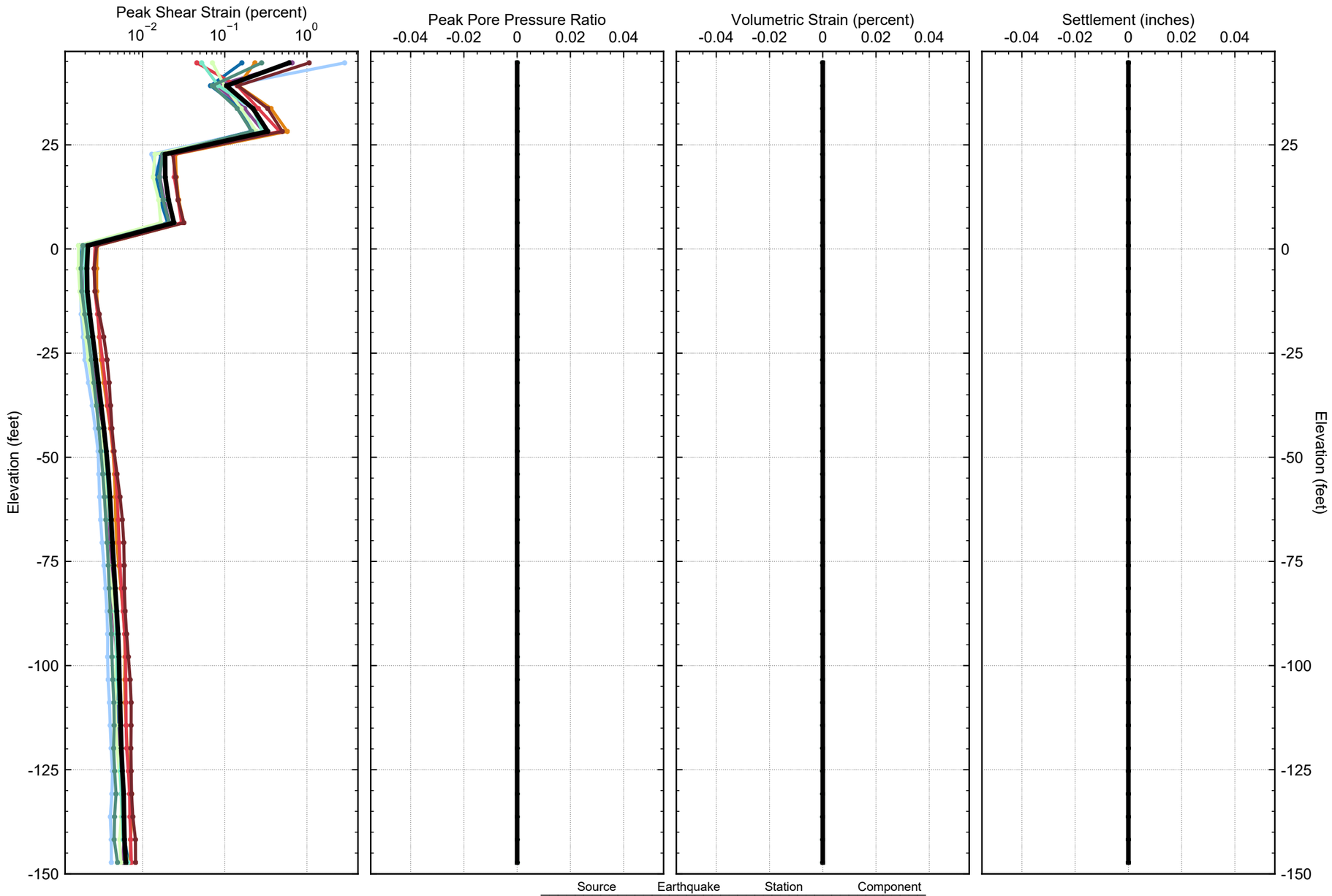
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-153

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 9
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 9
EFFECTIVE STRESS ANALYSES
1,000-YEAR PROBABILISTIC SEISMIC SETTLEMENT

April 2022 102636-009

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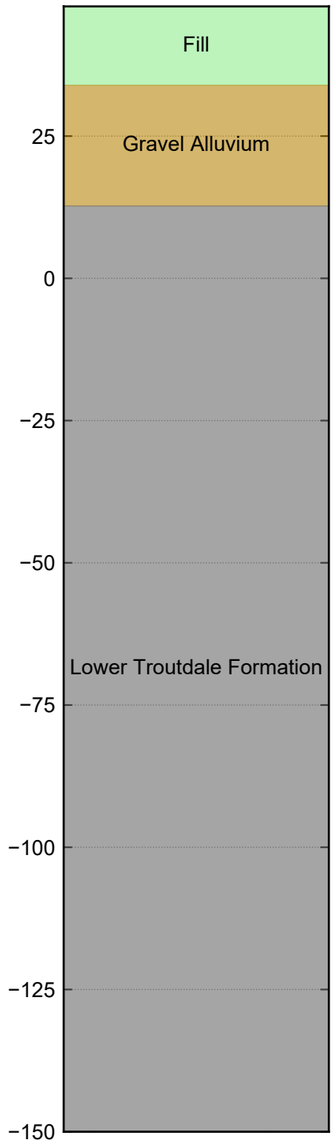
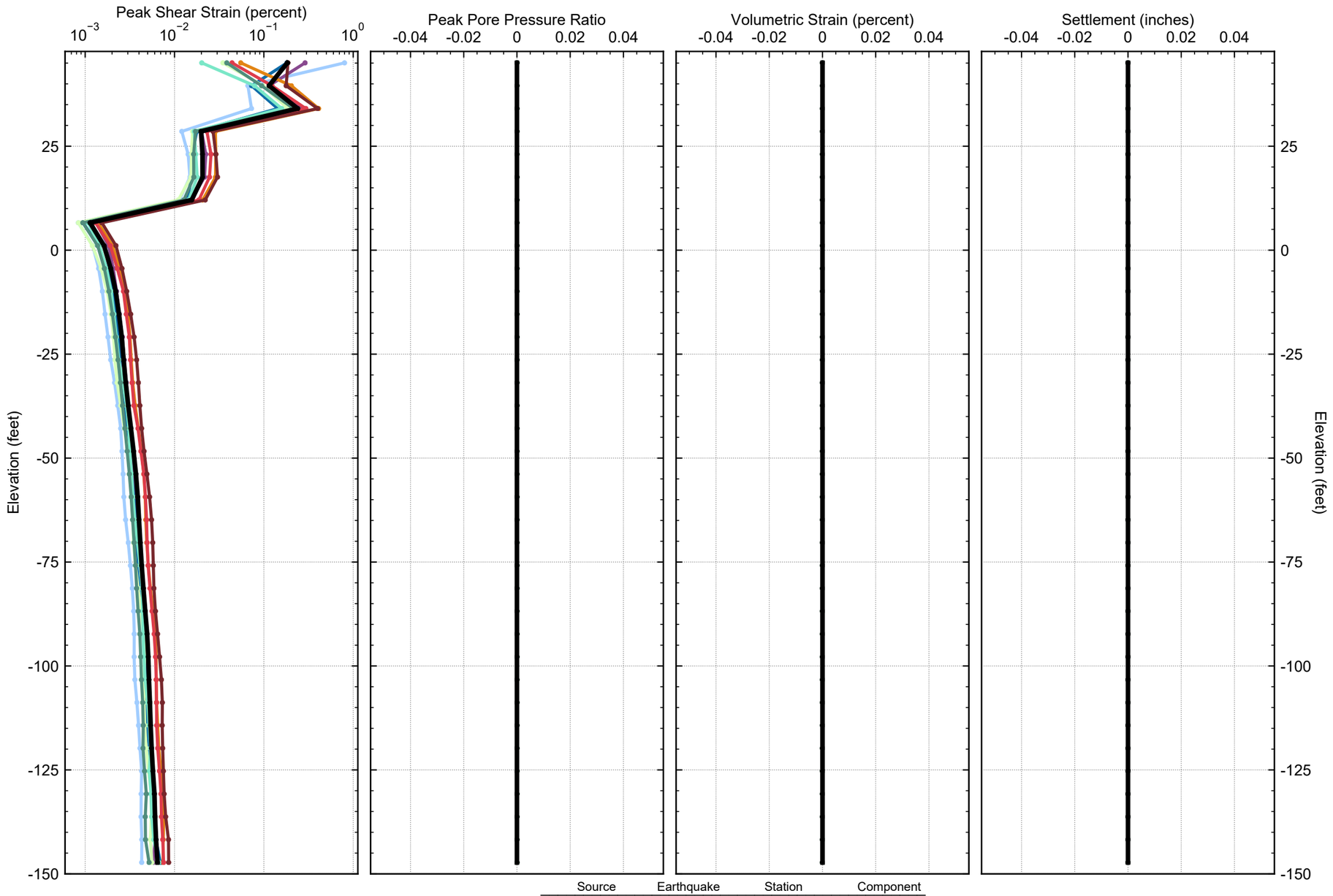
FIG. H-154

C:_FLAC\PROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 10
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	SLUC	90 deg.
CSZ	Tohoku	TAIWA	NS
CRUSTAL	Northridge	Burbank	60 deg.
CRUSTAL	Christchurch	MQZ	EW
CRUSTAL	Niigata	NIGH12	EW
SLAB	Nisqually	BEVT	ENE
SLAB	Nisqually	EARN	ENE
SLAB	Western WA 1965	Olympia	176 deg.
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 10
EFFECTIVE STRESS ANALYSES
1,000-YEAR PROBABILISTIC SEISMIC SETTLEMENT

April 2022 102636-009

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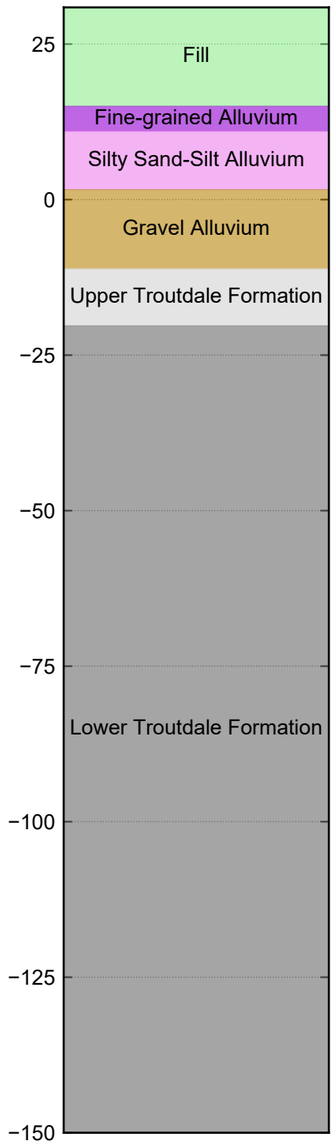
Geotechnical and Environmental Consultants

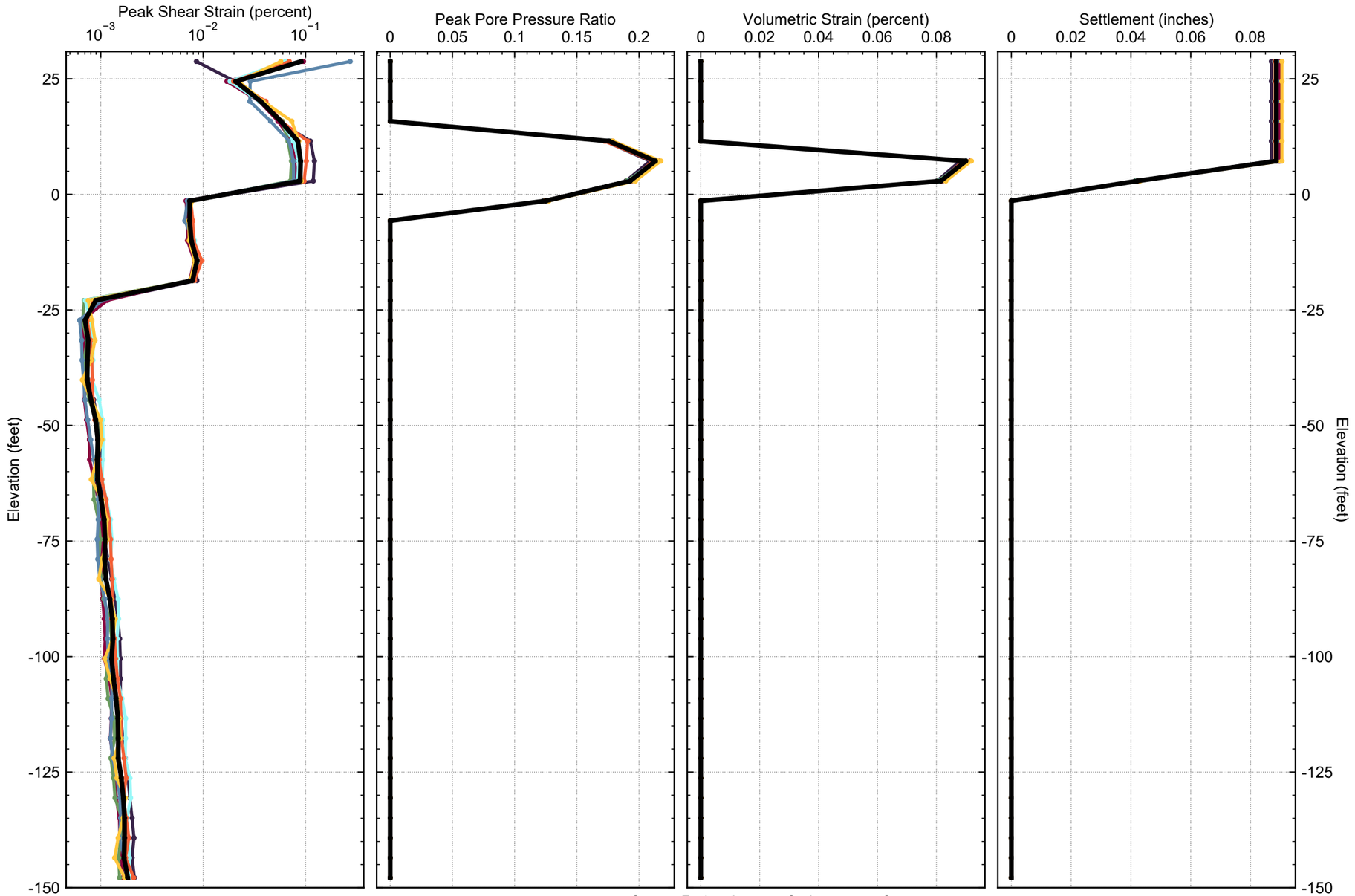
FIG. H-155

C:_FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d, by:SSS

Bent 1
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 1
EFFECTIVE STRESS ANALYSES
DETERMINISTIC CSZ
SEISMIC SETTLEMENT

April 2022 102636-009

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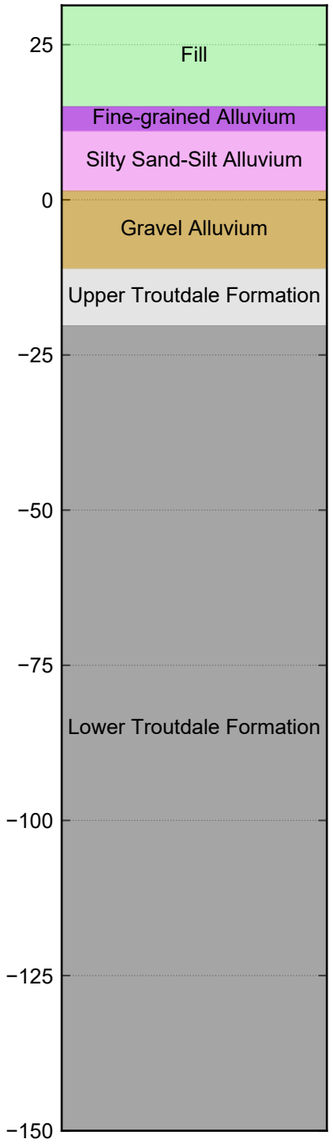
Geotechnical and Environmental Consultants

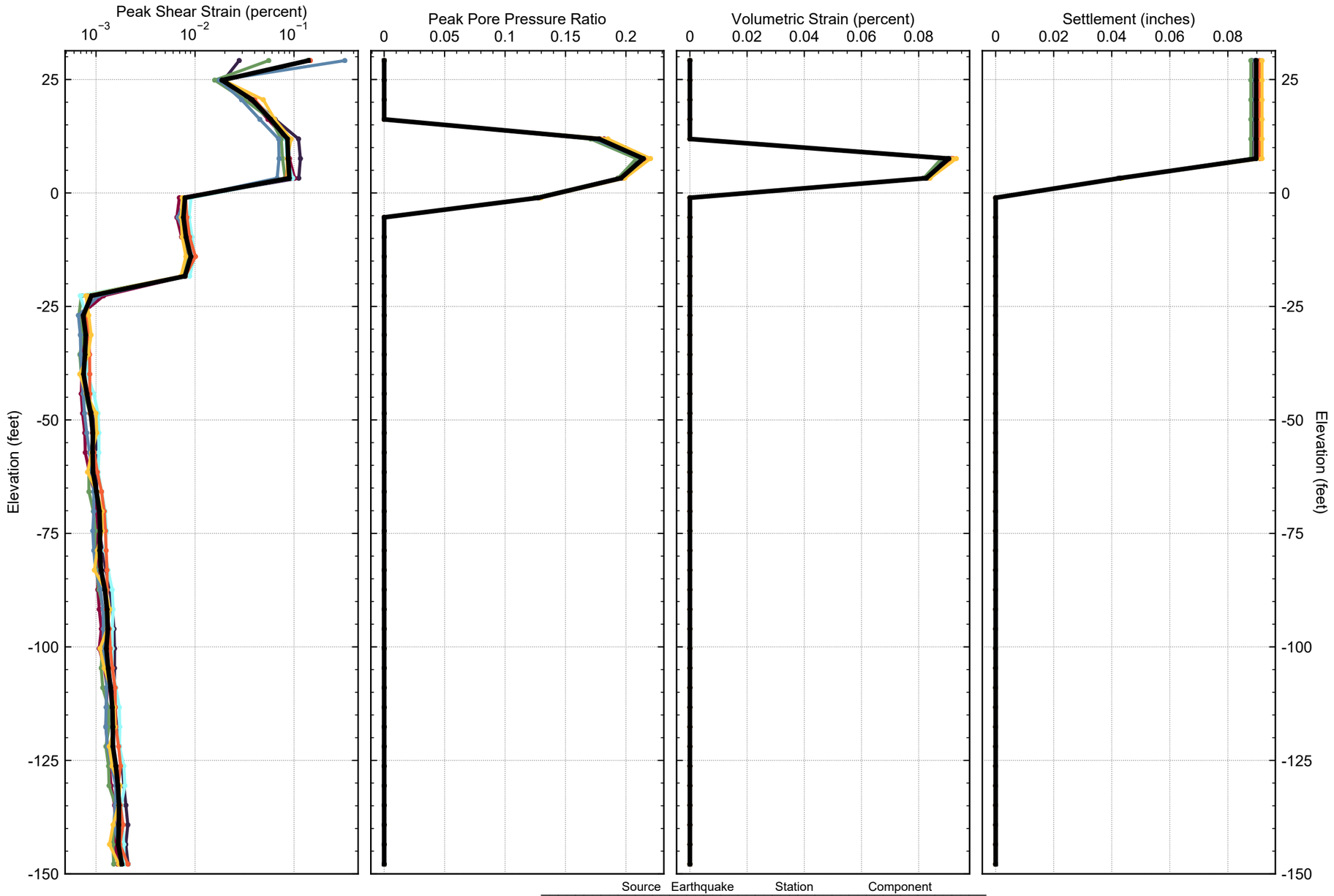
FIG. H-156

C:_FLAC\PROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 2
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 2
EFFECTIVE STRESS ANALYSES
DETERMINISTIC CSZ
SEISMIC SETTLEMENT

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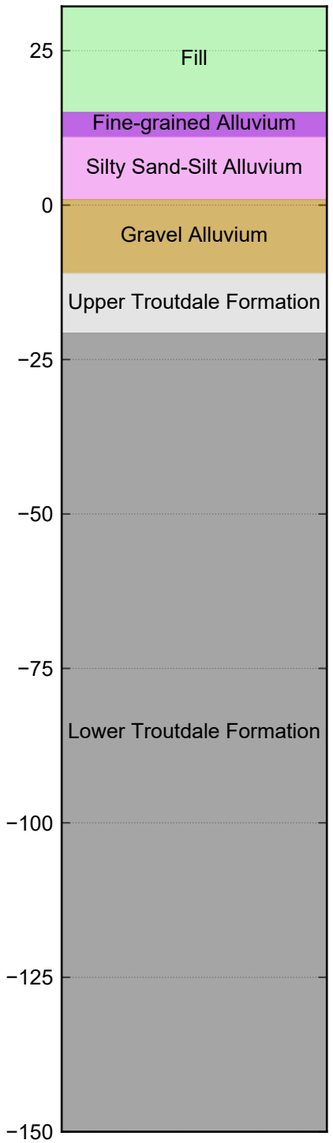
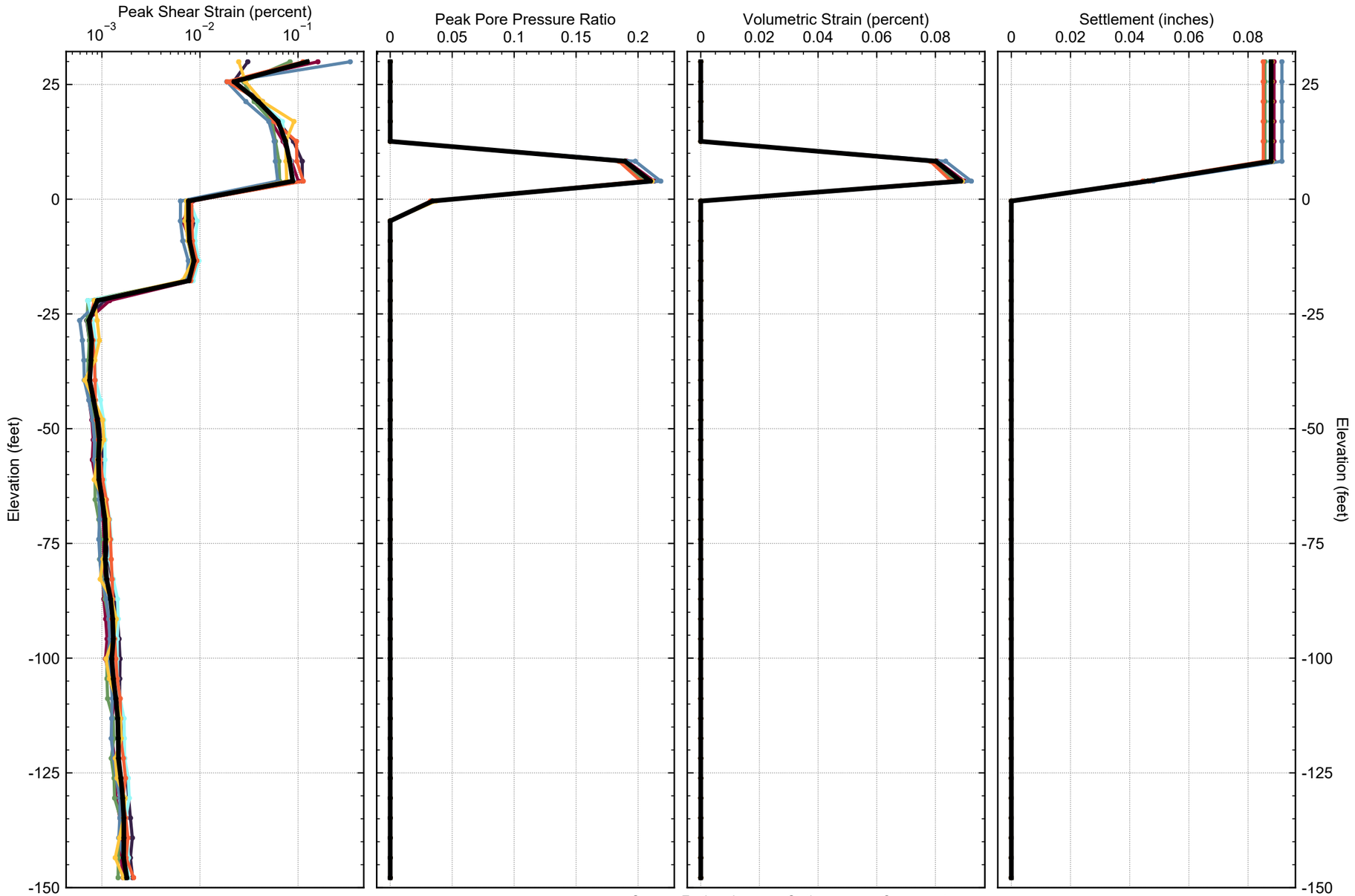
FIG. H-157

C:_FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 3
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 3
EFFECTIVE STRESS ANALYSES
DETERMINISTIC CSZ
SEISMIC SETTLEMENT

April 2022 102636-009

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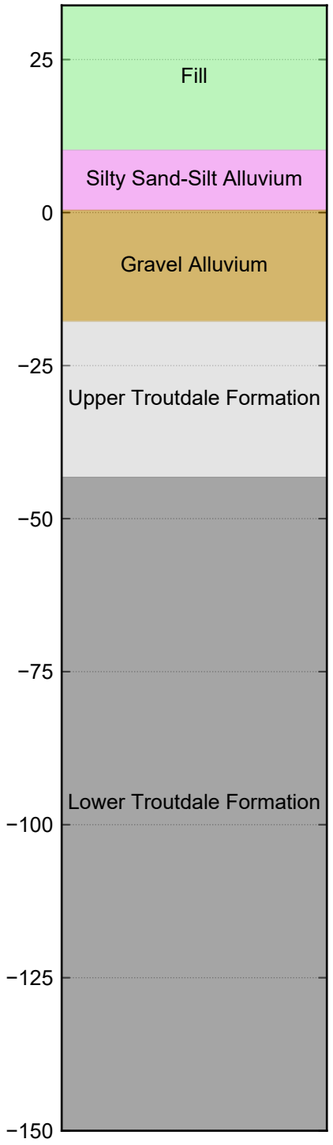
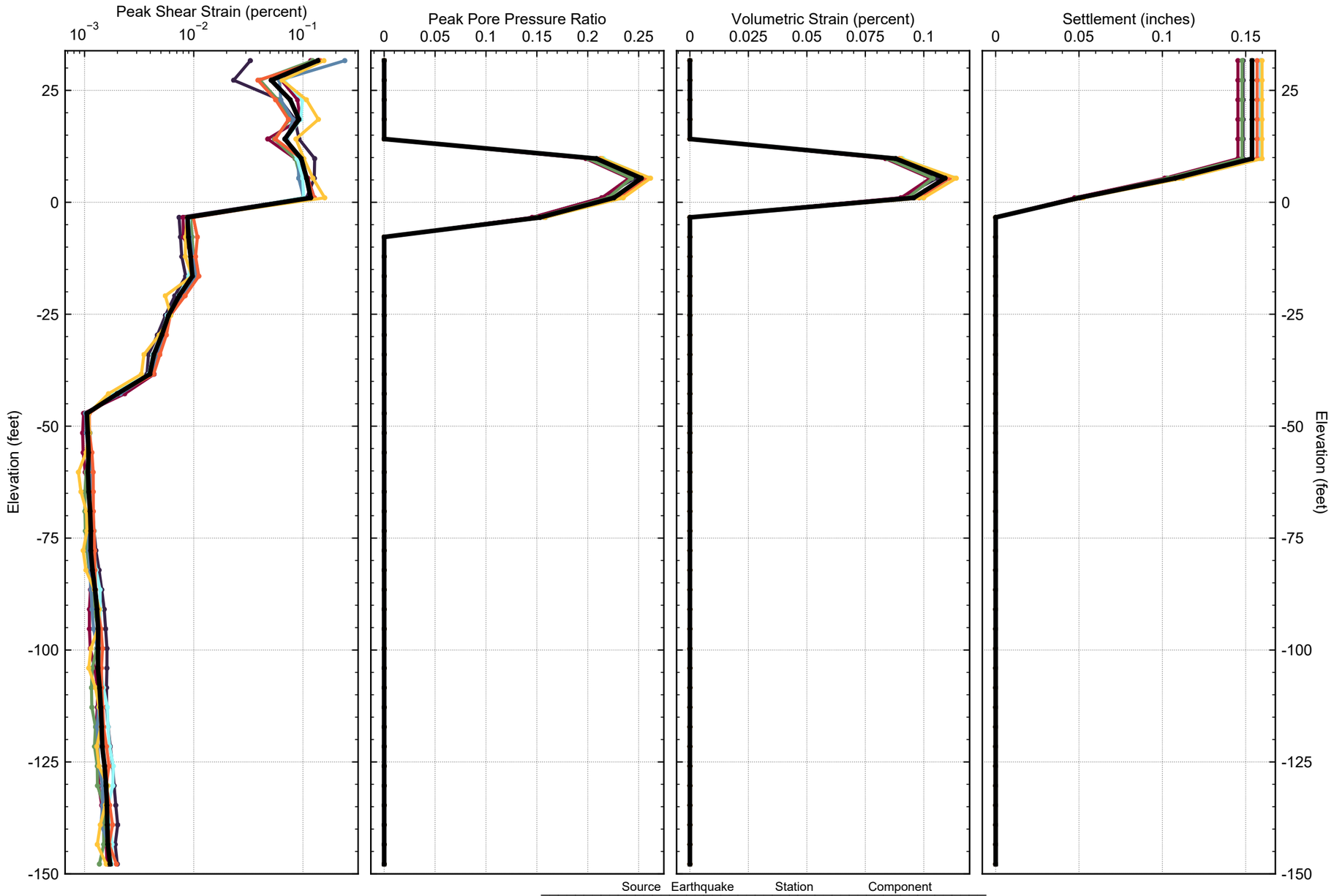
FIG. H-158

C:_FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 4
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 4
EFFECTIVE STRESS ANALYSES
DETERMINISTIC CSZ
SEISMIC SETTLEMENT

April 2022 102636-009

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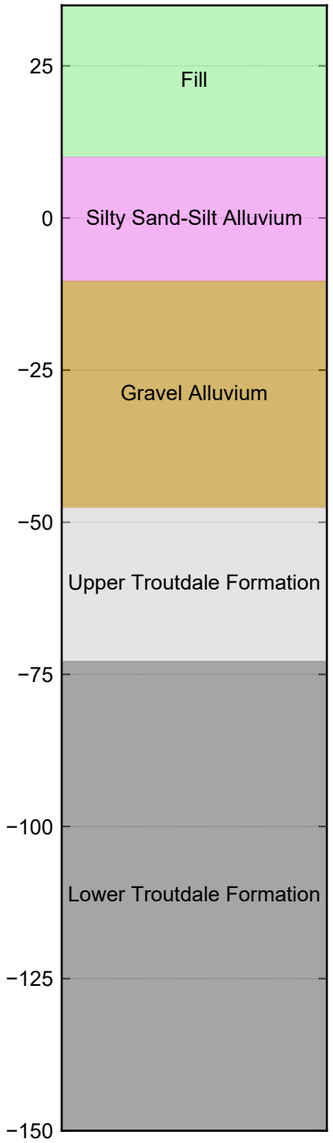
Geotechnical and Environmental Consultants

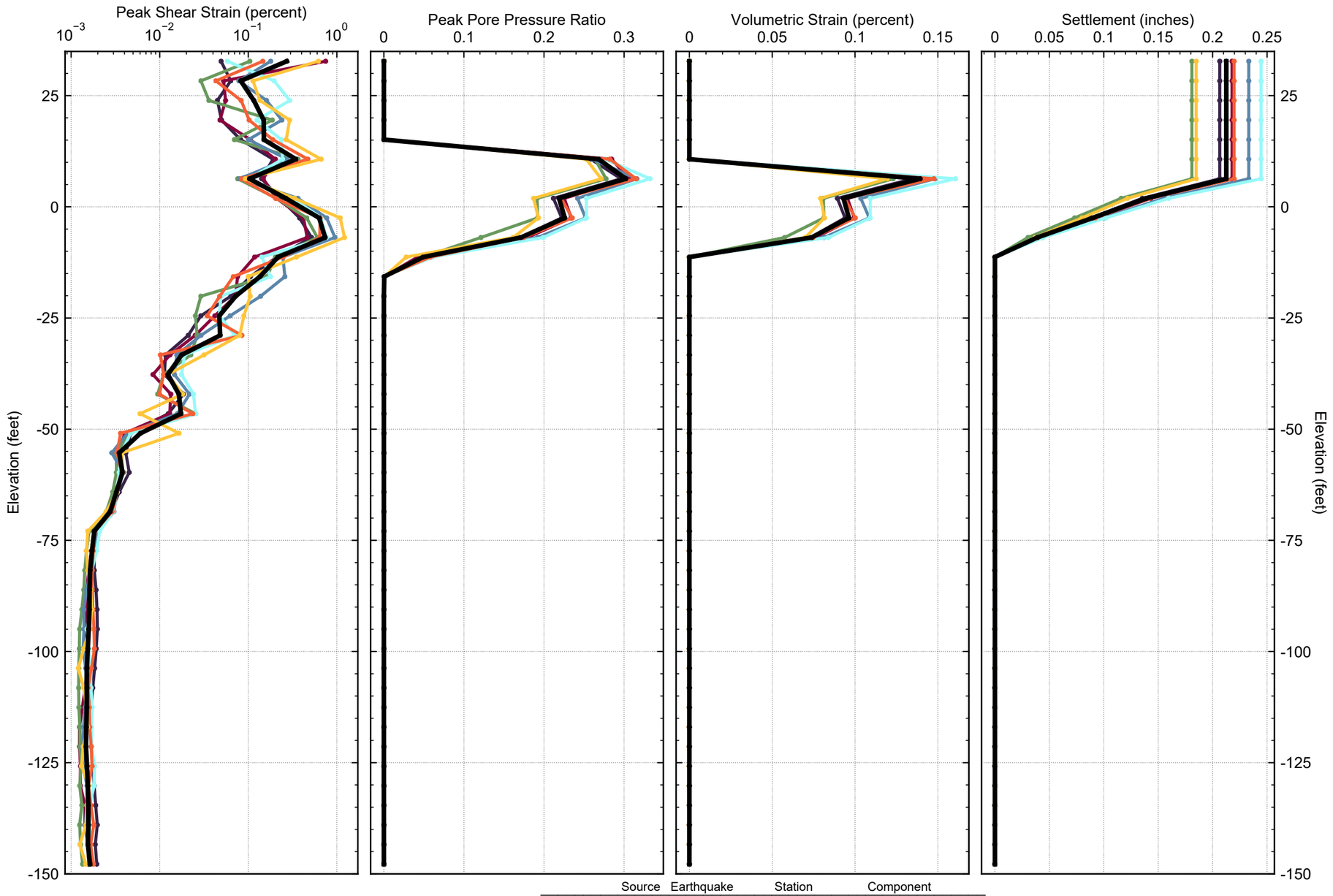
FIG. H-159

C:_FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 5
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 5
EFFECTIVE STRESS ANALYSES
DETERMINISTIC CSZ
SEISMIC SETTLEMENT

April 2022 102636-009

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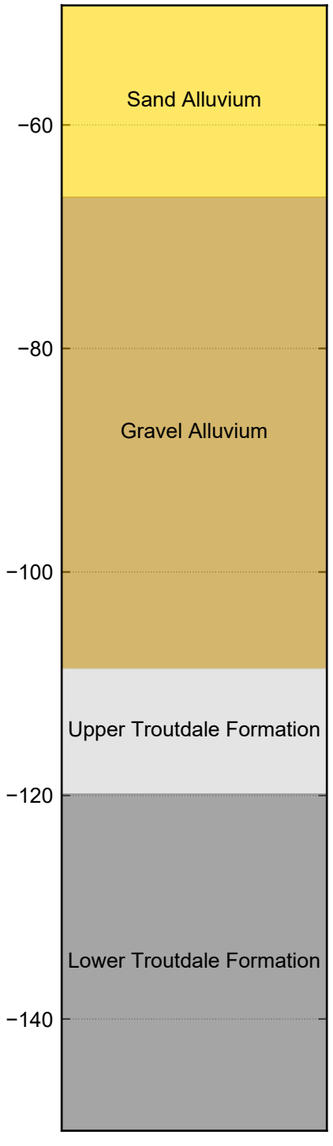
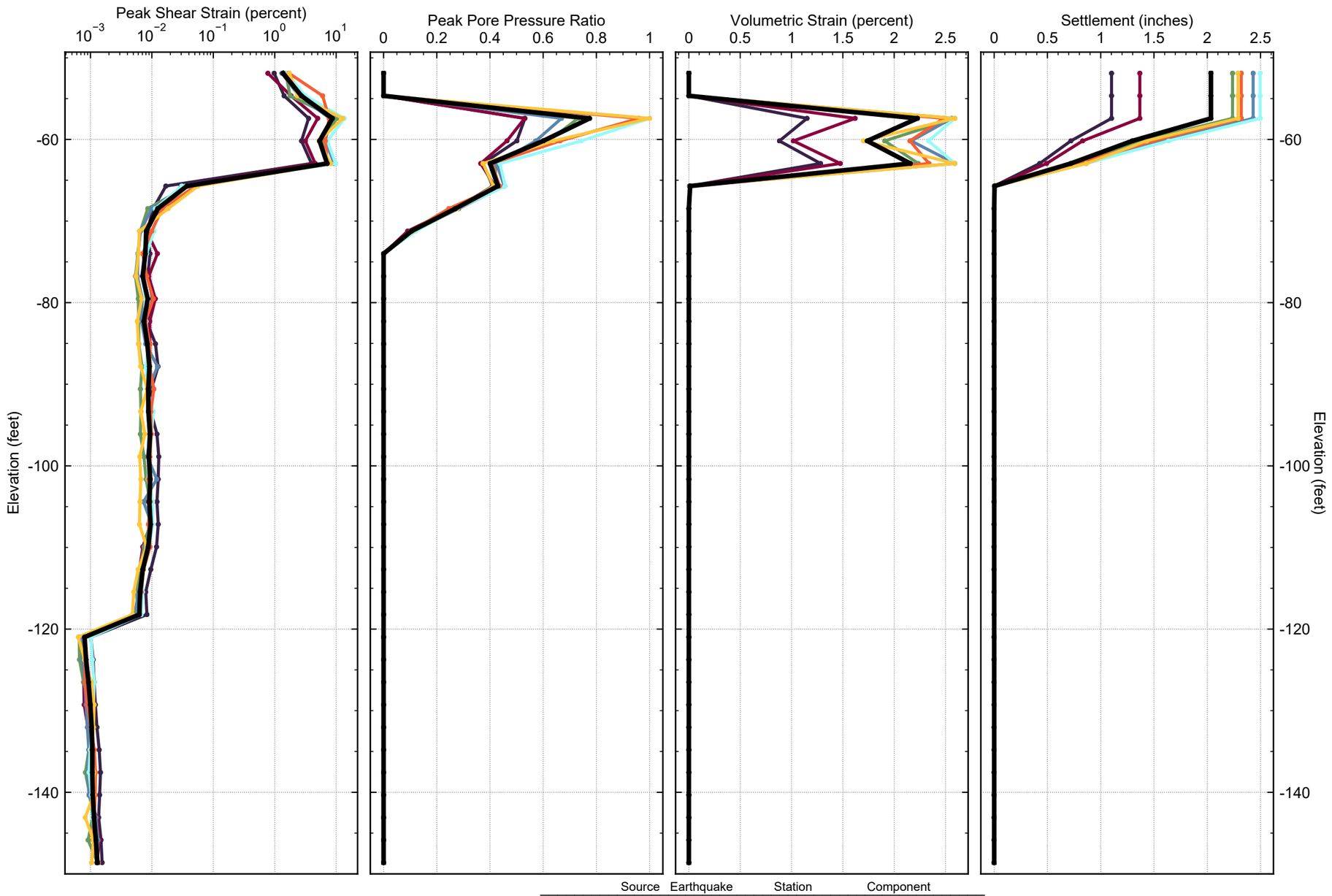
FIG. H-160

C:\...FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 6
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 6
EFFECTIVE STRESS ANALYSES
DETERMINISTIC CSZ
SEISMIC SETTLEMENT

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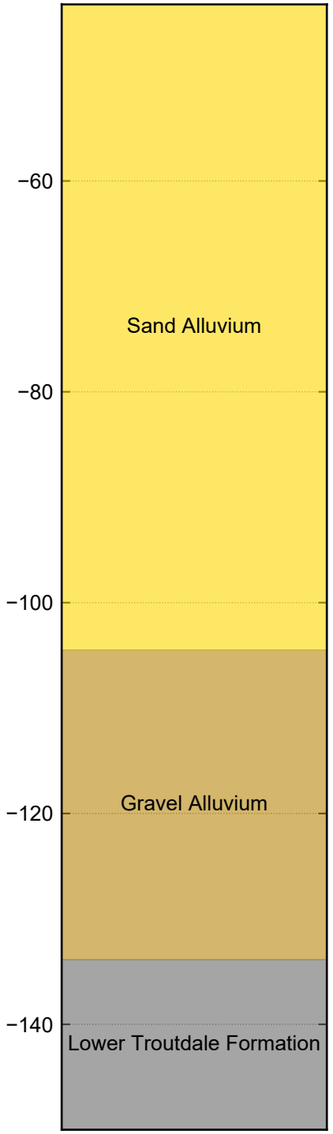
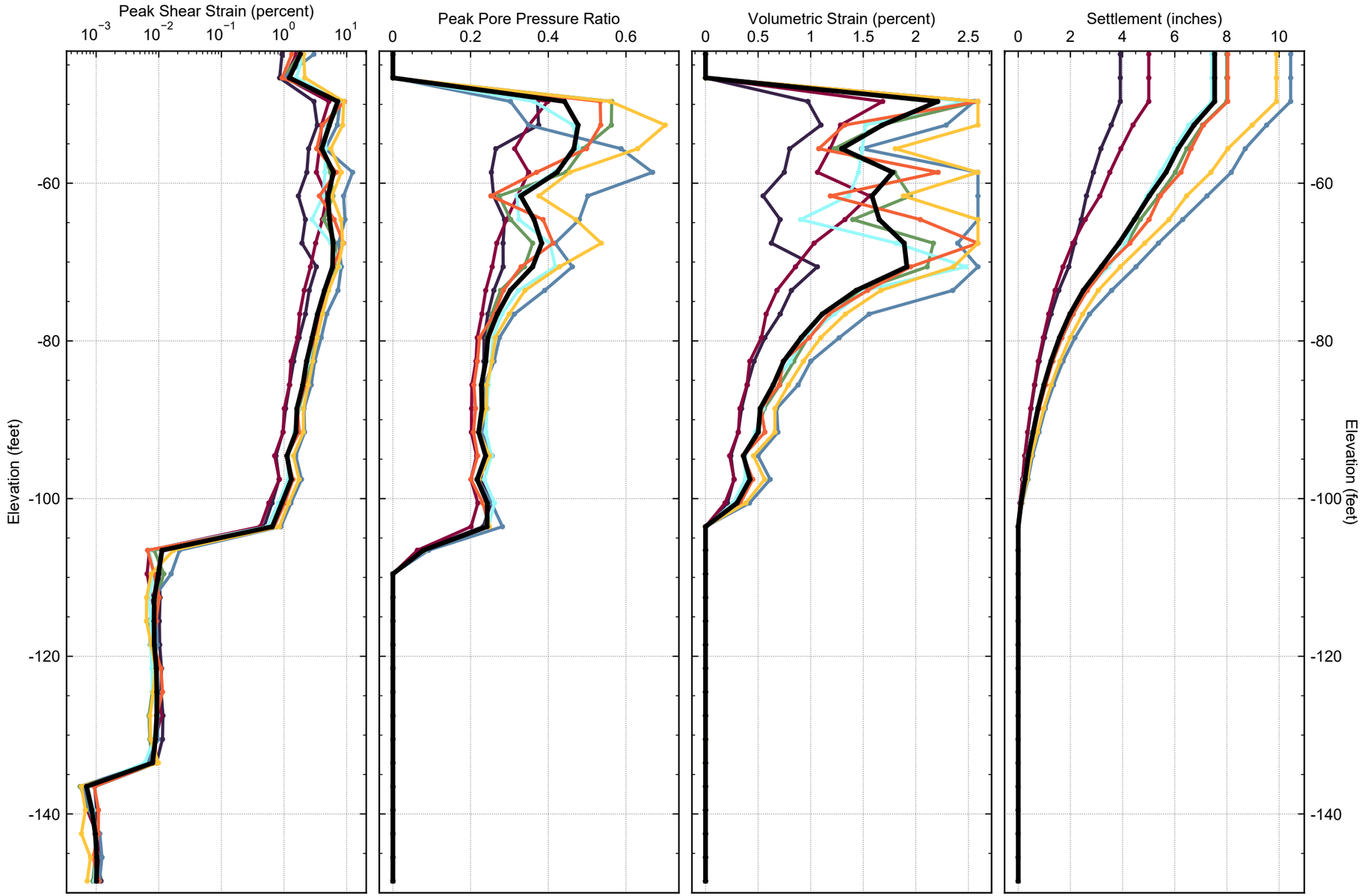
FIG. H-161

C:_FLAC\PROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 7
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 7
EFFECTIVE STRESS ANALYSES
DETERMINISTIC CSZ
SEISMIC SETTLEMENT

April 2022 102636-009

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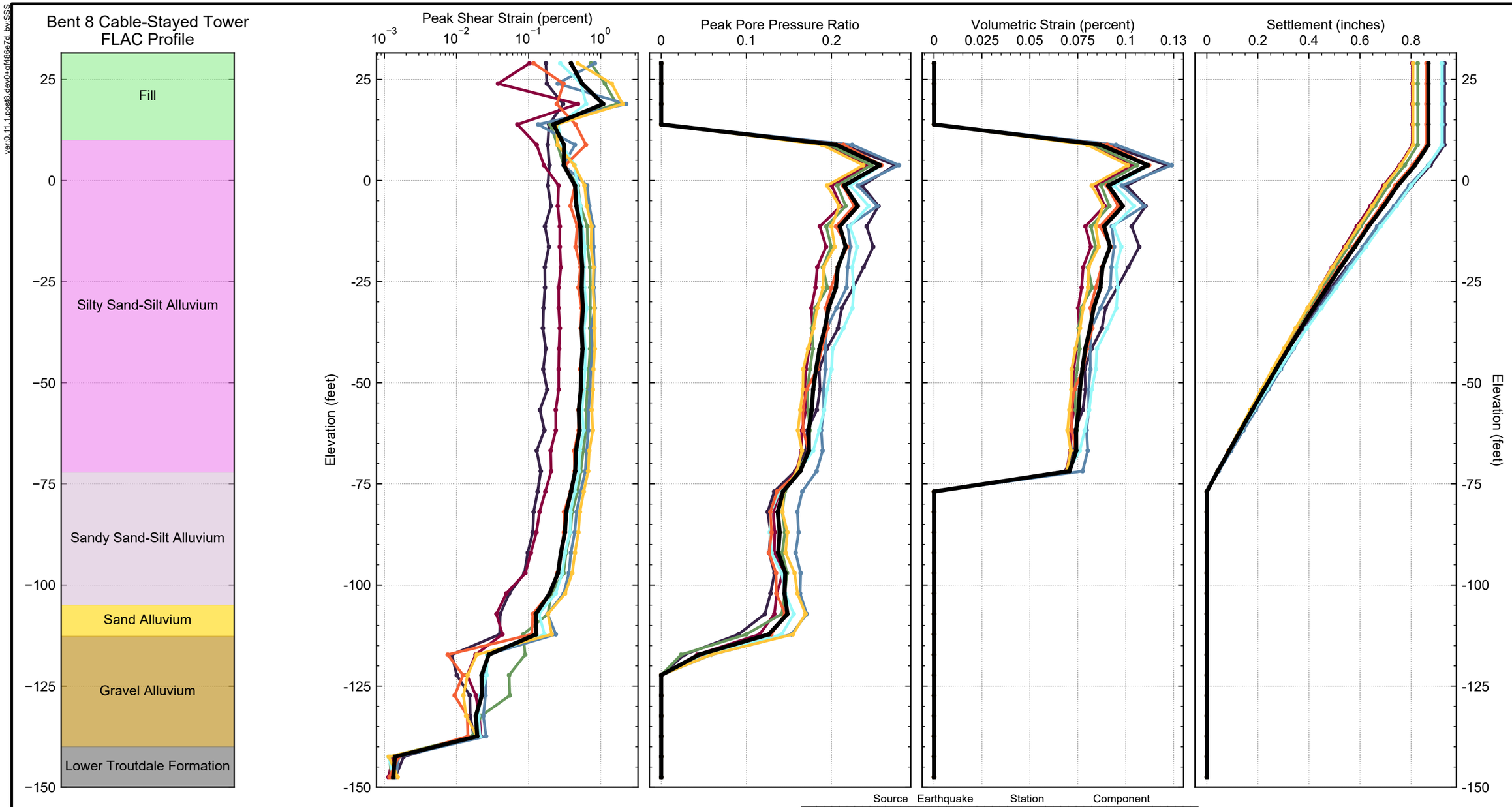
FIG. H-162

C:_FLAGPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by.SSS



Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 8 CABLE-STAYED TOWER
EFFECTIVE STRESS ANALYSES
DETERMINISTIC CSZ
SEISMIC SETTLEMENT

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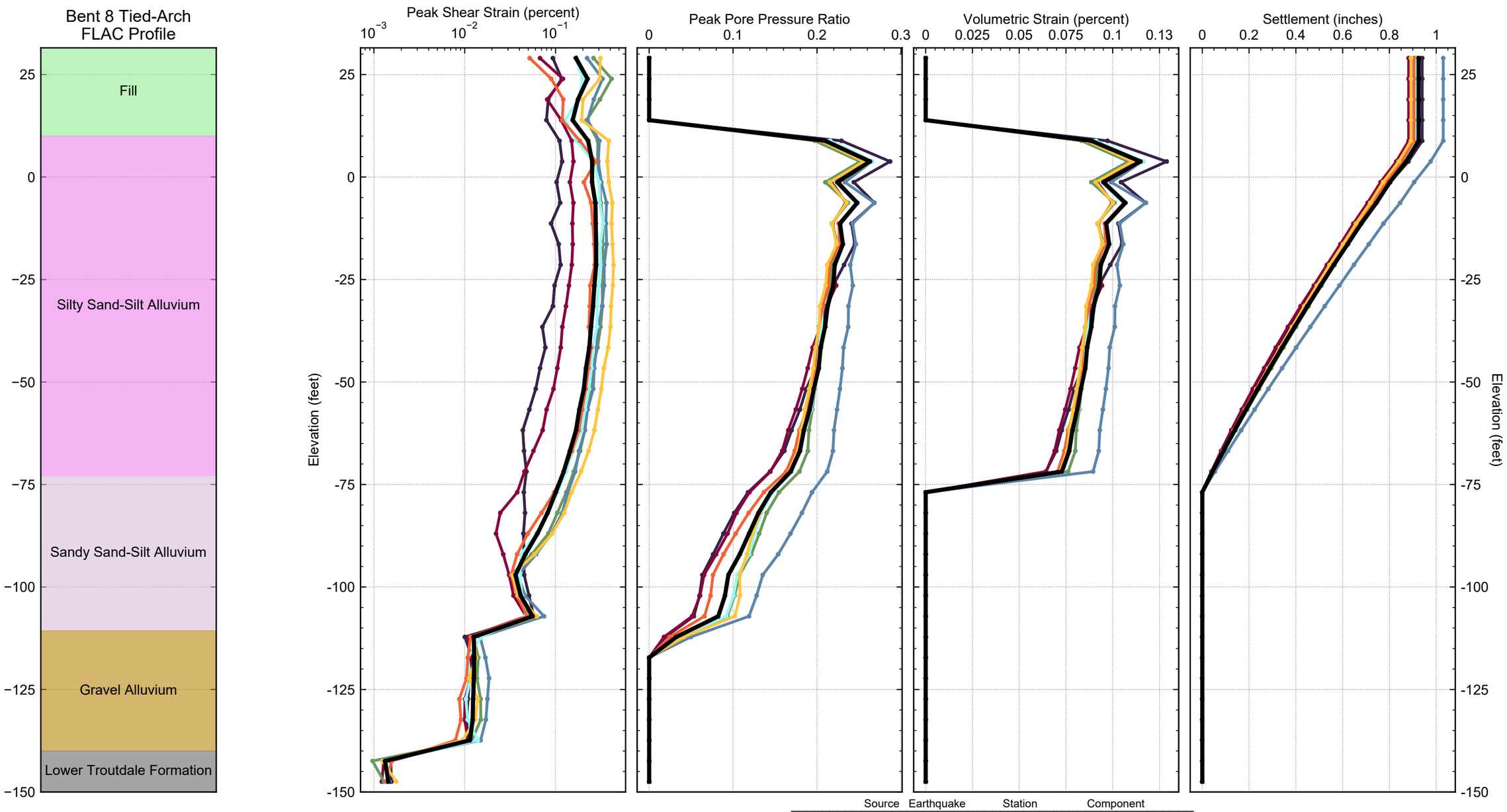
FIG. H-163

C:_FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS



Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 8 TIED-ARCH
EFFECTIVE STRESS ANALYSES
DETERMINISTIC CSZ
SEISMIC SETTLEMENT

April 2022 102636-009

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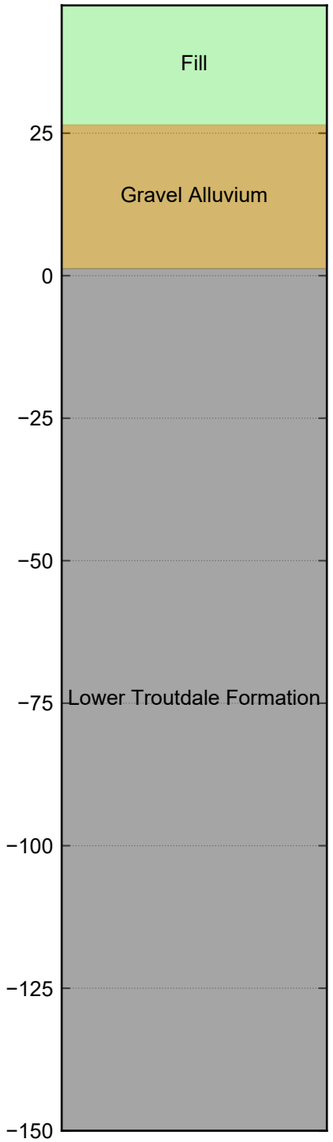
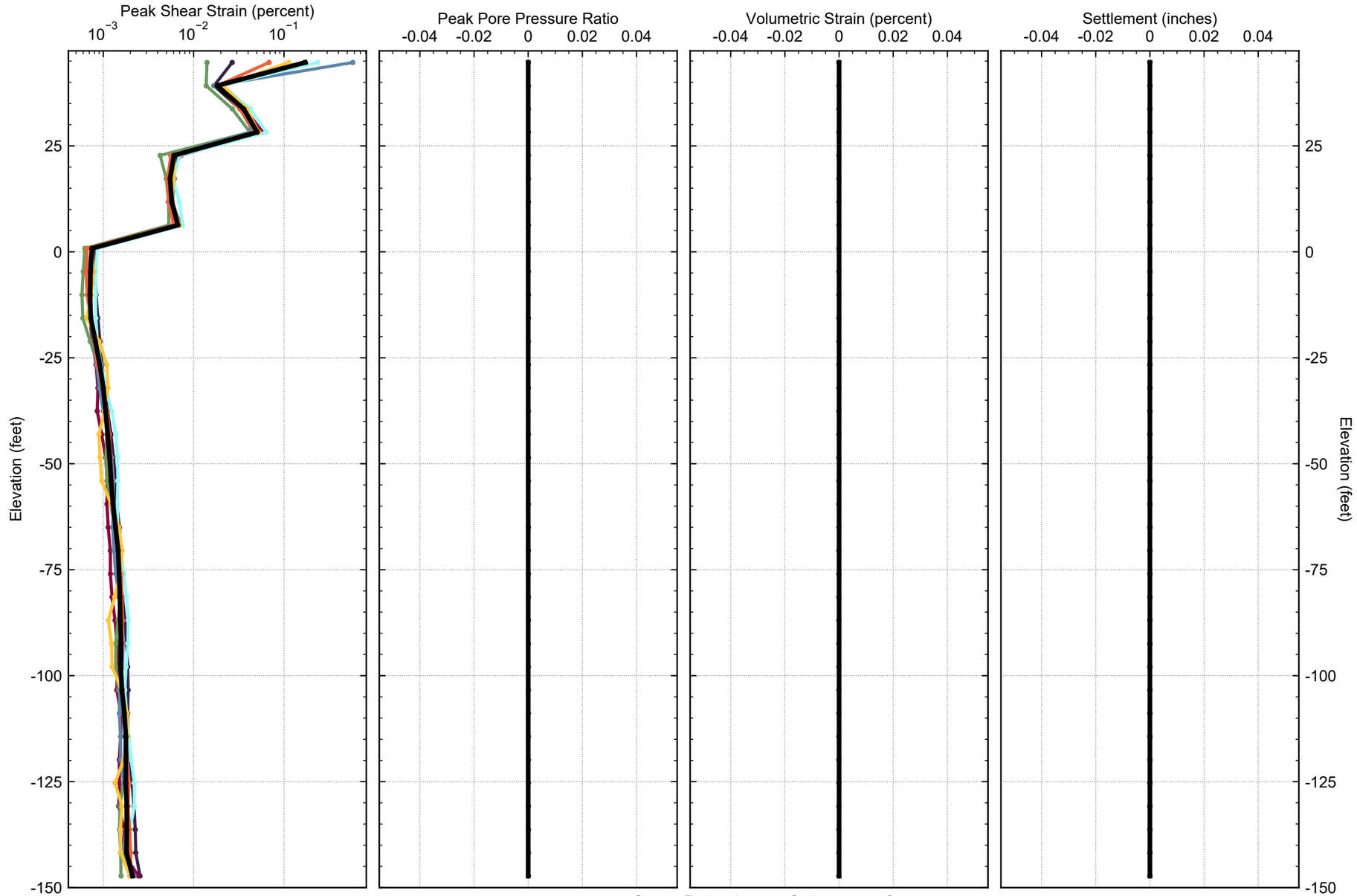
FIG. H-164

C:_FLACPROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by.SSS

Bent 9
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 9
EFFECTIVE STRESS ANALYSES
DETERMINISTIC CSZ
SEISMIC SETTLEMENT

April 2022 102636-009

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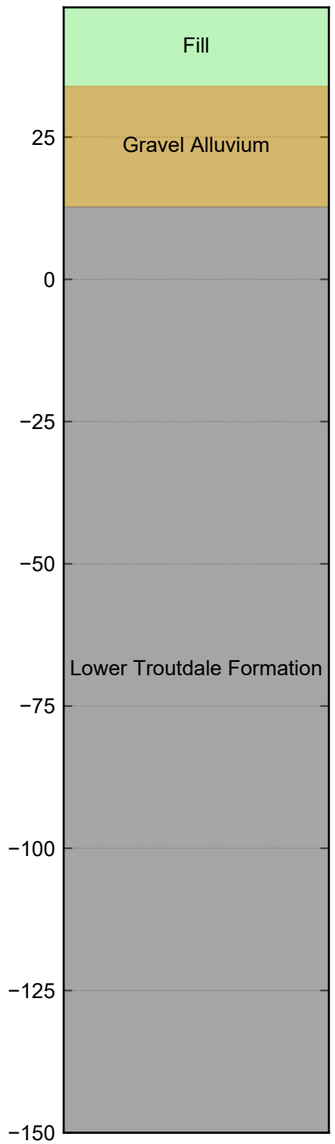
Geotechnical and Environmental Consultants

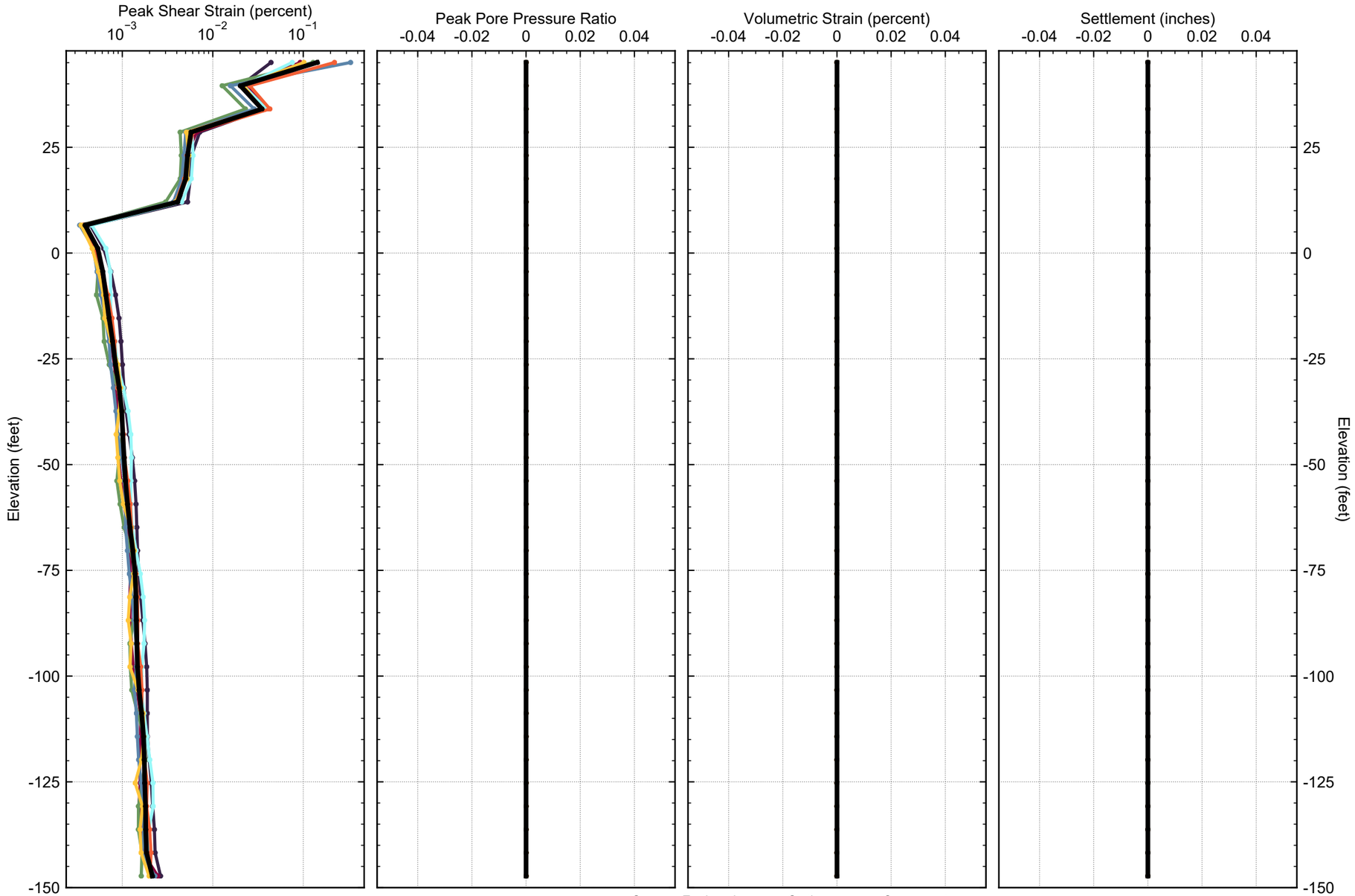
FIG. H-165

C:_FLAC\PROCESS\Burnside

ver:0.11.1.post8.dev0+gf486e7d.by:SSS

Bent 10
FLAC Profile





Source	Earthquake	Station	Component
CSZ	Maule	ANTU	90 deg.
CSZ	Maule	VICH	90 deg.
CSZ	Tohoku	AKT017	EW
CSZ	Tohoku	YMTH05	NS
CSZ	M9 Project	CSZ005	EW
CSZ	M9 Project	CSZ018	EW
CSZ	M9 Project	CSZ024	EW
Average			

Notes:
1. The profile shown above corresponds to the profile used in the FLAC model at the provided pier location.
2. Seismic settlement for sand-like soils was evaluated based on the procedures of Ishihara and Yoshimine (1992).
3. Seismic settlement for silt-like soils was evaluated based on the laboratory testing program performed for the project.

Earthquake Ready Burnside Bridge
Portland, Oregon

BENT 10
EFFECTIVE STRESS ANALYSES
DETERMINISTIC CSZ
SEISMIC SETTLEMENT

April 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. H-166

C:_FLAGPROCESS\Burnside

APPENDIX I: FOUNDATION DESIGN PARAMETERS AND AXIAL RESISTANCE PLOTS

Appendix I

Foundation Design Parameters and Axial Resistance Plots

CONTENTS

- Table I1: Recommended Soil Parameters for LPile/FB-MultiPier Analyses
- Figures I1 through I12: Estimated Axial Resistance Plots for Bents 1 through 10

Table I1. Recommended Soil Parameters for LPile/FB-MultiPier Analyses

Pier	GWT Elev.	Subsurface Stratigraphy[a]			Soil Parameters [b]				Recommended LPile and FB-MultiPier Soil Model				Drilled Shaft Design Parameters							
		Geologic Unit	Top Elev.	Bottom Elev.	Static Friction Angle, ϕ'	Reduced Strength Friction Angle, ϕ_r'	Cohesion, c	Total Unit Weight, γ [c]	Lateral (p-y)	Axial (t-z) [d]	Tip (Q-z) [e]	Torsional[f]	Static Modulus of Subgrade Reaction, k	Reduced Strength Modulus of Subgrade Reaction, k	Average Cohesion, c_{avg}	Strain at 50% of failure, ε_{50}	Static Side Resist. & Torsional Shear Stress	Reduced Strength Side Resist. & Torsional Shear Stress	Displ. at Nominal Unit Side Resistance	Unit Base Resistance (q_{nom}) [g]
	(feet)		(feet)	(feet)	(degrees)	(degrees)	(psf)	(pcf)					(pci)	(pci)	(psf)		(psf)	(psf)	(inches)	(ksf)
Bent 1	10	Fill	31	23	27	27	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	25	25	-	-	200	200	0.005 x D	-
		Fine-Grained Alluvium	23	16	-	-	200	105	Soft Clay (Matlock)	Driven Pile Sand (API)	-	Hyperbolic	-	-	200	0.02	110	110	0.005 x D	-
		Sand/Silt Alluvium (Silt-like)	16	4	26	24	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	20	20	-	-	700	700	0.005 x D	-
		Gravel Alluvium	4	-22	42	42	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	3,000	3,000	0.005 x D	-
		Upper Troutdale Formation	-22	-68	40	40	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	4,000	4,000	0.005 x D	-
		Lower Troutdale Formation	-68	-80	44	44	-	140	Sand (Reese)	Driven Pile Sand (API)	Custom	Hyperbolic	225	225	-	-	20,000	20,000	0.005 x D	165
Bent 2	10	Fill	30	23	27	27	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	25	25	-	-	200	200	0.005 x D	-
		Fine-Grained Alluvium	23	16	-	-	200	105	Soft Clay (Matlock)	Driven Pile Sand (API)	-	Hyperbolic	-	-	200	0.02	110	110	0.005 x D	-
		Sand/Silt Alluvium (Silt-like)	16	4	26	24	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	20	20	-	-	700	700	0.005 x D	-
		Gravel Alluvium	4	-14	42	42	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	3,000	3,000	0.005 x D	-
		Upper Troutdale Formation	-14	-42	40	40	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	4,000	4,000	0.005 x D	-
		Lower Troutdale Formation	-42	-80	44	44	-	140	Sand (Reese)	Driven Pile Sand (API)	Custom	Hyperbolic	225	225	-	-	20,000	20,000	0.005 x D	165

Table I1. Recommended Soil Parameters for LPile/FB-MultiPier Analyses

Pier	GWT Elev.	Subsurface Stratigraphy[a]			Soil Parameters [b]				Recommended LPile and FB-MultiPier Soil Model				Drilled Shaft Design Parameters							
		Geologic Unit	Top Elev.	Bottom Elev.	Static Friction Angle, ϕ'	Reduced Strength Friction Angle, ϕ_r'	Cohesion, c	Total Unit Weight, γ [c]	Lateral (p-y)	Axial (t-z) [d]	Tip (Q-z) [e]	Torsional[f]	Static Modulus of Subgrade Reaction, k	Reduced Strength Modulus of Subgrade Reaction, k	Average Cohesion, c_{avg}	Strain at 50% of failure, ε_{50}	Static Side Resist. & Torsional Shear Stress	Reduced Strength Side Resist. & Torsional Shear Stress	Displ. at Nominal Unit Side Resistance	Unit Base Resistance (q_{nom}) [g]
	(feet)		(feet)	(feet)	(degrees)	(degrees)	(psf)	(pcf)					(pci)	(pci)	(psf)		(psf)	(psf)	(inches)	(ksf)
Bent 3	10	Fill	32	21	27	27	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	25	25	-	-	200	200	0.005 x D	-
		Fine-Grained Alluvium	21	14	-	-	200	105	Soft Clay (Matlock)	Driven Pile Sand (API)	-	Hyperbolic	-	-	200	0.02	110	110	0.005 x D	-
		Sand/Silt Alluvium (Silt-like)	14	4	25	24	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	20	20	-	-	700	700	0.005 x D	-
		Gravel Alluvium	4	-24	42	42	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	3,000	3,000	0.005 x D	-
		Upper Troutdale Formation	-24	-42	40	40	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	4,000	4,000	0.005 x D	-
		Lower Troutdale Formation	-42	-80	44	44	-	140	Sand (Reese)	Driven Pile Sand (API)	Custom	Hyperbolic	225	225	-	-	20,000	20,000	0.005 x D	165
Bent 4	10	Fill	34	10	27	27	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	10	10	-	-	200	200	0.005 x D	-
		Sand/Silt Alluvium (Silt-like)	10	6	27	24	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	30	30	-	-	700	700	0.005 x D	-
		Gravel Alluvium	6	-34	42	42	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	3,000	3,000	0.005 x D	-
		Upper Troutdale Formation	-34	-40	40	40	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	4,000	4,000	0.005 x D	-
		Lower Troutdale Formation	-40	-80	44	44	-	140	Sand (Reese)	Driven Pile Sand (API)	Custom	Hyperbolic	225	225	-	-	20,000	20,000	0.005 x D	165

Table I1. Recommended Soil Parameters for LPile/FB-MultiPier Analyses

Pier	GWT Elev.	Subsurface Stratigraphy[a]			Soil Parameters [b]				Recommended LPile and FB-MultiPier Soil Model				Drilled Shaft Design Parameters							
		Geologic Unit	Top Elev.	Bottom Elev.	Static Friction Angle, ϕ'	Reduced Strength Friction Angle, ϕ_r'	Cohesion, c	Total Unit Weight, γ [c]	Lateral (p-y)	Axial (t-z) [d]	Tip (Q-z) [e]	Torsional[f]	Static Modulus of Subgrade Reaction, k	Reduced Strength Modulus of Subgrade Reaction, k	Average Cohesion, c_{avg}	Strain at 50% of failure, ε_{50}	Static Side Resist. & Torsional Shear Stress	Reduced Strength Side Resist. & Torsional Shear Stress	Displ. at Nominal Unit Side Resistance	Unit Base Resistance (q_{nom}) [g]
	(feet)		(feet)	(feet)	(degrees)	(degrees)	(psf)	(pcf)					(pci)	(pci)	(psf)		(psf)	(psf)	(inches)	(ksf)
Bent 5	10	Fill	35	10	30	30	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	25	25	-	-	400	400	0.005 x D	-
		Sand/Silt Alluvium (Silt-like)	10	-8	26	22	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	25	25	-	-	700	700	0.005 x D	-
		Gravel Alluvium	-8	-40	42	42	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	3,500	3,500	0.005 x D	-
		Upper Troutdale Formation	-40	-60	40	40	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	4,000	4,000	0.005 x D	-
		Lower Troutdale Formation	-60	-100	44	44	-	140	Sand (Reese)	Driven Pile Sand (API)	Custom	Hyperbolic	225	225	-	-	20,000	20,000	0.005 x D	165
Bent 6	10	Fill/Sand Alluvium	-60	-72	32	15	-	115	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	35	2	-	-	500	25	0.005 x D	-
		Gravel Alluvium	-72	-88	38	38	-	125	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	85	85	-	-	1,300	1,300	0.005 x D	-
		Sand/Silt Alluvium (Sand-like)	-88	-109	30	30	-	115	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	60	60	-	-	1,000	1,000	0.005 x D	-
		Upper Troutdale Formation	-109	-121	38	38	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	115	115	-	-	2,500	2,500	0.005 x D	-
		Lower Troutdale Formation	-121	-140	44	44	-	140	Sand (Reese)	Driven Pile Sand (API)	Custom	Hyperbolic	225	225	-	-	20,000	20,000	0.005 x D	165
		Sandy River Mudstone	-140	-180	-	-	-	-	Available upon request	Available upon request	Available upon request	Available upon request	-	-	-	-	-	-	-	-

Table I1. Recommended Soil Parameters for LPile/FB-MultiPier Analyses

Pier	GWT Elev.	Subsurface Stratigraphy[a]			Soil Parameters [b]				Recommended LPile and FB-MultiPier Soil Model				Drilled Shaft Design Parameters							
		Geologic Unit	Top Elev.	Bottom Elev.	Static Friction Angle, ϕ'	Reduced Strength Friction Angle, ϕ_r'	Cohesion, c	Total Unit Weight, γ [c]	Lateral (p-y)	Axial (t-z) [d]	Tip (Q-z) [e]	Torsional[f]	Static Modulus of Subgrade Reaction, k	Reduced Strength Modulus of Subgrade Reaction, k	Average Cohesion, c_{avg}	Strain at 50% of failure, ε_{50}	Static Side Resist. & Torsional Shear Stress	Reduced Strength Side Resist. & Torsional Shear Stress	Displ. at Nominal Unit Side Resistance	Unit Base Resistance (q_{nom}) [g]
	(feet)		(feet)	(feet)	(degrees)	(degrees)	(psf)	(pcf)					(pci)	(pci)	(psf)		(psf)	(psf)	(inches)	(ksf)
Bent 7	10	Fill/Sand Alluvium 1	-60	-72	30	15	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	20	3	-	-	400	60	0.005 x D	-
		Sand Alluvium 2	-72	-85	30	24	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	20	10	-	-	400	200	0.005 x D	-
		Sand Alluvium 3	-85	-104	32	26	-	115	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	45	32	-	-	800	560	0.005 x D	-
		Gravel Alluvium	-104	-135	38	38	-	125	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	105	105	-	-	2,500	2,500	0.005 x D	-
		Lower Troutdale Formation	-135	-190	44	44	-	140	Sand (Reese)	Driven Pile Sand (API)	Custom	Hyperbolic	225	225	-	-	20,000	20,000	0.005 x D	165
		Sandy River Mudstone	-190	-200	-	-	-	-	Available upon request	Available upon request	Available upon request	Available upon request	-	-	-	-	-	-	-	-

Table I1. Recommended Soil Parameters for LPile/FB-MultiPier Analyses

Pier	GWT Elev.	Subsurface Stratigraphy[a]			Soil Parameters [b]				Recommended LPile and FB-MultiPier Soil Model				Drilled Shaft Design Parameters							
		Geologic Unit	Top Elev.	Bottom Elev.	Static Friction Angle, ϕ'	Reduced Strength Friction Angle, ϕ_r'	Cohesion, c	Total Unit Weight, γ [c]	Lateral (p-y)	Axial (t-z) [d]	Tip (Q-z) [e]	Torsional[f]	Static Modulus of Subgrade Reaction, k	Reduced Strength Modulus of Subgrade Reaction, k	Average Cohesion, c_{avg}	Strain at 50% of failure, ε_{50}	Static Side Resist. & Torsional Shear Stress	Reduced Strength Side Resist. & Torsional Shear Stress	Displ. at Nominal Unit Side Resistance	Unit Base Resistance (q_{nom}) [g]
	(feet)		(feet)	(feet)	(degrees)	(degrees)	(psf)	(pcf)					(pci)	(pci)	(psf)		(psf)	(psf)	(inches)	(ksf)
Bent 8 (Cable Stay Tower)	10	Fill	34	17	30	30	-	115	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	20	20	-	-	250	250	0.005 x D	-
		Fine-Grained Alluvium	17	-1	-	-	200	105	Soft Clay (Matlock)	Driven Pile Sand (API)	-	Hyperbolic	-	-	200	0.02	110	110	0.005 x D	-
		Sand/Silt Alluvium (Silt-like) 1	-1	-27	24	16	-	105	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	5	5	-	-	300	300	0.005 x D	-
		Sand/Silt Alluvium (Silt-like) 2	-27	-73	26	19	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	20	20	-	-	1,200	1,200	0.005 x D	-
		Sand/Silt Alluvium (Sand-like)	-73	-104	30	26	-	115	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	50	40	-	-	2,500	2,000	0.005 x D	-
		Sand Alluvium	-104	-110	36	33	-	120	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	85	68	-	-	2,800	2,250	0.005 x D	-
		Gravel Alluvium	-110	-150	42	42	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	4,000	4,000	0.005 x D	-
		Lower Troutdale Formation	-150	-170	44	44	-	140	Sand (Reese)	Driven Pile Sand (API)	Custom	Hyperbolic	225	225	-	-	20,000	20,000	0.005 x D	165

Table I1. Recommended Soil Parameters for LPile/FB-MultiPier Analyses

Pier	GWT Elev.	Subsurface Stratigraphy[a]			Soil Parameters [b]				Recommended LPile and FB-MultiPier Soil Model				Drilled Shaft Design Parameters							
		Geologic Unit	Top Elev.	Bottom Elev.	Static Friction Angle, ϕ'	Reduced Strength Friction Angle, ϕ_r'	Cohesion, c	Total Unit Weight, γ [c]	Lateral (p-y)	Axial (t-z) [d]	Tip (Q-z) [e]	Torsional[f]	Static Modulus of Subgrade Reaction, k	Reduced Strength Modulus of Subgrade Reaction, k	Average Cohesion, c_{avg}	Strain at 50% of failure, ε_{50}	Static Side Resist. & Torsional Shear Stress	Reduced Strength Side Resist. & Torsional Shear Stress	Displ. at Nominal Unit Side Resistance	Unit Base Resistance (q_{nom}) [g]
	(feet)		(feet)	(feet)	(degrees)	(degrees)	(psf)	(pcf)					(pci)	(pci)	(psf)		(psf)	(psf)	(inches)	(ksf)
Bent 8 (Tied-Arch)	10	Fill	32	18	30	30	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	20	20	-	-	250	250	0.005 x D	-
		Fine-Grained Alluvium 1	18	0	-	-	200	105	Soft Clay (Matlock)	Driven Pile Sand (API)	-	Hyperbolic	-	-	200	0.02	110	110	0.005 x D	-
		Fine-Grained Alluvium 2	0	-33	24	16	-	105	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	5	5	-	-	300	300	0.005 x D	-
		Sand/Silt Alluvium (Silt-like)	-33	-72	25	19	-	110	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	20	20	-	-	1,200	1,200	0.005 x D	-
		Sand/Silt Alluvium (Sand-like)	-72	-110	31	27	-	115	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	65	52	-	-	2,500	2,000	0.005 x D	-
		Gravel Alluvium	-110	-150	42	42	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	4,000	4,000	0.005 x D	-
		Lower Troutdale Formation	-150	-170	44	44	-	140	Sand (Reese)	Driven Pile Sand (API)	Custom	Hyperbolic	225	225	-	-	20,000	20,000	0.005 x D	165

Table I1. Recommended Soil Parameters for LPile/FB-MultiPier Analyses

Pier	GWT Elev.	Subsurface Stratigraphy[a]			Soil Parameters [b]				Recommended LPile and FB-MultiPier Soil Model				Drilled Shaft Design Parameters							
		Geologic Unit	Top Elev.	Bottom Elev.	Static Friction Angle, ϕ'	Reduced Strength Friction Angle, ϕ_r'	Cohesion, c	Total Unit Weight, γ [c]	Lateral (p-y)	Axial (t-z) [d]	Tip (Q-z) [e]	Torsional[f]	Static Modulus of Subgrade Reaction, k	Reduced Strength Modulus of Subgrade Reaction, k	Average Cohesion, c_{avg}	Strain at 50% of failure, ε_{50}	Static Side Resist. & Torsional Shear Stress	Reduced Strength Side Resist. & Torsional Shear Stress	Displ. at Nominal Unit Side Resistance	Unit Base Resistance (q_{nom}) [g]
	(feet)		(feet)	(feet)	(degrees)	(degrees)	(psf)	(pcf)					(pci)	(pci)	(psf)		(psf)	(psf)	(inches)	(ksf)
Bent 9	10	Fill	47	27	32	32	-	115	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	25	25	-	-	500	500	0.005 x D	-
		Gravel Alluvium	27	2	42	42	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	3,000	3,000	0.005 x D	-
		Lower Troutdale Formation	2	-30	44	44	-	140	Sand (Reese)	Driven Pile Sand (API)	Custom	Hyperbolic	225	225	-	-	10,000	10,000	0.005 x D	80
Bent 10	10	Fill	65	45	32	32	-	115	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	25	25	-	-	500	500	0.005 x D	-
		Catastrophic Flood Deposits - Channel Facies	45	22	36	36	-	120	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	70	70	-	-	1,500	1,500	0.005 x D	-
		Gravel Alluvium	22	13	42	42	-	130	Sand (Reese)	Driven Pile Sand (API)	-	Hyperbolic	125	125	-	-	3,000	3,000	0.005 x D	-
		Lower Troutdale Formation	13	-10	44	44	-	140	Sand (Reese)	Driven Pile Sand (API)	Custom	Hyperbolic	225	225	-	-	10,000	10,000	0.005 x D	80

Notes:

a The soil stratigraphy is based on the shaft locations from files downloaded from ProjectWise on January 7, 2022. The soil stratigraphy may change based on additional subsurface explorations and laboratory testing to be performed during subsequent design phases.

b Static (drained) strength parameters are based on correlations to SPT blowcounts and our engineering judgement. Reduced strength (undrained) parameters are based on laboratory test results and reflect excess pore pressures generated in our seismic hazard analyses for the 1,000 year ground motions.

c LPILE analyses require input of Effective Unit Weight, γ'. Above the GWT, Effective Unit Weight = Total Unit Weight. Below the GWT, Effective Unit Weight = Total Unit Weight - Unit Weight of Water (approximately 62.4 pcf).

d The recommended curve for the axial t-z response is the Driven Pile Sand (API) curve. In our opinion, this curve provides a reasonable approximation of drilled shaft side resistance that is more suitable than other models available in FB-MultiPier.

e See Section 10.2.1.1 of the report for details regarding the recommended custom Q-z spring.

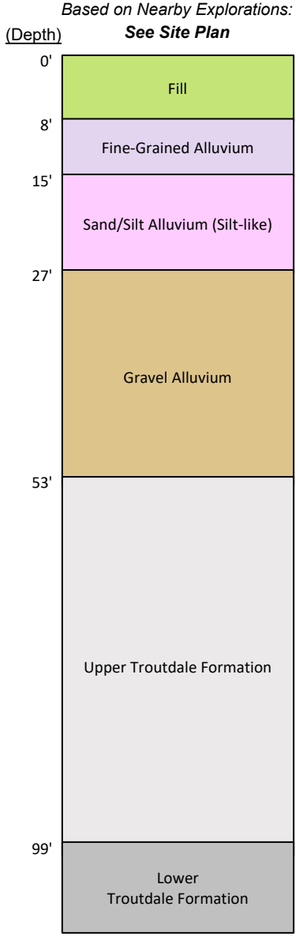
f Torsional shear stress is assumed equal to the unit side resistance for each soil layer.

g If the base of the drilled shaft is located within 1.5D of the Sandy River Mudstone (SRM) layer, the value of q_{nom} should be linearly interpolated between the full value (e.g. 165 ksf) at 1.5D from the SRM layer and 80 ksf at the Lower Troutdale Formation-SRM contact.

D = shaft diameter in inches; GWT = ground water table; ksf = kips per square foot; ksi = kips per square inch; pci = pounds per cubic inch; and psf = pounds per square foot

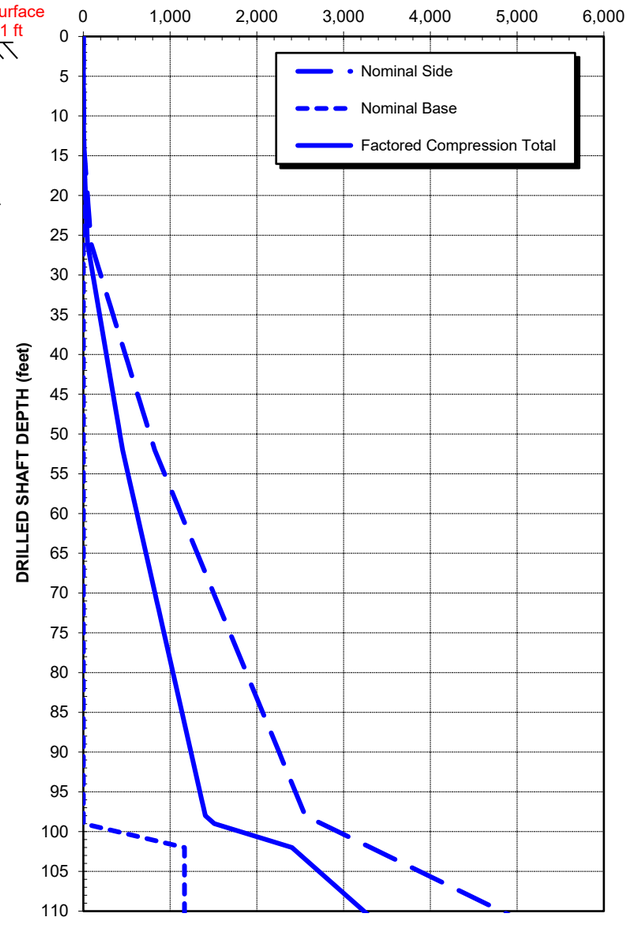
ASSUMED SUBSURFACE PROFILE

Based on Nearby Explorations: ***See Site Plan***

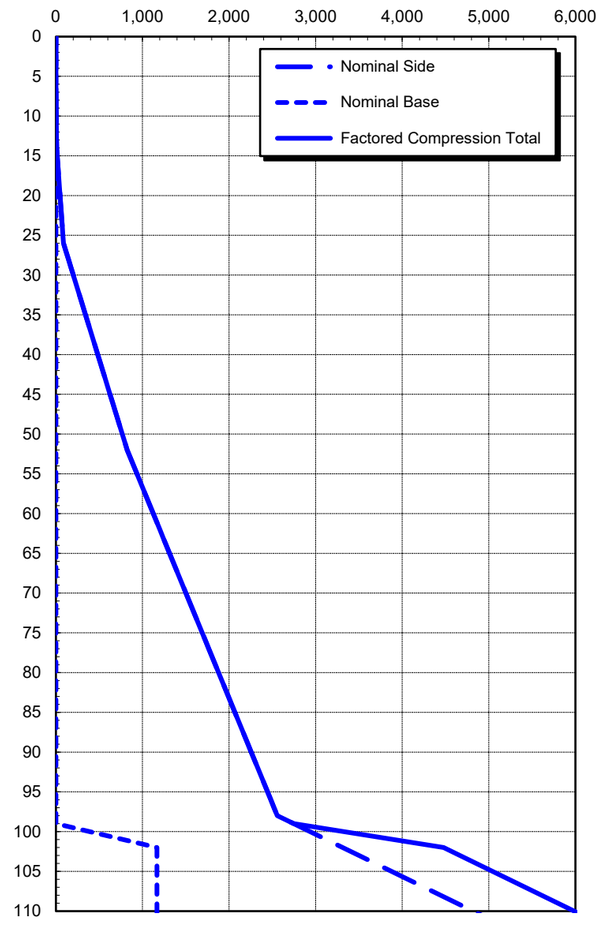


Ground Surface
Elev. 31 ft

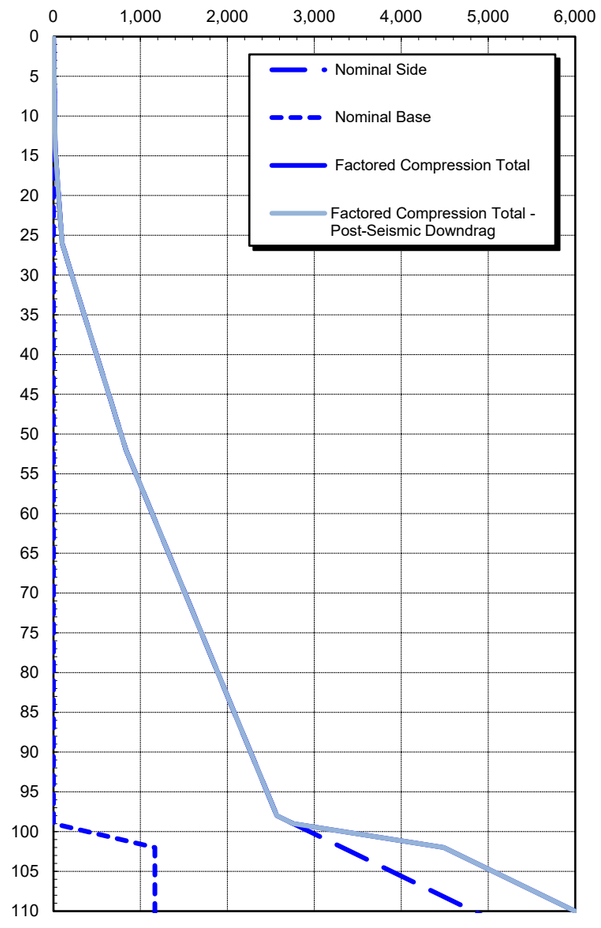
STRENGTH LIMIT



EXTREME EVENT: NON-LIQUEFIED STRENGTH



EXTREME EVENT: LIQUEFIED / REDUCED STRENGTH



NOTES

1. The analyses were performed based on guidelines included in AASHTO 2020, the ODOT GDM, and local experience. The analyses are based on a single shaft or a single row of shafts at a center-to-center spacing greater than or equal to 3 diameters.
2. Factored total shaft compression resistance shown on plots is determined by adding nominal side and base resistances multiplied by the corresponding resistance factors:

	Strength	Extreme: Non-Liquefied	Extreme: Liquefied/Reduced
Side Resistance - Compression	0.55	1.0	1.0
Side Resistance - Uplift	0.45	0.8	0.8
Base Resistance	0.50	1.0	1.0

3. The resistance factors should be reduced by 20% for a non-redundant single shaft supporting a bridge pier.
4. Estimated shaft resistance assumes temporary casing will be removed following drilled shaft installation and permanent casing will not be used.
5. Estimated shaft resistance for the Extreme Event: Liquefied/Reduced Strength case is based on the estimated reduced soil shear strength due to excess pore pressure generation determined in the seismic site response analyses.
6. The estimated post-seismic downdrag force is 0 kips. Post-seismic downdrag forces should be considered with the post-seismic downdrag resistance curves on the Extreme Event: Liquefied/Reduced Strength plot.

Earthquake Ready Burnside Bridge
Portland, Oregon

ESTIMATED AXIAL RESISTANCE
BENT 1
3-FOOT DIAMETER DRILLED SHAFT

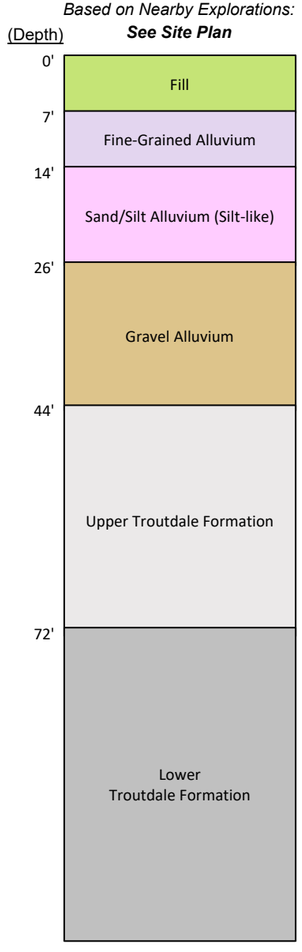
January 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

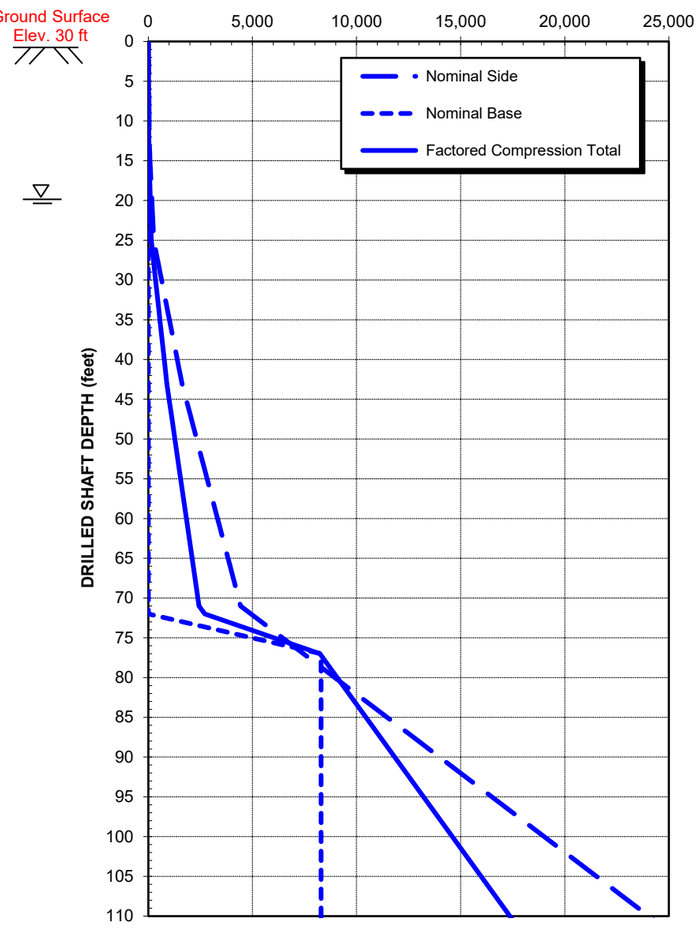
FIG. I1

ASSUMED SUBSURFACE PROFILE

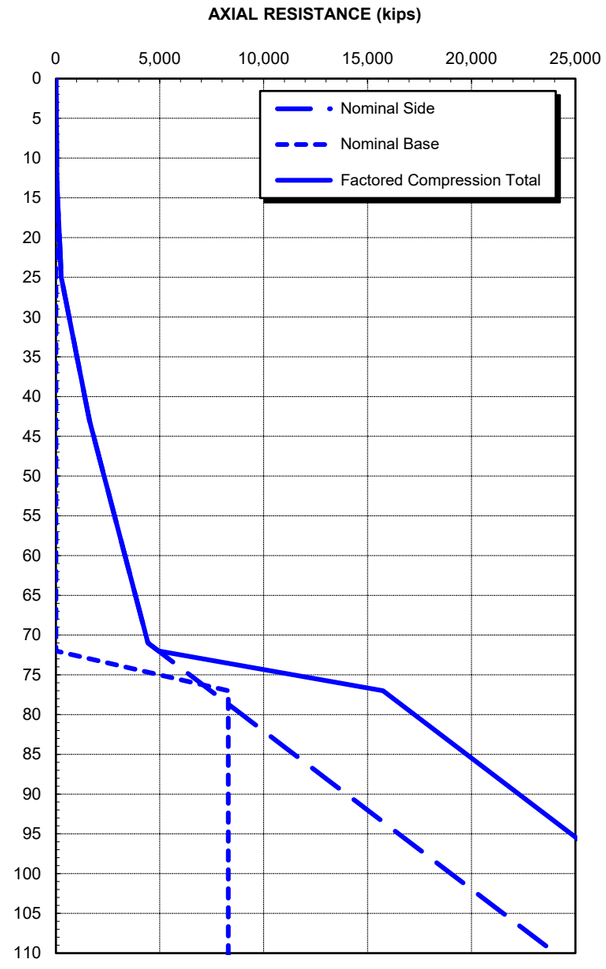
Based on Nearby Explorations: ***See Site Plan***



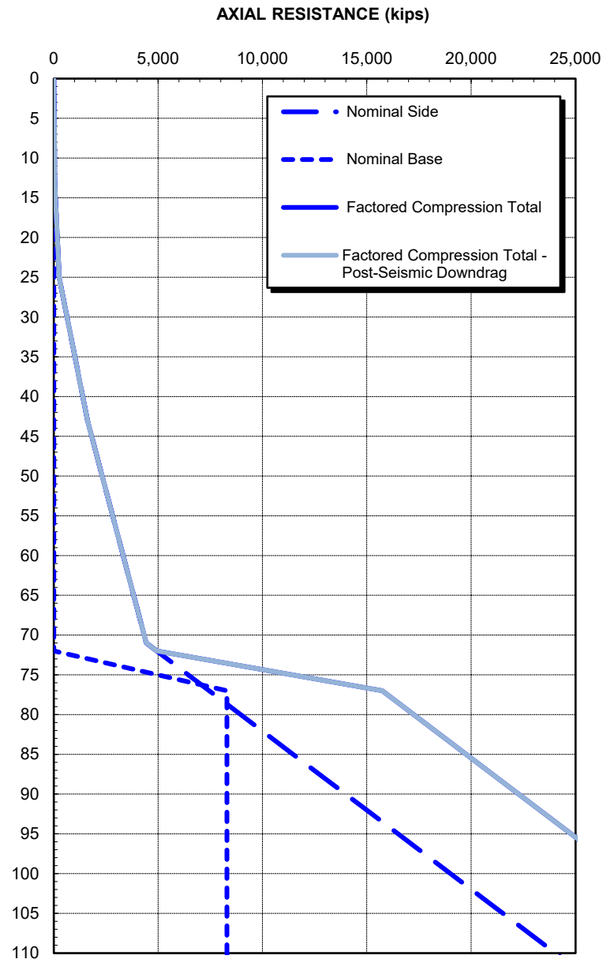
STRENGTH LIMIT



EXTREME EVENT: NON-LIQUEFIED STRENGTH



EXTREME EVENT: LIQUEFIED / REDUCED STRENGTH



NOTES

1. The analyses were performed based on guidelines included in AASHTO 2020, the ODOT GDM, and local experience. The analyses are based on a single shaft or a single row of shafts at a center-to-center spacing greater than or equal to 3 diameters.
2. Factored total shaft compression resistance shown on plots is determined by adding nominal side and base resistances multiplied by the corresponding resistance factors:

	Strength	Extreme: Non-Liquefied	Extreme: Liquefied/Reduced
Side Resistance - Compression	0.55	1.0	1.0
Side Resistance - Uplift	0.45	0.8	0.8
Base Resistance	0.50	1.0	1.0

3. The resistance factors should be reduced by 20% for a non-redundant single shaft supporting a bridge pier.
4. Estimated shaft resistance assumes temporary casing will be removed following drilled shaft installation and permanent casing will not be used.
5. Estimated shaft resistance for the Extreme Event: Liquefied/Reduced Strength case is based on the estimated reduced soil shear strength due to excess pore pressure generation determined in the seismic site response analyses.
6. The estimated post-seismic downdrag force is 0 kips. Post-seismic downdrag forces should be considered with the post-seismic downdrag resistance curves on the Extreme Event: Liquefied/Reduced Strength plot.

Earthquake Ready Burnside Bridge
Portland, Oregon

ESTIMATED AXIAL RESISTANCE
BENT 2
8-FOOT DIAMETER DRILLED SHAFT

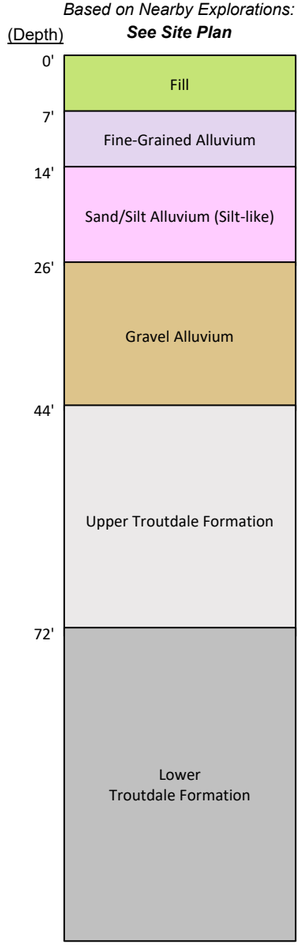
January 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. I2

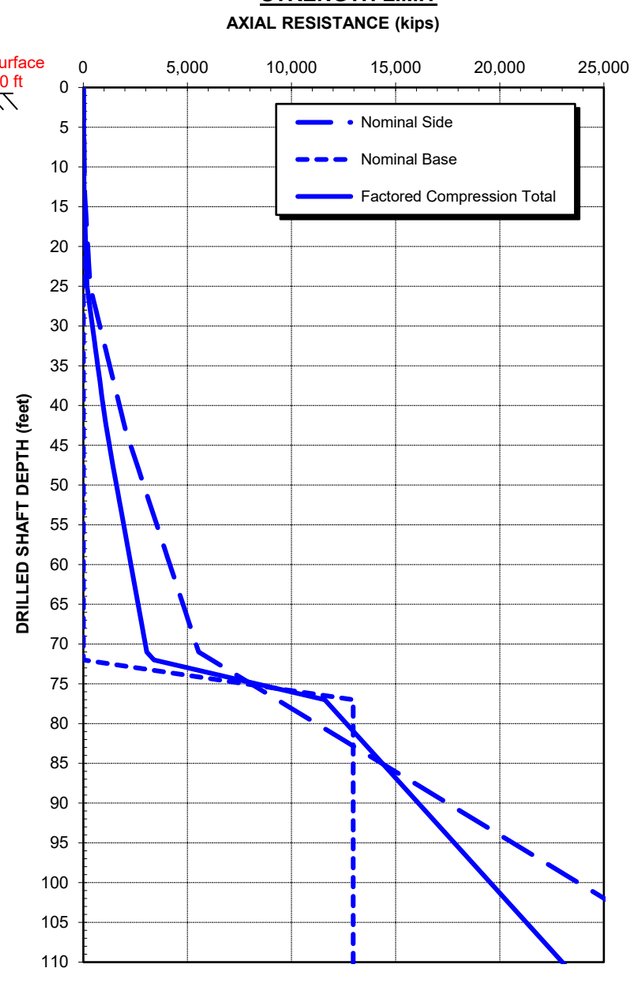
ASSUMED SUBSURFACE PROFILE

Based on Nearby Explorations: ***See Site Plan***

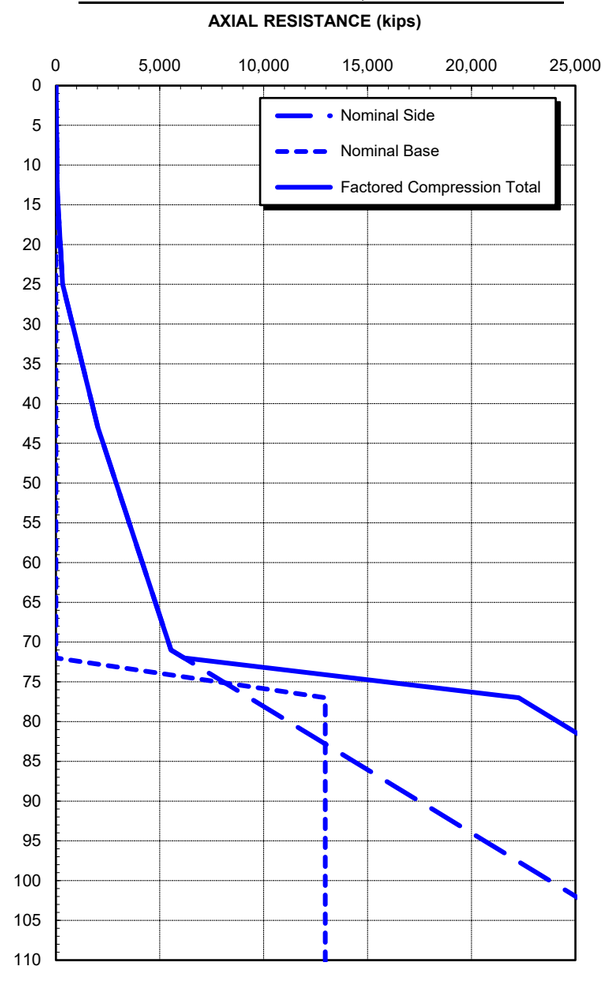




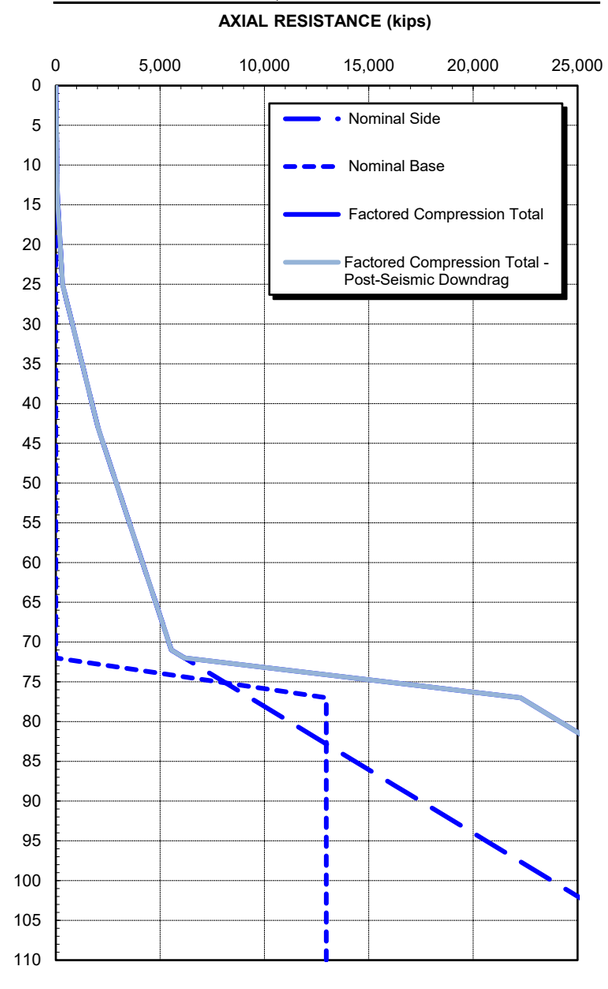
STRENGTH LIMIT



EXTREME EVENT: NON-LIQUEFIED STRENGTH



EXTREME EVENT: LIQUEFIED / REDUCED STRENGTH



NOTES

1. The analyses were performed based on guidelines included in AASHTO 2020, the ODOT GDM, and local experience. The analyses are based on a single shaft or a single row of shafts at a center-to-center spacing greater than or equal to 3 diameters.
2. Factored total shaft compression resistance shown on plots is determined by adding nominal side and base resistances multiplied by the corresponding resistance factors:

	Strength	Extreme: Non-Liquefied	Extreme: Liquefied/Reduced
Side Resistance - Compression	0.55	1.0	1.0
Side Resistance - Uplift	0.45	0.8	0.8
Base Resistance	0.50	1.0	1.0

3. The resistance factors should be reduced by 20% for a non-redundant single shaft supporting a bridge pier.
4. Estimated shaft resistance assumes temporary casing will be removed following drilled shaft installation and permanent casing will not be used.
5. Estimated shaft resistance for the Extreme Event: Liquefied/Reduced Strength case is based on the estimated reduced soil shear strength due to excess pore pressure generation determined in the seismic site response analyses.
6. The estimated post-seismic downdrag force is 0 kips. Post-seismic downdrag forces should be considered with the post-seismic downdrag resistance curves on the Extreme Event: Liquefied/Reduced Strength plot.

Earthquake Ready Burnside Bridge
Portland, Oregon

ESTIMATED AXIAL RESISTANCE
BENT 2
10-FOOT DIAMETER DRILLED SHAFT

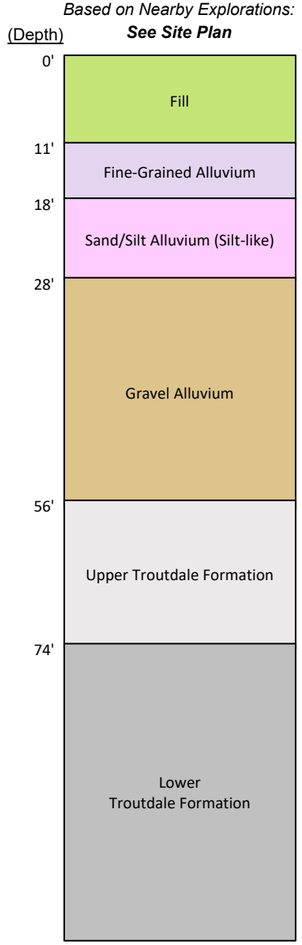
January 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

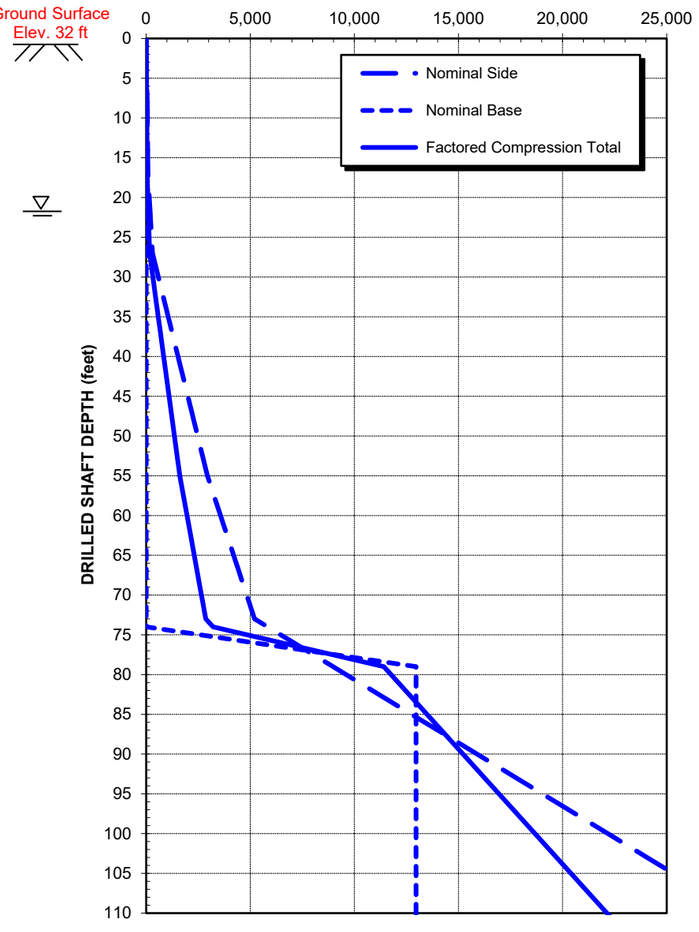
FIG. I3

ASSUMED SUBSURFACE PROFILE

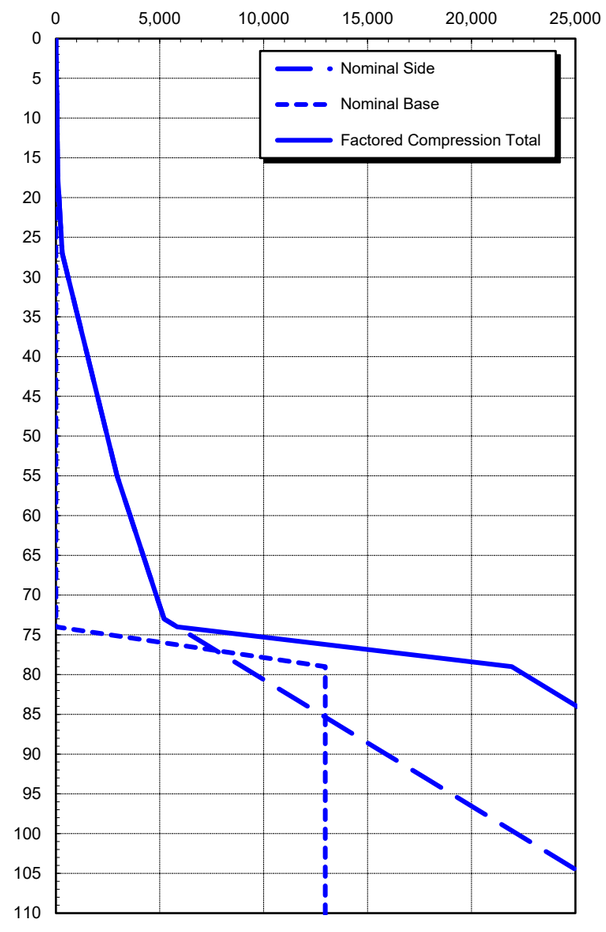
Based on Nearby Explorations: ***See Site Plan***



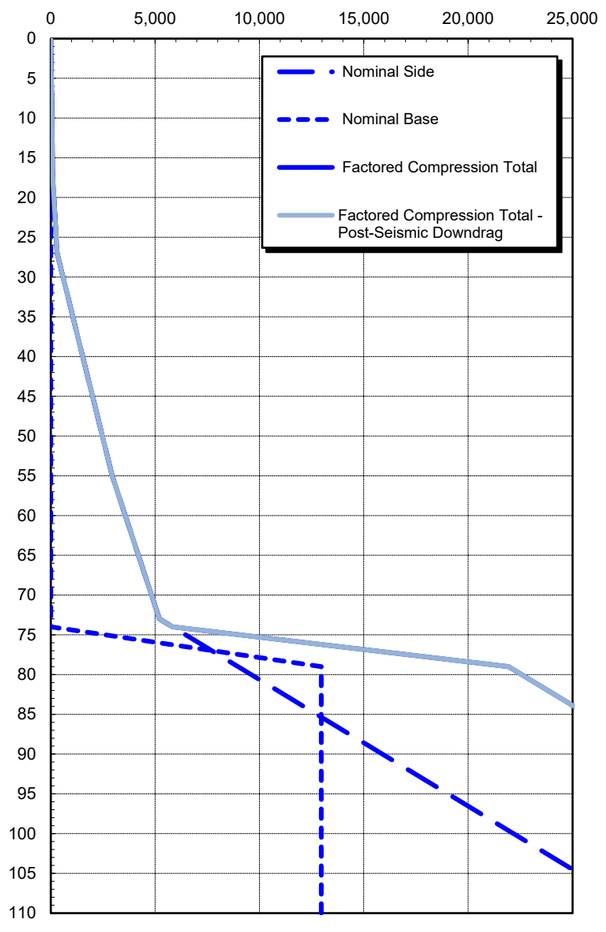
STRENGTH LIMIT



EXTREME EVENT: NON-LIQUEFIED STRENGTH



EXTREME EVENT: LIQUEFIED / REDUCED STRENGTH



NOTES

1. The analyses were performed based on guidelines included in AASHTO 2020, the ODOT GDM, and local experience. The analyses are based on a single shaft or a single row of shafts at a center-to-center spacing greater than or equal to 3 diameters.
2. Factored total shaft compression resistance shown on plots is determined by adding nominal side and base resistances multiplied by the corresponding resistance factors:

	Strength	Extreme: Non-Liquefied	Extreme: Liquefied/Reduced
Side Resistance - Compression	0.55	1.0	1.0
Side Resistance - Uplift	0.45	0.8	0.8
Base Resistance	0.50	1.0	1.0

3. The resistance factors should be reduced by 20% for a non-redundant single shaft supporting a bridge pier.
4. Estimated shaft resistance assumes temporary casing will be removed following drilled shaft installation and permanent casing will not be used.
5. Estimated shaft resistance for the Extreme Event: Liquefied/Reduced Strength case is based on the estimated reduced soil shear strength due to excess pore pressure generation determined in the seismic site response analyses.
6. The estimated post-seismic downdrag force is 0 kips. Post-seismic downdrag forces should be considered with the post-seismic downdrag resistance curves on the Extreme Event: Liquefied/Reduced Strength plot.

Earthquake Ready Burnside Bridge
Portland, Oregon

ESTIMATED AXIAL RESISTANCE
BENT 3
10-FOOT DIAMETER DRILLED SHAFT

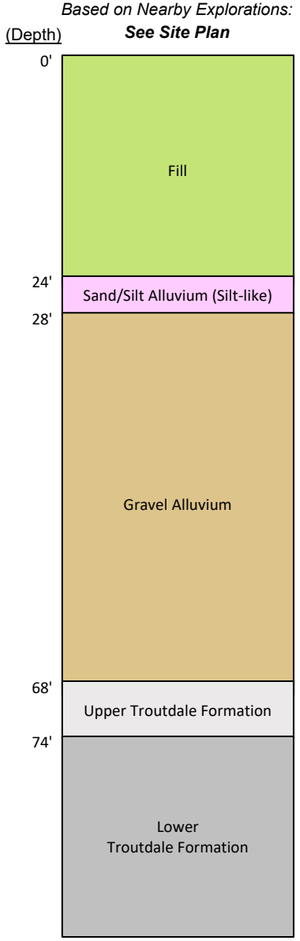
January 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

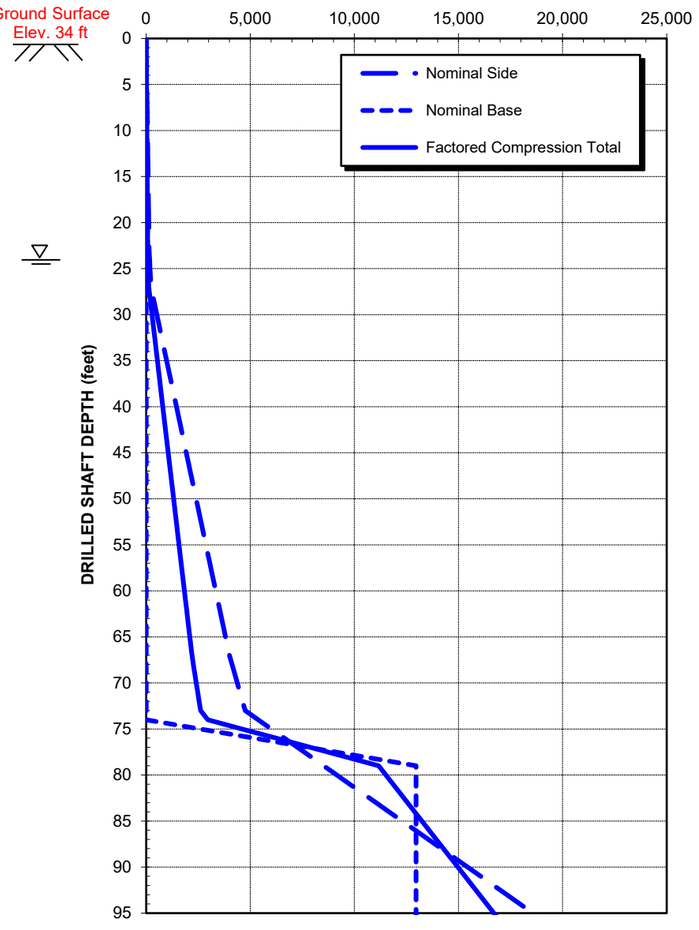
FIG. I4

ASSUMED SUBSURFACE PROFILE

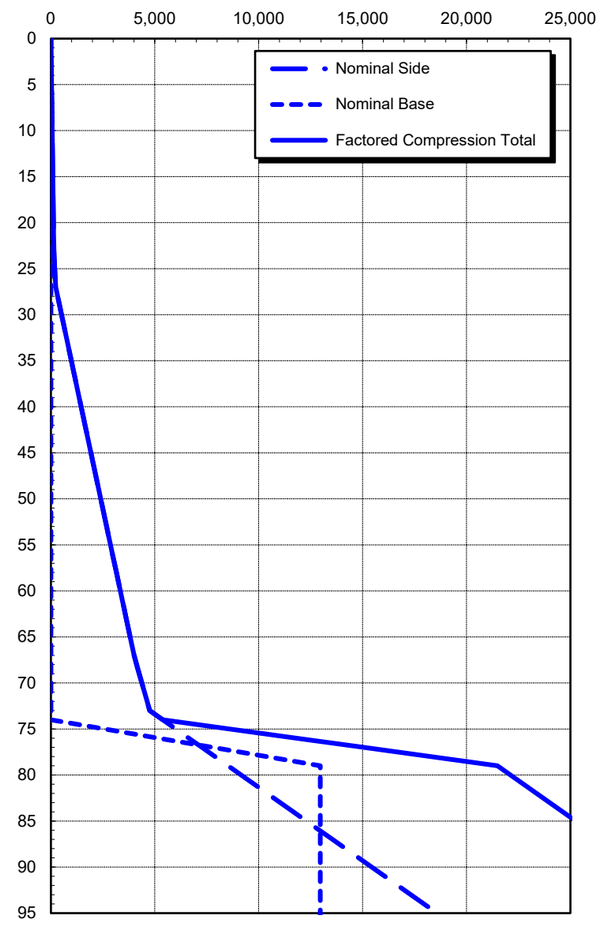
Based on Nearby Explorations: ***See Site Plan***



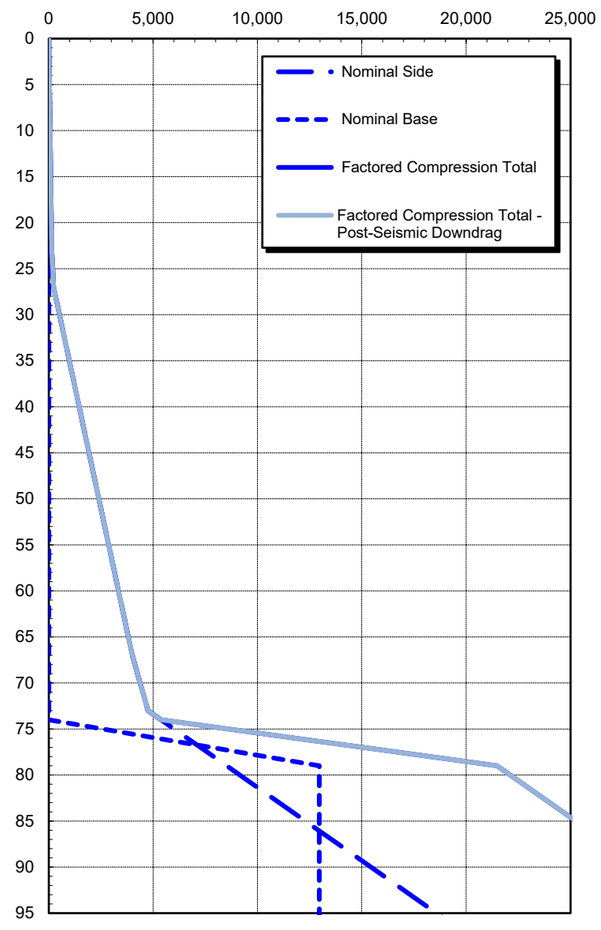
STRENGTH LIMIT



EXTREME EVENT: NON-LIQUEFIED STRENGTH



EXTREME EVENT: LIQUEFIED / REDUCED STRENGTH



NOTES

1. The analyses were performed based on guidelines included in AASHTO 2020, the ODOT GDM and local experience. The analyses are based on a single shaft or a single row of shafts at a center-to-center spacing greater than or equal to 3 diameters.
2. Factored total shaft compression resistance shown on plots is determined by adding nominal side and base resistances multiplied by the corresponding resistance factor:

	Strength	Extreme: Non-Liquefied	Extreme: Liquefied/Reduced
Side Resistance - Compression	0.55	1.0	1.0
Side Resistance - Uplift	0.45	0.8	0.8
Base Resistance	0.50	1.0	1.0

3. The resistance factors should be reduced by 20% for a non-redundant single shaft supporting a bridge pier.
4. Estimated shaft resistance assumes temporary casing will be removed following drilled shaft installation and permanent casing will not be used.
5. Estimated shaft resistance for the Extreme Event: Liquefied/Reduced Strength case is based on the estimated reduced soil shear strength due to excess pore pressure generation determined in the seismic site response analyses.
6. The estimated post-seismic downdrag force is 0 kips. Post-seismic downdrag forces should be considered with the post-seismic downdrag resistance curves on the Extreme Event: Liquefied/Reduced Strength plot.

Earthquake Ready Burnside Bridge
Portland, Oregon

ESTIMATED AXIAL RESISTANCE
BENT 4
10-FOOT DIAMETER DRILLED SHAFT

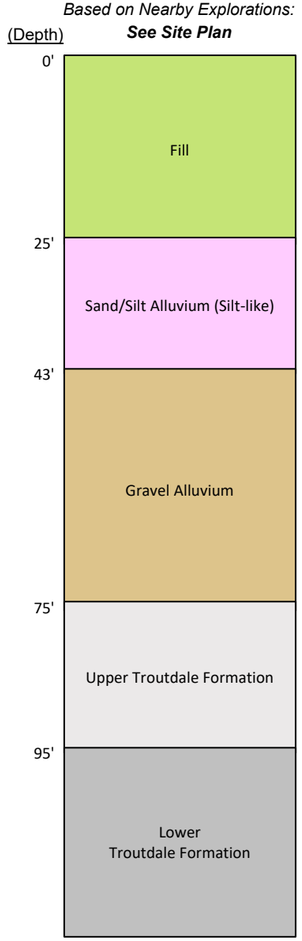
January 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. I5

ASSUMED SUBSURFACE PROFILE

Based on Nearby Explorations:
See Site Plan



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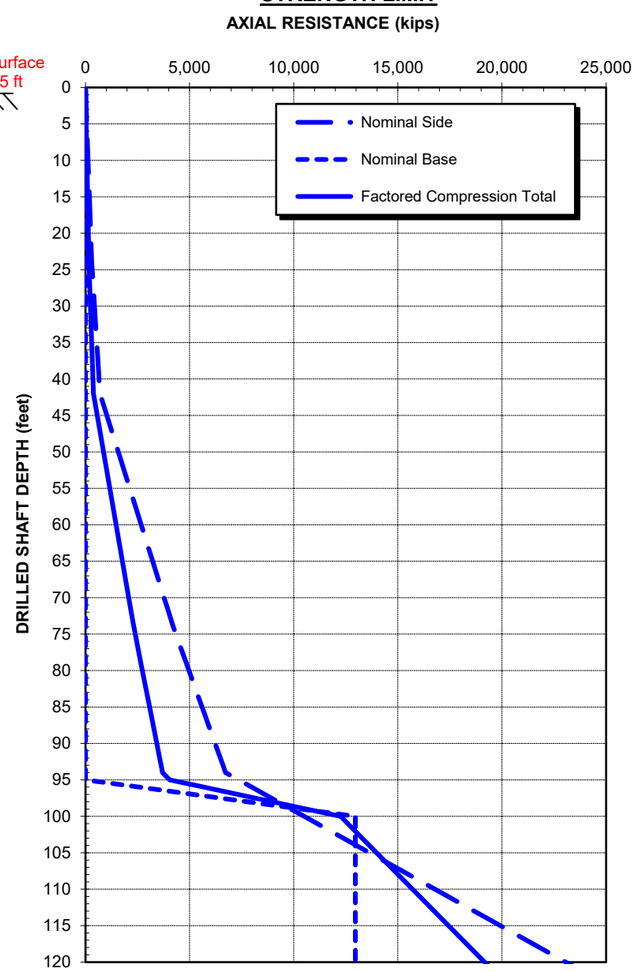
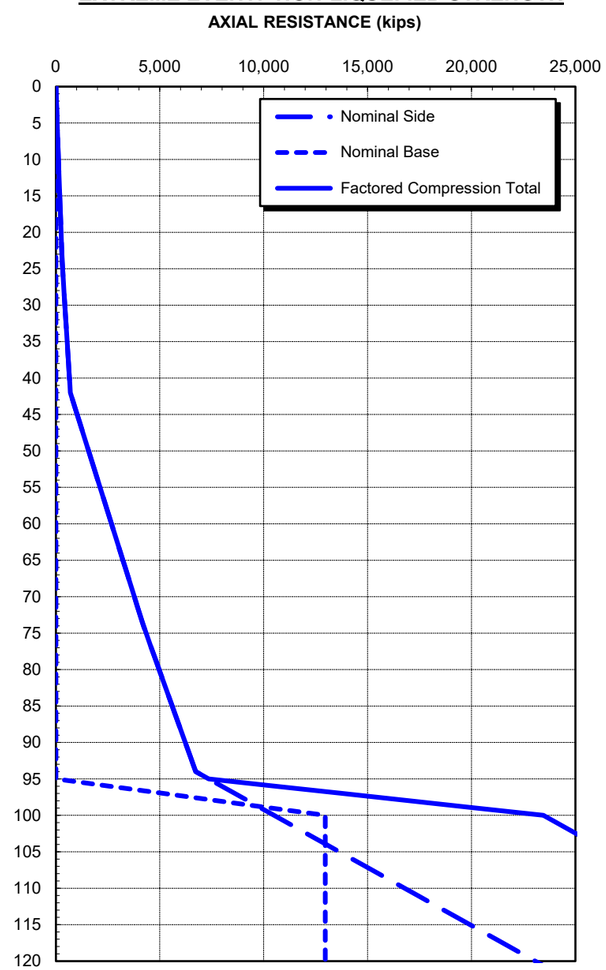
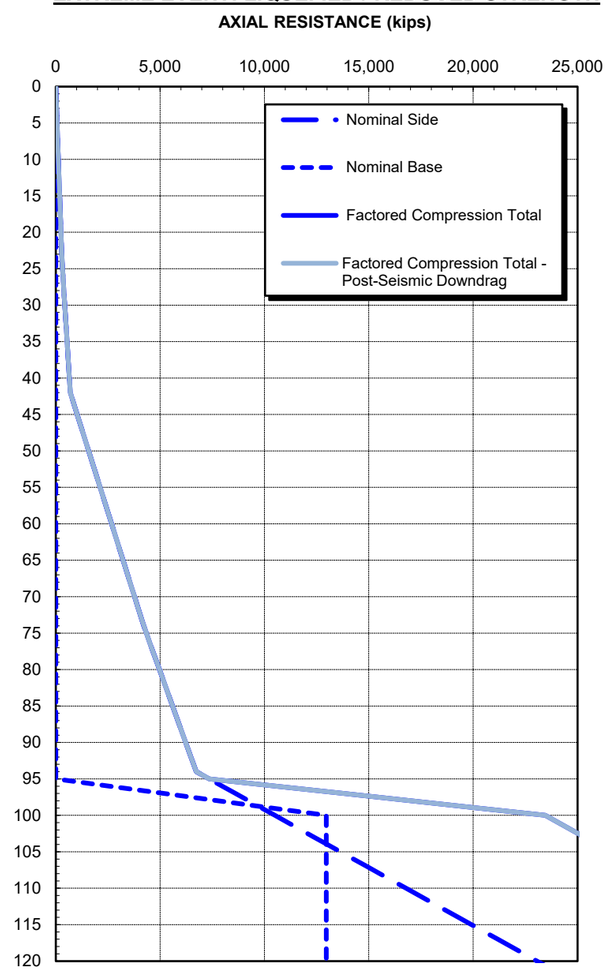


EXTREME EVENT: NON-LIQUEFIED STRENGTH



EXTREME EVENT: LIQUEFIED / REDUCED STRENGTH



NOTES

1. The analyses were performed based on guidelines included in AASHTO 2020, the ODOT GDM, and local experience. The analyses are based on a single shaft or a single row of shafts at a center-to-center spacing greater than or equal to 3 diameters.
2. Factored total shaft compression resistance shown on plots is determined by adding nominal side and base resistances multiplied by the corresponding resistance factors:

	Strength	Extreme: Non-Liquefied	Extreme: Liquefied/Reduced
Side Resistance - Compression	0.55	1.0	1.0
Side Resistance - Uplift	0.45	0.8	0.8
Base Resistance	0.50	1.0	1.0

3. The resistance factors should be reduced by 20% for a non-redundant single shaft supporting a bridge pier.
4. Estimated shaft resistance assumes temporary casing will be removed following drilled shaft installation and permanent casing will not be used.
5. Estimated shaft resistance for the Extreme Event: Liquefied/Reduced Strength case is based on the estimated reduced soil shear strength due to excess pore pressure generation determined in the seismic site response analyses.
6. The estimated post-seismic downdrag force is 0 kips. Post-seismic downdrag forces should be considered with the post-seismic downdrag resistance curves on the Extreme Event: Liquefied/Reduced Strength plot.

Earthquake Ready Burnside Bridge
Portland, Oregon

ESTIMATED AXIAL RESISTANCE
BENT 5
10-FOOT DIAMETER DRILLED SHAFT

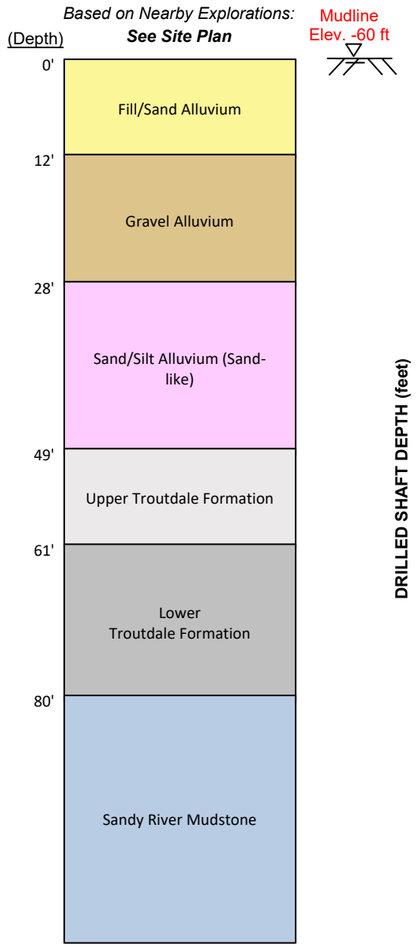
January 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

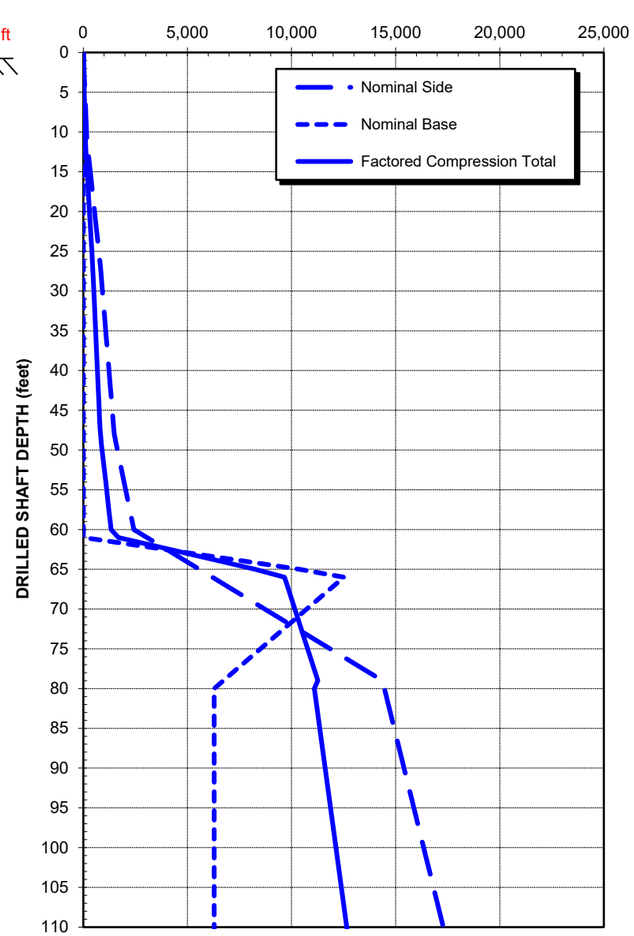
FIG. I6

ASSUMED SUBSURFACE PROFILE

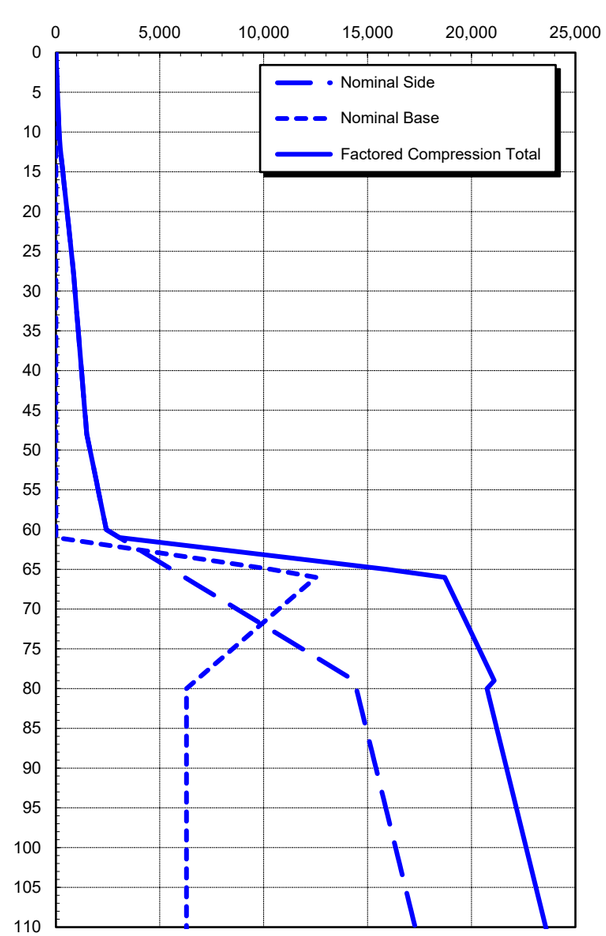
Based on Nearby Explorations: ***See Site Plan***



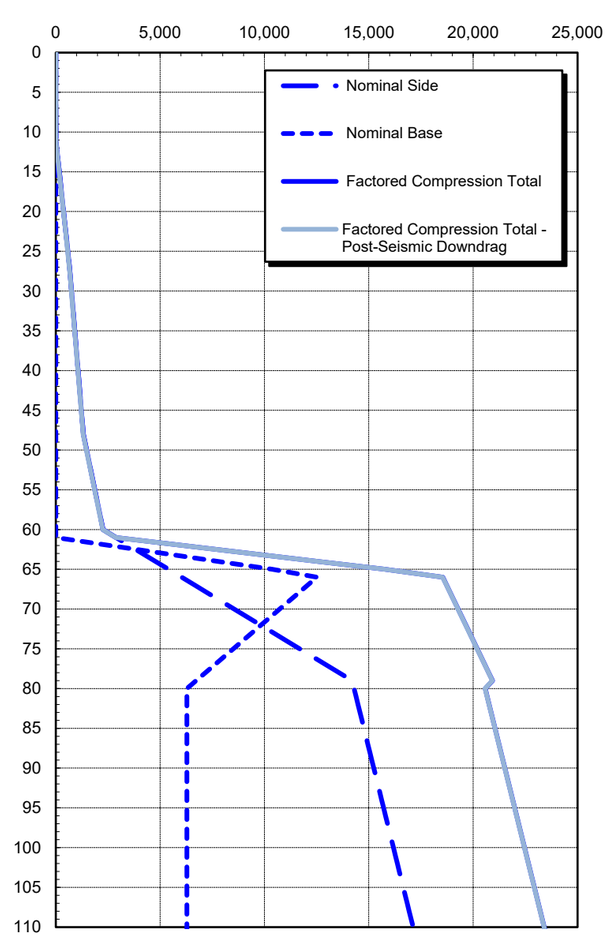
STRENGTH LIMIT



EXTREME EVENT: NON-LIQUEFIED STRENGTH



EXTREME EVENT: LIQUEFIED / REDUCED STRENGTH



NOTES

1. The analyses were performed based on guidelines included in AASHTO 2020, the ODOT GDM, and local experience. The analyses are based on a single shaft or multiple rows of shafts at a center-to-center spacing greater than or equal to 4 diameters.
2. Factored total shaft compression resistance shown on plots is determined by adding nominal side and base resistances multiplied by the corresponding resistance factors:

	Strength	Extreme: Non-Liquefied	Extreme: Liquefied/Reduced
Side Resistance - Compression	0.55	1.0	1.0
Side Resistance - Uplift	0.45	0.8	0.8
Base Resistance	0.50	1.0	1.0

3. The resistance factors should be reduced by 20% for a non-redundant single shaft supporting a bridge pier.
4. Estimated shaft resistance assumes permanent casing will be installed to a maximum depth of 15 feet into the Gravel Alluvium.
5. Estimated shaft resistance for the Extreme Event: Liquefied/Reduced Strength case is based on the estimated reduced soil shear strength due to excess pore pressure generation determined in the seismic site response analyses.
6. The estimated post-seismic downdrag force is 86 kips. Post-seismic downdrag forces should be considered with the post-seismic downdrag resistance curves on the Extreme Event: Liquefied/Reduced Strength plot.

Earthquake Ready Burnside Bridge
Portland, Oregon

ESTIMATED AXIAL RESISTANCE
BENT 6
10-FOOT DIAMETER DRILLED SHAFT

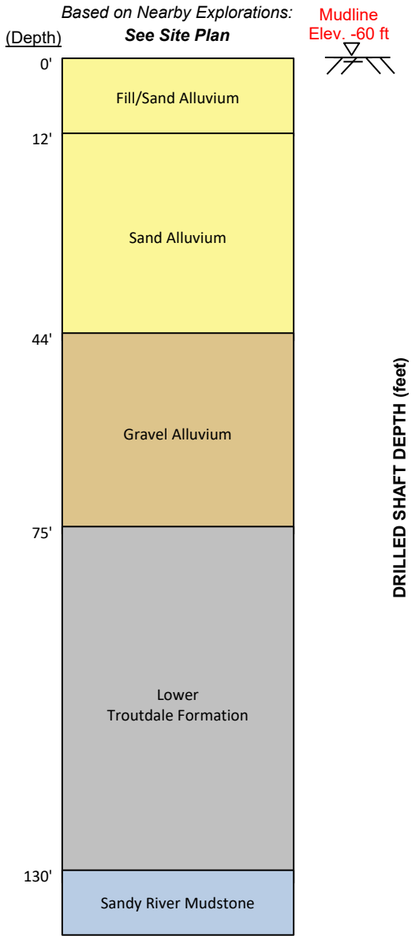
January 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

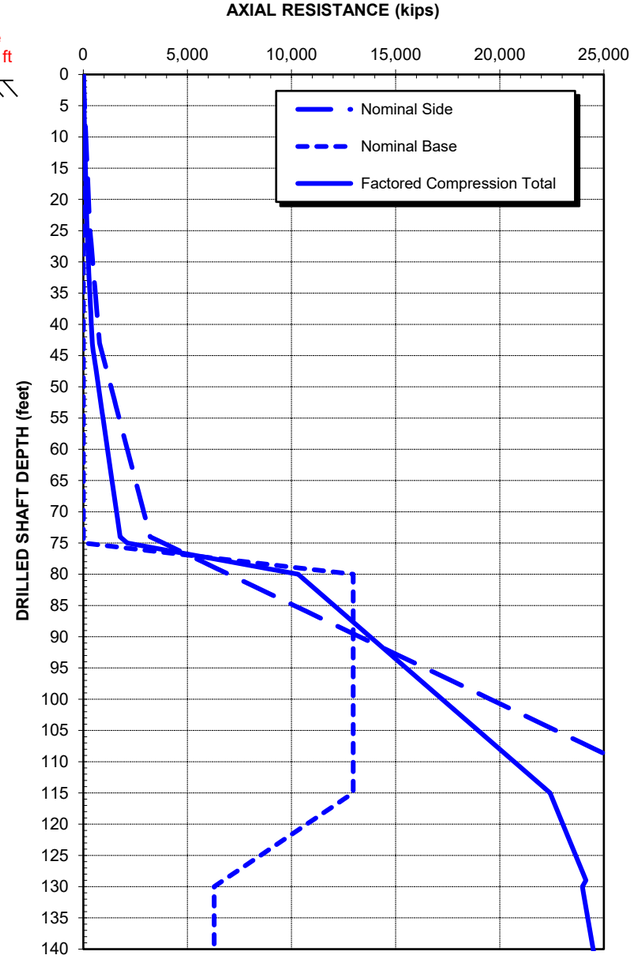
FIG. I7

ASSUMED SUBSURFACE PROFILE

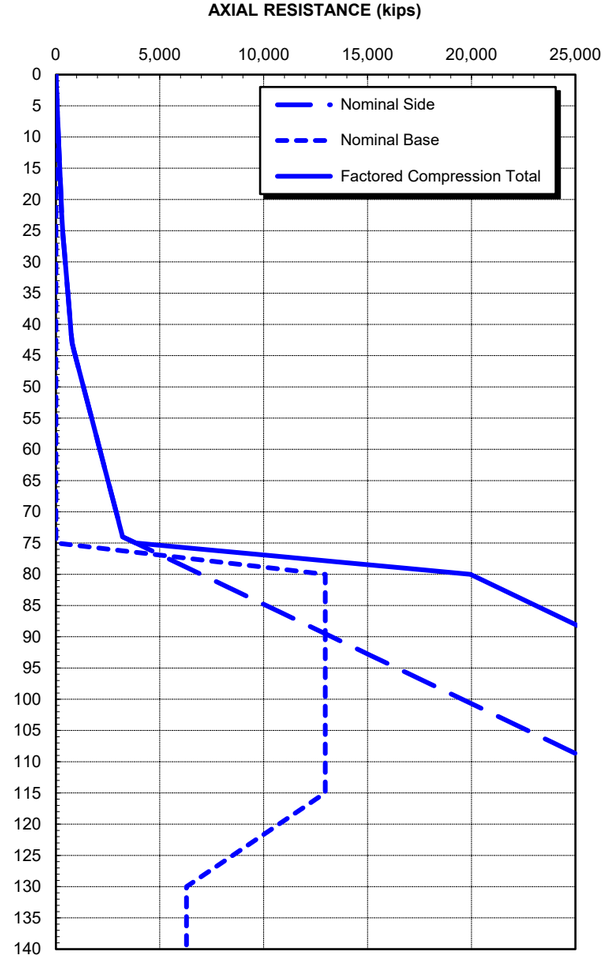
Based on Nearby Explorations: ***See Site Plan***



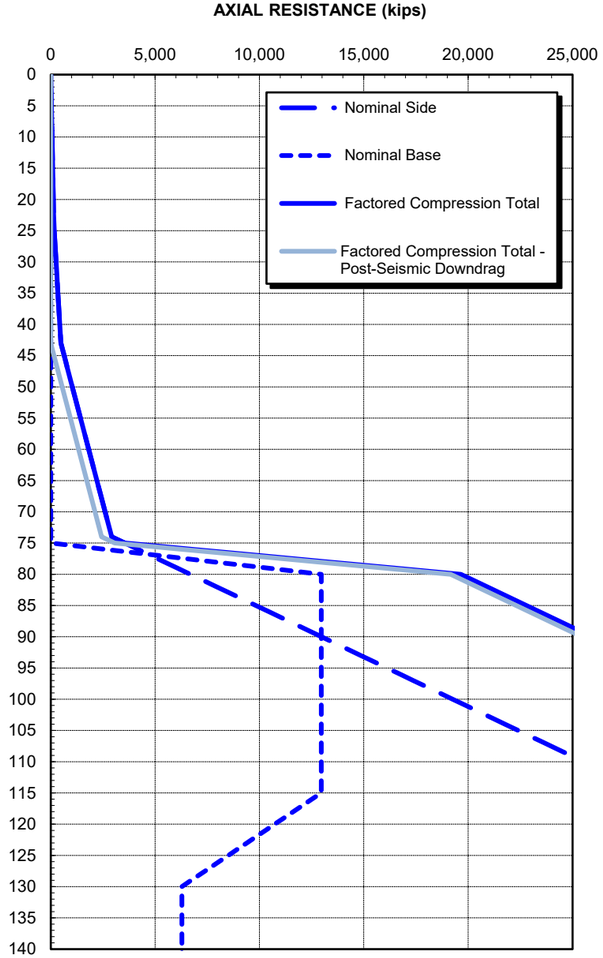
STRENGTH LIMIT



EXTREME EVENT: NON-LIQUEFIED STRENGTH



EXTREME EVENT: LIQUEFIED / REDUCED STRENGTH



NOTES

1. The analyses were performed based on guidelines included in AASHTO 2020, the ODOT GDM, and local experience. The analyses are based on a single shaft or multiple rows of shafts at a center-to-center spacing greater than or equal to 4 diameters.
2. Factored total shaft compression resistance shown on plots is determined by adding nominal side and base resistances multiplied by the corresponding resistance factors:

	Strength	Extreme: Non-Liquefied	Extreme: Liquefied/Reduced
Side Resistance - Compression	0.55	1.0	1.0
Side Resistance - Uplift	0.45	0.8	0.8
Base Resistance	0.50	1.0	1.0

3. The resistance factors should be reduced by 20% for a non-redundant single shaft supporting a bridge pier.
4. Estimated shaft resistance assumes permanent casing will be installed to a maximum depth of 15 feet into the Gravel Alluvium.
5. Estimated shaft resistance for the Extreme Event: Liquefied/Reduced Strength case is based on the estimated reduced soil shear strength due to excess pore pressure generation determined in the seismic site response analyses.
6. The estimated post-seismic downdrag force is 490 kips. Post-seismic downdrag forces should be considered with the post-seismic downdrag resistance curves on the Extreme Event: Liquefied/Reduced Strength plot.

Earthquake Ready Burnside Bridge
Portland, Oregon

ESTIMATED AXIAL RESISTANCE
BENT 7
10-FOOT DIAMETER DRILLED SHAFT

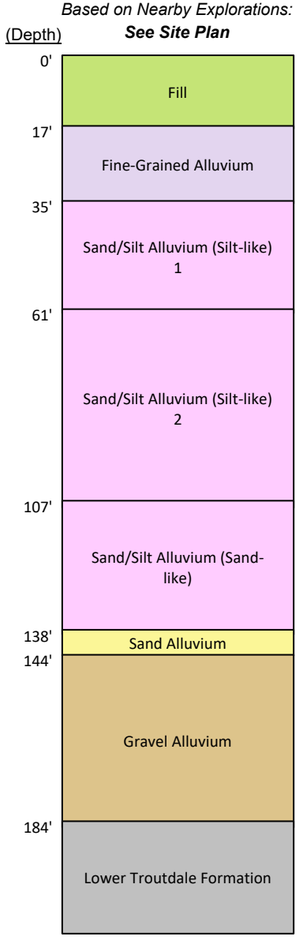
January 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. I8

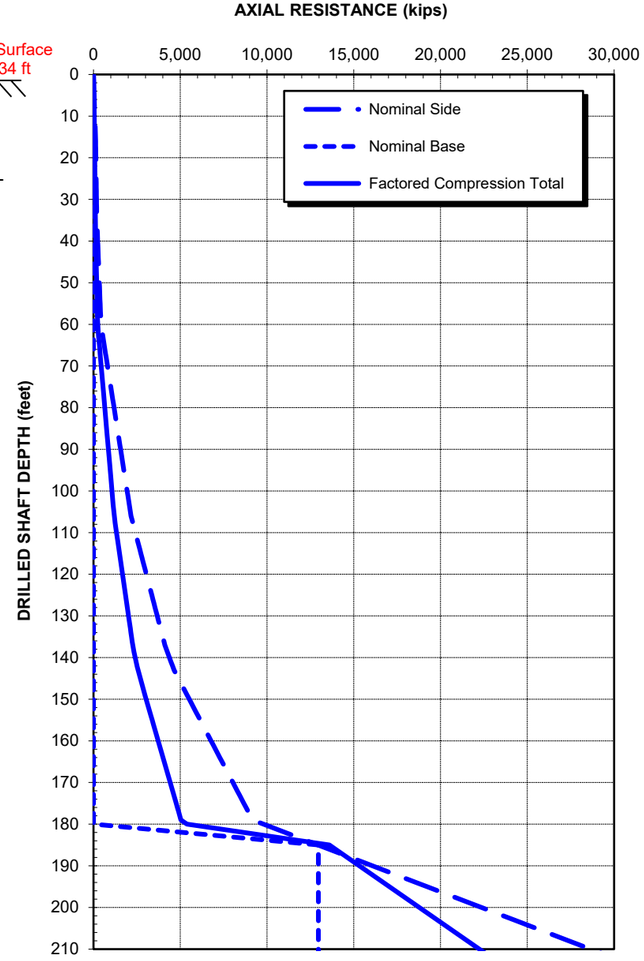
ASSUMED SUBSURFACE PROFILE

Based on Nearby Explorations: ***See Site Plan***

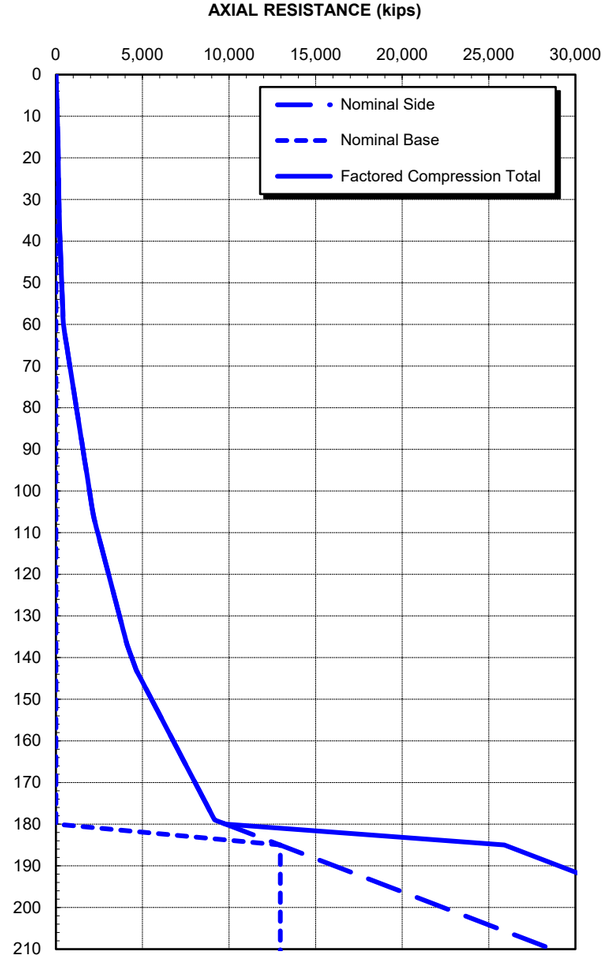


Bottom of Boring at 194 feet

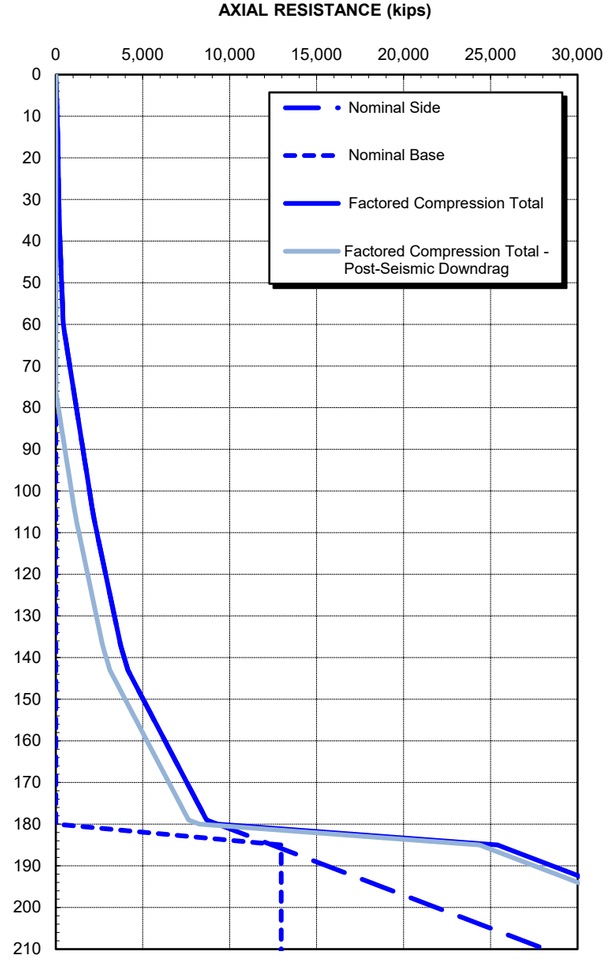
STRENGTH LIMIT



EXTREME EVENT: NON-LIQUEFIED STRENGTH



EXTREME EVENT: LIQUEFIED / REDUCED STRENGTH



NOTES

1. The analyses were performed based on guidelines included in AASHTO 2020, the ODOT GDM, and local experience. The analyses are based on a single shaft or multiple rows of shafts at a center-to-center spacing greater than or equal to 4 diameters.
2. Factored total shaft compression resistance shown on plots is determined by adding nominal side and base resistances multiplied by the corresponding resistance factors:

	Strength	Extreme: Non-Liquefied	Extreme: Liquefied/Reduced
Side Resistance - Compression	0.55	1.0	1.0
Side Resistance - Uplift	0.45	0.8	0.8
Base Resistance	0.50	1.0	1.0

3. The resistance factors should be reduced by 20% for a non-redundant single shaft supporting a bridge pier.
4. Estimated shaft resistance assumes temporary casing will be removed following drilled shaft installation and permanent casing will not be used.
5. Estimated shaft resistance for the Extreme Event: Liquefied/Reduced Strength case is based on the estimated reduced soil shear strength due to excess pore pressure generation determined in the seismic site response analyses.
6. The estimated post-seismic downdrag force is 1,040 kips. Post-seismic downdrag forces should be considered with the post-seismic downdrag resistance curves on the Extreme Event: Liquefied/Reduced Strength plot.

Earthquake Ready Burnside Bridge
Portland, Oregon

ESTIMATED AXIAL RESISTANCE
BENT 8 (CABLE STAY TOWER)
10-FOOT DIAMETER DRILLED SHAFT

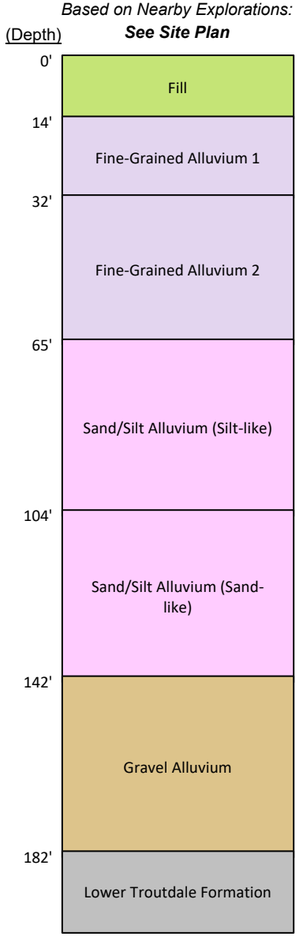
January 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

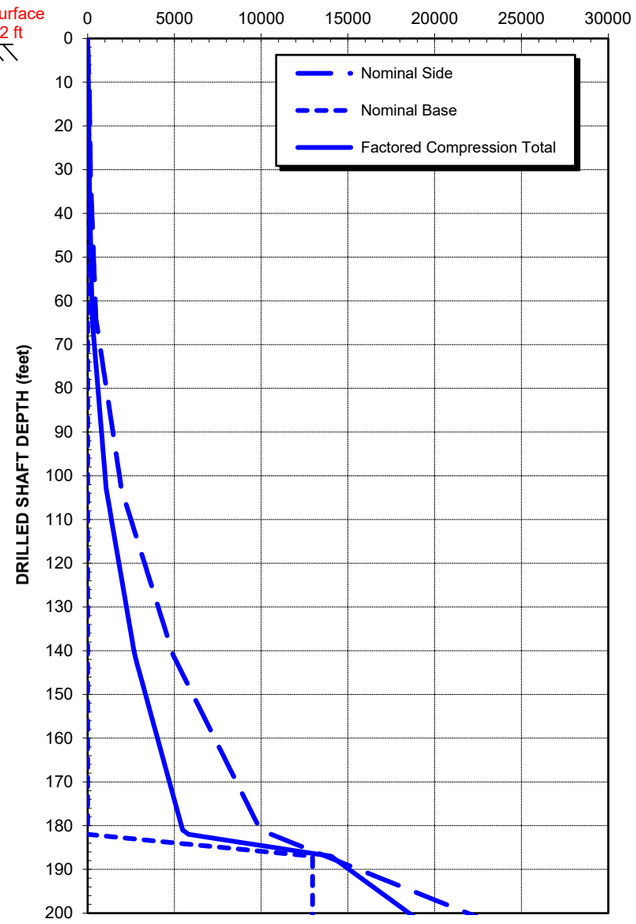
FIG. I9

ASSUMED SUBSURFACE PROFILE

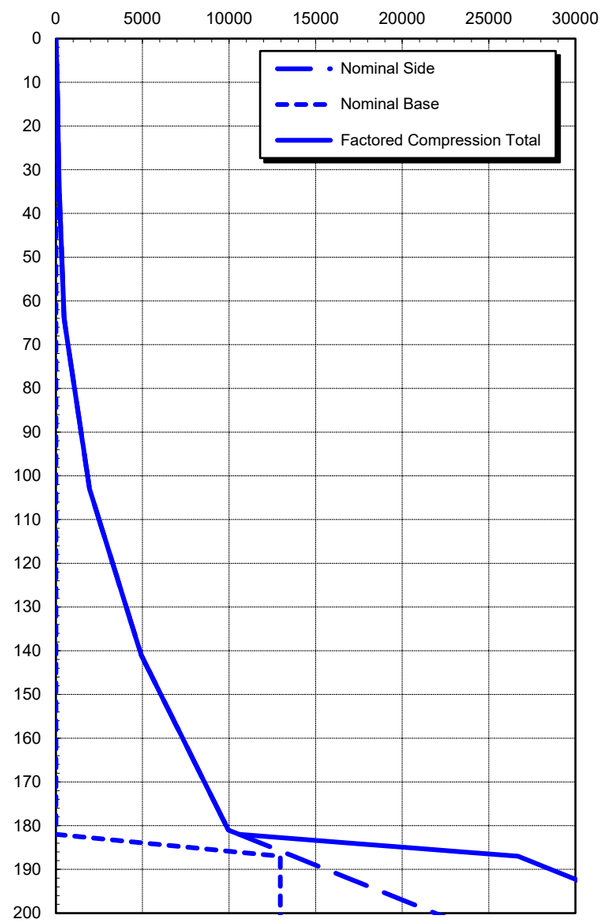
Based on Nearby Explorations: ***See Site Plan***



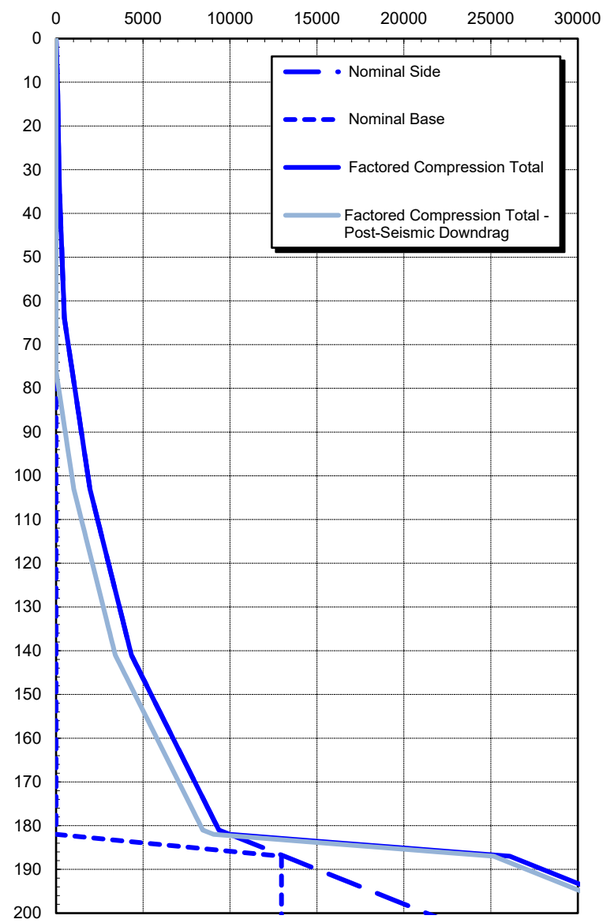
STRENGTH LIMIT



EXTREME EVENT: NON-LIQUEFIED STRENGTH



EXTREME EVENT: LIQUEFIED / REDUCED STRENGTH



NOTES

1. The analyses were performed based on guidelines included in AASHTO 2020, the ODOT GDM, and local experience. The analyses are based on a single shaft or a single row of shafts at a center-to-center spacing greater than or equal to 3 diameters.
2. Factored total shaft compression resistance shown on plots is determined by adding nominal side and base resistances multiplied by the corresponding resistance factors:

	Strength	Extreme: Non-Liquefied	Extreme: Liquefied/Reduced
Side Resistance - Compression	0.55	1.0	1.0
Side Resistance - Uplift	0.45	0.8	0.8
Base Resistance	0.50	1.0	1.0

3. The resistance factors should be reduced by 20% for a non-redundant single shaft supporting a bridge pier.
4. Estimated shaft resistance assumes temporary casing will be removed following drilled shaft installation and permanent casing will not be used.
5. Estimated shaft resistance for the Extreme Event: Liquefied/Reduced Strength case is based on the estimated reduced soil shear strength due to excess pore pressure generation determined in the seismic site response analyses.
6. The estimated post-seismic downdrag force is 930 kips. Post-seismic downdrag forces should be considered with the post-seismic downdrag resistance curves on the Extreme Event: Liquefied/Reduced Strength plot.

Earthquake Ready Burnside Bridge
Portland, Oregon

ESTIMATED AXIAL RESISTANCE
BENT 8 (LONG ARCH)
10-FOOT DIAMETER DRILLED SHAFT

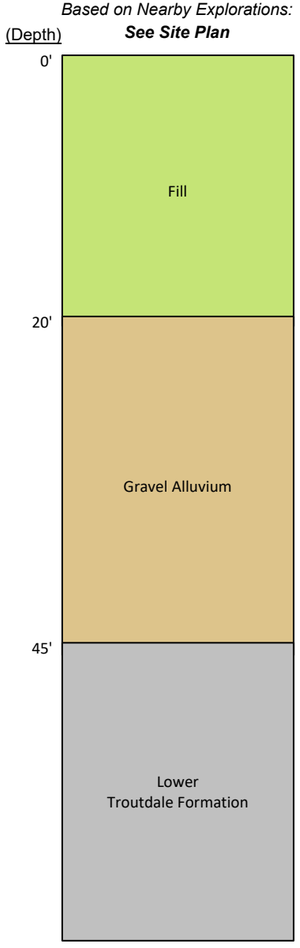
January 2022 102636-009

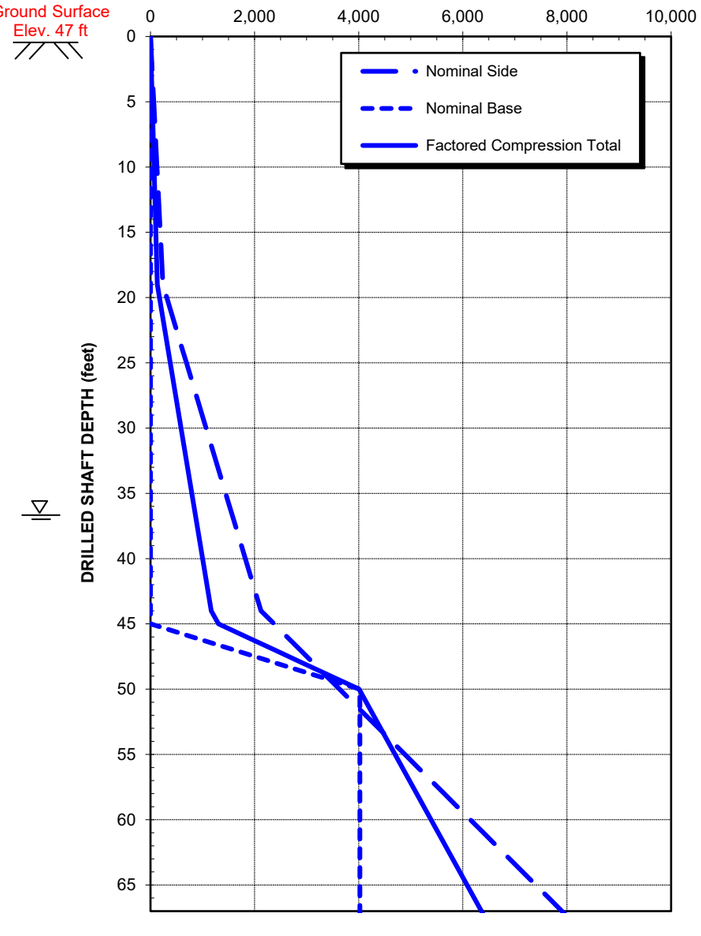
SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. I10

ASSUMED SUBSURFACE PROFILE

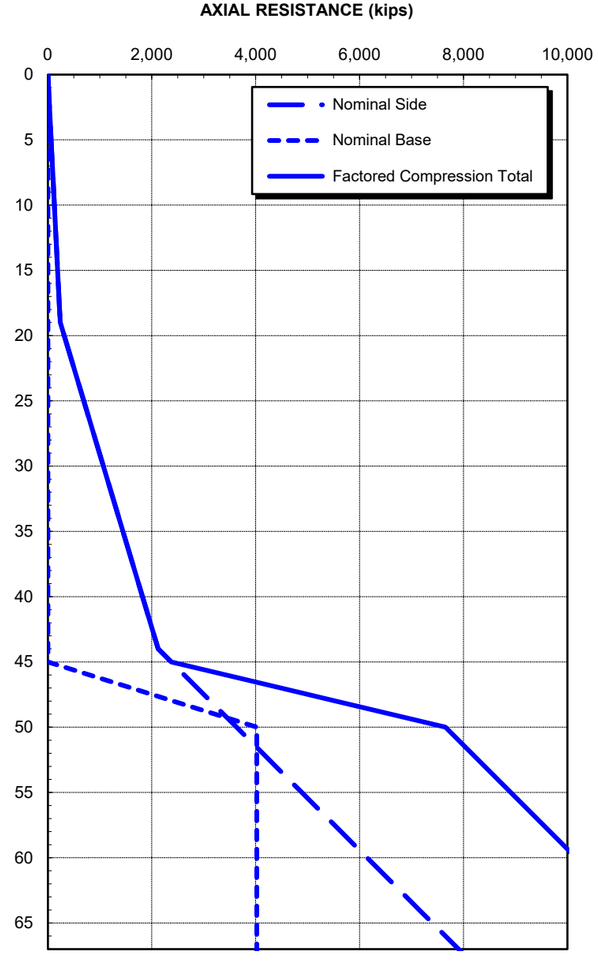
Based on Nearby Explorations: ***See Site Plan***



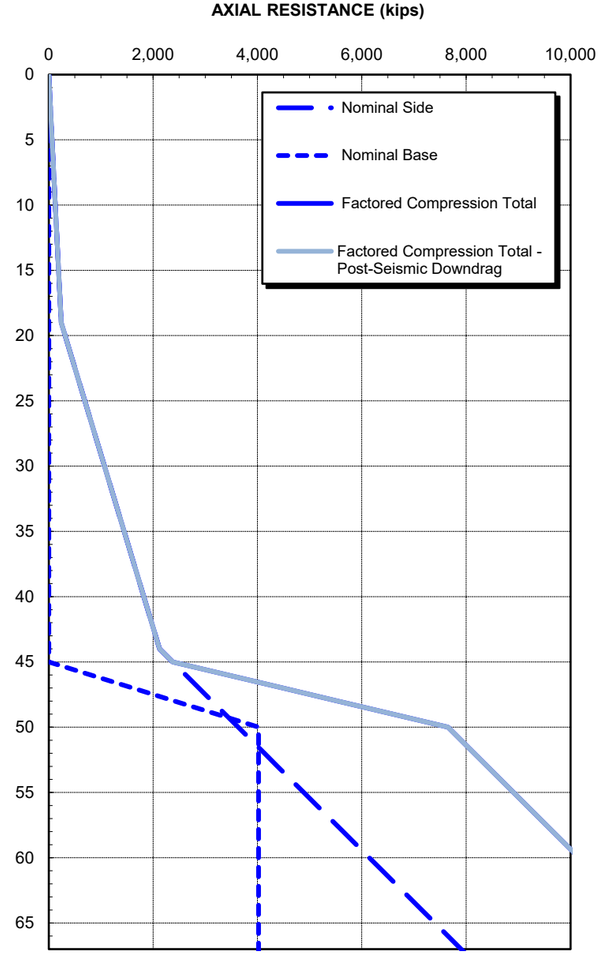


STRENGTH LIMIT

EXTREME EVENT: NON-LIQUEFIED STRENGTH



EXTREME EVENT: LIQUEFIED / REDUCED STRENGTH



NOTES

1. The analyses were performed based on guidelines included in AASHTO 2020, the ODOT GDM and local experience. The analyses are based on a single shaft or a single row of shafts at a center-to-center spacing greater than or equal to 3 diameters.
2. Factored total shaft compression resistance shown on plots is determined by adding nominal side and base resistances multiplied by the corresponding resistance factors:

	Strength	Extreme: Non-Liquefied	Extreme: Liquefied/Reduced
Side Resistance - Compression	0.55	1.0	1.0
Side Resistance - Uplift	0.45	0.8	0.8
Base Resistance	0.50	1.0	1.0

3. The resistance factors should be reduced by 20% for a non-redundant single shaft supporting a bridge pier.
4. Estimated shaft resistance assumes temporary casing will be removed following drilled shaft installation and permanent casing will not be used.
5. Estimated shaft resistance for the Extreme Event: Liquefied/Reduced Strength case is based on the estimated reduced soil shear strength due to excess pore pressure generation determined in the seismic site response analyses.
6. The estimated post-seismic downdrag force is 0 kips. Post-seismic downdrag forces should be considered with the post-seismic downdrag resistance curves on the Extreme Event: Liquefied/Reduced Strength plot.

Earthquake Ready Burnside Bridge
Portland, Oregon

ESTIMATED AXIAL RESISTANCE
BENT 9
8-FOOT DIAMETER DRILLED SHAFT

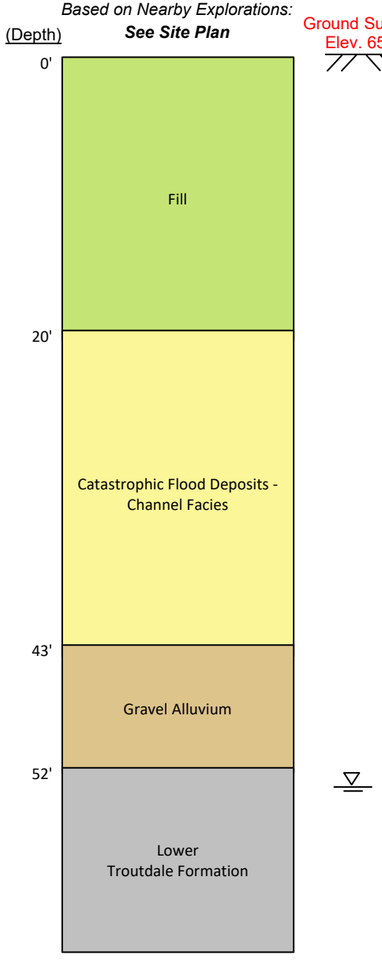
January 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

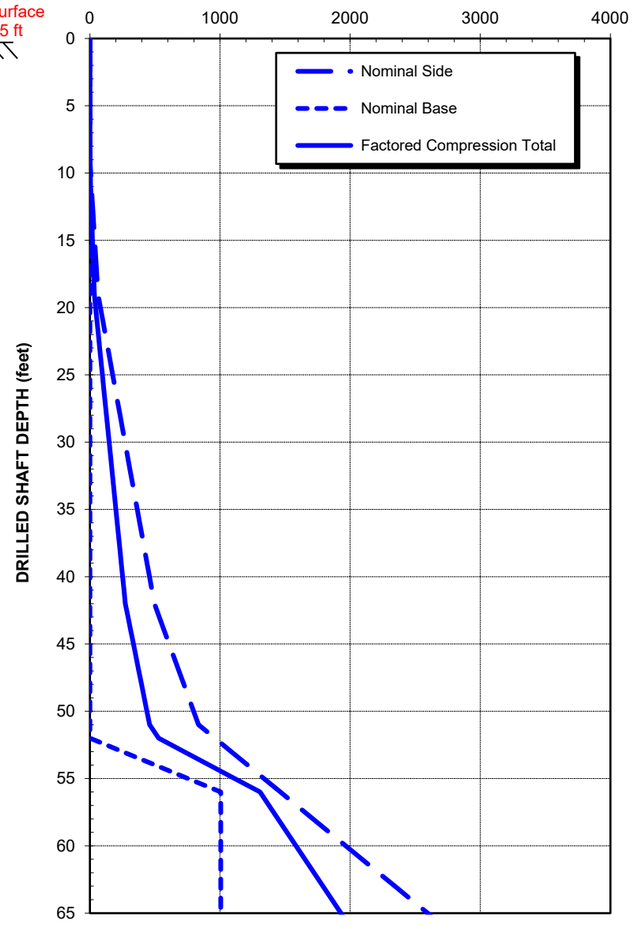
FIG. I11

ASSUMED SUBSURFACE PROFILE

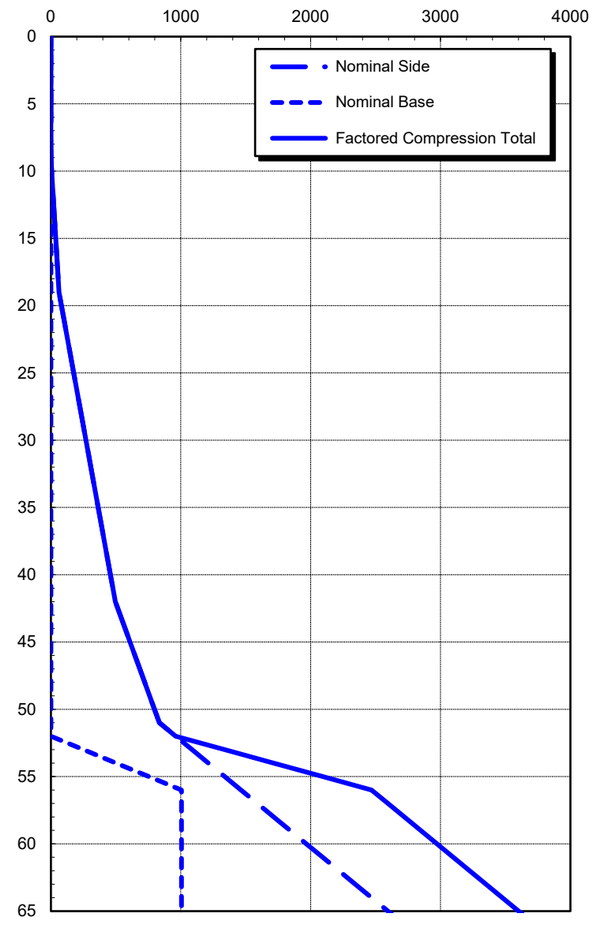
Based on Nearby Explorations: ***See Site Plan***



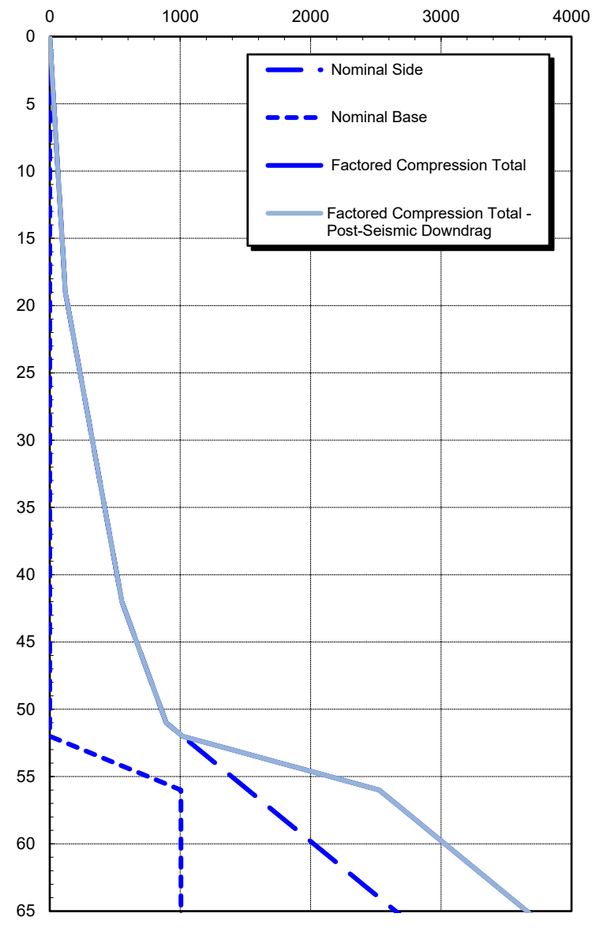
STRENGTH LIMIT



EXTREME EVENT: NON-LIQUEFIED STRENGTH



EXTREME EVENT: LIQUEFIED / REDUCED STRENGTH



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Earthquake Ready Burnside Bridge
Portland, Oregon

ESTIMATED AXIAL RESISTANCE
BENT 10
4-FOOT DIAMETER DRILLED SHAFT

January 2022 102636-009

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. I12

IMPORTANT INFORMATION

Important Information

About Your Geotechnical Report

IMPORTANT INFORMATION

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining

IMPORTANT INFORMATION

your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims

IMPORTANT INFORMATION

being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland