Figure B-16.13
B-16 Box 7 Runs 25-28 Dry

Figure B-16.14
B-16 Box 7 Runs 25-28 Wet

MOTT MACDONALD M M	PennEast Pipeline Project Rock Core Photographs	BORING NO.: B-16

Figure B-16.15
B-16 Box 8 Runs 29-32 Dry

Figure B-16.16
B-16 Box 8 Runs 29-32 Wet

MOTT MACDONALD M M	PennEast Pipeline Project Rock Core Photographs	BORING NO.: B-16

MOTT MACDONALD M M

SOIL BORING LOG

BORING NO.: **B-17**
Page **1** of **1**

Project:	PennEast Pipeline Project	**Project No.:**	353754
Location:	Beltzville Lake Crossing, Lehighton, PA	**Project Mgr:**	Vatsal Shah
Client:	PennEast Pipeline	**Field Eng. Staff:**	Dafydd Chandler
Drilling Co.:	Craig Test Boring Co., Inc.	**Date/Time Started:**	January 12, 2016 at 7:35 am
Driller/Helper:	Craig Test Boring Co., Inc. /Nick Beehler	**Date/Time Finished:**	January 14, 2016 at 9:00 am

Elevation: 720 ft. **Vertical Datum:** NAVD 1988 **Boring Location:** East of the access to the right of way. **Coord.:** **N:** 40.88035 **E:** -75.548164 **Horizontal Datum:** NAD 1983

Item	Casing	Sampler	Core Barrel
Type	HW	SS	NQ2
Length (ft)	5	2	5
Inside Dia. (in.)	4	1.375	2.0
Hammer Wt. (lb.)	140	140	-
Hammer Fall (in.)	30	30	-

Rig Make & Model: CME-750X

☐ Truck ☐ Tripod ☐ Cat-Head
☑ ATV ☐ Geoprobe ☑ Winch
☐ Track ☐ Air Track ☑ Roller Bit
☐ Skid ☐ _____ ☐ Cutting Head

Hammer Type
☐ Safety
☐ Doughnut
☑ Automatic
☐ _____

Drilling Fluid
☐ Bentonite
☐ Polymer
☑ Water
☐ None

Drill Rod Size:

Casing Advance
Mud Rotary

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Group Symbol	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests: Dilatancy	Toughness	Plasticity	Dry Strength	Remarks
720	0.0'-'					Loose, Gray DECOMPOSED SHALE fragments	-	-	-	-	0" - 7" Hand cleared
5	S-1 5.0'- 7.0'	22	10 19 23 26			Dense, Gray and brown DECOMPOSED SHALE fragments with Silt and Sand, dry	N	-	NP	N	
10 710	S-2 10.0'- 10.4'	4	100/5"			Very dense, Gray DECOMPOSED SHALE fragments with Clay, moist	N	-	NP	N	
						15.0					
15	S-3 15.0'- 15.1'	0	100/1"			No Recovery Top of Rock at 15 feet BGS. See Rock Coring Log.	N	-	NP	N	

Water Level Data

Date	Time	Elapsed Time (hr)	Depth in feet to: Bot. of Casing	Bottom of Hole	Water

Sample Type

O Open End Rod
T Thin-Wall Tube
U Undisturbed Sample
S Split Spoon Sample
G Geoprobe

Notes:

PP = Pocket Penetrometer
TV = Torvane

Boring No.: **B-17**

Field Test Legend:
Dilatancy: N - None S - Slow R - Rapid
Toughness: L - Low M - Medium H - High
Plasticity: NP - Non-Plastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High VH - Very High

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

MOTT MACDONALD M M

CORE BORING LOG

BORING NO.: **B-17**
Page **1** of **5**

Project:	PennEast Pipeline Project	**Project No.:**	353754
Location:	Beltzville Lake Crossing, Lehighton, PA	**Project Mgr:**	Vatsal Shah
Client:	PennEast Pipeline	**Field Eng. Staff:**	Dafydd Chandler
Drilling Co.:	Craig Test Boring Co., Inc.	**Date/Time Started:**	January 12, 2016 at 7:35 am
Driller/Helper:	Craig Test Boring Co., Inc. /Nick Beehler	**Date/Time Finished:**	January 14, 2016 at 9:00 am

Elevation: 720 ft. **Vertical Datum:** NAVD 1988

Boring Location: East of the access to the right of way.

Coord.: N: 40.88035 **E:** -75.548164

Item	Casing	Core Barrel	Core Bit
Type	HW	NQ2	Imp. Diamond
Length (ft)	5	5	3.25
Inside Dia. (in.)	4	2.0	2.0

Horizontal Datum: NAD 1983
Rig Make & Model: CME-750X

Drilling Method: Wireline

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec (in. / %)	RQD (in / %)	Rock Core Hard.	Rock Core Weath	Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities Type	Dip	Rgh	Wea	Aper	Infill	Remarks
									SEE TEST BORING LOG FOR OVERBURDEN DETAILS		(See Legend for Rock Description System)						
	5.00	15.0							SHALE, Dark gray, very fine grained, moderately weathered, weak, highly fractured 15' - 20' Highly fractured zone, has discoloration of joint and Clay infill								
	5.00																
	5.00		R-1	39 65%	0 0%	R2	M										
	5.00																
	5.00	20.0															
20 700	4.00	20.0							SHALE, Dark gray and brown, very fine grained, moderately weathered, weak, highly fractured 20' - 25' Highly fractured zone, discolored joints and Clay infill								
	4.00																
	4.00		R-2	60 100%	4 7%	R2	M										
	4.00																
	4.00	25.0															
25	4.00	25.0							SHALE, Dark gray and brown, very fine grained, moderately weathered, weak, highly fractured 25' - 30' Highly fractured zone, discolored joints and Clay infill								
	4.00																
	4.00		R-3	60 100%	0 0%	R2	M										
	4.00																
	4.00	30.0															
30 690	4.00	30.0							SHALE, Dark gray and brown, very fine grained, moderately weathered, weak, highly fractured 30' - 35' Highly fractured zone Discoloration is around fractures Joints have minor Clay infill								
	4.00																
	4.00		R-4	60 100%	4 7%	R2	M										
	4.00																
	5.00	35.0															

Water Level Data

Date	Time	Elapsed Time (hr)	Depth in feet to: Bot. of Casing	Bottom of Hole	Water
		-			

Notes:

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core Hard.	Rock Core Weath	Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities (See Legend for Rock Description System) Type	Dip	Rgh	Wea	Aper	Infill	Remarks
	3.00	35.0							SHALE, Dark gray, very fine grained, moderately weathered, weak, highly fractured 35' - 41.5' Highly fractured zone								
	3.00																
	4.00		R-5	60 100%	8 13%	R2	M										
	4.00								38' - 41.5' SHALE, Dark gray, very fine grained, slightly weathered, weak, very close spaced discontinuities								
	4.00	40.0															
40 680	4.00	40.0															
	4.00																
	4.00		R-6	58 97%	32 53%	R3	FR		41.5' - 45' SHALE, Dark gray, very fine grained, fresh, medium strong, medium spaced discontinuities Fossils noted in descrete layers Small coral and foraminifera								Used up 270 Gallons for R1 through R6. No fossils.
	5.00																
	5.00	45.0								44.20	B	30	P,R	FR	VT	N	
45																	
	4.00	45.0							SHALE, Dark gray, very fine grained, fresh, medium strong, moderately spaced discontinuities								
	4.00									46.50	B	30	P,R	DE	VW	CL	
	4.00		R-7	58 97%	54 90%	R3	FR										
	4.00																
	5.00	50.0								49.00	B	30	P,R	FR	VT	N	
50 670	4.00	50.0							SHALE, Dark gray, very fine grained, discolored weathering, medium strong, very close spaced discontinuities								
	4.00								51' - 53' Highly fractured zone								
	4.00		R-8	60 100%	38 63%	R3	FR										
	4.00								SHALE, Dark gray, very fine grained, discolored weathering, medium strong, wide spaced discontinuities	53.50	B	30	P,R	FR	VT	N	
	5.00	55.0							53.9' Shell fossil encountered	54.00	B	30	P,R	FR	VT	N	
55																	
	4.00	55.0							55' - 56.9' SHALE, Dark gray, very fine grained, fresh, medium strong, moderately spaced discontinuities								Used up to 270 Gallons for R7/R8/R9.
	4.00																
	5.00		R-9	58 97%	22 37%	R3	FR		56.9' - 60' SHALE, Dark gray, very fine grained, slightly weathered, highly fractured 56.9' - 60' Highly fractured zone								
	5.00																
	5.00	60.0															
60 660		60.0							SHALE, Dark gray, very fine grained, fresh, medium strong, moderate to close spaced discontinuities								

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core Hard.	Rock Core Weath	Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities (See Legend for Rock Description System) Type	Dip	Rgh	Wea	Aper	Infill	Remarks
	3.00								60.5' - 62.3' Highly fractured zone 60.5' - 62' Vertical fracture								
	3.00																
	3.50		R-10	59 98%	37 62%	R3	FR										
	3.50																
	4.00	65.0								64.30	B	35	P,R	FR	T	N	
65		65.0							SHALE, Dark gray, very fine grained, fresh, medium strong, moderate to close spaced discontinuities 65' - 65.6' Highly fractured zone								Used up to 540 Gallons for R10/R11.
	5.00																
	5.00									66.50	B	50	P,R	FR	T	N	
										66.90	B	30	P,R	FR	T	N	
	5.00		R-11	60 100%	34 57%	R3	FR			67.70	J	50	P,R	DS	PO	CL	
										68.10	B	30	P,R	FR	VT	N	
	5.00									68.50	J	90	P,R	FR	T	N	
	5.00	70.0								69.10	B	70	P,R	DG	PO	C	
70 650		70.0							SHALE, Dark gray, very fine grained, fresh, strong, wide spaced discontintuities								No discontinuities. Used up to 270 Gallons for R12.
	4.00																
	4.00																
	4.00		R-12	60 100%	60 100%	R4	FR										
	4.00																
	4.00	75.0							74.5' Bed of fossilized shells								
75		75.0							SHALE, Dark gray, very fine grained, fresh, strong, close spaced discontinuities	75.30	B	60	P,R	FR	T	N	Used up to 270 Gallons for R13.
	4.00									76.00	J	60	S,R	FR	T	N	
	4.00																
	4.00		R-13	60 100%	50 83%	R4	FR			77.00	J	60	P,R	FR	T	N	
										77.60	J	60	P,R	FR	VT	N	
	4.00								78.5' Fossilized shells								
	4.00	80.0															
80 640		80.0								79.80	B	30	P,R	DS	T	CL	
	4.00								80' - 81' SHALE, Dark gray, very fine grained, weak, slightly weathered, close spaced discontinuities								
	4.00								81' - 82' Firm, Brown CLAY								
	4.00		R-14	60 100%	37 62%	R4	FR		82' - 85' SHALE, Dark gray, very fine grained, fresh, strong, wide spaced discontinuities								
	3.00																
	4.00	85.0															
85		85.0							SHALE, Dark gray, very fine grained, fresh, strong, wide spaced discontinuities								Mechanical breaks only. Used up to 270 Gallons for R15.
	4.00																

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core Hard.	Rock Core Weath	Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities (See Legend for Rock Description System) Type	Dip	Rgh	Wea	Aper	Infill	Remarks
	4.00																
	3.00		R-15	60 100%	60 100%	R4	FR										
	4.00																
	4.00	90.0															
90 630	3.00	90.0							SHALE, Dark gray, very fine grained, fresh, strong, wide spaced discontinuities								Used up to 270 Gallons for R16.
	3.00																
	3.00		R-16	60 100%	60 100%	R4	FR										
	4.00									93.10	B	35	P,R	FR	T	N	
	4.00	95.0							95.0								
95	3.00	95.0							SLATE, Dark gray, very fine grained, fresh, strong, wide spaced discontinuities	95.30	J	70	P,R	FR	T	N	Used up to 270 Gallons for R17.
	3.00																
	3.00		R-17	60 100%	60 100%	R4	FR										
	3.00									98.20	B	15	P,R	FR	PO	N	
	4.00	100.0															
100 620	3.00	100.0							SLATE, Dark gray, very fine grained, fresh, strong, wide spaced discontinuities								No discontinuities. Used up to 270 Gallons for R18.
	3.00																
	3.00		R-18	60 100%	60 100%	R4	FR										
	3.00																
	3.00	105.0															
105	3.00	105.0							SLATE, Dark gray, very fine grained, fresh, strong, moderately spaced discontinuities								Used up to 270 Gallons for R19.
	3.00																
	3.00		R-19	54 90%	51 85%	R4	FR										
	3.50																
	3.50	110.0							109.3' - 110' Highly fractured zone, possibly mechanical breaks								
110 610	3.00	110.0							SLATE, Dark gray, very fine grained, fresh, strong, moderate to wide spaced discontinuities								No discontinuities, mechanical breaks only. Used up to 270 Gallons for R20.
	3.00																

MOTT MACDONALD M M

CORE BORING LOG
(continued)

BORING NO.: **B-17**
Page **5** of **5**

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core Hard.	Rock Core Weath	Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities (See Legend for Rock Description System) Type	Dip	Rgh	Wea	Aper	Infill	Remarks
	3.00																
	3.00		R-20	60 100%	60 100%	R4	FR										
	3.50																
	3.50	115.0															
115		115.0							SLATE, Dark gray, very fine grained, fresh, strong, moderate to wide spaced discontinuities								Used up to 200 Gallons for R21.
	3.00																
	3.00																
	3.00		R-21	60 100%	60 100%	R4	FR										
	3.00																
	3.50	120.0							120.0								
120 600									End of Boring at 120 feet BGS. Borehole grouted with cement and bentonite hole plug.								
125																	
130 590																	
135																	

NOTES:

PROJECT NO.: **353754**

Boring No.: **B-17**

Figure B-17.1
B-17 Box 1 Runs 1-4 Dry

Figure B-17.2
B-17 Box 1 Runs 1-4 Wet

MOTT MACDONALD M M	PennEast Pipeline Project Rock Core Photographs	BORING NO.: B-17

Figure B-17.3
B-17 Box 2 Runs 5-8 Dry

Figure B-17.4
B-17 Box 2 Runs 5-8 Wet

MOTT MACDONALD M M	PennEast Pipeline Project Rock Core Photographs	BORING NO.: B-17

Figure B-17.5
B-17 Box 3 Runs 9-12 Dry

Figure B-17.6
B-17 Box 3 Runs 9-12 Wet

MOTT MACDONALD M M	**PennEast Pipeline Project** **Rock Core Photographs**	**BORING NO.:** B-17

Figure B-17.7
B-17 Box 4 Runs 13-16 Dry

Figure B-17.8
B-17 Box 4 Runs 13-16 Wet

MOTT MACDONALD M M	**PennEast Pipeline Project** **Rock Core Photographs**	**BORING NO.:** B-17

Figure B-17.9
B-17 Box 5 Runs 17-20 Dry

Figure B-17.10
B-17 Box 5 Runs 17-20 Wet

MOTT MACDONALD M M	**PennEast Pipeline Project** **Rock Core Photographs**	**BORING NO.:** B-17

Figure B-17.11
B-17 Box 6 Run 21 Dry

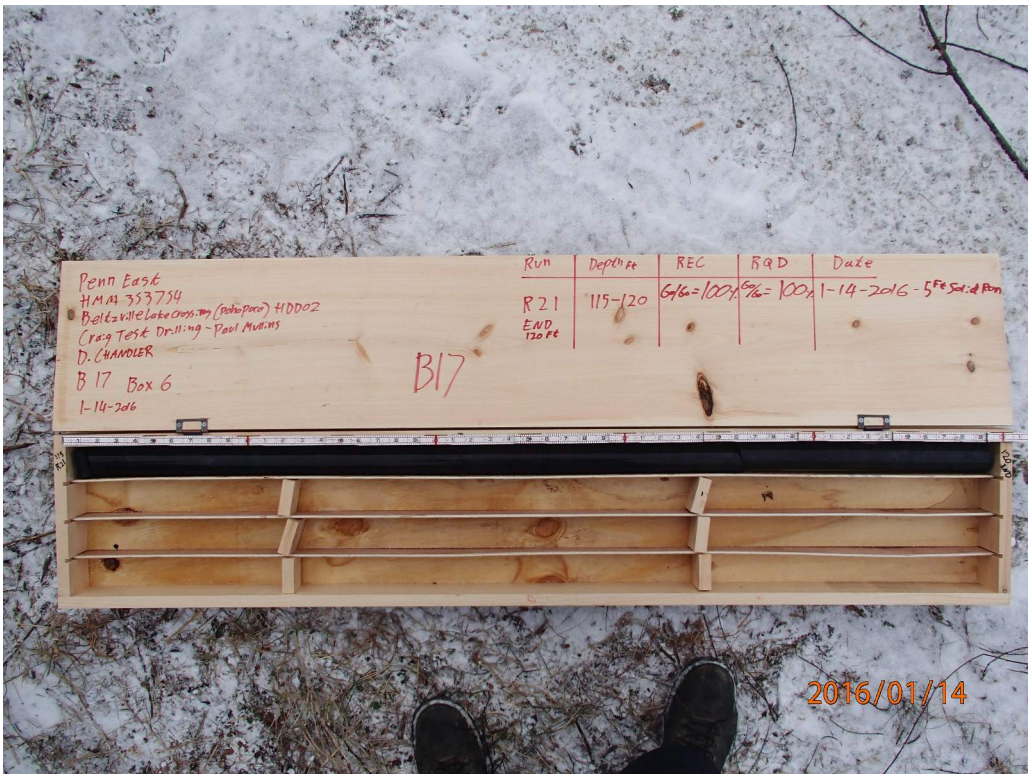


Figure B-17.12
B-17 Box 6 Run 21 Wet

MOTT MACDONALD M M

SOIL BORING LOG

BORING NO.: **B-Poh-1**
Page **1** of **2**

Project:	PennEast Pipeline Project	**Project No.:**	353754
Location:	Beltzville Lake Crossing, Lehighton, PA	**Project Mgr:**	Vatsal Shah
Client:	PennEast Pipeline	**Field Eng. Staff:**	Bernard Cortes
Drilling Co.:	Craig Test Boring Co., Inc.	**Date/Time Started:**	February 5, 2016 at 7:45 am
Driller/Helper:	Paul Mullins /Nick Beehler	**Date/Time Finished:**	February 10, 2016 at 10:45 am

Elevation: 695 ft. **Vertical Datum:** NAVD 1988 **Boring Location:** Off Penn Forest Road South. **Coord.:** **N:** 40.88418 **E:** -75.556409 **Horizontal Datum:** NAD 1983

Item	Casing	Sampler	Core Barrel
Type	HW	SS	NQ2
Length (ft)	5	2	5
Inside Dia. (in.)	4	1.375	2.0
Hammer Wt. (lb.)	140	140	-
Hammer Fall (in.)	30	30	-

Rig Make & Model: CME-750X

☐ Truck ☐ Tripod ☐ Cat-Head
☑ ATV ☐ Geoprobe ☑ Winch
☐ Track ☐ Air Track ☑ Roller Bit
☐ Skid ☐ _____ ☐ Cutting Head

Hammer Type: ☐ Safety ☐ Doughnut ☑ Automatic ☐ _____

Drilling Fluid: ☑ Bentonite ☐ Polymer ☑ Water ☐ None

Drill Rod Size:

Casing Advance: Mud Rotary

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Group Symbol	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests: Dilatancy	Toughness	Plasticity	Dry Strength	Remarks
	S-1 0.0'- 2.0'	24	4 1 1 1		CL	Very soft, Brownish yellow Lean CLAY (CL)	N	-	M	N	
5 690	S-2 5.0'- 7.0'	12	5 16 18 22		CL	Hard, Brownish yellow to yellowish red Lean CLAY with Decomposed Shale fragments, moist (CL)	N	L	M	N	
						8.5					
10	S-3 10.0'- 12.0'	24	13 17 22 32		ML	Hard, Brownish yellow to reddish brown Clayey SILT with Decomposed Shale fragments, moist (ML)	N	L	L	N	
15 680	S-4 15.0'- 17.0'	3	60/3"		ML	Hard, Yellowish brown Clayey SILT with Decomposed Shale fragments, moist (ML)	N	-	NP	N	
						18.5					

Water Level Data

Date	Time	Elapsed Time (hr)	Depth in feet to: Bot. of Casing	Bottom of Hole	Water

Sample Type

O Open End Rod
T Thin-Wall Tube
U Undisturbed Sample
S Split Spoon Sample
G Geoprobe

Notes:

PP = Pocket Penetrometer
TV = Torvane

Boring No.: **B-Poh-1**

Field Test Legend:
Dilatancy: N - None S - Slow R - Rapid
Toughness: L - Low M - Medium H - High
Plasticity: NP - Non-Plastic L - Low M - Medium H - High
Dry Strength: N - None L - Low M - Medium H - High VH - Very High

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

MOTT MACDONALD M M

SOIL BORING LOG
(continued)

BORING NO.: **B-Poh-1**
Page **2** of **2**

Depth/ Elev. (ft)	Sample No. / Interval (ft)	Rec. (in)	Sample Blows per 6"	Stratum Graphic	USCS Symbol Group	Visual - Manual Identification & Description (Density/consistency, color, Group Name, constituents, particle size, structure, moisture, optional descriptions, geologic interpretation, Symbol)	Field Tests: Dilatancy	Toughness	Plasticity	Dry Strength	Remarks*
	S-5 20.0'-22.0'	2	50/2"			Very dense, Black DECOMPOSED SHALE fragments with Clay, wet	N	L	L	N	
25 670	S-6 25.0'-27.0'	6	80/6"			Very dense, Black DECOMPOSED SHALE fragments with Clay, wet	N	L	L	N	
30	S-7 30.0'-32.0'	1	50/1"			Very dense, Black DECOMPOSED SHALE fragments with Clay, wet	N	L	L	N	
						32.0 Top of Rock at 32 feet BGS. See Rock Coring Log.					
35 660											
40											
45 650											

NOTES:

PROJECT NO.: **353754**

BORING NO.: **B-Poh-1**

NOTES: 1.) "ppd" denotes soil sample average diametral pocket penetrometer reading. 2.) "ppa" denotes soil sample average axial pocket penetrometer reading.
3.) Maximum Particle Size is determined by direct observation within limitations of sampler size. 4.) Soil identifications and field tests based on visual-manual methods per ASTM D2488.

MOTT MACDONALD M M

CORE BORING LOG

BORING NO.: **B-Poh-1**
Page **1** of **8**

Project:	PennEast Pipeline Project	**Project No.:**	353754
Location:	Beltzville Lake Crossing, Lehighton, PA	**Project Mgr:**	Vatsal Shah
Client:	PennEast Pipeline	**Field Eng. Staff:**	Bernard Cortes
Drilling Co.:	Craig Test Boring Co., Inc.	**Date/Time Started:**	February 5, 2016 at 7:45 am
Driller/Helper:	Paul Mullins /Nick Beehler	**Date/Time Finished:**	February 10, 2016 at 10:45 am

Elevation: 695 ft. **Vertical Datum:** NAVD 1988 **Boring Location:** Off Penn Forest Road South. **Coord.: N:** 40.88418 **E:** -75.556409

Item	Casing	Core Barrel	Core Bit
Type	HW	NQ2	Imp. Diamond
Length (ft)	5	5	3.25
Inside Dia. (in.)	4	2.0	2.0

Horizontal Datum: NAD 1983 **Rig Make & Model:** CME-750X **Drilling Method:** Wireline

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec (in. / %)	RQD (in / %)	Rock Core Hard.	Rock Core Weath	Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities (See Legend for Rock Description System) Type	Dip	Rgh	Wea	Aper	Infill	Remarks
660									SEE TEST BORING LOG FOR OVERBURDEN DETAILS								
	2.50	35.0							SHALE, Dark gray, very fine grained, moderately weathered, strong, extremely close to close spaced discontinuities	35.70	J	60	P,R	FR	T	N	
										35.90	J	-	X,R	DS	O	CL	
	2.00									36.40	J	60	P,Sm	DG	O	N	
										36.70	J	60	P,Sm	DG	O	N	
	2.00		R-1	60 100%	15 25%	R4	M		37.1' - 38.2' Highly fractured zone								
	3.00									38.40	J	70	P,Sm	DG	T	N	
										38.70	J	70	P,R	DG	O	CL	
	5.00	40.0								38.90	J	70	P,Sm	DS	PO	CL	
40		40.0							SHALE, Dark gray, very fine grained, fresh, strong, extremely close to close spaced discontinuities	40.20	J	60	P,Sm	FR	T	N	Used up to 275 Gallons (R1 to R2).
	3.00									41.30	J	60	P,Sm	DG	T	N	
	3.00									41.40	J	60	P,R	DG	T	N	
	3.50		R-2	60 100%	48 80%	R4	FR			42.70	J	70	P,R	FR	O	N	
	3.00									43.60	J	-	X,R	FR	VT	N	
	3.00	45.0															
45 650		45.0							SHALE, Dark gray, very fine grained, fresh, strong, extremely close to wide spaced discontinuities	45.50	J	70	P,Sm	FR	T	N	
	3.00									45.90	J	60	P,Sm	FR	PO	N	
	3.50									46.60	J	70	P,Sm	FR	PO	N	
	3.50		R-3	60 100%	44 73%	R4	FR			47.20	J	60	P,Sm	FR	T	N	
	3.50									47.90	J	-	X,R	FR	O	N	
	3.50	50.0								49.20	J	65	P,R	DG	PO	N	
50		50.0							SHALE, Dark gray, very fine grained, moderately weathered, strong, extremely close to wide spaced discontinuities	50.60	J	70	P,Sm	FR	T	N	
	3.00																
	3.00								51.7' - 52.4' Highly fractured zone								
	3.00		R-4	60 100%	36 60%	R4	M										
	4.00									52.90	J	70	P,Sm	FR	T	N	
	4.00	55.0															

Water Level Data

Date	Time	Elapsed Time (hr)	Depth in feet to: Bot. of Casing	Bottom of Hole	Water
		-			

Notes:

CORE BORING LOG
(continued)

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core Hard.	Rock Core Weath	Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities (See Legend for Rock Description System) Type	Dip	Rgh	Wea	Aper	Infill	Remarks
640	3.50	55.0							SHALE, Dark gray, very fine grained, fresh, strong, close to wide spaced discontinuities	55.60	J	65	P,Sm	FR	T	N	Loss of water.
	2.50																
	3.00		R-5	60 100%	54 90%	R4	FR										
	3.00																
	3.00	60.0															
60	2.50	60.0							SHALE, Dark gray, very fine grained, fresh, strong, close to wide spaced discontinuities	60.60	J	80	P,R	FR	T	N	Used up to 275 Gallons (R3 to R6).
										60.80	J	80	P,Sm	FR	T	N	
	3.00																
	3.50		R-6	60 100%	45 75%	R4	FR										
	3.00																
	3.00	65.0								64.10	J	-	X,R	FR	PO	N	
65 630	3.50	65.0							SHALE, Dark gray, very fine grained, fresh, strong, extremely close to close spaced discontinuities	65.30	J	50	P,R	FR	T	N	
										65.80	J	10	P,R	FR	PO	N	
	3.50									66.20	MB						
	3.00		R-7	60 100%	47 78%	R4	FR			66.90	J	50	P,Sm	FR	T	N	
										67.00	J	50	P,Sm	FR	VT	N	
										67.80	J	50	P,R	FR	T	N	
	3.50									68.50	J	60	P,Sm	FR	PO	N	
	3.50	70.0															
70	3.50	70.0							SHALE, Dark gray, very fine grained, fresh, strong, extremely close to close spaced discontinuities	70.70	J	60	P,R	FR	T	N	
										71.00	J	-	X,R	DS	O	QZ	
	3.00									71.10	J	50	P,R	FR	PO	N	
	2.50		R-8	60 100%	46 77%	R4	FR			72.00	J	60	P,Sm	FR	T	N	
	3.00									73.30	J	10	P,R	FR	O	N	
										73.40	J	40	P,Sm	FR	T	N	
	3.00	75.0								74.40	J	40	P,Sm	FR	T	N	
75 620	3.50	75.0							75.0 SLATE, Dark gray, very fine grained, fresh, strong, close to wide spaced discontinuities	75.70	J	60	P,Sm	FR	VT	N	
										75.80	J	60	P,Sm	FR	VT	N	
	3.50									76.00	J	60	P,Sm	FR	VT	N	
										76.50	J	60	P,Sm	FR	T	N	
	3.50		R-9	60 100%	45 75%	R4	FR			77.40	J	60	P,Sm	FR	T	N	
	3.00									78.30	J	60	P,Sm	FR	VT	N	
	3.00	80.0								79.50	J	60	P,Sm	FR	PO	N	
80		80.0							SLATE, Dark gray, very fine grained, fresh, strong, close to wide spaced discontinuities								Loss of water at 80 feet BGS.

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core Hard.	Rock Core Weath	Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities (See Legend for Rock Description System) Type	Dip	Rgh	Wea	Aper	Infill	Remarks
	3.00																
	3.00									81.10	J	50	P,K	FR	VT	N	
	3.00		R-10	60 100%	60 100%	R4	FR										
										82.60	J	70	P,Sm	FR	VT	N	
	3.50									83.40	J	60	P,Sm	FR	T	N	
	3.00	85.0								84.40	MB						
85 610		85.0							SLATE, Dark gray, very fine grained, fresh, strong, extremely close to wide spaced discontinuities								
	3.00									85.70	J	60	P,Sm	FR	T	N	
	3.00									86.70	J	10	P,Sm	FR	T	N	
	3.00		R-11	60 100%	52 87%	R4	FR										
	3.50								87.9' - 88.1' Highly fractured zone								
	3.00	90.0								89.50	J	-	X,R	DG	O	N	Lost all water at 89.4 feet BGS.
90		90.0							SLATE, Dark gray, very fine grained, fresh, strong, extremely close wide spaced discontinuities								
	3.00								90.4' - 90.6' Highly fractured zone								
	3.00									91.00	J	60	P,Sm	FR	VT	N	
	3.50		R-12	55 92%	42 70%	R4	FR			92.00	J	65	P,R	FR	VT	N	
	3.50									93.70	J	60	P,Sm	FR	VT	N	
	4.00	95.0															
95 600		95.0							SLATE, Dark gray, very fine grained, fresh, medium strong, extremely close to wide spaced discontinuities								Used up to 275 Gallons (R7 to R13).
	3.50									95.20	J	50	P,Sm	FR	VT	N	
										95.70	J		X,R	FR	O	N	
	3.00									96.30	J	-	P,Sm	FR	VT	N	
	3.50		R-13	60 100%	48 80%	R3	FR			97.00 97.20 97.30	J MB J	90 70	P,Sm P,Sm	FR FR	T O	N N	
	3.00																
	5.00	100.0								99.30	J	15	P,R	DG	O	N	
100		100.0							SLATE, Dark gray, very fine grained, fresh, strong, wide spaced discontinuities								
	3.00									100.70	J	60	P,Sm	FR	VT	N	
	3.00																
	3.50		R-14	60 100%	60 100%	R4	FR										
	3.00																
	3.00	105.0															
105 590		105.0							SLATE, Dark gray, very fine grained, fresh, strong, extremely close to wide spaced discontinuities								Used up to 275 Gallons (R14 to R15).
	3.00									105.60	J	60	P,K	FR	VT	N	

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core Hard.	Rock Core Weath	Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities Type	Dip	Rgh	Wea	Aper	Infill	Remarks
	3.00									106.20	J	20	P,Sm	FR	T	N	
										106.80	J	60	P,Sm	FR	VT	N	
	3.00		R-15	60 100%	55 92%	R4	FR			107.30	J	60	P,R	FR	T	N	
	3.00																
	3.00	110.0															
110	3.50	110.0							SLATE, Dark gray, fine grained, fresh, strong, close to wide spaced discontinuities								
	3.50									111.10	J	60	P,K	FR	VT	N	
	3.50		R-16	60 100%	54 90%	R4	FR			112.30	J	60	P,Sm	FR	PO	N	
	3.50																
	3.50	115.0								114.60	J	60	P,Sm	FR	VT	N	
115 580	3.00	115.0							SLATE, Dark gray, very fine grained, slightly weathered, strong, extremely close to wide spaced discontinuities Calcite infilling encountered.	114.70	MB						
	3.00																
	3.50		R-17	60 100%	46 77%	R4	SL		117.8' - 118.7' Highly fractured zone	117.40	J	70	P,Sm	FR	T	N	
	3.50																
	3.50	120.0															
120	3.50	120.0							SLATE, Dark gray, very fine grained, slightly weathered, strong, close to wide spaced discontinuities								Used up to 275 Gallons (R16 to R18).
										120.50	J	60	P,Sm	FR	VT	N	
										121.00	J	10	P,Sm	FR	T	N	
	3.50									121.40	J	-	X,R	DS	O	Py	
	3.50		R-18	60 100%	52 87%	R4	SL										
	3.50																
	4.50	125.0															
125 570	3.00	125.0							SLATE, Dark gray, very fine grained, slightly weathered, strong, extremely close to wide spaced discontinuities								
	3.00																
	3.00		R-19	60 100%	50 83%	R4	SL										
										128.00	J	30	P,R	FR	PO	Py	
	3.00									128.50	J	60	P,Sm	FR	VT	N	
										129.10	J	60	P,R	DG	PO	N	
	3.00	130.0								129.50	J	60	P,R	DG	O	N	
130	4.00	130.0							SLATE, Dark gray, very fine grained, fresh, extremely close to wide spaced discontinuities								
	3.50																

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core Hard.	Rock Core Weath	Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities (See Legend for Rock Description System) Type	Dip	Rgh	Wea	Aper	Infill	Remarks
	3.50																
	4.00		R-20	60 100%	55 92%	R4	FR										
	4.00									133.70	J	20	X,R	DG	O	N	
										133.90	J	-	X,R	DG	O	CL	
										134.10	J	60	P,Sm	DG	T	N	
	5.00	135.0															
135 560		135.0							SLATE, Dark gray, very fine grained, fresh, strong, wide spaced discontinuities								Used up to 275 Gallons (R19 to R21).
	4.00																
	4.00																
	4.50		R-21	60 100%	60 100%	R4	FR										
	5.00									138.30	J	40	P,Wa	FR	T	N	
	5.00	140.0															
140		140.0							SLATE, Dark gray, very fine grained, fresh, strong, wide spaced discontinuities								
	3.00									140.60	J	70	P,Sm	FR	VT	N	
										140.80	MB						
	3.00																
	2.00		R-22	60 100%	60 100%	R4	FR										
	2.50																
	2.50	145.0															
145 550		145.0							SLATE, Dark gray, very fine grained, fresh, strong, wide spaced discontinuities								
	5.00																
										145.90	MB						
	3.00																
	4.00		R-23	60 100%	60 100%	R4	FR										
	4.00																
	4.50									149.10	J	40	P,R	DG	O	N	
										149.40	MB						
		150.0															
150		150.0							SLATE, Dark gray, very fine grained, fresh, strong, wide spaced discontinuities								Used up to 275 Gallons (R22 to R24). Lossing water more rapid.
	3.50																
	3.50																
										151.70	J	50	P,R	DG	O	N	
	5.00		R-24	60 100%	60 100%	R4	FR										
	4.00																
	5.00	155.0								154.60	MB						
155 540		155.0							SLATE, Dark gray, very fine grained, fresh, strong, wide to very wide spaced discontinuities	155.00	MB						No discontinuities.
	3.00																
	3.00																

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core Hard.	Rock Core Weath	Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities (See Legend for Rock Description System) Type	Dip	Rgh	Wea	Aper	Infill	Remarks
	5.00		R-25	60 100%	60 100%	R4	FR										
	5.00																
	4.00	160.0															
160	3.50	160.0							SLATE, Dark gray, very fine grained, fresh, strong, wide to very wide spaced discontinuities								No discontinuities. Used up to 275 Gallons (R24 to R26).
	3.50																
	3.50		R-26	60 100%	60 100%	R4	FR										
	4.00																
	5.00	165.0															
165 530	4.00	165.0							SLATE, Dark gray, very fine grained, fresh, strong, close to wide spaced discontinuities								Used up to 275 Gallons for R27.
	4.00																
	4.00		R-27	58 97%	58 97%	R4	FR			167.00	J	60	P,R	FR	VT	N	
	4.50									168.60	J	60	P,Sm	FR	VT	N	
	5.00									169.00	J	10	P,R	DG	PO	N	
		170.0								169.30	MB						
170	3.00	170.0							SLATE, Dark gray, very fine grained, fresh, strong, close to wide spaced discontinuities								
	3.50																
	4.50		R-28	60 100%	57 95%	R4	FR			171.70	J	60	P,R	FR	PO	N	
	4.50									173.10	J	60	P,Sm	FR	T	N	
	4.00	175.0								174.00	J	50	P,Sm	FR	T	N	
175 520	3.50	175.0							SLATE, Dark gray, very fine grained, slightly weathered, strong, extremely close to moderately spaced discontinuities								
	4.50									176.20	J	50	P,Sm	FR	VT	N	
	4.00		R-29	60 100%	51 85%	R4	SL			177.80	J	60	P,Sm	FR	VT	N	
	4.00									177.90	J	30	P,Sm	FR	T	N	
	4.00	180.0								179.30	J	50	P,R	FR	T	N	
180	3.50	180.0							SLATE, Dark gray, very fine grained, slightly weathered, strong, extremely close to close spaced discontinuities Pyrite infilling encountered	180.60	J	20	P,Wa	FR	T	N	Used up to 275 Gallons (R29 to R30).
	4.50									180.80	J	70	P,Sm	FR	T	N	
										181.40	MB						
	4.00		R-30	60	46	R4	SL			182.30	J	40	P,Sm	DG	PO	Py	

CORE BORING LOG
(continued)

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core Hard.	Rock Core Weath	Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities (See Legend for Rock Description System) Type	Dip	Rgh	Wea	Aper	Infill	Remarks
	4.00			100%	77%												
	4.00								183.4' - 184.5' Highly fractured zone with Calcite infill								
	3.50	185.0															
185 510	3.25	185.0							SLATE, Dark gray, very fine grained, slightly weathered, strong, extremely close to moderately spaced discontinuities	185.30	MB						Lossing water more rapid.
	3.00									186.50	J	40	P,Sm	FR	T	N	
	3.50		R-31	60 100%	52 87%	R4	FR			187.70	J	60	P,Sm	FR	T	N	
	3.50									188.30	J	40	P,Sm	FR	T	N	
										188.50	J	40	P,Sm	FR	T	N	
	3.50	190.0								189.10	J	40	P,Sm	FR	PO	N	
190	3.00	190.0							SLATE, Dark gray, fine grained, fresh, strong, extremely close to moderately spaced discontinuities 190.4' - 192.2' Highly fractured zone								Used up to 275 Gallons (R31 to R32).
	3.00																
	3.50		R-32	60 100%	34 57%	R4	FR			192.70	J	30	P,Sm	FR	PO	N	
	3.50																
	3.50	195.0								194.40	J	40	P,Sm	FR	T	N	
										194.60	J	40	P,R	FR	T	N	
195 500	3.00	195.0							SLATE, Dark gray, very fine grained, fresh, medium strong, close to moderately spaced discontinuities	195.80	J	40	P,R	FR	O	N	
	3.00									196.40	J	90	P,Sm	DG	VT	N	
	3.00		R-33	60 100%	42 70%	R3	FR			197.30	J	40	P,Sm	FR	VT	N	
	3.00									197.90	J	40	P,Sm	FR	VT	N	
										198.00	J	30	P,R	FR	VT	N	
										198.30	J	40	P,Sm	FR	VT	N	
										198.70	J	40	P,Sm	FR	VT	N	
	3.00	200.0								199.00	J	40	P,Sm	FR	VT	N	
										199.40	MB						
200										199.80	MB						
	4.00	200.0							SLATE, Dark gray, very fine grained, moderately weathered, medium strong, extremely close to close spaced discontinuities								Used up to 275 Gallons (R33 to R34).
										200.80	J	40	P,Sm	FR	VT	N	
	3.50									201.50	J	40	P,R	DG	PO	N	
										201.70	J	40	P,R	FR	T	N	
	3.50		R-34	60 100%	43 72%	R3	M			202.10	J	40	P,Sm	FR	VT	N	
										202.30	J	40	P,Sm	FR	VT	N	
									202.8' - 203.4' Highly fractured zone								
	3.00									203.60	J	40	P,R	DG	PO	QZ	
										203.90	J	40	P,Sm	FR	VT	N	
	3.50	205.0								204.10	J	40	P,R	DG	T	N	
205 490	4.50	205.0							SLATE, Dark gray, very fine grained, moderately weathered, medium strong, extremely close to moderately spaced discontinuities	205.20	J	40	P,R	DG	PO	N	
	4.00									206.20	J	40	P,Sm	FR	T	N	
									206.6' - 207.1' Highly fractured zone with Quartz infill	206.30	MB						
	4.00		R-35	60 100%	42 70%	R3	M			207.80	J	40	X,R	DE	T	N	

CORE BORING LOG
(continued)

Depth/ Elev. (ft)	Avg Core Rate (min /ft)	Depth (ft)	Run/ (Box) No.	Rec. (in. / %)	RQD (in. / %)	Rock Core Hard.	Rock Core Weath	Stratum Graphic	Visual Identification, Description and Remarks (Rock type, colour, texture, weathering, field strength, discontinuity spacing, optional additional geological observations)	Depth (ft.)	Discontinuities (See Legend for Rock Description System) Type	Dip	Rgh	Wea	Aper	Infill	Remarks
	4.50																
	4.50									208.40	J	40	P,Sm	FR	T	N	
	4.00	210.0								209.50	J	40	P,Sm	DS	T	QZ	
210		210.0							SLATE, Dark gray, very fine grained, slightly weathered, medium strong, extremely close to close spaced discontinuities								
	4.00									210.80	J	10	P,R	DG	T	N	
	4.00									211.40	J	20	P,R	DS	T	QZ	
										211.90	J	30	P,R	DS	T	QZ	
	4.00		R-36	60 100%	47 78%	R3	SL		212.5' - 212.9' Highly fractured zone	212.30	J	30	P,R	FR	T	N	
	4.00									213.40	J	20	P,R	FR	O	N	
	4.50	215.0							214.4' - 215' Highly fractured zone								
215 480		215.0							SLATE, Dark gray, very fine grained, moderately weathered, medium strong, extremely close to close spaced discontinuities								
	4.00									215.50	MB						
	4.00								216' - 216.7' Highly fractured zone								
	4.00		R-37	57 95%	39 65%	R3	M			217.00	J	20	P,Sm	FR	T	N	
										217.20	J	70	P,Sm	FR	VT	N	
										217.40	J	15	P,Sm	FR	VT	N	
										217.90	J	30	P,Sm	DS	T	N	
	4.00									218.20	J	30	P,R	FR	T	N	
										218.40	J	20	P,Sm	FR	T	N	
	4.00	220.0								219.20	J	20	P,Sm	FR	T	N	
220		220.0							SLATE, Dark gray, very fine grained, moderately weathered, extremely close to moderately spaced discontinuities								
	4.00									220.30	J	30	P,Sm	DS	PO	Ca	
	4.00									221.50	J	50	P,R	DG	PO	Ca	
										221.90	J	50	P,Sm	FR	VT	N	
										222.00	J	50	P,R	FR	VT	N	
	4.00		R-38	60 100%	32 53%	R3	M			222.30	J	40	P,Sm	FR	PO	N	
									222.7' - 225' Highly fractured zone with Calcite infill								
	4.00																
	4.00	225.0															
225 470									225.0 End of Boring at 225 feet BGS. Borehole grouted with cement and bentonite hole plug.								
230																	

NOTES:

PROJECT NO.: **353754**

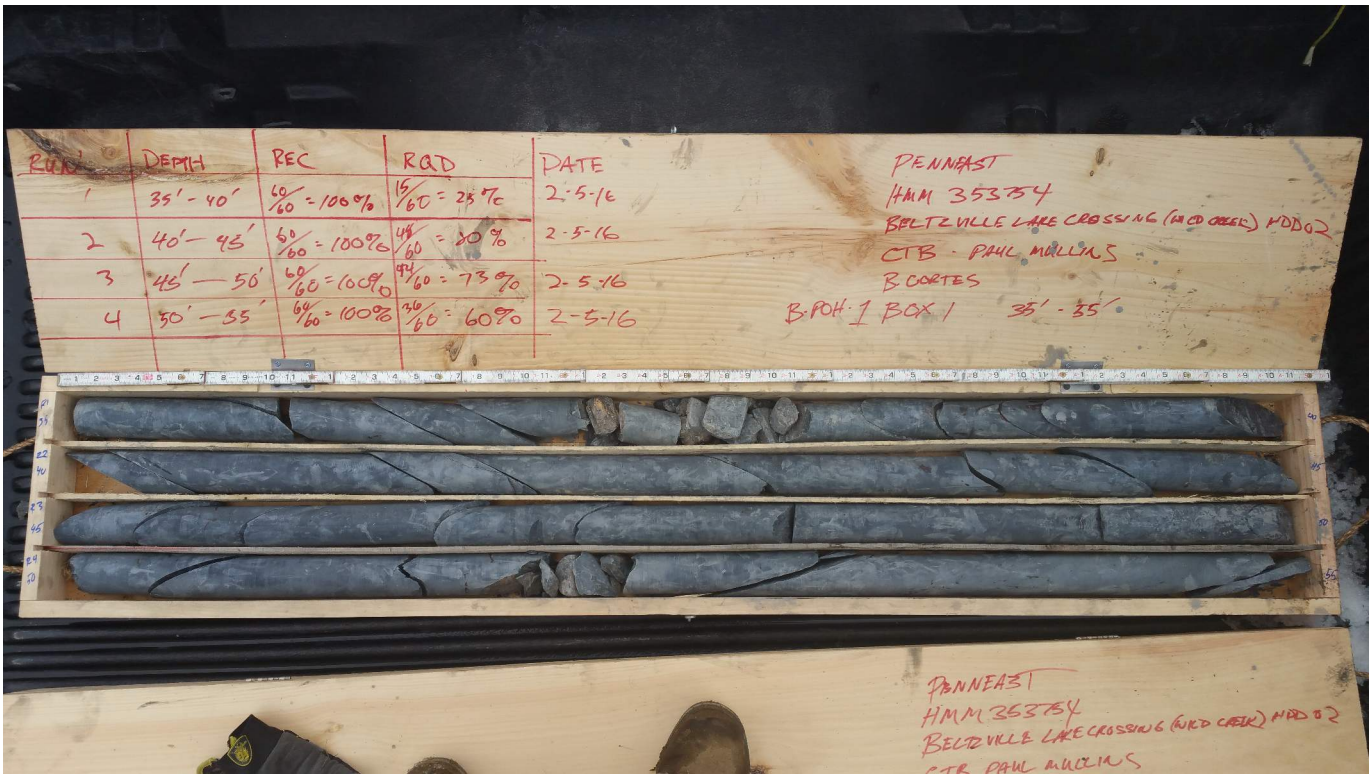


Figure B-Poh-1.1
B-Poh-1 Box 1 Runs 1-4 Dry

Figure B-Poh-1.2
B-Poh-1 Box 1 Runs 1-4 Wet

MOTT MACDONALD M M	**PennEast Pipeline Project** **Rock Core Photographs**	**BORING NO.:** B-Poh-1

Figure B-Poh-1.3
B-Poh-1 Box 2 Runs 5-8 Dry

Figure B-Poh-1.4
B-Poh-1 Box 2 Runs 5-8 Wet

MOTT MACDONALD M M	PennEast Pipeline Project Rock Core Photographs	BORING NO.: B-Poh-1

Figure B-Poh-1.5
B-Poh-1 Box 3 Runs 9-12 Dry

Figure B-Poh-1.6
B-Poh-1 Box 3 Runs 9-12 Wet

MOTT MACDONALD M M	**PennEast Pipeline Project** **Rock Core Photographs**	**BORING NO.:** B-Poh-1

Figure B-Poh-1.7
B-Poh-1 Box 4 Runs 13-16 Dry

Figure B-Poh-1.8
B-Poh-1 Box 4 Runs 13-16 Wet

MOTT MACDONALD M M	**PennEast Pipeline Project** **Rock Core Photographs**	**BORING NO.:** B-Poh-1

Figure B-Poh-1.9
B-Poh-1 Box 5 Runs 17-20 Dry

Figure B-Poh-1.10
B-Poh-1 Box 5 Runs 17-20 Wet

MOTT MACDONALD M M	**PennEast Pipeline Project** **Rock Core Photographs**	**BORING NO.:** B-Poh-1

Figure B-Poh-1.11
B-Poh-1 Box 6 Runs 21-24 Dry

Figure B-Poh-1.12
B-Poh-1 Box 6 Runs 21-24 Wet

MOTT MACDONALD M M	**PennEast Pipeline Project** **Rock Core Photographs**	**BORING NO.:** B-Poh-1

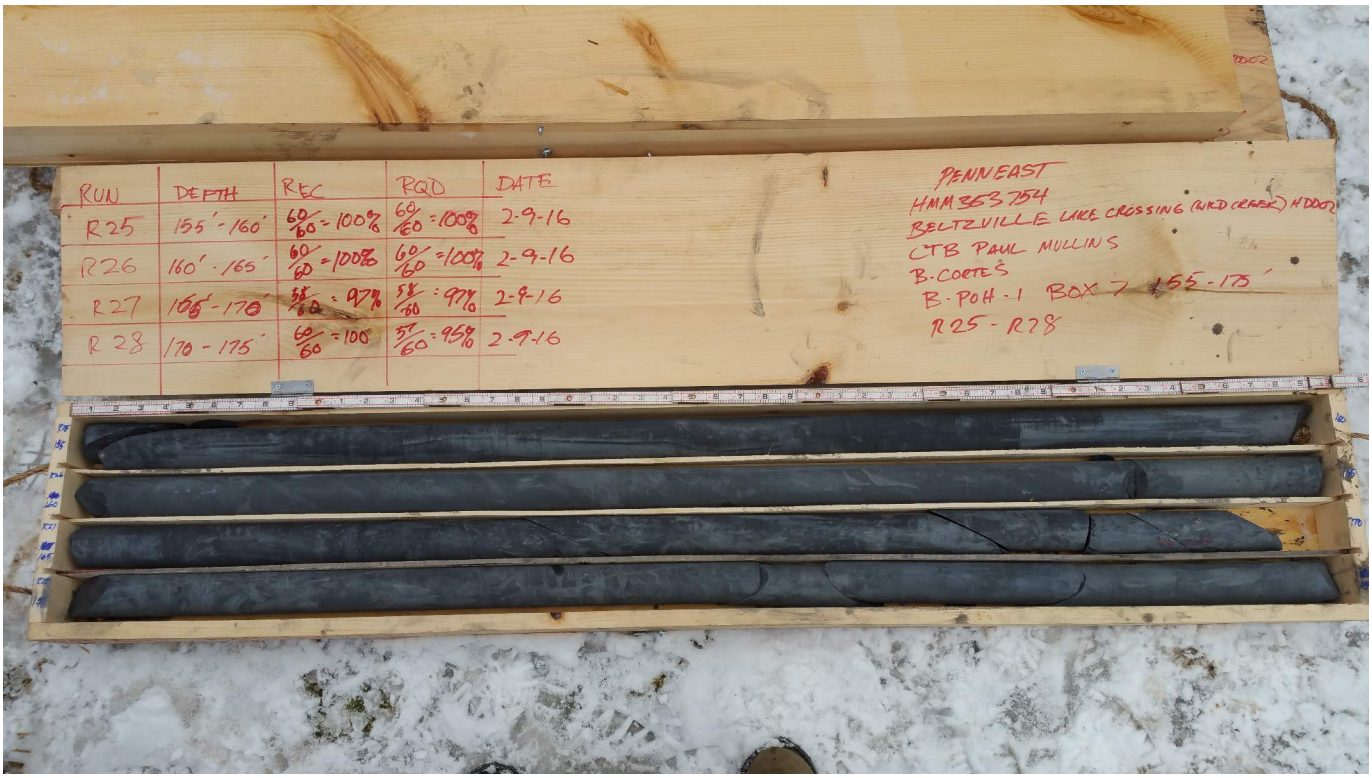


Figure B-Poh-1.13
B-Poh-1 Box 7 Runs 25-28 Dry

Figure B-Poh-1.14
B-Poh-1 Box 7 Runs 25-28 Wet

MOTT MACDONALD M M	**PennEast Pipeline Project** **Rock Core Photographs**	**BORING NO.:** B-Poh-1

Figure B-Poh-1.15
B-Poh-1 Box 8 Runs 29-32 Dry

Figure B-Poh-1.16
B-Poh-1 Box 8 Runs 29-32 Wet

MOTT MACDONALD M M	PennEast Pipeline Project Rock Core Photographs	BORING NO.: B-Poh-1

Figure B-Poh-1.17
B-Poh-1 Box 9 Runs 33-36 Dry

Figure B-Poh-1.18
B-Poh-1 Box 9 Runs 33-36 Wet

MOTT MACDONALD M M	**PennEast Pipeline Project** **Rock Core Photographs**	**BORING NO.:** B-Poh-1

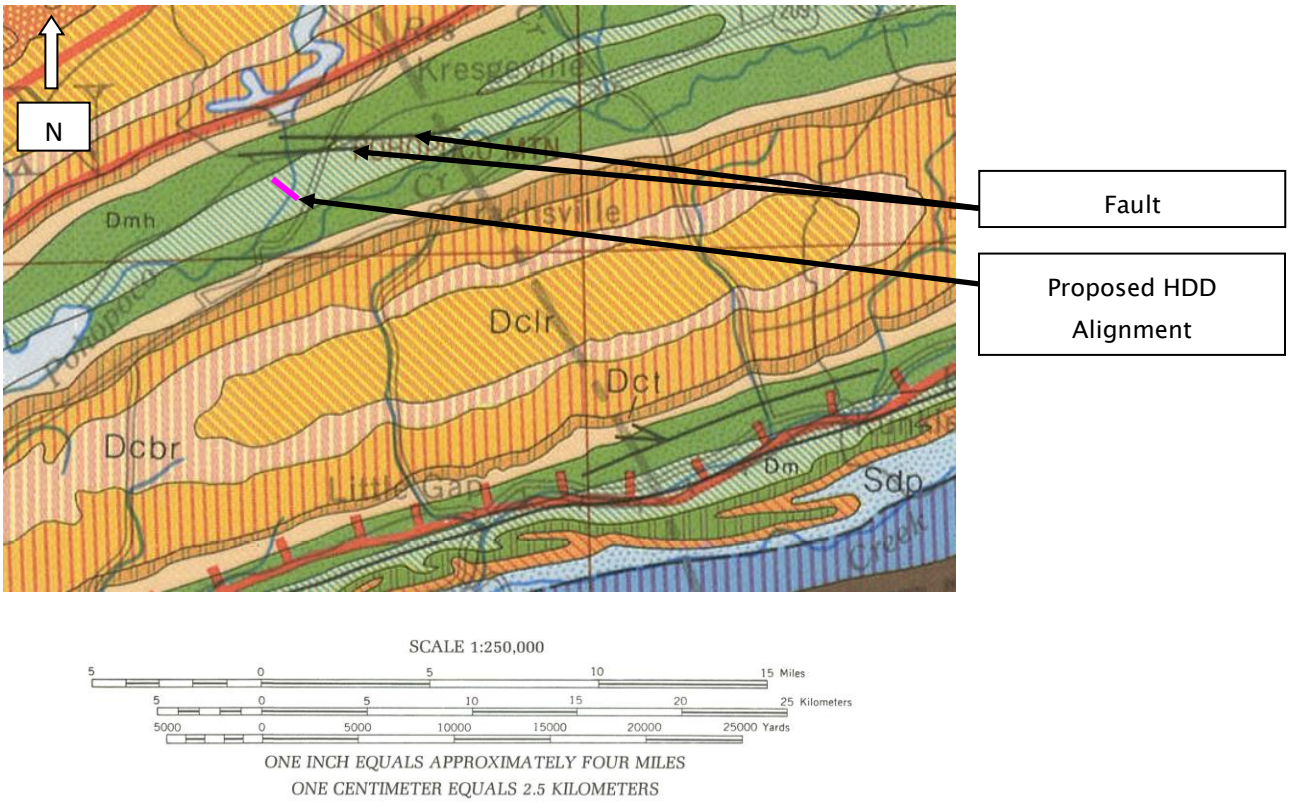
Figure B-Poh-1.19
B-Poh-1 Box 10 Runs 37-38 Dry

Figure B-Poh-1.20
B-Poh-1 Box 10 Runs 37-38 Wet

MOTT MACDONALD M M	**PennEast Pipeline Project** **Rock Core Photographs**	**BORING NO.:** B-Poh-1

D. Geologic Background References

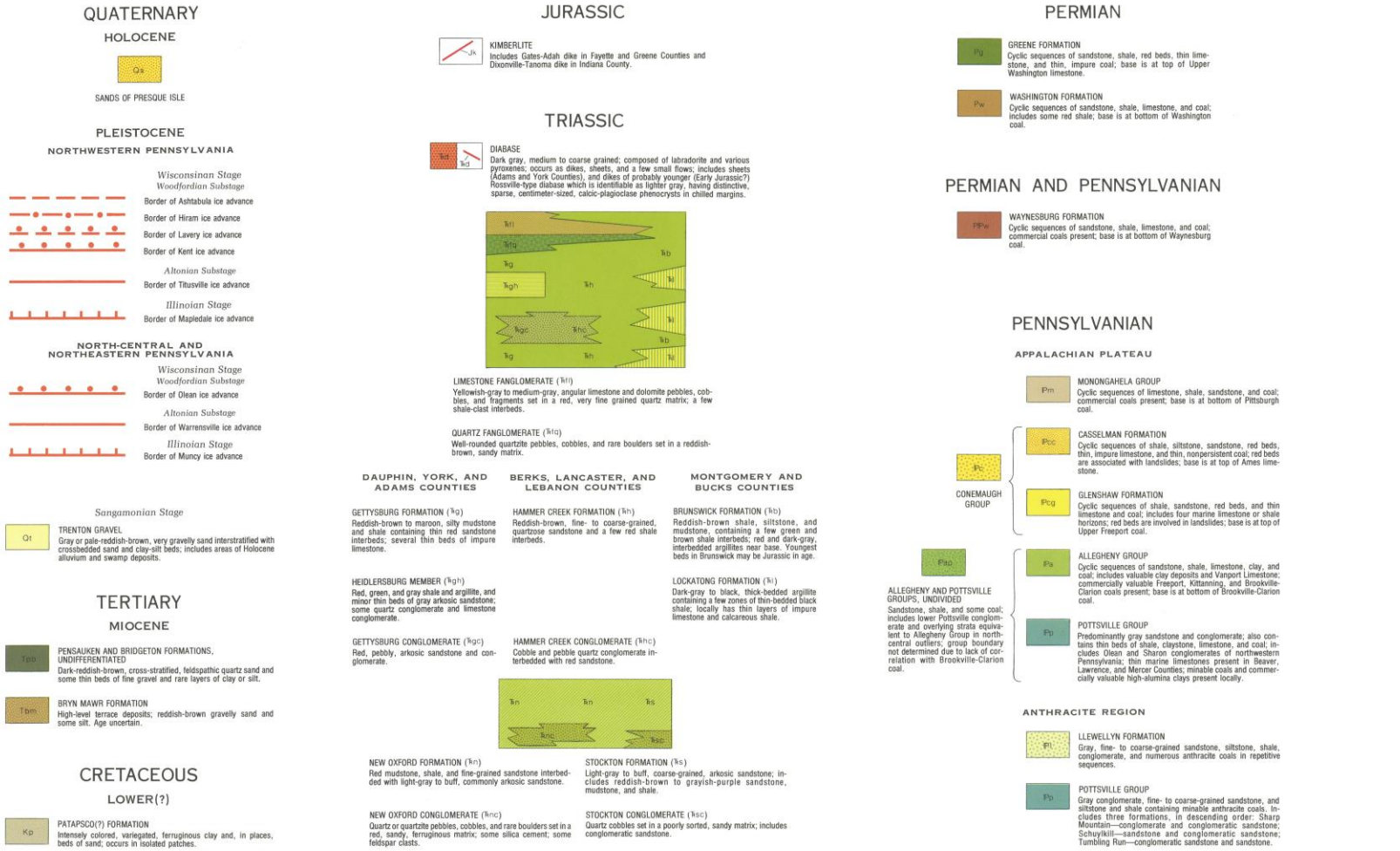
Figure 1: Bedrock Geology



Notes:

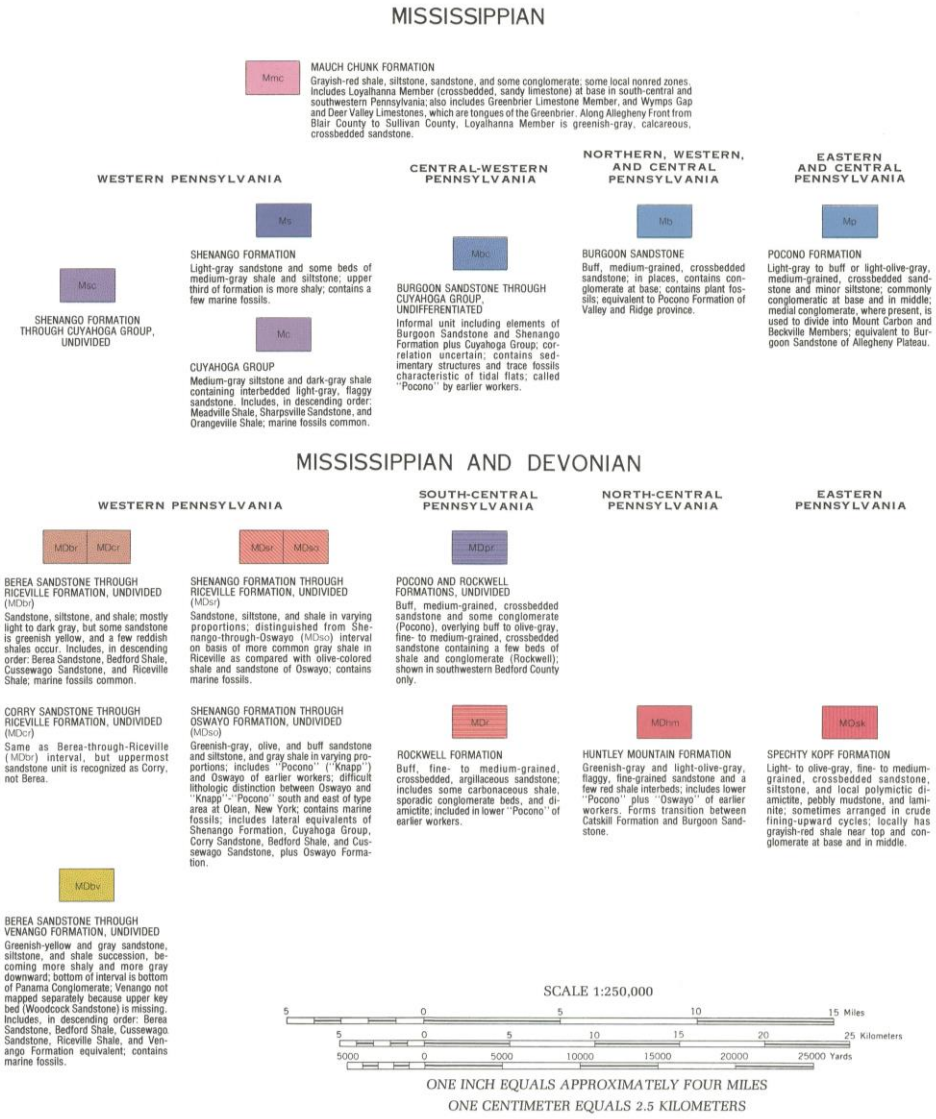
1. The proposed HDD alignment falls within the Marcellus Formation (Dm).
2. Geologic Imaging taken from:
    a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

Geological Map of Pennsylvania: Bedrock Formation Legend



1. Note: Geologic Legend taken from:
   a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

Geological Map of Pennsylvania: Bedrock Formation Legend



1. Note: Geologic Legend taken from:
   a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

Geological Map of Pennsylvania: Bedrock Formation Legend

DEVONIAN

UPPER

WESTERN PENNSYLVANIA

Dv — VENANGO FORMATION
Light-gray siltstone interbedded with some bluish-gray shale and some flaggy, gray sandstone; Panama Conglomerate and Woodcock Sandstone are, respectively, the lower and upper key beds defining the formation; referred to as "Cattaraugus" by some workers; includes some red shales where it interfingers to the east and south with the Catskill Formation; marine fossils present.

Dch — CHADAKOIN FORMATION
Light-gray or brownish siltstone and some sandstone, interbedded with medium-gray shale; included in Conneaut Group and "Chemung" of earlier workers; marine fossils common; includes "pink rock" of drillers.

Dg — GIRARD SHALE
Argillaceous, ashen-gray, flaky shale; included in Conneaut Group and "Chemung" of earlier workers; marine fossils rare.

Dne — NORTHEAST SHALE
Medium-gray shale and some thin light-gray siltstone interbeds; included in Canadaway Formation of New York; included in "Chemung" of earlier workers; contains sparse fossil marine fauna.

SOUTH-CENTRAL PENNSYLVANIA

Dck — CATSKILL FORMATION
Grayish-red sandstone, siltstone, and shale; locally conglomeratic; contains gray sandstone in upper part; lithologies arranged in fining-upward cycles; equivalent to the Hampshire Formation south of Pennsylvania.

Df — FOREKNOBS FORMATION
Interbedded sandstone, siltstone, and shale; gray to olive gray, red near top; substantial brownish-gray sandstone; some marine fossils; a few conglomerate beds at base and top.

Ds — SCHERR FORMATION
Chiefly siltstone; some fine-grained sandstone and shale; light olive gray; marine fossils.

Dbh — BRALLIER AND HARRELL FORMATIONS, UNDIVIDED
In descending order: Brallier—medium-gray, planar-bedded siltstone interbedded with light-olive shale; sparse marine fauna; Harrell—black shale (Burket Member) and dark-gray shale.

CENTRAL PENNSYLVANIA

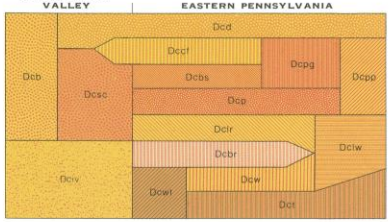
Dck — CATSKILL FORMATION
Grayish-red sandstone, siltstone, and shale; units of gray sandstone occur in upper part; lithologies in upper part arranged in fining-upward cycles.

Dlh — LOCK HAVEN FORMATION
Interbedded olive-gray sandstone, siltstone, claystone, and thin conglomerate; marine fossils throughout; "Chemung" of earlier workers. Laterally equivalent to Scherr and Foreknobs Formations.

CENTRAL AND EASTERN PENNSYLVANIA

Dck — CATSKILL FORMATION, UNDIVIDED
Succession of grayish-red sandstone, siltstone, and shale, generally in fining-upward cycles; some gray sandstone and conglomerate.

SUSQUEHANNA VALLEY | EASTERN PENNSYLVANIA



BUDDYS RUN MEMBER (Dcb)
Grayish-red and brownish-gray sandstone, siltstone, and claystone; some gray and dusky-yellow sandstone and siltstone; laterally equivalent to Duncannon, Clarks Ferry, and Sherman Creek Members.

SHERMAN CREEK MEMBER (Dcsc)
Alternating grayish-red siltstone and claystone in poorly defined, fining-upward cycles, and minor intervals of gray sandstone; laterally equivalent to Berry Run, Sawmill Run, Packerton, and Long Run Members.

IRISH VALLEY MEMBER (Dciv)
Nonmarine, gray and grayish-red sandstone and grayish-red claystone interbedded with minor, thin, light-olive-gray marine siltstone; arranged in fining-upward cycles. Lower part of member has conglomeratic sandstones.

DUNCANNON MEMBER (Dcd)
Grayish-red sandstone, siltstone, and claystone in fining-upward cycles; conglomerate occurs at base of some cycles.

CLARKS FERRY MEMBER (Dccf)
Gray to yellowish-gray sandstone and conglomerate.

BERRY RUN AND SAWMILL RUN MEMBERS, UNDIVIDED (Dcbs)
Greenish-gray to gray sandstone and minor red siltstone and claystone.

POPLAR GAP MEMBER (Dcpg)
Gray and light-olive-gray sandstone conglomerate containing intermittent red beds; laterally equivalent to Clarks Ferry, Sawmill Run, and Berry Run Members.

PACKERTON MEMBER (Dcp)
Greenish-gray to gray sandstone; some laterally persistent conglomerate beds in lower part.

POPLAR GAP AND PACKERTON MEMBERS, UNDIVIDED (Dcpp)

LONG RUN MEMBER (Dclr)
Gray and grayish-red sandstone and grayish-red siltstone and claystone in fining-upward cycles.

BEAVERDAM RUN MEMBER (Dcbr)
Alternating olive-gray siltstone and sandstone; marine fossils.

WALCKSVILLE MEMBER (Dcw)
Greenish-gray sandstone and red siltstone and claystone in fining-upward cycles.

LONG RUN AND WALCKSVILLE MEMBERS, UNDIVIDED (Dclw)

TOWAMENSING MEMBER (Dct)
Dominantly gray sandstone and some siltstone; freshwater fossils.

WALCKSVILLE AND TOWAMENSING MEMBERS, UNDIVIDED (Dcwt)

Dtr — TRIMMERS ROCK FORMATION
Olive-gray siltstone and shale, characterized by graded bedding; marine fossils; some very fine grained sandstone in northeast; black shale of Harrell Formation at base in Susquehanna Valley.

DEVONIAN

MIDDLE AND LOWER

Dh — HAMILTON GROUP

Dmh — MAHANTANGO FORMATION
Gray, brown, and olive shale and siltstone; marine fossils. Includes following members, in descending order: Tully—limestone or calcareous shale; Sherman Ridge, Montebello (sandstone), Fisher Ridge, Dalmatia, and Turkey Ridge. In south-central Pennsylvania, includes Clearville, Frame, Chaneysville, and Gander Run Members. Characterized by coarsening-upward cycles.

Dm — MARCELLUS FORMATION
Black, carbonaceous shale; sparse marine fauna and siderite concretions. Contains local limestone ("Purcell") member. Tioga bentonite included at base in eastern Pennsylvania.

CENTRAL AND EAST-CENTRAL PENNSYLVANIA

Don — ONONDAGA FORMATION
Medium-gray calcareous shale; marine fossils; medium-gray argillaceous limestone of Selinsgrove Member at top; called "Needmore Formation" west of 78° longitude; Tioga bentonite at top.

Dor — OLD PORT FORMATION
Dosn — Includes, in descending order: Ridgeley Member (Dor)—fine- to very coarse grained, light-gray sandstone ("Oriskany" of earlier workers); Shriver, Mandata, Corriganville, and New Creek Members (Dosn)—siliceous siltstone, chert, shale, and limestone. In Fulton County, limestone and chert of the Licking Creek Member replaces the Shriver and Mandata.

EASTERN PENNSYLVANIA

Dpe — BUTTERMILK FALLS LIMESTONE THROUGH ESOPUS FORMATION, UNDIVIDED
In descending order: Buttermilk Falls Limestone—gray fossiliferous limestone and black chert; Palmerton Sandstone—massive white siliceous sandstone; Schoharie Formation—gray calcareous, argillaceous siltstone; Esopus Formation—gray silty shale and sandy siltstone.

Dre — RIDGELEY FORMATION THROUGH COEYMANS FORMATION, UNDIVIDED
In descending order: Ridgeley Formation—white siliceous sandstone; Shriver Chert—gray siltstone and shale and dark-gray chert; Port Ewen Shale—dark-gray calcareous siltstone and shale; Minisink Limestone—dark-gray clayey limestone; New Scotland Formation—dark-gray fossiliferous shale and clayey limestone; Coeymans Formation—gray, clayey to sandy limestone.

DEVONIAN AND SILURIAN

CENTRAL AND EAST-CENTRAL PENNSYLVANIA

DSkt — KEYSER AND TONOLOWAY FORMATIONS, UNDIVIDED
In descending order: Keyser—medium-gray, crystalline to nodular, fossiliferous limestone; upper part laminated and mud cracked; not present east of Harrisburg; passes into lower Coeymans, Rondout, and Decker Formations in the east. Tonoloway—medium-gray laminated, mud-cracked limestone containing some medium-dark- or olive-gray shale and siltstone interbeds; lower part passes into Wills Creek Formation east and south; passes into Bossardville and Poxono Island beds in the east.

DSkm — KEYSER FORMATION THROUGH MIFFLINTOWN FORMATION, UNDIVIDED
In descending order: Keyser Formation—limestone; Tonoloway Formation—limestone and interbedded shale; Wills Creek Formation—interbedded shale, siltstone, sandstone, limestone, and dolomite; Bloomsburg Formation—grayish-red claystone; Mifflintown Formation—interbedded shale and limestone.

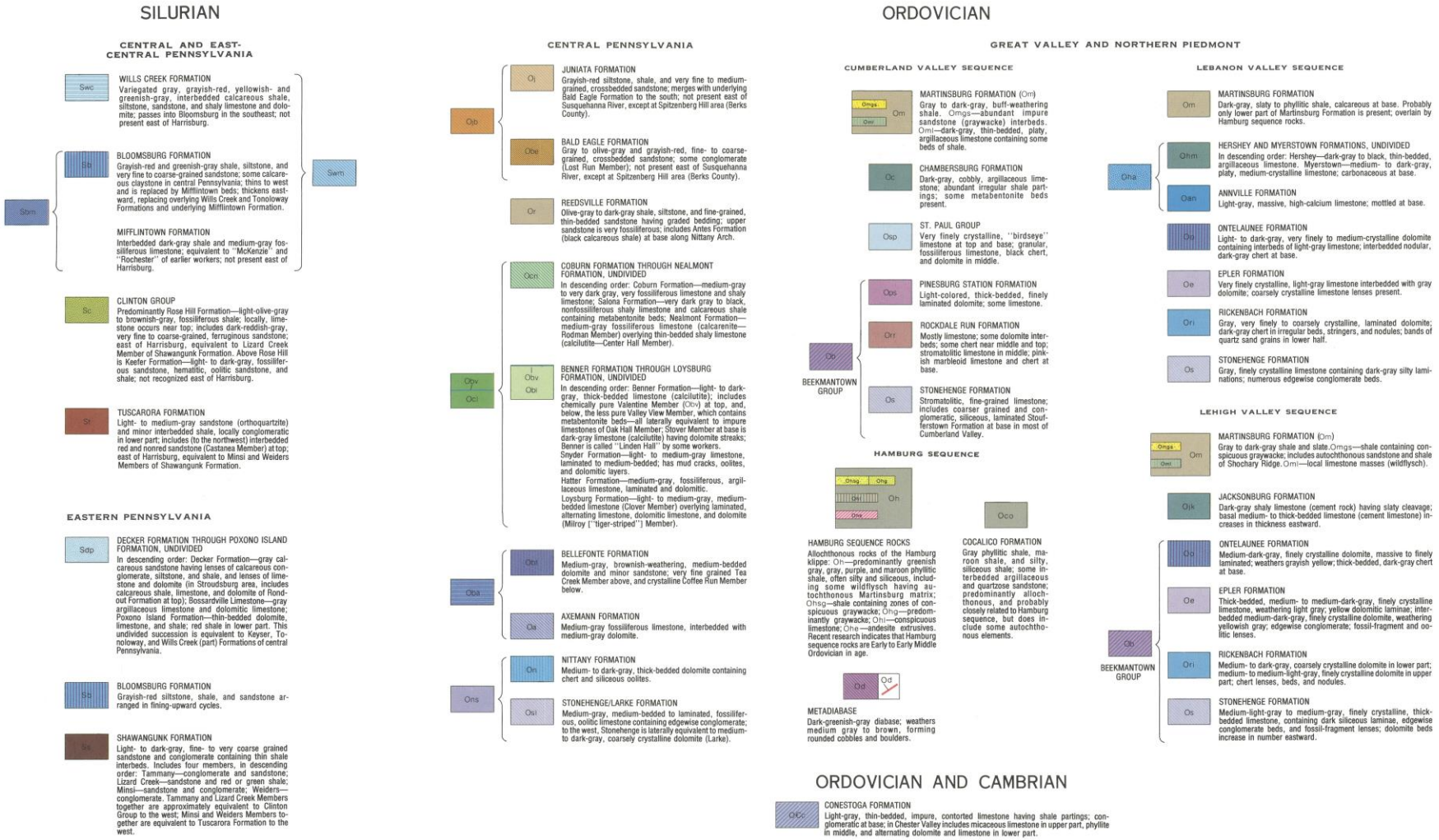
DSkc — KEYSER FORMATION THROUGH CLINTON GROUP, UNDIVIDED
Same as Keyser-through-Mifflintown (DSkm) interval, plus Clinton Group at base. Clinton includes, in descending order: Keefer Formation—fossiliferous sandstone and hematitic, oolitic sandstone and shale; Rose Hill Formation—fossiliferous shale.

EASTERN PENNSYLVANIA

DSop — ONONDAGA FORMATION THROUGH POXONO ISLAND FORMATION, UNDIVIDED
In descending order: Onondaga Formation—gray calcareous, sandy shale; Ridgeley Formation—brown sandstone; Rondout Formation—gray interbedded limestone, dolomite, and shale; Decker Formation—gray calcareous sandstone, and Andreas Red Beds at top; Bossardville Limestone—gray, mud-cracked, shaly limestone; Poxono Island Formation—olive-gray, calcareous and dolomitic shale, siltstone, and sandstone.

1. Note: Geologic Legend taken from:
   a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

Geological Map of Pennsylvania: Bedrock Formation Legend



1. Note: Geologic Legend taken from:
   a. Berg, T.M., Edmunds, W.E., Geyer, A.R., and others, compilers, 1980, Geologic map of Pennsylvania (2nd ed.): Pennsylvania Geological Survey, 4th ser., Map 1, 3 sheets, scale 1:250,000.

Geological Map of Pennsylvania: Bedrock Formation Legend

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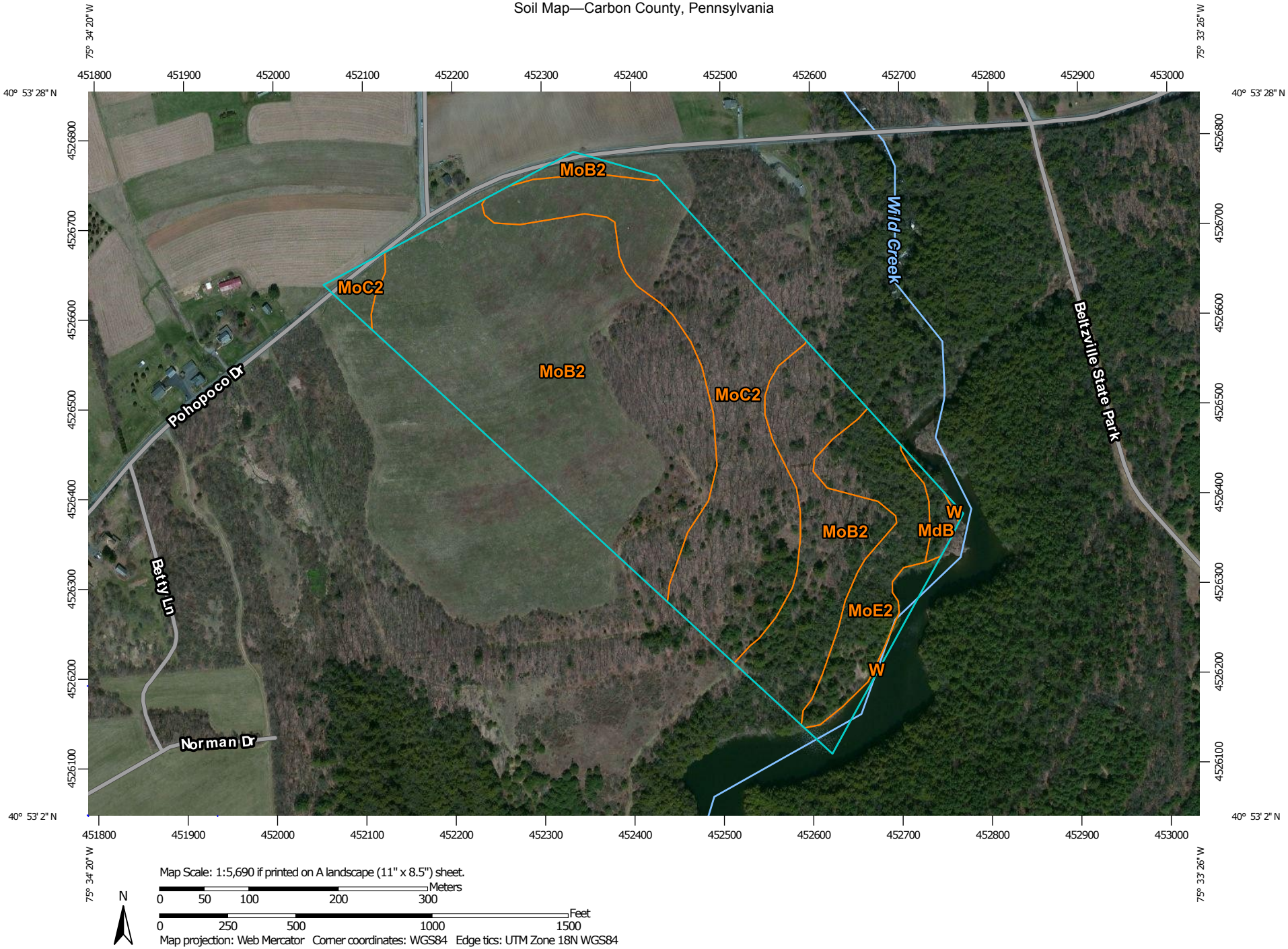
Soil Map—Carbon County, Pennsylvania



Map Scale: 1:5,690 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Carbon County, Pennsylvania
Survey Area Data: Version 11, Sep 15, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

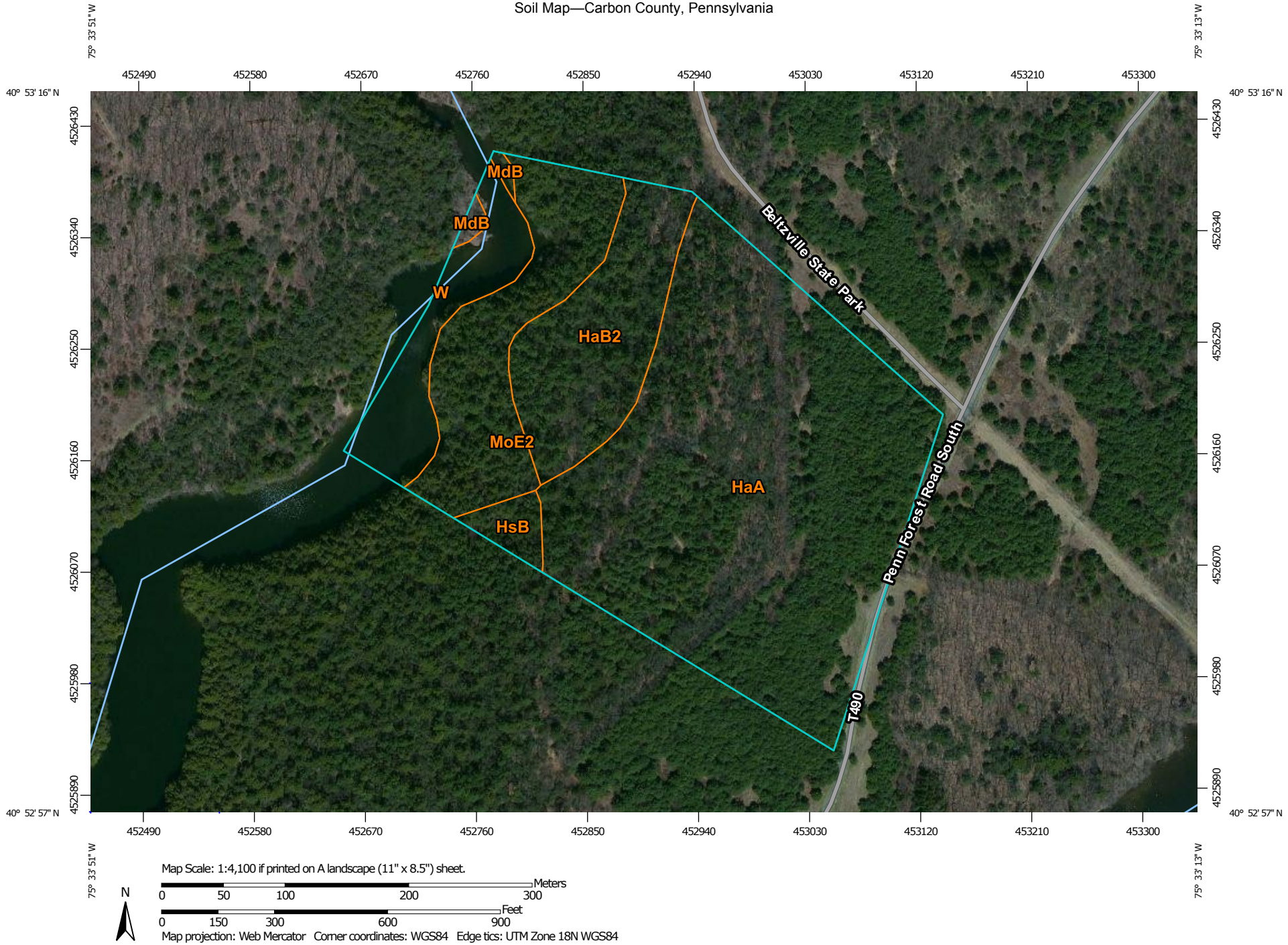
Date(s) aerial images were photographed: Mar 19, 2011—Jul 1, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Carbon County, Pennsylvania (PA025)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
MdB	Middlebury silt loam, 3 to 8 percent slopes	0.6	1.1%
MoB2	Montevallo channery silt loam, 3 to 8 percent slopes, moderately eroded	31.6	58.9%
MoC2	Montevallo channery silt loam, 8 to 15 percent slopes, moderately eroded	15.3	28.6%
MoE2	Montevallo channery silt loam, 25 to 35 percent slopes, moderately eroded	5.2	9.6%
W	Water	1.0	1.9%
Totals for Area of Interest		**53.7**	**100.0%**

Soil Map—Carbon County, Pennsylvania



Map Scale: 1:4,100 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 50 100 200 300

Feet
0 150 300 600 900

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 18N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

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- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

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Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
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Survey Area Data: Version 11, Sep 15, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 19, 2011—Jul 1, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend

Carbon County, Pennsylvania (PA025)			
Map Unit Symbol	**Map Unit Name**	**Acres in AOI**	**Percent of AOI**
HaA	Hartleton channery silt loam, 0 to 3 percent slopes	19.6	60.1%
HaB2	Hartleton channery silt loam, 3 to 8 percent slopes, moderately eroded	4.6	14.1%
HsB	Hartleton very stony loam, 0 to 8 percent slopes	0.6	1.8%
MdB	Middlebury silt loam, 3 to 8 percent slopes	0.2	0.7%
MoE2	Montevallo channery silt loam, 25 to 35 percent slopes, moderately eroded	5.0	15.2%
W	Water	2.7	8.1%
Totals for Area of Interest		**32.6**	**100.0%**

Pennsylvania
Abandoned Mine Land Inventory

N
W E
S

Erie
Warren
McKean
Potter
Tioga
Bradford
Susquehanna
Wayne
Wyoming
Luzerne
Pike
Crawford
Forest
Elk
Cameron
Lycoming
Sullivan
Clinton
Columbia
Montour
Carbon
Monroe
Northampton
Venango
Mercer
Clarion
Jefferson
Clearfield
Centre
Union
Northumberland
Schuylkill
Lehigh
Snyder
Lawrence
Butler
Armstrong
Indiana
Mifflin
Juniata
Dauphin
Lebanon
Berks
Bucks
Montgomery
Perry
Blair
Huntingdon
Cambria
Beaver
Allegheny
Westmoreland
Cumberland
Lancaster
Chester
Philadelphia
Delaware
York
Adams
Franklin
Bedford
Fulton
Washington
Somerset
Fayette
Greene

Map Legend

- Counties
- AML Inventory Site (PA)

AML Features

- Unreclaimed
- Reclaimed

0 10 20 40 60 Miles

Please refer to one of the individual County maps
for the Disrtict Offices contact information

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Map Prepared By: Katelyn I. Smith
Date: 1/09/2014
Data Source: Bureau of Abandoned Mine Reclamation
Projection: North_America_Albers_Equal_Area_Conic

For Information only
Priority 1 (P1): An AML problem concerning the protection of public health, safety, and property from extreme danger of adverse effects of mining practices or adjacent land and water reclamation.
Priority 2 (P2): An AML problem concerning the protection of public health and safety from adverse effects of mining practices or adjacent land and water reclamation.
Priority 3 (P3): An AML problem concerning the restoration of land and water resources and the environment previously degraded by adverse effects of mining practices.

E. Laboratory Data

GEOTECHNICAL LABORATORY TESTING RESULTS

US Army Corps of Engineers

CLIENT: Mott MacDonald
111 Wood Ave South
Iselin, New Jersey 08830-4112

ATTN: Mr. Bernad O. Cortes

PROJECT: Penn East Pipeline
Wild Creek

CTL # 548000C
CTB # 150167

DATE: August 10, 2015

CHECKED BY: Eduardo M. Freire, P.E.
Geotechnical Laboratory Manager

SAMPLES RECEIVED: July 20, 2015 **SAMPLES TESTED:** 7/20/15 - 8/10/15 **LAB TECHNICIAN(S):** J. Veach, A. Platt, Terrasence

Test Boring No.	Sample No.	Depth (ft)	Water Content (%) (ASTM D2216)	Atterberg Limits (ASTM D4318)			Unit Weight of Oven dried Rock	Rock Unconfined Compression w/ Stress-Strain (ASTM D7012-D)*	Point Load Strength (ASTM D5731)	Rock Unconfined Compression (ksi) (ASTM D7012-C)^	Chloride (mg/L) (ASTM D4327)	pH of Soil (ASTM G51)	Consolidation* (ASTM D2435)	UU Triaxial* (ASTM D2850)	CU Triaxial (ASTM D4767)	Soil Perm. Class Rating (NJAC 7:9A-6.3)					
				LL	PL	PI										A	B				
B-10	R-3	26.8-27.2					158.4														
	R-4	20.75-31.65							Plate 1												
	R-14	83-83.5							Plate 2												
	R-15	86.8-87.4						RC-1													
B-11	R-15	80-80.6						RC-2													
	R-15	82.95-83.45							Plate 3												
	R-16	88.95-89.55							Plate 4												
	R-16	86.2-86.79					171.8														
	R-17	92.5-93.3						RC-3	Plate 5												
		Billing Total:					**2**	**3**	**5**												

Comments/Remarks: *See attached Plates

CRAIG
TESTING LABORATORIES, INC.
5439 Harding Highway • P.O. Box 427 • Mays Landing, NJ 08330 • P:609.625.1700 • F:609.625.1798

UNCONFINED COMPRESSION TEST WITH STRESS-STRAIN CURVE REPORT

(ASTM D 7012 - Method D (Mod))

Client:	Mott MacDonald	Test Date:	July 31, 2015	Plate :	RC-1
Project:	Penn East Pipeline - Wildcreek			CTL #:	548000C
Boring No.:	B-10	Core Run:	R-15	Depth (ft):	86.8-87.4
Description:	Shale Dark gray			Tested By:	JV
				Checked By:	EF

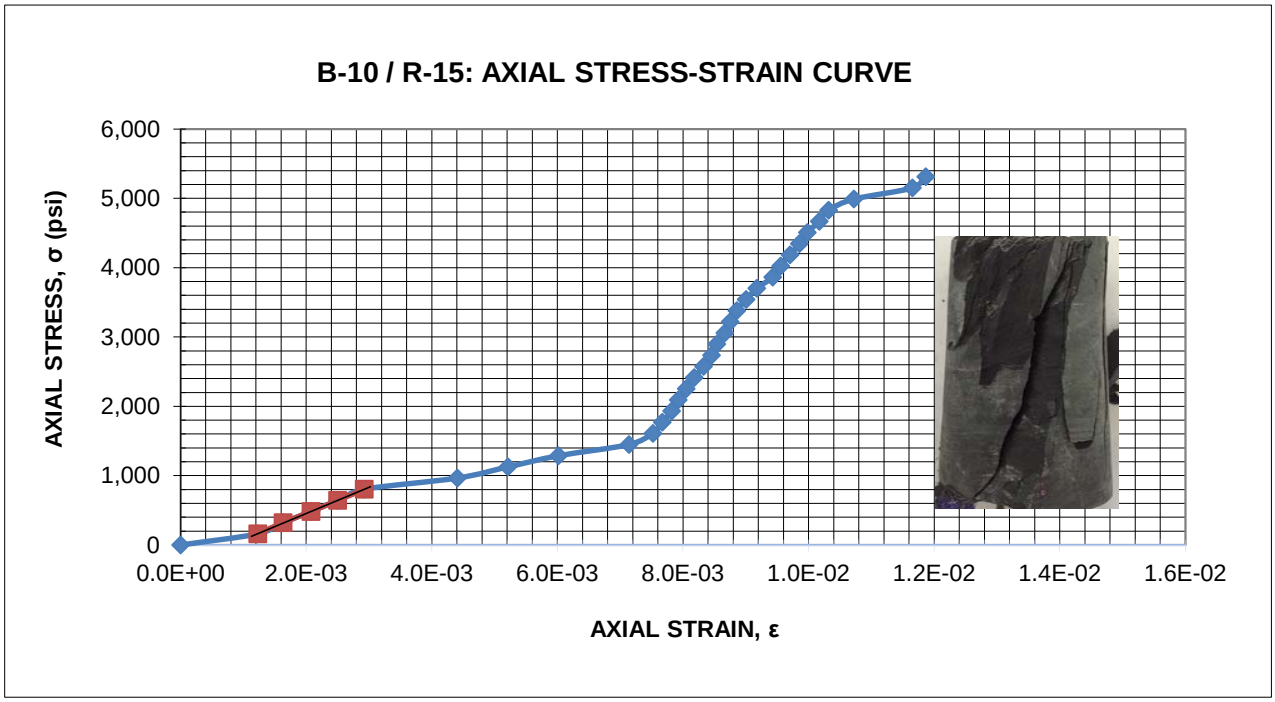
Core Data:

Avg. Length (inch) =	4.720	Avg. Diameter (inch) =	1.989
L/D Ratio (2.0 to 2.5) =	2.37	Area (inch^2) =	3.106
Dry Unit Weight (pcf)	170.9		

Note: Test specimen not prepared in accordance with D4543

Load (lbs)	Stress (psi)	Deformation (in)	Strain
0	0	0.0000	0.00E+00
500	161	0.0058	1.23E-03
1,000	322	0.0077	1.63E-03
1,500	483	0.0098	2.08E-03
2,000	644	0.0118	2.50E-03
2,500	805	0.0138	2.92E-03
3,000	966	0.0208	4.41E-03
3,500	1,127	0.0246	5.21E-03
4,000	1,288	0.0284	6.02E-03
4,500	1,449	0.0337	7.14E-03
5,000	1,610	0.0355	7.52E-03
5,500	1,771	0.0362	7.67E-03
6,000	1,932	0.0369	7.82E-03
6,500	2,092	0.0374	7.92E-03
7,000	2,253	0.0380	8.05E-03
7,500	2,414	0.0386	8.18E-03
8,000	2,575	0.0393	8.33E-03
8,500	2,736	0.0399	8.45E-03
9,000	2,897	0.0403	8.54E-03
9,500	3,058	0.0409	8.67E-03
10,000	3,219	0.0413	8.75E-03
10,500	3,380	0.0418	8.86E-03
11,000	3,541	0.0425	9.01E-03
11,500	3,702	0.0433	9.17E-03
12,000	3,863	0.0445	9.43E-03
12,500	4,024	0.0451	9.56E-03
13,000	4,185	0.0458	9.70E-03
13,500	4,346	0.0465	9.85E-03
14,000	4,507	0.0471	9.98E-03
14,500	4,668	0.0480	1.02E-02
15,000	4,829	0.0487	1.03E-02
15,500	4,990	0.0506	1.07E-02
16,000	5,151	0.0550	1.17E-02
16,500	5,312	0.0560	1.19E-02
16,860	5,428	**FAIL**	

UNIAXIAL COMPRESSIVE STRENGTH, σ_u:	**5,428**	**psi**	**=**	**5.4** **ksi**
ESTIMATED YOUNG'S MODULUS, E:	**3.80E+05**	**psi**	**(Avg. Linear Portion of Curve, shown)**	



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UNCONFINED COMPRESSION TEST WITH STRESS-STRAIN CURVE REPORT

(ASTM D 7012 - Method D (Mod))

Client:	Mott MacDonald	Test Date:	July 31, 2015	Plate :	RC-2
Project:	Penn East Pipeline - Wildcreek			CTL #:	548000C
Boring No.:	B-11	Core Run:	R-15	Depth (ft):	80-80.6
Description:	Shale Dark gray			Checked By:	EF

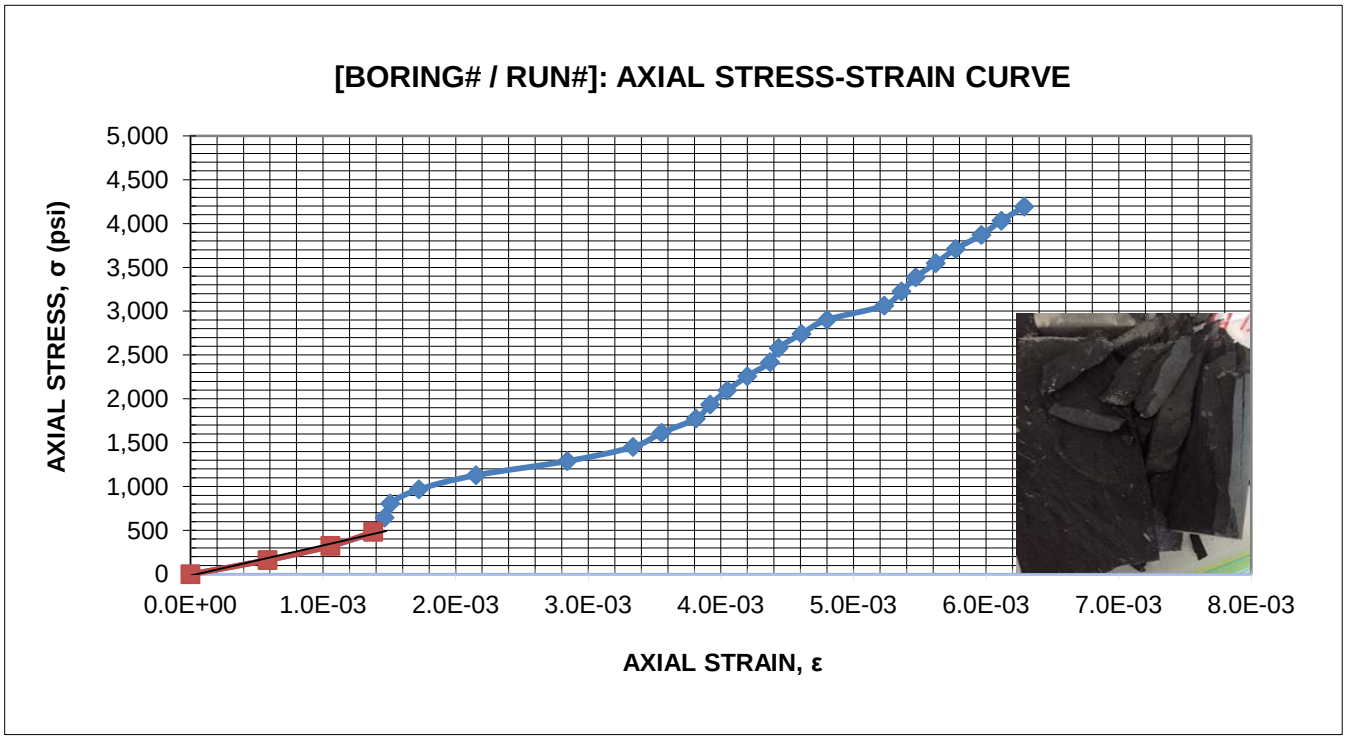
Core Data:

Avg. Length (inch) =	4.645	Avg. Diameter (inch) =	1.987
L/D Ratio (2.0 to 2.5) =	2.34	Area (inch^2) =	3.101
Dry Unit Weight (pcf)	170.8		

Note: Test specimen not prepared in accordance with D4543

Load (lbs)	Stress (psi)	Deformation (in)	Strain
0	0	0.0000	0.00E+00
500	161	0.0027	5.81E-04
1,000	322	0.0049	1.06E-03
1,500	484	0.0064	1.38E-03
2,000	645	0.0068	1.46E-03
2,500	806	0.0070	1.51E-03
3,000	967	0.0080	1.72E-03
3,500	1,129	0.0100	2.15E-03
4,000	1,290	0.0132	2.84E-03
4,500	1,451	0.0155	3.34E-03
5,000	1,612	0.0165	3.55E-03
5,500	1,774	0.0177	3.81E-03
6,000	1,935	0.0182	3.92E-03
6,500	2,096	0.0188	4.05E-03
7,000	2,257	0.0195	4.20E-03
7,500	2,419	0.0203	4.37E-03
8,000	2,580	0.0206	4.44E-03
8,500	2,741	0.0214	4.61E-03
9,000	2,902	0.0223	4.80E-03
9,500	3,064	0.0243	5.23E-03
10,000	3,225	0.0249	5.36E-03
10,500	3,386	0.0254	5.47E-03
11,000	3,547	0.0261	5.62E-03
11,500	3,709	0.0268	5.77E-03
12,000	3,870	0.0277	5.96E-03
12,500	4,031	0.0284	6.11E-03
13,000	4,192	0.0292	6.29E-03
13,300	4,289	**FAIL**	

UNIAXIAL COMPRESSIVE STRENGTH, σ_u:	**4,289**	**psi**	**= 4.3**	**ksi**
ESTIMATED YOUNG'S MODULUS, E:	**3.51E+05**	**psi**	**(Avg. Linear Portion of Curve, shown)**	



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UNCONFINED COMPRESSION TEST WITH STRESS-STRAIN CURVE REPORT

(ASTM D 7012 - Method D (Mod))

Client:	Mott MacDonald	Test Date:	July 31, 2015	Plate :	RC-3
Project:	Penn East Pipeline - Wildcreek			CTL #:	548000C
Boring No.:	B-11	Core Run:	R-17	Depth (ft):	92.5-93.3
Description:	Shale Dark gray			Tested By:	JV
				Checked By:	EF

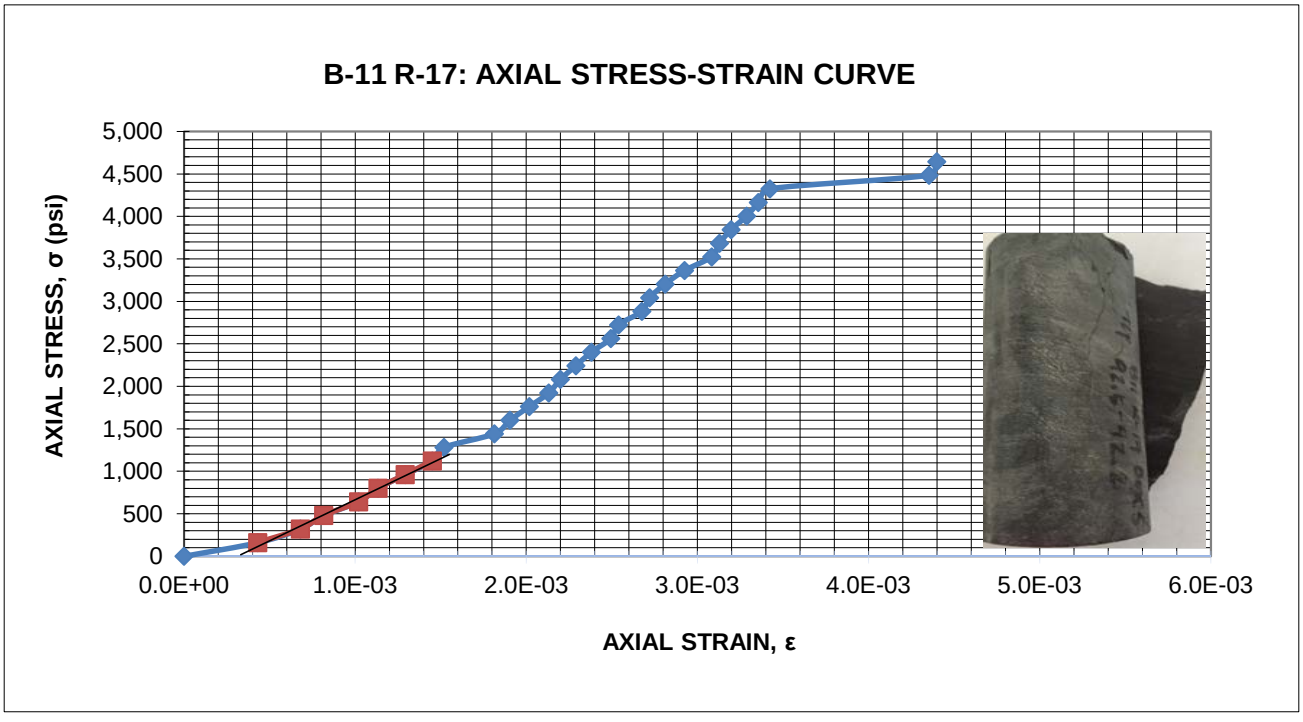
Core Data:

Avg. Length (inch) =	4.411	Avg. Diameter (inch) =	1.994
L/D Ratio (2.0 to 2.5) =	2.21	Area (inch^2) =	3.123
Dry Unit Weight (pcf)	169.5		

Note: Test specimen not prepared in accordance with D4543

Load (lbs)	Stress (psi)	Deformation (in)	Strain
0	0	0.0000	0.00E+00
500	160	0.0019	4.31E-04
1,000	320	0.0030	6.80E-04
1,500	480	0.0036	8.16E-04
2,000	640	0.0045	1.02E-03
2,500	801	0.0050	1.13E-03
3,000	961	0.0057	1.29E-03
3,500	1,121	0.0064	1.45E-03
4,000	1,281	0.0067	1.52E-03
4,500	1,441	0.0080	1.81E-03
5,000	1,601	0.0084	1.90E-03
5,500	1,761	0.0089	2.02E-03
6,000	1,921	0.0094	2.13E-03
6,500	2,081	0.0097	2.20E-03
7,000	2,242	0.0101	2.29E-03
7,500	2,402	0.0105	2.38E-03
8,000	2,562	0.0110	2.49E-03
8,500	2,722	0.0112	2.54E-03
9,000	2,882	0.0118	2.68E-03
9,500	3,042	0.0120	2.72E-03
10,000	3,202	0.0124	2.81E-03
10,500	3,362	0.0129	2.92E-03
11,000	3,523	0.0136	3.08E-03
11,500	3,683	0.0138	3.13E-03
12,000	3,843	0.0141	3.20E-03
12,500	4,003	0.0145	3.29E-03
13,000	4,163	0.0148	3.36E-03
13,500	4,323	0.0151	3.42E-03
14,000	4,483	0.0192	4.35E-03
14,500	4,643	0.0194	4.40E-03
14,530	4,653	**FAIL**	

UNIAXIAL COMPRESSIVE STRENGTH, σ_u:	**4,653**	**psi**	**=**	**4.7**	**ksi**
ESTIMATED YOUNG'S MODULUS, E:	**9.42E+05**	**psi**	**(Avg. Linear Portion of Curve, shown)**		



Depth:				
Load Orientation:	Diametral		Axial	
Length to nearest free end, L (mm)	27.7		25.0	
Specimen Width, W (mm)	50.3		50.3	
D (mm)	50.3		48.0	
D' (mm)	49.0		48.0	
D_e (mm)	49.0		55.4	
Failure Load, P (lb)	511		645	
Point Load (N)	**2273**		**2869**	
Point Load (Mpa)	**0.94**		**0.98**	
Index, Is50 (psi)	**140**		**140**	
Unconfined Compressive Strength (psi)	**3208**		**3371**	
Specimen /Failure Sketch				
Tare No.			M19	
Wet + Tare (gm)			293.96	
Dry + Tare (gm)			289.34	
Tare (gm)			49.31	
Water Content%			**1.92**	
Comments				

Test by: RAT Test Date: 7/30/2015 Reviewed by: GET

Penn East Wild Creek		**POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731**
Craig Testing Laboratories	548000C	**Boring: B-10 Run: R-4**
TerraSense, LLC	7735-15009	**Depth: 30.75-31.65 ft.**

Analysis File: PLV4 (9/09)

8/5/2015
PLb10R04.xlsx

Plate 1

Depth:				
Load Orientation:	Diametral		Axial	
Length to nearest free end, L (mm)	29.0		25.0	
Specimen Width, W (mm)	50.5		50.5	
D (mm)	50.5		42.0	
D' (mm)	50.5		28.0	
D_e (mm)	50.5		42.4	
Failure Load, P (lb)	1750		2671	
Point Load (N)	**7784**		**11881**	
Point Load (Mpa)	**3.07**		**6.13**	
Index, Is50 (psi)	**440**		**890**	
Unconfined Compressive Strength (psi)	**10217**		**19105**	
Specimen /Failure Sketch				
Tare No.	M39			
Wet + Tare (gm)	232.93			
Dry + Tare (gm)	232.6			
Tare (gm)	49.42			
Water Content%	**0.18**			
Comments				

Test by: RAT Test Date: 7/30/2015 Reviewed by: GET

Penn East Wild Creek		**POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731**
Craig Testing Laboratories	548000C	**Boring: B-10 Run: R-14**
TerraSense, LLC	7735-15009	**Depth: 83-83.5 ft.**

Analysis File: PLV4 (9/09)

8/5/2015
PLb10R14.xlsx

Depth:				
Load Orientation:	Diametral		Diametral B	
Length to nearest free end, L (mm)	27.0		25.0	
Specimen Width, W (mm)	50.0		50.0	
D (mm)	50.0		29.0	
D' (mm)	48.0		25.0	
D_e (mm)	48.0		39.9	
Failure Load, P (lb)	276		2230	
Point Load (N)	**1228**		**9920**	
Point Load (Mpa)	**0.52**		**5.63**	
Index, Is50 (psi)	**80**		**820**	
Unconfined Compressive Strength (psi)	**1816**		**17148**	
Specimen /Failure Sketch				
Tare No.	M38			
Wet + Tare (gm)	175.28			
Dry + Tare (gm)	174.85			
Tare (gm)	49.31			
Water Content%	**0.34**			
Comments				

Test by: RAT Test Date: 7/30/2015 Reviewed by: GET

Penn East Wild Creek	**POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731**
Craig Testing Laboratories 548000C	**Boring: B-11 Run: R-15**
TerraSense, LLC 7735-15009	**Depth: 82.95-83.45 ft.**

Depth:				
Load Orientation:	Diametral		Diametral B	
Length to nearest free end, L (mm)	30.0		25.0	
Specimen Width, W (mm)	50.5		50.5	
D (mm)	50.5		12.0	
D' (mm)	50.0		9.0	
D_e (mm)	50.0		24.1	
Failure Load, P (lb)	163		763	
Point Load (N)	**725**		**3394**	
Point Load (Mpa)	**0.29**		**4.22**	
Index, Is50 (psi)	**40**		**610**	
Unconfined Compressive Strength (psi)	**925**		**11041**	
Specimen /Failure Sketch				
Tare No.	33			
Wet + Tare (gm)	151.78			
Dry + Tare (gm)	151.23			
Tare (gm)	50.89			
Water Content%	**0.55**			
Comments				

Test by: RAT Test Date: 7/30/2015 Reviewed by: GET

Penn East Wild Creek		**POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731**
Craig Testing Laboratories	548000C	**Boring: B-11 Run: R-16**
TerraSense, LLC	7735-15009	**Depth: 88.95-89.55 ft.**

Analysis File: PLV4 (9/09)

8/5/2015
PLb11R16.xlsx

Depth:				
Load Orientation:	Diametral		Diametral B	
Length to nearest free end, L (mm)	28.0		25.0	
Specimen Width, W (mm)	50.5		50.5	
D (mm)	50.5		27.0	
D' (mm)	49.0		27.0	
D_e (mm)	49.0		41.7	
Failure Load, P (lb)	2042		2302	
Point Load (N)	**9083**		**10240**	
Point Load (Mpa)	**3.75**		**5.43**	
Index, Is50 (psi)	**540**		**790**	
Unconfined Compressive Strength (psi)	**12373**		**16825**	
Specimen /Failure Sketch				
Tare No.	M25			
Wet + Tare (gm)	193.71			
Dry + Tare (gm)	193.43			
Tare (gm)	51.08			
Water Content%	**0.20**			
Comments				

Test by: RAT Test Date: 7/30/2015 Reviewed by: GET

Penn East Wild Creek	**POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731**
Craig Testing Laboratories 548000C	**Boring: B-11 Run: R-17**
TerraSense, LLC 7735-15009	**Depth: 92.5-93.3 ft.**

GEOTECHNICAL LABORATORY TESTING RESULTS

AASHTO R18 — US Army Corps of Engineers

CLIENT: Hatch Mott MacDonald
111 Wood Ave South
Iselin, NJ 08830-4112

ATTN: Ms. Erica Viglirolo

PROJECT: Penn East
Beltizville Lake

CTL # 548000Q
CTB # 150167

DATE: February 9, 2016

CHECKED BY: Eduardo M. Freire, P.E.
Geotechnical Laboratory Manager

SAMPLES RECEIVED: January 28, 2016 **SAMPLES TESTED:** 1/28/16 - 2/9/16 **LAB TECHNICIAN(S):** J. Veach

Test Boring No.	Sample No.	Depth (ft)	Water Content (%) (ASTM D2216)	Atterberg Limits (ASTM D4318)			Rock Unconfined Compression* (ASTM D7012-C)^	Unit Weight of Oven Dried Rock (pcf)	Point Load Strength (ASTMD D5731)	Sulfate (mg/L) (ASTM D4327)	Chloride (mg/L) (ASTM D4327)	pH of Soil (ASTM G51)	Consolidation* (ASTM D2435)	UU Triaxial* (ASTM D2850)	CU Triaxial (ASTM D4767)	Soil Perm. Class Rating (NJAC 7:9A-6.3)					
				LL	PL	PI										A	B				
B-12	R-30	148.2-185					RUC-1														
	R-31	185.8-186.6							PR-1												
	R-32	193.5-193.9						168.3													
	R-33	196-196.7							PR-2												
	R-33	196.9-198					RUC-1														
B-13	R-32	188.6-189.3							PR-3												
	R-32	190.3-191					RUC-2														
	R-33	195.1-195.7						171.6													
	R-33	199-200					RUC-2														
	R-34	201.4-202.7							PR-4												
Billing Total:							**4**	**2**	**4**												

Comments/Remarks: *See attached Plates

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Lab: (609) 625-0386: Fax: (609) 625-9133

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ROCK UNCONFINED COMPRESSIVE STRENGTH TEST REPORT

(ASTM D 7012 - Method C)

Client: Hatch Mott MacDonald Test Date: February 9, 2016 Plate : RUC-1

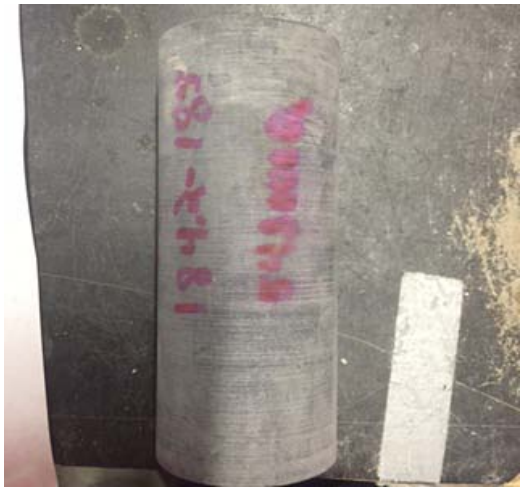
Project: Penn East Beltzville Lake CTL #: 548000Q

Tested By: J. Veach Checked By: E. Freire

Boring No.: B-12 Core Run: R-30 Depth (ft): 184.2-185

Core Data:
- Avg. Length (inch) = 4.749
- L/D Ratio (2.0 to 2.5) = 2.41
- Dry Unit Weight (pcf) 173.4
- Avg. Diameter (inch) = 1.971
- Area (inch^2) = 3.052

Note: Test specimen not prepared in accordance with D4543



BEFORE

AFTER

UNIAXIAL COMPRESSIVE STRENGTH, σ_u:	**6,680**	**psi**	**=**	**6.7**	**ksi**

Boring No.: B-12 Core Run: R-33 Depth (ft): 196.9-198

Core Data:
- Avg. Length (inch) = 4.617
- L/D Ratio (2.0 to 2.5) = 2.34
- Dry Unit Weight (pcf) 172.2
- Avg. Diameter (inch) = 1.972
- Area (inch^2) = 3.055

Note: Test specimen not prepared in accordance with D4543

BEFORE

AFTER

UNIAXIAL COMPRESSIVE STRENGTH, σ_u:	**1,896**	**psi**	**=**	**1.9**	**ksi**

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ROCK UNCONFINED COMPRESSIVE STRENGTH TEST REPORT

(ASTM D 7012 - Method C)

Client: Hatch Mott MacDonald Test Date: February 9, 2016 Plate : RUC-2

Project: Penn East Beltzville Lake CTL #: 548000Q

Tested By: J. Veach Checked By: E. Freire

Boring No.: B-13 Core Run: R-32 Depth (ft): 190.3-191

Core Data:
- Avg. Length (inch) = 4.548
- Avg. Diameter (inch) = 1.968
- L/D Ratio (2.0 to 2.5) = 2.31
- Area (inch^2) = 3.042
- Dry Unit Weight (pcf) 175.0

Note: Test specimen not prepared in accordance with D4543

BEFORE

AFTER

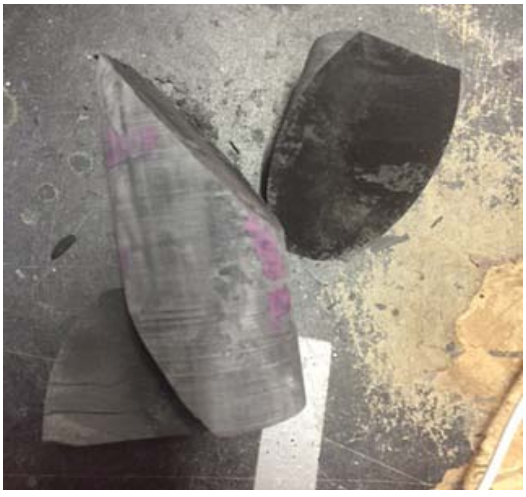
UNIAXIAL COMPRESSIVE STRENGTH, σ_u:	**1,082**	**psi**	**=**	**1.1**	**ksi**

Boring No.: B-13 Core Run: R-33 Depth (ft): 199-200

Core Data:
- Avg. Length (inch) = 4.821
- Avg. Diameter (inch) = 1.969
- L/D Ratio (2.0 to 2.5) = 2.45
- Area (inch^2) = 3.045
- Dry Unit Weight (pcf) 171.5

Note: Test specimen not prepared in accordance with D4543

BEFORE



AFTER

UNIAXIAL COMPRESSIVE STRENGTH, σ_u:	**736**	**psi**	**=**	**0.7**	**ksi**

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POINT LOAD STRENGTH INDEX OF ROCK REPORT

(ASTM D-5731)

Client:	Hatch Mott MacDoandl	Test Date:	February 9, 2016	Plate :	PR-1
Project:	Penn East Beltzville Lake			CTL #:	548000Q
Boring No.:	B-12	Core Run:	R-31	Depth (ft):	185.8-186.6
Tested By:	J. Veach				
As Received Water Content (%):	0.2%			Checked By:	E. Freire

DIAMETRAL TEST 1

Length, L (in):	3.09	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	1,997
Diameter, D (in):	1.98		Uncorrected Point Load Index I_s (psi):	511
L/D Ratio (>1):	1.56		Size Correction Factor, F:	1.002
Length to Nearest Free End, L' (>0.5D (>1")) (in):	1.20		Corrected Point Load Index $I_{s(50)}$ (psi):	512
Equivalent Core Diameter, D_e = D (in):	1.98		Index to Strength Conversion Factor, K	23.1
Reduced Core Diameter, D' = D (in):	1.98		**Est. Uniaxial Compresive Strength, s_c (psi):**	**11,804**
Comments:				

DIAMETRAL TEST 2

Length, L (in):	2.52	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	2,200
Diameter, D (in):	1.98		Uncorrected Point Load Index I_s (psi):	562
L/D Ratio (>1):	1.27		Size Correction Factor, F:	1.002
Length to Nearest Free End, L' (>0.5D (>1")) (in):	1.40		Corrected Point Load Index $I_{s(50)}$ (psi):	563
Equivalent Core Diameter, D_e = D (in):	1.98		Index to Strength Conversion Factor, K	23.1
Reduced Core Diameter, D' = D (in):	1.98		**Est. Uniaxial Compresive Strength, s_c (psi):**	**12,998**
Comments:				

AXIAL TEST

Distance, D = D_e (in): (0.3W<D<W (0.6 to 2"))	1.73	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	1,734
Average Width, W (in):	1.98		Uncorrected Point Load Index I_s (psi):	399
Reduced Core Distance, D' = D (in):	1.73		Size Correction Factor, F:	0.944
Minimum Cross-Sectional Area, A (in^2)	3.42		Corrected Point Load Index $I_{s(50)}$ (psi):	376
Equivalent Core Area, D_e^2 (in^2):	4.35		Index to Strength Conversion Factor, K	21.4
			Est. Uniaxial Compresive Strength, s_c (psi):	**8,065**
Comments:				

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POINT LOAD STRENGTH INDEX OF ROCK REPORT

(ASTM D-5731)

Client:	Hatch Mott MacDoandl	Test Date:	February 9, 2016	Plate :	PR-2
Project:	Penn East Beltzville Lake			CTL #:	548000Q
Boring No.:	B-12	Core Run:	R-33	Depth (ft):	196-196.7
As Received Water Content (%):	0.3%			Checked By:	E. Freire

DIAMETRAL TEST 1

Length, L (in):	2.44	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	2,519
Diameter, D (in):	1.97		Uncorrected Point Load Index I_s (psi):	649
L/D Ratio (>1):	1.24		Size Correction Factor, F:	1.000
Length to Nearest Free End, L' (>0.5D (>1")) (in):	1.00		Corrected Point Load Index $I_{s(50)}$ (psi):	649
Equivalent Core Diameter, D_e = D (in):	1.97		Index to Strength Conversion Factor, K	23.0
Reduced Core Diameter, D' = D (in):	1.97		**Est. Uniaxial Compresive Strength, s_c (psi):**	**14,945**
Comments:				

DIAMETRAL TEST 2

Length, L (in):	2.09	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	1,118
Diameter, D (in):	1.97		Uncorrected Point Load Index I_s (psi):	289
L/D Ratio (>1):	1.06		Size Correction Factor, F:	0.999
Length to Nearest Free End, L' (>0.5D (>1")) (in):	1.10		Corrected Point Load Index $I_{s(50)}$ (psi):	289
Equivalent Core Diameter, D_e = D (in):	1.97		Index to Strength Conversion Factor, K	23.0
Reduced Core Diameter, D' = D (in):	1.97		**Est. Uniaxial Compresive Strength, s_c (psi):**	**6,650**
Comments:				

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POINT LOAD STRENGTH INDEX OF ROCK REPORT

(ASTM D-5731)

Client:	Hatch Mott MacDoandl	Test Date:	February 9, 2016	Plate :	PR-3
Project:	Penn East Beltzville Lake			CTL #:	548000Q
Boring No.:	B-13	Core Run:	R-32	Depth (ft):	186.6-189.3
As Received Water Content (%):	0.7%			Checked By:	E. Freire

DIAMETRAL TEST 1

Length, L (in):	3.71	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	788
Diameter, D (in):	1.97		Uncorrected Point Load Index I_s (psi):	203
L/D Ratio (>1):	1.88		Size Correction Factor, F:	1.001
Length to Nearest Free End, L' (>0.5D (>1")) (in):	1.00		Corrected Point Load Index $I_{s(50)}$ (psi):	203
Equivalent Core Diameter, D_e = D (in):	1.97		Index to Strength Conversion Factor, K	23.0
Reduced Core Diameter, D' = D (in):	1.97		**Est. Uniaxial Compresive Strength, s_c (psi):**	**4,672**
Comments:				

DIAMETRAL TEST 2

Length, L (in):	2.27	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	636
Diameter, D (in):	1.98		Uncorrected Point Load Index I_s (psi):	163
L/D Ratio (>1):	1.15		Size Correction Factor, F:	1.002
Length to Nearest Free End, L' (>0.5D (>1")) (in):	1.30		Corrected Point Load Index $I_{s(50)}$ (psi):	163
Equivalent Core Diameter, D_e = D (in):	1.98		Index to Strength Conversion Factor, K	23.1
Reduced Core Diameter, D' = D (in):	1.98		**Est. Uniaxial Compresive Strength, s_c (psi):**	**3,760**
Comments:				

AXIAL TEST

Distance, D = D_e (in): (0.3W<D<W (0.6 to 2"))	1.83	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	444
Average Width, W (in):	1.98		Uncorrected Point Load Index I_s (psi):	96
Reduced Core Distance, D' = D (in):	1.83		Size Correction Factor, F:	0.968
Minimum Cross-Sectional Area, A (in^2)	3.62		Corrected Point Load Index $I_{s(50)}$ (psi):	93
Equivalent Core Area, D_e^2 (in^2):	4.60		Index to Strength Conversion Factor, K	22.1
			Est. Uniaxial Compresive Strength, s_c (psi):	**2,059**
Comments:				

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POINT LOAD STRENGTH INDEX OF ROCK REPORT

(ASTM D-5731)

Client:	Hatch Mott MacDoandl	Test Date:	February 9, 2016	Plate :	PR-4
Project:	Penn East Beltzville Lake			CTL #:	548000Q
Boring No.:	B-13	Core Run:	R-34	Depth (ft):	201.4-202.7
As Received Water Content (%):	0.7%			Checked By:	E. Freire

DIAMETRAL TEST 1

Length, L (in):	3.56	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	710
Diameter, D (in):	2.00		Uncorrected Point Load Index I_s (psi):	178
L/D Ratio (>1):	1.79		Size Correction Factor, F:	1.006
Length to Nearest Free End, L' (>0.5D (>1")) (in):	1.00		Corrected Point Load Index $I_{s(50)}$ (psi):	179
Equivalent Core Diameter, D_e = D (in):	2.00		Index to Strength Conversion Factor, K	23.2
Reduced Core Diameter, D' = D (in):	2.00		**Est. Uniaxial Compresive Strength, s_c (psi):**	**4,161**
Comments:				

DIAMETRAL TEST 2

Length, L (in):	4.47	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	1,632
Diameter, D (in):	2.00		Uncorrected Point Load Index I_s (psi):	409
L/D Ratio (>1):	2.24		Size Correction Factor, F:	1.007
Length to Nearest Free End, L' (>0.5D (>1")) (in):	1.30		Corrected Point Load Index $I_{s(50)}$ (psi):	412
Equivalent Core Diameter, D_e = D (in):	2.00		Index to Strength Conversion Factor, K	23.2
Reduced Core Diameter, D' = D (in):	2.00		**Est. Uniaxial Compresive Strength, s_c (psi):**	**9,555**
Comments:				

AXIAL TEST

Distance, D = D_e (in): (0.3W<D<W (0.6 to 2"))	1.49	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	342
Average Width, W (in):	1.97		Uncorrected Point Load Index I_s (psi):	91
Reduced Core Distance, D' = D (in):	1.49		Size Correction Factor, F:	0.882
Minimum Cross-Sectional Area, A (in^2)	2.94		Corrected Point Load Index $I_{s(50)}$ (psi):	81
Equivalent Core Area, D_e^2 (in^2):	3.74		Index to Strength Conversion Factor, K	20.2
			Est. Uniaxial Compresive Strength, s_c (psi):	**1,628**
Comments:				

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UNCONFINED COMPRESSION TEST WITH STRESS-STRAIN CURVE REPORT

(ASTM D 7012 - Method D (Mod))

Client: Hatch Mott MacDonald | Test Date: July 18, 2015 | Plate : RC-1

Project: Penn East- Pohopoco Stream Crossing | CTL #: 548000

Boring No.: B-14 | Core Run: R-10 | Depth (ft): 60.1-61.5 | Tested By: JV

Description: Black SHALE | Checked By: EF

Core Data:

Avg. Length (inch) = 4.948 | Avg. Diameter (inch) = 1.988

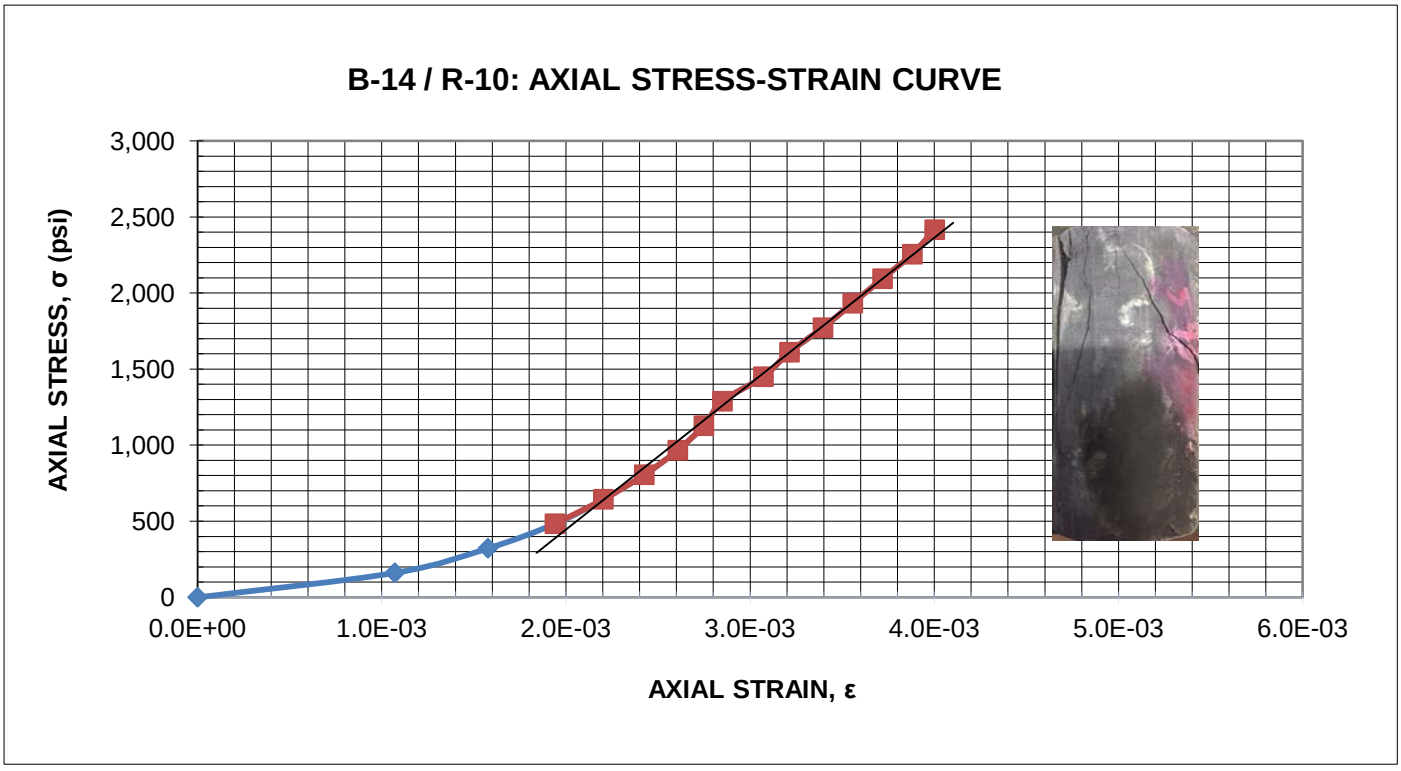
L/D Ratio (2.0 to 2.5) = 2.49 | Area (inch^2) = 3.103

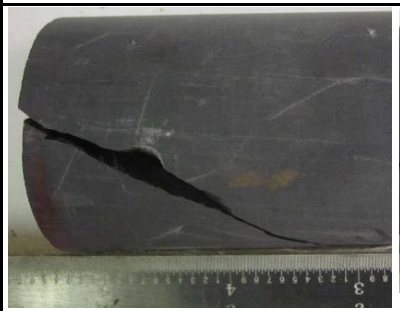
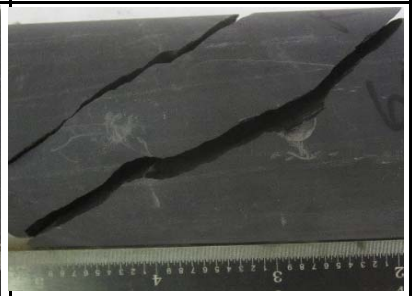
Dry Unit Weight (pcf) 170.0 | Note: Test specimen not prepared in accordance with D4543

Load (lbs)	Stress (psi)	Deformation (in)	Strain
0	0	0.0000	0.00E+00
500	161	0.0053	1.07E-03
1,000	322	0.0078	1.58E-03
1,500	483	0.0096	1.94E-03
2,000	644	0.0109	2.20E-03
2,500	806	0.0120	2.43E-03
3,000	967	0.0129	2.61E-03
3,500	1,128	0.0136	2.75E-03
4,000	1,289	0.0141	2.85E-03
4,500	1,450	0.0152	3.07E-03
5,000	1,611	0.0159	3.21E-03
5,500	1,772	0.0168	3.40E-03
6,000	1,933	0.0176	3.56E-03
6,500	2,095	0.0184	3.72E-03
7,000	2,256	0.0192	3.88E-03
7,500	2,417	0.0198	4.00E-03
7,840	2,526	**FAIL**	

UNIAXIAL COMPRESSIVE STRENGTH, σ_u: 2,526 psi = 2.5 ksi

ESTIMATED YOUNG'S MODULUS, E: 9.38E+05 psi (Avg. Linear Portion of Curve, shown)



Depth:				
Load Orientation:	Diametral	Diametral	Axial	
Length to nearest free end, L (mm)	26.0	26.4	14.3	
Specimen Width, W (mm)	50.4	50.4	50.4	
D (mm)	50.0	50.0	15.0	
D' (mm)	50.0	50.0	25.0	
D_e (mm)	50.0	50.0	40.0	
Failure Load, P (lb)	544	829	1042	
Point Load (N)	**2420**	**3688**	**4635**	
Point Load (Mpa)	**0.97**	**1.48**	**2.62**	
Index, Is50 (psi)	**140**	**210**	**380**	
Unconfined Compressive Strength (psi)	**3237**	**4855**	**7959**	
Specimen /Failure Sketch				
Tare No.	M-27			
Wet + Tare (gm)	190.6			
Dry + Tare (gm)	190.1			
Tare (gm)	49.43			
Water Content%	**0.36**			
Comments				

Test by: RAT Test Date: 7/20/2015 Reviewed by: GET

Penn East Pohopoco Stream		**POINT LOAD STRENGTH INDEX OF ROCK ASTM D5731**
Craig Testing Laboratories	548000	**Boring: B-14 Run: R-10**
TerraSense, LLC	7735-15007	**Depth: 60.1-61.5 ft.**

GEOTECHNICAL LABORATORY TESTING RESULTS

CLIENT: Hatch Mott MacDonald
111 Wood Ave South
Iselin, NJ 08830-4112

ATTN: Ms. Erica Viglirolo

PROJECT: Penn East
Beltizville Lake

CTL # 548000S
CTB # 150167

DATE: February 17, 2016

CHECKED BY: Eduardo M. Freire, P.E.
Geotechnical Laboratory Manager

SAMPLES RECEIVED: February 15, 2016

SAMPLES TESTED: 2/15/16 - 2/17/16

LAB TECHNICIAN(S): J. Veach

Test Boring No.	Sample No.	Depth (ft)	Water Content (%) (ASTM D2216)	Atterberg Limits (ASTM D4318)			Rock Unconfined Compression* (ASTM D7012-C)^	Unit Weight of Oven Dried Rock (pcf)	Point Load Strength (ASTMD D5731)	Sulfate (mg/L) (ASTM D4327)	Chloride (mg/L) (ASTM D4327)	pH of Soil (ASTM G51)	Consolidation* (ASTM D2435)	UU Triaxial* (ASTM D2850)	CU Triaxial (ASTM D4767)	Soil Perm. Class Rating (NJAC 7:9A-6.3)					
				LL	PL	PI										A	B				
B-POH-1	R-31	186.7-187.8					RUC-1														
	R-31	188.6-189.1							PR-1												
	R-32	194-194.6						169.7													
	R-33	195.2-196.8							PR-2												
	R-33	196.4-197.3					RUC-1														
Billing Total:							**2**	**1**	**2**												

Comments/Remarks: *See attached Plates

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ROCK UNCONFINED COMPRESSIVE STRENGTH TEST REPORT

(ASTM D 7012 - Method C)

Client: Hatch Mott MacDonald Test Date: February 17, 2016 Plate : RUC-1

Project: Penn East Beltzville Lake CTL #: 548000S

Tested By: J, Veach Checked By: E. Freire

Boring No.: B-POH-1 Core Run: R-31 Depth (ft): 186.7-187.8

Core Data:
Avg. Length (inch) = 4.962
L/D Ratio (2.0 to 2.5) = 2.49
Dry Unit Weight (pcf) 169.8
Avg. Diameter (inch) = 1.989
Area (inch^2) = 3.106

Note: Test specimen not prepared in accordance with D4543

BEFORE

AFTER

UNIAXIAL COMPRESSIVE STRENGTH, σ_u: 1,284 psi = 1.3 ksi

Boring No.: B-POH-1 Core Run: R-33 Depth (ft): 196.4-197.3

Core Data:
Avg. Length (inch) = 4.430
L/D Ratio (2.0 to 2.5) = 2.23
Dry Unit Weight (pcf) 170.5
Avg. Diameter (inch) = 1.989
Area (inch^2) = 3.106

Note: Test specimen not prepared in accordance with D4543

BEFORE

AFTER

UNIAXIAL COMPRESSIVE STRENGTH, σ_u: 2,231 psi = 2.2 ksi

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POINT LOAD STRENGTH INDEX OF ROCK REPORT

(ASTM D-5731)

Client:	Hatch Mott MacDonald	Test Date:	February 17, 2016	Plate :	PR-1
Project:	Penn East Beltzville Lake			CTL #:	548000S
Boring No.:	B-POH-1 Core Run: R-31	Depth (ft):	188.6-189.1	Tested By:	J. Veach
As Received Water Content (%):	0.4%			Checked By:	E. Freire

DIAMETRAL TEST 1

Length, L (in):	2.54	**SPECIMEN PHOTOGRAPH**	Failure Load, P (lbs):	889
Diameter, D (in):	1.98		Uncorrected Point Load Index I_s (psi):	226
L/D Ratio (>1):	1.28		Size Correction Factor, F:	1.004
Length to Nearest Free End, L' (>0.5D (>1")) (in):	1.10		Corrected Point Load Index $I_{s(50)}$ (psi):	227
Equivalent Core Diameter, D_e = D (in):	1.98		Index to Strength Conversion Factor, K	23.1
Reduced Core Diameter, D' = D (in):	1.98		**Est. Uniaxial Compresive Strength, s_c (psi):**	**5,238**

Comments: Diametral Test #2 and Axial Test specimens broke during cutting/drying phase of sample preparation

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POINT LOAD STRENGTH INDEX OF ROCK REPORT

(ASTM D-5731)

Client:	Hatch Mott MacDonald	Test Date:	February 17, 2016	Plate :	PR-2
Project:	Penn East Beltzville Lake			CTL #:	548000S
Boring No.:	B-POH-1	Core Run:	R-33	Depth (ft):	195.2-195.8
As Received Water Content (%):	0.5%			Tested By:	J. Veach
				Checked By:	E. Freire

DIAMETRAL TEST 1

		SPECIMEN PHOTOGRAPH		
Length, L (in):	2.47		Failure Load, P (lbs):	429
Diameter, D (in):	1.98		Uncorrected Point Load Index I_s (psi):	109
L/D Ratio (>1):	1.25		Size Correction Factor, F:	1.003
Length to Nearest Free End, L' (>0.5D (>1")) (in):	1.00		Corrected Point Load Index $I_{s(50)}$ (psi):	110
Equivalent Core Diameter, D_e = D (in):	1.98		Index to Strength Conversion Factor, K	23.1
Reduced Core Diameter, D' = D (in):	1.98		**Est. Uniaxial Compresive Strength, s_c (psi):**	**2,533**
Comments:				

DIAMETRAL TEST 2

		SPECIMEN PHOTOGRAPH		
Length, L (in):	2.87		Failure Load, P (lbs):	697
Diameter, D (in):	1.98		Uncorrected Point Load Index I_s (psi):	178
L/D Ratio (>1):	1.45		Size Correction Factor, F:	1.003
Length to Nearest Free End, L' (>0.5D (>1"))(in):	1.50		Corrected Point Load Index $I_{s(50)}$ (psi):	178
Equivalent Core Diameter, D_e = D (in):	1.98		Index to Strength Conversion Factor, K	23.1
Reduced Core Diameter, D' = D (in):	1.98		**Est. Uniaxial Compresive Strength, s_c (psi):**	**4,113**
Comments:	Axial Test specimens broke during cutting/drying phase of sample preparation			

AASHTO R18

US Army Corps of Engineers

GEOTECHNICAL LABORATORY TESTING RESULTS

CLIENT: Hatch Mott MacDonald
111 Wood Ave South
Iselin, NJ 08830-4112

ATTN: Ms. Erica Viglirolo

PROJECT: Penn East
Beltizville Lake

CTL # 548000R
CTB # 150167

DATE: February 15, 2016

CHECKED BY: Eduardo M. Freire, P.E.
Geotechnical Laboratory Manager

SAMPLES RECEIVED: February 10, 2016 **SAMPLES TESTED:** 2/10/16 - 2/15/16 **LAB TECHNICIAN(S):** J. Veach

Test Boring No.	Sample No.	Depth (ft)	Water Content (%) (ASTM D2216)	Atterberg Limits (ASTM D4318)			Rock Unconfined Compression* (ASTM D7012-C)^	Unit Weight of Oven Dried Rock (pcf)	Point Load Strength (ASTMD D5731)	Sulfate (mg/L) (ASTM D4327)	Chloride (mg/L) (ASTM D4327)	pH of Soil (ASTM G51)	Consolidation* (ASTM D2435)	UU Triaxial* (ASTM D2850)	CU Triaxial (ASTM D4767)	Soil Perm. Class Rating (NJAC 7:9A-6.3)					
				LL	PL	PI										A	B				
B-15	R-20	11-116.1					RUC-1														
	R-20	116.2-117.2							PR-1												
	R-21	121.7-122.4						171.8													
	R-21	123.5-124.7					RUC-1														
	R-22	128.6-129.9							PR-2												
Billing Total:							**2**	**1**	**2**												

Comments/Remarks: *See attached Plates

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ROCK UNCONFINED COMPRESSIVE STRENGTH TEST REPORT

(ASTM D 7012 - Method C)

Client: Hatch Mott MacDonald Test Date: February 15, 2016 Plate : RUC-1

Project: Penn East Beltzville Lake CTL #: 548000R

Tested By: J, Veach Checked By: E. Freire

Boring No.: B-15 Core Run: R-20 Depth (ft): 115-116.1

Core Data:
Avg. Length (inch) = 4.762
L/D Ratio (2.0 to 2.5) = 2.40
Dry Unit Weight (pcf) 171.5
Avg. Diameter (inch) = 1.987
Area (inch^2) = 3.101
Note: Test specimen not prepared in accordance with D4543

BEFORE

AFTER

UNIAXIAL COMPRESSIVE STRENGTH, σ_u: 3,135 psi = 3.1 ksi

Boring No.: B-15 Core Run: R-21 Depth (ft): 123.5-124.7

Core Data:
Avg. Length (inch) = 4.729
L/D Ratio (2.0 to 2.5) = 2.38
Dry Unit Weight (pcf) 170.9
Avg. Diameter (inch) = 1.984
Area (inch^2) = 3.091
Note: Test specimen not prepared in accordance with D4543

BEFORE

AFTER

UNIAXIAL COMPRESSIVE STRENGTH, σ_u: 2,582 psi = 2.6 ksi

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POINT LOAD STRENGTH INDEX OF ROCK REPORT

(ASTM D-5731)

Client:	Hatch Mott MacDonald	Test Date:	February 15, 2016	Plate :	PR-1
Project:	Penn East Beltzville Lake			CTL #:	548000R
Boring No.:	B-15	Core Run:	R-20	Depth (ft):	116.2-117.2
				Tested By:	J. Veach
As Received Water Content (%):	0.3%			Checked By:	E. Freire

DIAMETRAL TEST 1

Length, L (in):	2.92	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	1,568
Diameter, D (in):	1.99		Uncorrected Point Load Index I_s (psi):	397
L/D Ratio (>1):	1.47		Size Correction Factor, F:	1.004
Length to Nearest Free End, L' (>0.5D (>1")) (in):	1.30		Corrected Point Load Index $I_{s(50)}$ (psi):	399
Equivalent Core Diameter, D_e = D (in):	1.99		Index to Strength Conversion Factor, K	23.1
Reduced Core Diameter, D' = D (in):	1.99		**Est. Uniaxial Compresive Strength, s_c (psi):**	**9,223**
Comments:				

DIAMETRAL TEST 2

Length, L (in):	2.79	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	1,782
Diameter, D (in):	1.99		Uncorrected Point Load Index I_s (psi):	451
L/D Ratio (>1):	1.41		Size Correction Factor, F:	1.004
Length to Nearest Free End, L' (>0.5D (>1"))(in):	1.70		Corrected Point Load Index $I_{s(50)}$ (psi):	453
Equivalent Core Diameter, D_e = D (in):	1.99		Index to Strength Conversion Factor, K	23.1
Reduced Core Diameter, D' = D (in):	1.99		**Est. Uniaxial Compresive Strength, s_c (psi):**	**10,485**
Comments:				

AXIAL TEST

Distance, D = D_e (in): (0.3W<D<W (0.6 to 2"))	1.85	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	1,193
Average Width, W (in):	1.99		Uncorrected Point Load Index I_s (psi):	255
Reduced Core Distance, D' = D (in):	1.85		Size Correction Factor, F:	0.973
Minimum Cross-Sectional Area, A (in^2)	3.68		Corrected Point Load Index $I_{s(50)}$ (psi):	248
Equivalent Core Area, D_e^2 (in^2):	4.68		Index to Strength Conversion Factor, K	22.2
			Est. Uniaxial Compresive Strength, s_c (psi):	**5,502**
Comments:				

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POINT LOAD STRENGTH INDEX OF ROCK REPORT

(ASTM D-5731)

Client:	Hatch Mott MacDonald	Test Date:	February 15, 2016	Plate :	PR-2
Project:	Penn East Beltzville Lake			CTL #:	548000R
Boring No.:	B-15	Core Run:	R-22	Depth (ft):	128.6-129.9
Tested By:	J. Veach				
As Received Water Content (%):	0.3%			Checked By:	E. Freire

DIAMETRAL TEST 1

Length, L (in):	3.04	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	1,757
Diameter, D (in):	1.98		Uncorrected Point Load Index I_s (psi):	446
L/D Ratio (>1):	1.53		Size Correction Factor, F:	1.004
Length to Nearest Free End, L' (>0.5D (>1")) (in):	1.50		Corrected Point Load Index $I_{s(50)}$ (psi):	448
Equivalent Core Diameter, D_e = D (in):	1.98		Index to Strength Conversion Factor, K	23.1
Reduced Core Diameter, D' = D (in):	1.98		**Est. Uniaxial Compresive Strength, s_c (psi):**	**10,349**
Comments:				

DIAMETRAL TEST 2

Length, L (in):	3.10	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	1,353
Diameter, D (in):	1.99		Uncorrected Point Load Index I_s (psi):	343
L/D Ratio (>1):	1.56		Size Correction Factor, F:	1.004
Length to Nearest Free End, L' (>0.5D (>1"))(in):	1.80		Corrected Point Load Index $I_{s(50)}$ (psi):	344
Equivalent Core Diameter, D_e = D (in):	1.99		Index to Strength Conversion Factor, K	23.1
Reduced Core Diameter, D' = D (in):	1.99		**Est. Uniaxial Compresive Strength, s_c (psi):**	**7,962**
Comments:				

AXIAL TEST

Distance, D = D_e (in): (0.3W<D<W (0.6 to 2"))	1.86	SPECIMEN PHOTOGRAPH	Failure Load, P (lbs):	1,084
Average Width, W (in):	1.98		Uncorrected Point Load Index I_s (psi):	231
Reduced Core Distance, D' = D (in):	1.86		Size Correction Factor, F:	0.974
Minimum Cross-Sectional Area, A (in^2)	3.68		Corrected Point Load Index $I_{s(50)}$ (psi):	225
Equivalent Core Area, D_e^2 (in^2):	4.69		Index to Strength Conversion Factor, K	22.2
			Est. Uniaxial Compresive Strength, s_c (psi):	**5,008**
Comments:				

Hatch Mott MacDonald
Penn East Pipeline
SUMMARY OF ROCK TESTING

SAMPLE IDENTIFICATION			STATE PROPERTIES			ENGINEERING PROPERTY TESTS			REMARKS
Boring	Run	Depth	WATER CONTENT (1) (%)	TOTAL UNIT WGT. (pcf)	DRY UNIT WGT. (pcf)	TEST TYPE (2)	ORIENTATION (3)	Brazilian (ASTM D3967) SPLITTING TENSILE STRENGTH (psi)	
B-10	R-16	94.5-94.58	0.15	170.8	170.6	B	A	691	
B-10	R-16	94.6-94.68	0.15	171.6	171.3	B	B	1042	
B-11	R-17	90.95-91.03	0.23	170.7	170.3	B	A	628	
B-11	R-17	91.05-91.13	0.24	170.7	170.3	B	B	1821	
B-14	R-10	64.03-67.25	0.53	168.4	167.5	B	A	566	
B-14	R-10	64.03-67.25	0.49	166.9	166.1	B	B	921	

Notes: (1) Water contents determined after trimming and shearing.
(2) Test Type Abbreviations: B: Brazilian Splitting Tensile
(3) A and B orientations approximately perpendicular to other orientation.

SPLITTING TENSILE (Brazilian) TEST

ASTM D 3967

Project Number: 7978-15004 **Test by:** AM **Sta:** B-10

Project Name: Penn East Pipeline **Test Date:** 7/23/15 **Run:** R-16

SPECIMEN READINGS

	Test A	Test B
Test Number:	A	B
Depth:	94.5-94.58	94.6-94.68
Specimen mass(gm):	134.75	139.17

Test A	Thickness (inch)	Diameter (inch)
	0.972	1.987
	0.966	1.987
	0.973	1.985
Average	0.970	1.986

Test B	Thickness (inch)	Diameter (inch)
	0.996	1.988
	0.999	1.985
	0.999	1.986
Average	0.998	1.986

	Test A	Test B
Thickness / Diameter, (t/d):	0.49	0.50
t/D ratio between 0.2 and 0.75	yes	yes
Largest Grain Diameter		inch
Data Acquisition File	b10r16a	b10r16b
Maximum Load	2090 lb	3243 lb

Failure Photo

	After Test	After Test
Container No.:	LA-42	LB-26
Initial Mass + cont. (g):	166.12	170.33
Dry Mass + cont. (g):	165.92	170.12
Mass of cont. (g):	34.09	32.82
Water content (%):	**0.15**	**0.15**
Total unit weight (pcf):	170.82	171.56
Dry unit weight (pcf):	170.56	171.29
Splitting Tensile Strength (psi)	690.56	1041.99

Hatch Mott MacDonald	353754	**Penn East Pipeline**	**DATA SHEET** **SPLITTING TENSILE STRENGTH TEST**
TerraSense, LLC	7978-15004		**Sta: B-10** **Run: R-16 Depth: 94.5-94.68 ft.**

SPLITTING TENSILE (Brazilian) TEST

ASTM D 3967

Project Number: 7978-15004 **Test by:** AM **Sta:** B-11

Project Name: Penn East Pipeline **Test Date:** 7/23/15 **Run:** R-17

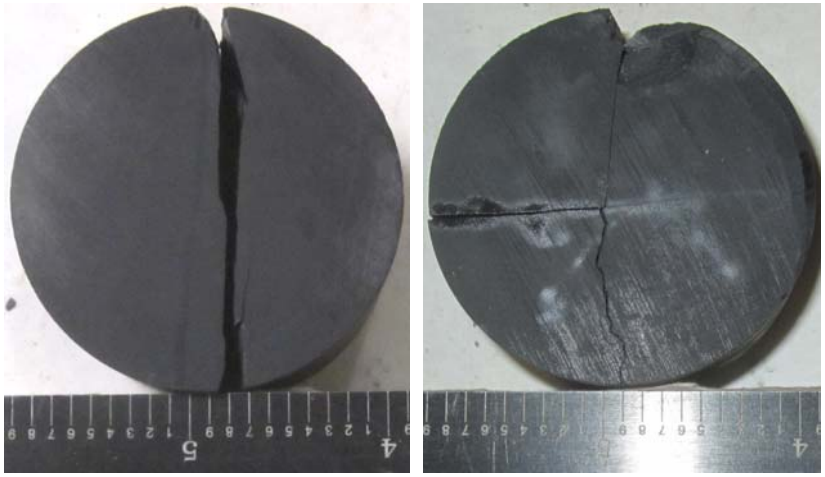
SPECIMEN READINGS

	Test A	Test B
Test Number:	A	B
Depth:	90.95-91.03	91.05-91.13
Specimen mass(gm):	148.11	140.74

Test A	Thickness (inch)	Diameter (inch)
	1.070	1.986
	1.066	1.986
	1.068	1.985
Average	1.068	1.986

Test B	Thickness (inch)	Diameter (inch)
	1.020	1.987
	1.010	1.986
	1.013	1.986
Average	1.014	1.986

	Test A	Test B
Thickness / Diameter, (t/d):	0.54	0.51
t/D ratio between 0.2 and 0.75	yes	yes
Largest Grain Diameter		inch
Data Acquisition File	b11r17a	b11r17b
Maximum Load	2091 lb	5761 lb



Failure Photo

	After Test	After Test
Container No.:	LA-204	LB-34
Initial Mass + cont. (g):	176.23	172.17
Dry Mass + cont. (g):	175.90	171.84
Mass of cont. (g):	33.25	32.89
Water content (%):	**0.23**	**0.24**
Total unit weight (pcf):	170.66	170.67
Dry unit weight (pcf):	170.27	170.26
Splitting Tensile Strength (psi)	627.86	1820.91

Hatch Mott MacDonald	353754	**Penn East Pipeline**	**DATA SHEET** **SPLITTING TENSILE STRENGTH TEST** **Sta: B-11** **Run: R-17 Depth: 90.95-91.13 ft.**
TerraSense, LLC	7978-15004		

SPLITTING TENSILE (Brazilian) TEST

ASTM D 3967

Project Number: 7978-15004 **Test by:** AM **Sta:** B-14

Project Name: Penn East Pipeline **Test Date:** 7/23/15 **Run:** R-10

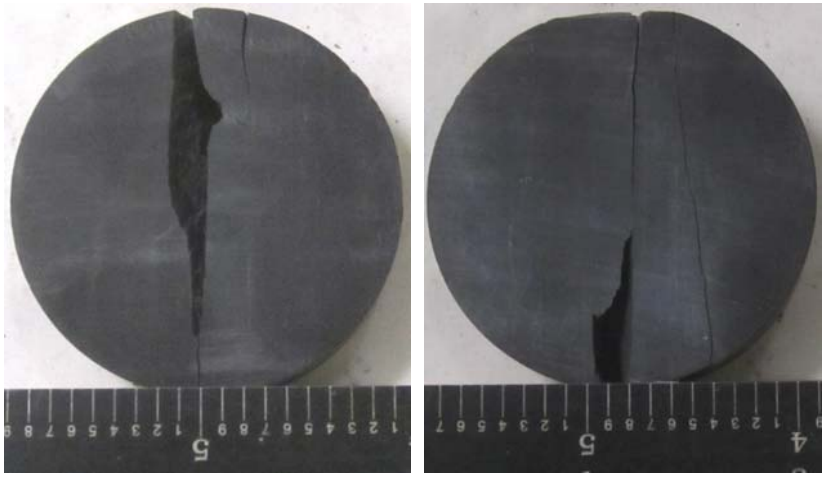
SPECIMEN READINGS

	Test A	Test B
Test Number:	A	B
Depth:	64.03-67.25	64.03-67.25
Specimen mass(gm):	75.46	81.73

Test A	Thickness (inch)	Diameter (inch)
	0.546	1.987
	0.558	1.989
	0.549	1.984
Average	0.551	1.987

Test B	Thickness (inch)	Diameter (inch)
	0.586	1.984
	0.617	1.990
	0.598	1.994
Average	0.600	1.989

	Test A	Test B
Thickness / Diameter, (t/d):	0.28	0.30
t/D ratio between 0.2 and 0.75	yes	yes
Largest Grain Diameter		inch
Data Acquisition File	b14r10a	b14r10b
Maximum Load	973 lb	1728 lb



Failure Photo

	After Test	After Test
Container No.:	LB-19	LB-11
Initial Mass + cont. (g):	106.22	112.45
Dry Mass + cont. (g):	105.84	112.06
Mass of cont. (g):	34.33	32.91
Water content (%):	**0.53**	**0.49**
Total unit weight (pcf):	168.39	166.90
Dry unit weight (pcf):	167.50	166.08
Splitting Tensile Strength (psi)	566.09	921.21

Hatch Mott MacDonald	353754	**Penn East Pipeline**	**DATA SHEET** **SPLITTING TENSILE STRENGTH TEST**
TerraSense, LLC	7978-15004		**Sta: B-14** **Run: R-10 Depth: 64.03-67.25 ft.**

Hatch Mott MacDonald
Penn East Pipeline Beltzville Lake
SUMMARY OF ROCK TESTING

SAMPLE IDENTIFICATION			STATE PROPERTIES			ENGINEERING PROPERTY TESTS			REMARKS
Boring	Run	Depth	WATER CONTENT (1) (%)	TOTAL UNIT WGT. (pcf)	DRY UNIT WGT. (pcf)	TEST TYPE (2)	ORIENTATION (3)	Brazilian (ASTM D3967) SPLITTING TENSILE STRENGTH (psi)	
B12	32	191.1-191.2	0.25	170.9	170.4	B	A	807	
B12	32	191.2-191.3	0.22	171.9	171.5	B	B	501	
B13	33	196.25-196.35	0.53	171.7	170.8	B	A	590	
B13	33	196.35-196.45	0.54	172.2	171.3	B	B	727	
B16	26	141.7-141.8	0.21	171.4	171.0	B	A	942	
B16	26	141.8-141.9	0.26	170.9	170.5	B	B	876	
B17	17	46.7-46.8	0.20	172.6	172.3	B	A	1024	
B17	17	46.8-46.9	0.19	172.5	172.2	B	B	1047	

Notes: (1) Water contents determined after trimming and shearing.
(2) Test Type Abbreviations: B: Brazilian Splitting Tensile
(3) A and B orientations approximately perpendicular to other orientation.

SPLITTING TENSILE (Brazilian) TEST

ASTM D 3967

Project Number: 7978-16001 **Test by:** MHC **Boring:** B12

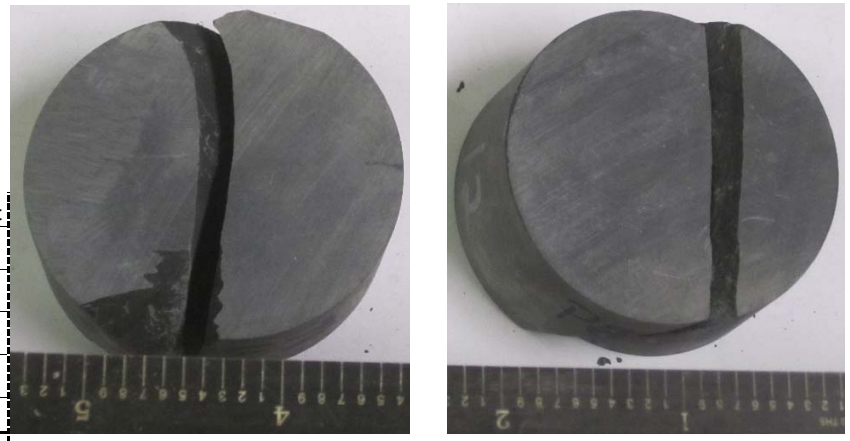
Project Name: Penn East Pipeline Beltzville Lake **Test Date:** 2/5/16 **Run:** 32

SPECIMEN READINGS

	Test A	Test B
Test Number:	A	B
Depth:	191.1-191.2	191.2-191.3
Specimen mass(gm):	140.12	143.48

	Test A Thickness (inch)	Test A Diameter (inch)	Test B Thickness (inch)	Test B Diameter (inch)
	1.012	1.986	1.034	1.981
	1.013	1.981	1.032	1.980
	1.012	1.982	1.034	1.979
Average	1.012	1.983	1.033	1.980

	Test A	Test B
Thickness / Diameter, (t/d):	0.51	0.52
t/D ratio between 0.2 and 0.75	yes	yes
Largest Grain Diameter		inch
Data Acquisition File	B12-R32-A	B12-R32-B
Maximum Load	2545 lb	1610 lb



Failure Photo

	After Test	After Test
Container No.:	404	107
Initial Mass + cont. (g):	352.83	354.73
Dry Mass + cont. (g):	352.48	354.41
Mass of cont. (g):	212.73	211.3
Water content (%):	**0.25**	**0.22**
Total unit weight (pcf):	170.85	171.91
Dry unit weight (pcf):	170.43	171.53
Splitting Tensile Strength (psi)	807.43	501.20

Hatch Mott MacDonald	353754AE01	**Penn East Pipeline**	**SPLITTING TENSILE STRENGTH TEST**
TerraSense, LLC	7978-16001	**Beltzville Lake**	**Boring: B12** **Run: 32 Depth: 191.1-191.2 ft.**

SPLITTING TENSILE (Brazilian) TEST

ASTM D 3967

Project Number: 7978-16001 **Test by:** MHC **Boring:** B13

Project Name: Penn East Pipeline Beltzville Lake **Test Date:** 2/5/16 **Run:** 33

SPECIMEN READINGS

	Test A	Test B
Test Number:	A	B
Depth:	196.25-196.35	196.35-196.45
Specimen mass(gm):	132.43	139.71

	Test A Thickness (inch)	Test A Diameter (inch)	Test B Thickness (inch)	Test B Diameter (inch)
	0.957	1.977	1.009	1.974
	0.960	1.978	1.009	1.975
	0.957	1.975	1.010	1.977
Average	0.958	1.977	1.009	1.975

	Test A	Test B
Thickness / Diameter, (t/d):	0.48	0.51
t/D ratio between 0.2 and 0.75	yes	yes
Largest Grain Diameter		inch
Data Acquisition File	B13-R33-A	B13-R33-B
Maximum Load	1754 lb	2275 lb

Failure Photo

	Test A After Test	Test B After Test
Container No.:	958	526
Initial Mass + cont. (g):	350.01	348.91
Dry Mass + cont. (g):	349.31	348.16
Mass of cont. (g):	217.66	209.24
Water content (%):	**0.53**	**0.54**
Total unit weight (pcf):	171.70	172.19
Dry unit weight (pcf):	170.80	171.26
Splitting Tensile Strength (psi)	589.93	726.78

Hatch Mott MacDonald	353754AE01	**Penn East Pipeline**	**SPLITTING TENSILE STRENGTH TEST**
TerraSense, LLC	7978-16001	**Beltzville Lake**	**Boring: B13** **Run: 33 Depth: 196.25-196.35 ft.**

SPLITTING TENSILE (Brazilian) TEST

ASTM D 3967

Project Number: 7978-16001 **Test by:** MHC **Boring:** B16

Project Name: Penn East Pipeline Beltzville Lake **Test Date:** 2/5/16 **Run:** 26

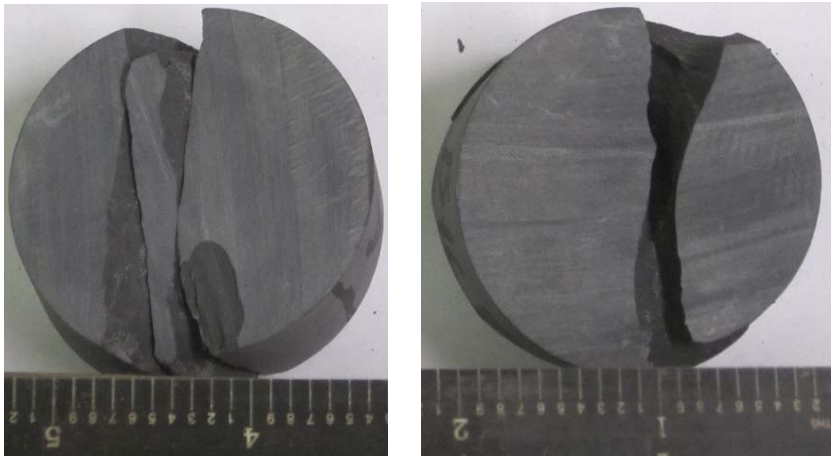
SPECIMEN READINGS

	Test A	Test B
Test Number:	A	B
Depth:	141.7-141.8	141.8-141.9
Specimen mass(gm):	135.22	138.69

Test A	Thickness (inch)	Diameter (inch)
	0.977	1.981
	0.977	1.980
	0.975	1.980
Average	0.976	1.980

Test B	Thickness (inch)	Diameter (inch)
	1.003	1.980
	1.005	1.981
	1.004	1.980
Average	1.004	1.980

	Test A	Test B
Thickness / Diameter, (t/d):	0.49	0.51
t/D ratio between 0.2 and 0.75	yes	yes
Largest Grain Diameter	inch	inch
Data Acquisition File	B16-R26-A	B16-R26-B
Maximum Load	2860 lb	2734 lb



Failure Photo

	After Test	After Test
Container No.:	75	68
Initial Mass + cont. (g):	347.48	349.65
Dry Mass + cont. (g):	347.19	349.29
Mass of cont. (g):	212.29	210.97
Water content (%):	**0.21**	**0.26**
Total unit weight (pcf):	171.39	170.94
Dry unit weight (pcf):	171.02	170.50
Splitting Tensile Strength (psi)	942.01	875.76

Hatch Mott MacDonald	353754AE01	**Penn East Pipeline**	**SPLITTING TENSILE STRENGTH TEST**
TerraSense, LLC	7978-16001	**Beltzville Lake**	**Boring: B16** **Run: 26 Depth: 141.7-141.8 ft.**

SPLITTING TENSILE (Brazilian) TEST

ASTM D 3967

Project Number: 7978-16001 **Test by:** MHC **Boring:** B17

Project Name: Penn East Pipeline Beltzville Lake **Test Date:** 2/5/16 **Run:** 17

SPECIMEN READINGS

	Test A	Test B
Test Number:	A	B
Depth:	46.7-46.8	46.8-46.9
Specimen mass(gm):	139.63	142.03

	Test A Thickness (inch)	Test A Diameter (inch)	Test B Thickness (inch)	Test B Diameter (inch)
	1.002	1.980	1.018	1.980
	1.001	1.981	1.020	1.982
	1.001	1.979	1.018	1.980
Average	1.001	1.980	1.018	1.981

	Test A	Test B
Thickness / Diameter, (t/d):	0.51	0.51
t/D ratio between 0.2 and 0.75	yes	yes
Largest Grain Diameter		inch
Data Acquisition File	B17-R7-A	B17-R7-B
Maximum Load	3187 lb	3318 lb

Failure Photo

	Test A After Test	Test B After Test
Container No.:	514	474
Initial Mass + cont. (g):	356.83	335.61
Dry Mass + cont. (g):	356.55	335.34
Mass of cont. (g):	217.37	193.61
Water content (%):	**0.20**	**0.19**
Total unit weight (pcf):	172.62	172.48
Dry unit weight (pcf):	172.27	172.15
Splitting Tensile Strength (psi)	1023.68	1047.35

Hatch Mott MacDonald	353754AE01	**Penn East Pipeline**	**SPLITTING TENSILE STRENGTH TEST**
TerraSense, LLC	7978-16001	**Beltzville Lake**	**Boring: B17** **Run: 17 Depth: 46.7-46.8 ft.**

Hatch Mott MacDonald
Penn East Pipeline Beltzville Lake
SUMMARY OF ROCK TESTING

SAMPLE IDENTIFICATION			STATE PROPERTIES			ENGINEERING PROPERTY TESTS			REMARKS
Boring	Run	Depth	WATER CONTENT (1) (%)	TOTAL UNIT WGT. (pcf)	DRY UNIT WGT. (pcf)	TEST TYPE (2)	ORIENTATION (3)	Brazilian (ASTM D3967) SPLITTING TENSILE STRENGTH (psi)	
B-15	21	120.5-120.6	0.28	171.0	170.5	B	A	745	
B-15	21	120.6-120.7	0.31	171.3	170.8	B	B	1542	
B-Poh-1	32	193.3-193.4	0.29	171.3	170.8	B	A	1380	
B-Poh-1	32	193.4-193.5	0.29	170.5	170.0	B	B	1134	

Notes: (1) Water contents determined after trimming and shearing.
(2) Test Type Abbreviations: B: Brazilian Splitting Tensile
(3) A and B orientations approximately perpendicular to other orientation.

SPLITTING TENSILE (Brazilian) TEST

ASTM D 3967

Project Number: 7978-16001 **Test by:** GET **Boring:** B-15

Project Name: Penn East Pipeline Beltzville Lake **Test Date:** 2/15/16 **Run:** 21

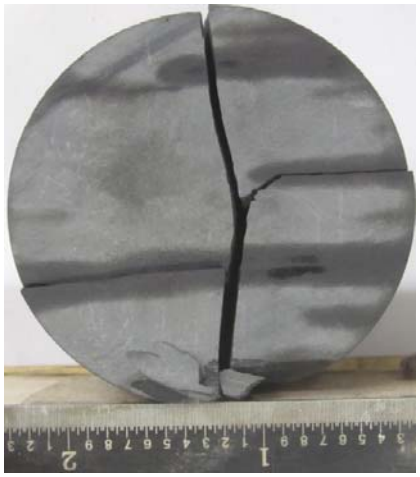
SPECIMEN READINGS

	A	B
Test Number:	A	B
Depth:	120.5-120.6	120.6-120.7
Specimen mass(gm):	134.94	133.64

	A Thickness (inch)	A Diameter (inch)	B Thickness (inch)	B Diameter (inch)
	0.975	1.981	0.963	1.982
	0.977	1.982	0.963	1.983
	0.974	1.983	0.964	1.982
Average	0.975	1.982	0.963	1.982

	A	B
Thickness / Diameter, (t/d):	0.49	0.49
t/D ratio between 0.2 and 0.75	yes	yes
Largest Grain Diameter		
Data Acquisition File	B15-R21-A	B15-R21-B
Maximum Load	2261 lb	4624 lb

A



B

Failure Photo

	A After Test	B After Test
Container No.:	BB	L50
Initial Mass + cont. (g):	187.27	195.55
Dry Mass + cont. (g):	186.90	195.14
Mass of cont. (g):	52.40	61.98
Water content (%):	**0.28**	**0.31**
Total unit weight (pcf):	170.95	171.30
Dry unit weight (pcf):	170.48	170.77
Splitting Tensile Strength (psi)	744.98	1541.76

Hatch Mott MacDonald	353754AE01	**Penn East Pipeline**	**SPLITTING TENSILE STRENGTH TEST**
TerraSense, LLC	7978-16001	**Beltzville Lake**	**Boring: B-15** **Run: 21 Depth: 120.5-120.6 ft.**

SPLITTING TENSILE (Brazilian) TEST

ASTM D 3967

Project Number: 7978-16001 **Test by:** GET **Boring:** B-Poh-1

Project Name: Penn East Pipeline Beltzville Lake **Test Date:** 2/15/16 **Run:** 32

SPECIMEN READINGS

	A	B
Test Number:	A	B
Depth:	193.3-193.4	193.4-193.5
Specimen mass(gm):	119.47	98.77

	A Thickness (inch)	A Diameter (inch)	B Thickness (inch)	B Diameter (inch)
	0.864	1.982	0.717	1.982
	0.861	1.982	0.718	1.982
	0.860	1.982	0.712	1.981
Average	0.862	1.982	0.716	1.982
Thickness / Diameter, (t/d):	0.43		0.36	
t/D ratio between 0.2 and 0.75	yes		yes	
Largest Grain Diameter		inch		inch
Data Acquisition File	ST-R32A		ST-R32B	
Maximum Load	3701	lb	2527	lb
	After Test		**After Test**	
Container No.:	J5		L62	
Initial Mass + cont. (g):	174.79		161.17	
Dry Mass + cont. (g):	174.45		160.88	
Mass of cont. (g):	55.45		62.45	
Water content (%):	**0.29**		**0.29**	
Total unit weight (pcf):	171.29		170.47	
Dry unit weight (pcf):	170.80		169.97	
Splitting Tensile Strength (psi)	1379.96		1134.34	

A B

Failure Photo

Hatch Mott MacDonald	353754AE01	**Penn East Pipeline**	**SPLITTING TENSILE STRENGTH TEST**
TerraSense, LLC	7978-16001	**Beltzville Lake**	**Boring: B-Poh-1** **Run: 32 Depth: 193.3-193.4 ft.**

F. Vibration Monitoring Results

Vibra-Tech

REPORT

TO

Craig Testing Laboratories, Inc.
5439 Harding Highway
P O Box 427
Mays Landing, New Jersey 08330

Attn: Mr. Eduardo Freire, P.E.

DATE

February 4, 2016

SUBJECT

Vibration Monitoring Report for
Craig Testing Laboratories, Inc.
Penn East Pipeline project
Lehighton, Pennsylvania
January 28, 29 and February 1, 2016

Re: Core Drilling Activities for Boring #B-15

COPY NUMBER 1 **OF** 3

Vibra-Tech

VibraTechinc.com

109 East First Street
P.O. Box 577
Hazleton, PA 18201

Phone 570.455.5861
Fax 570.455.0626

February 4, 2016

Mr. Eduardo Freire, P.E.
Craig Testing Laboratories, Inc.
5439 Harding Highway P O Box 427
Mays Landing, New Jersey 08330

Re: Penn East Pipeline project
Core Drilling Activities for Boring #B-15
Lehighton, Pennsylvania

Dear Mr. Freire:

The following report is based upon the results of vibration monitoring results of the core drilling activities for Boring #B-15 conducted on January 28, 29 and February 1, 2016 at the above referenced project. The recorded vibration levels were compared to the 0.75 in/sec vibration criteria provided to Vibra-Tech Engineers, Inc., by Mr. Eduardo Freire, P. E., of Craig Testing Laboratories, Inc..

The report contains the original seismograph records obtained during the core drilling activities for Boring #B-15. All of the recorded vibration levels were below and in conformance with the above mentioned vibration criteria.

Please refer to our report, the individual report forms and the original seismograph records in the appendix of this report for specific recording locations and intensities.

Respectfully submitted,

VIBRA-TECH ENGINEERS, INC.

Robert C. Perilla
Field Representative

Douglas Rudenko
Vice President

RCP/ly

VT#11160540

February 4, 2016

Vibration Monitoring Report for
Craig Testing Laboratories, Inc.

Penn East Pipeline project
Lehighton, Pennsylvania
January 28, 29 and February 1, 2016

Introduction

Vibration monitoring authorized by Craig Testing Laboratories, Inc. was conducted by Vibra-Tech Engineers, Inc., at the above referenced project. Ground vibrations resulting from the core drilling activities for Boring #B-15 were monitored on January 28, 29 and February 1, 2016. The recorded vibration levels were compared to the 0.75 in/sec vibration criteria provided to Vibra-Tech Engineers, Inc., by Mr. Eduardo Freire, P. E., of Craig Testing Laboratories, Inc..

Scope and Condition of Study

Vibra-Tech Engineers, Inc., conducted on-site vibration monitoring of the core drilling activities for Boring #B-15 (N40°53.008' W075°33.2016') on the Penn East Pipeline project Lehighton, Pennsylvania. The core boring tests were in conjunction with the proposed pipeline construction.

Vibration Monitoring

A vibration monitoring seismograph equipped with a triaxial geophone was utilized to monitor ground vibrations between the core boring activities and an existing water pipeline located adjacent to the activities. The seismograph was programmed to continuously record and store the highest peak particle velocity at 15 second intervals.

Instrumentation

The seismographs used for this project directly measure particle velocity in three mutually perpendicular planes of motion. The seismographs have a dynamic range of 10 in/sec and a sample rate of 1,024 samples per second per channel. The entire system is calibrated internally prior to and after each monitoring period in addition to an annual shake table calibration.

The Vibra-Tech seismographs are four channel recorders that directly measure particle velocity in three mutually perpendicular directions. "Particle Velocity" is defined as "how fast a particle is moved by

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passing waves, measured in inches per second". The fourth channel employed for monitoring air overpressure is not applicable for this study.

The data is stored on the seismograph's internal memory, (when trigger levels are exceeded) and processed into analog printouts. Analog representations of this data are included in the appendix at the end of this report. The three (3) ground vibration traces are individually labeled. The trace labeled "longitudinal" represents horizontal motion along a line between the recorder and the energy source. The trace labeled "transverse" represents horizontal motion at right angles to the energy source. The "vertical" trace represents particle velocity in that plane of motion.

Vibration and Vibration Measurements

The measurement of vibration involves quantifying the rate and amount of oscillation occurring in a vibrating body. The rate of motion, or the number of vibrations occurring in a given time frame, usually one second, is called the frequency of the motion, which is described as the number of cycles/second (cps) or Hertz (Hz).

The amount of movement associated with a vibration can be measured in terms of displacement, velocity, or acceleration. Displacement is a measure of the physical distance traveled from a position of equilibrium or base line. Velocity is a measure of the speed at which the displacement occurred and acceleration is a measure of the change in velocity occurring during the vibration event. The relationships between displacement, velocity, and acceleration are also dependent upon the frequency of the motions measured. The seismograph used to record at this site measures vibration in velocity.

Results of the Monitoring

Monitoring information including the equipment used in the core drilling activities, the vibration monitoring location, distance from the core drilling activities and recorded peak particle velocity histogram charts are included in the appendix of this report. Each histogram contains three plots representing vibration amplitudes for each plane of motion.

Conclusions

All of the recorded vibrations were below and in conformance with the limit 0.75 in/sec vibration criteria provided to Vibra-Tech Engineers, Inc., by Mr. Eduardo Freire, P. E., of Craig Testing Laboratories, Inc.

If you have any questions, or if we may be of further assistance, please feel free to contact our office.

Respectfully submitted,

VIBRA-TECH ENGINEERS, INC.

Robert C. Perilla
Field Representative

Douglas Rudenko
Vice President

RCP/ly

VT#11160443

Vibra-Tech Engineers, Inc. shall not be liable for any claims of tangible property damage where such damage is not solely, directly, and physically caused by Vibra-Tech Engineers, Inc. Additionally, Vibra-Tech Engineers, Inc. shall not be liable, in whole or in part, for any claims of tangible property damage brought by or on behalf of third-party claims.

APPENDIX

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Vibra-Tech

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VIBRATION MONITORING REPORT

Client: Craig

Project: 1116 0540 Pipeline

Vibration Source: Drill Rig CME 750X

Specification/Limit: 0.75 in/sec

Caution Level: 0.6 in/sec

Event No.	Activity	Pile No.*	Start	Stop	Work Location	Seismograph Location	Distance (ft)	Results (cm/sec)
1	soil sampling	B-15	8:00			~15' north of boring, ~35' south of pipe	~50	0.04
2	"		8:20					0.045
3	"		8:30					0.04
4	"		9:10					0.03
5	foot stomp		9:45					0.12
6	soil sampling		10:40					0.035
7	removing core from barrel		11:20					0.22
8	foot stomp		13:05					0.055
9	removing core from barrel		14:35					0.03

* ___ Actual pile #s from pile plan
___ Not actual pile #s; for tracking only.

___ Measured distan
___ Estimated distan

Seismograph: BB8334

Range: 0-10 in/sec

Field Technician: David Caldwell

Date: 1/26/16

Downloaded by: MS

Printed by:

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	08:02:20 January 28, 2016	**Serial Number**	BB8334 V 7.04-8.0 EVERLERT III
Histogram Finish Time	08:17:24 January 28, 2016	**Battery Level**	6.0 Volts
Number of Intervals	60 at 15 seconds	**Calibration**	July 20, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J334G7TA.BW1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name:
General:

Extended Notes

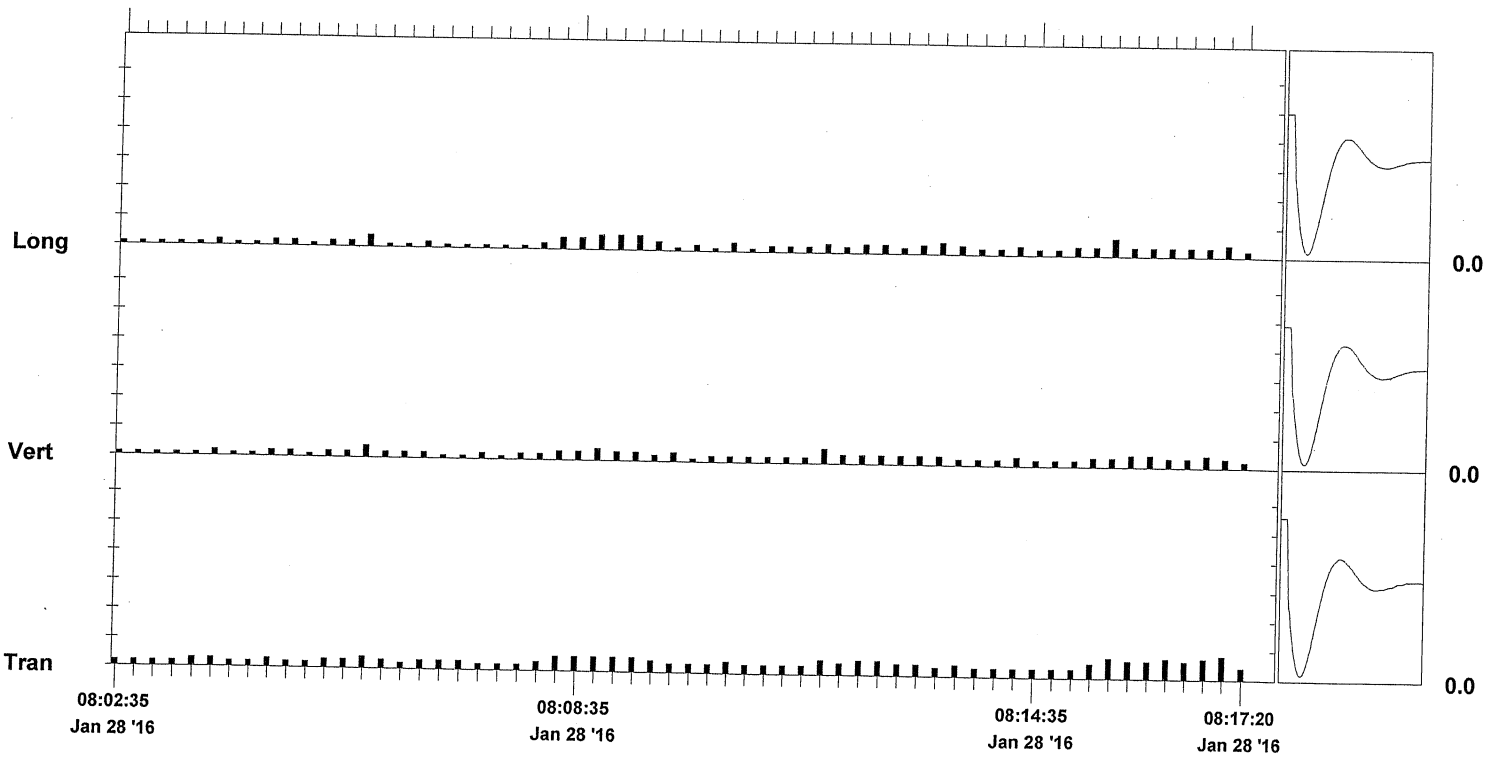
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0400	0.0250	0.0300	in/s
ZC Freq	47	73	47	Hz
Date	Jan 28 '16	Jan 28 '16	Jan 28 '16	
Time	08:17:05	08:11:50	08:15:35	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.8	7.7	7.7	Hz
Overswing Ratio	3.8	3.7	4.2	

Peak Vector Sum 0.0412 in/s on January 28, 2016 at 08:17:05

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

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Event Report

Histogram Start Time	08:19:57 January 28, 2016	**Serial Number**	BB8334 V 7.04-8.0 EVERLERT III
Histogram Finish Time	08:30:25 January 28, 2016	**Battery Level**	6.0 Volts
Number of Intervals	41 at 15 seconds	**Calibration**	July 20, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J334G7TB.591
Sample Rate	1024sps		

Notes
Location:
Client:
User Name:
General:

Extended Notes

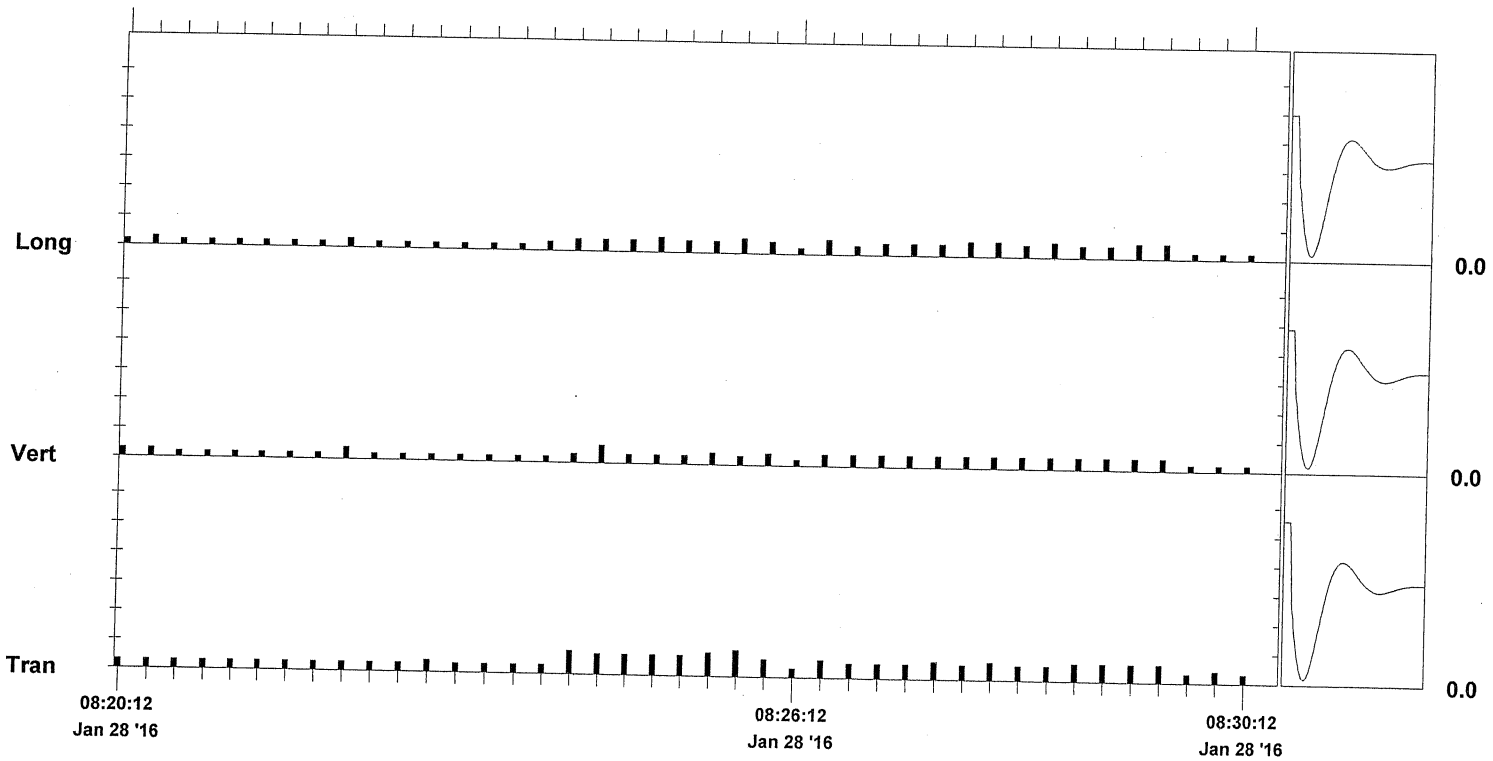
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0450	0.0300	0.0250	in/s
ZC Freq	43	>100	51	Hz
Date	Jan 28 '16	Jan 28 '16	Jan 28 '16	
Time	08:25:42	08:24:27	08:24:57	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.8	7.7	7.7	Hz
Overswing Ratio	3.9	3.7	4.2	

Peak Vector Sum 0.0453 in/s on January 28, 2016 at 08:25:42

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

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Event Report

Histogram Start Time	08:31:19 January 28, 2016	**Serial Number**	BB8334 V 7.04-8.0 EVERLERT III
Histogram Finish Time	09:08:18 January 28, 2016	**Battery Level**	6.0 Volts
Number of Intervals	147 at 15 seconds	**Calibration**	July 20, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J334G7TB.O71
Sample Rate	1024sps		

Notes
Location:
Client:
User Name:
General:

Extended Notes

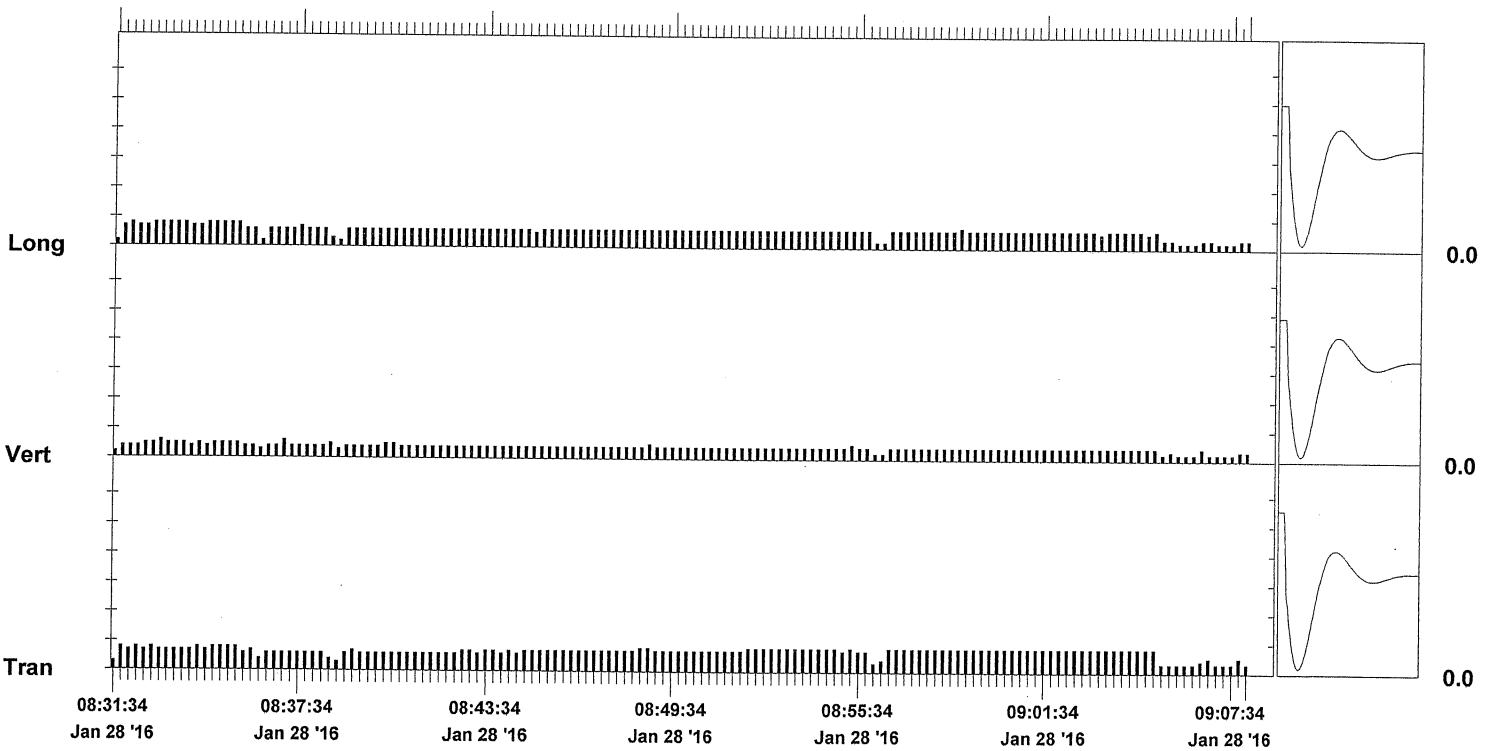
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0400	0.0300	0.0400	in/s
ZC Freq	51	64	64	Hz
Date	Jan 28 '16	Jan 28 '16	Jan 28 '16	
Time	08:31:49	08:33:04	08:32:04	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.8	7.7	7.6	Hz
Overswing Ratio	3.9	3.7	4.2	

Peak Vector Sum 0.0461 in/s on January 28, 2016 at 08:55:19

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

VIBRA-TECH
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Event Report

Histogram Start Time	09:09:15 January 28, 2016	**Serial Number**	BB8334 V 7.04-8.0 EVERLERT III
Histogram Finish Time	09:20:31 January 28, 2016	**Battery Level**	6.0 Volts
Number of Intervals	45 at 15 seconds	**Calibration**	July 20, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J334G7TD.FF1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name:
General:

Extended Notes

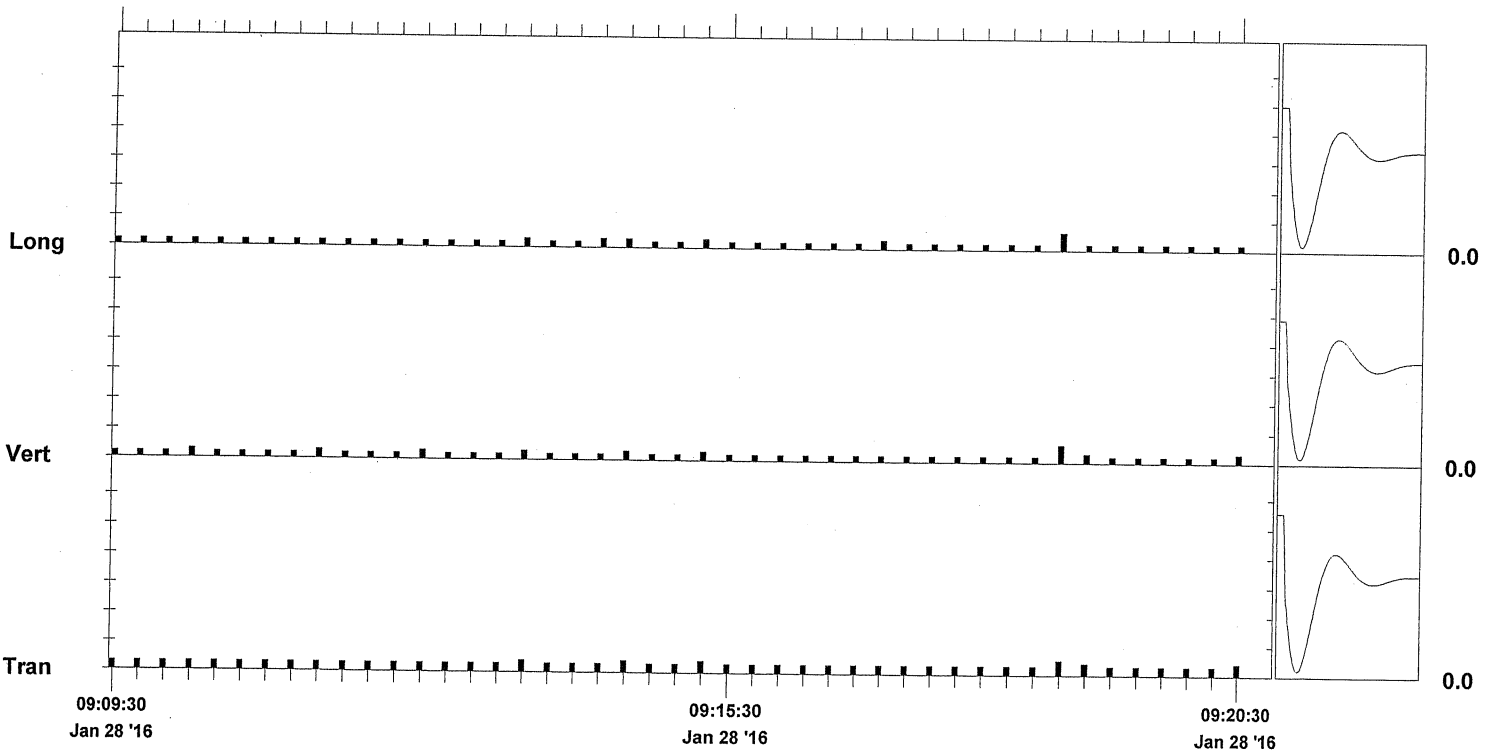
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0250	0.0300	0.0300	in/s
ZC Freq	2.5	47	85	Hz
Date	Jan 28 '16	Jan 28 '16	Jan 28 '16	
Time	09:18:45	09:18:45	09:18:45	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.8	7.7	7.7	Hz
Overswing Ratio	3.9	3.7	4.2	

Peak Vector Sum 0.0374 in/s on January 28, 2016 at 09:18:45

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	09:43:22 January 28, 2016	**Serial Number**	BB8334 V 7.04-8.0 EVERLERT III
Histogram Finish Time	10:38:15 January 28, 2016	**Battery Level**	6.0 Volts
Number of Intervals	219 at 15 seconds	**Calibration**	July 20, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J334G7TF.0A1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name:
General:

Extended Notes

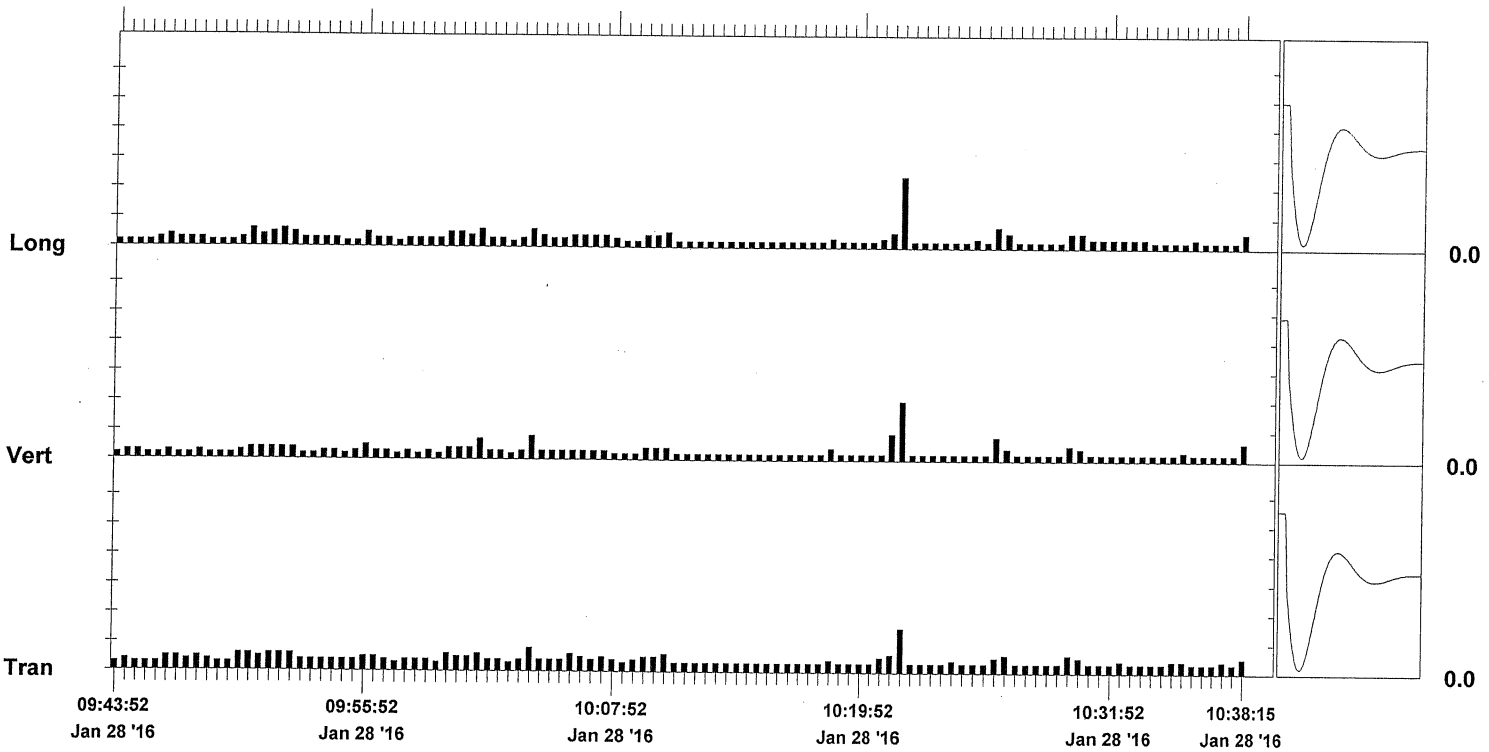
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0750	0.1000	0.120	in/s
ZC Freq	47	73	64	Hz
Date	Jan 28 '16	Jan 28 '16	Jan 28 '16	
Time	10:21:37	10:21:37	10:21:37	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.8	7.6	7.6	Hz
Overswing Ratio	3.9	3.7	4.2	

Peak Vector Sum 0.131 in/s on January 28, 2016 at 10:21:37

N/A: Not Applicable



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

VIBRA-TECH
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Event Report

Histogram Start Time	10:39:18 January 28, 2016	**Serial Number**	BB8334 V 7.04-8.0 EVERLERT III
Histogram Finish Time	11:18:48 January 28, 2016	**Battery Level**	6.0 Volts
Number of Intervals	158 at 15 seconds	**Calibration**	July 20, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J334G7TH.LI1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name:
General:

Extended Notes

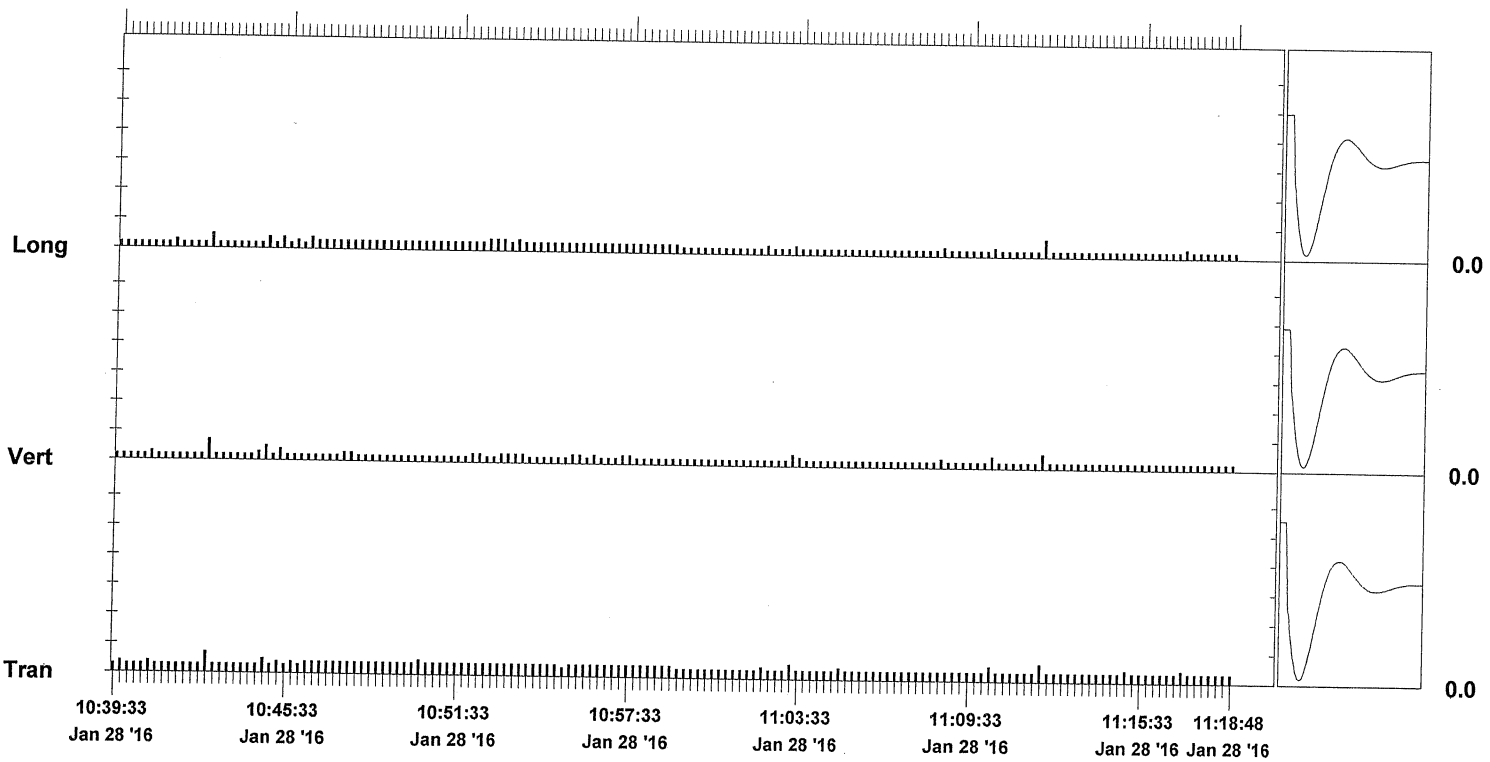
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0350	0.0350	0.0300	in/s
ZC Freq	32	64	73	Hz
Date	Jan 28 '16	Jan 28 '16	Jan 28 '16	
Time	10:42:48	10:42:48	11:12:03	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.8	7.6	7.6	Hz
Overswing Ratio	3.9	3.7	4.2	

Peak Vector Sum 0.0439 in/s on January 28, 2016 at 11:12:03

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	11:19:46 January 28, 2016	**Serial Number**	BB8334 V 7.04-8.0 EVERLERT III
Histogram Finish Time	13:03:28 January 28, 2016	**Battery Level**	6.1 Volts
Number of Intervals	414 at 15 seconds	**Calibration**	July 20, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J334G7TJ.GY1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name:
General:

Extended Notes

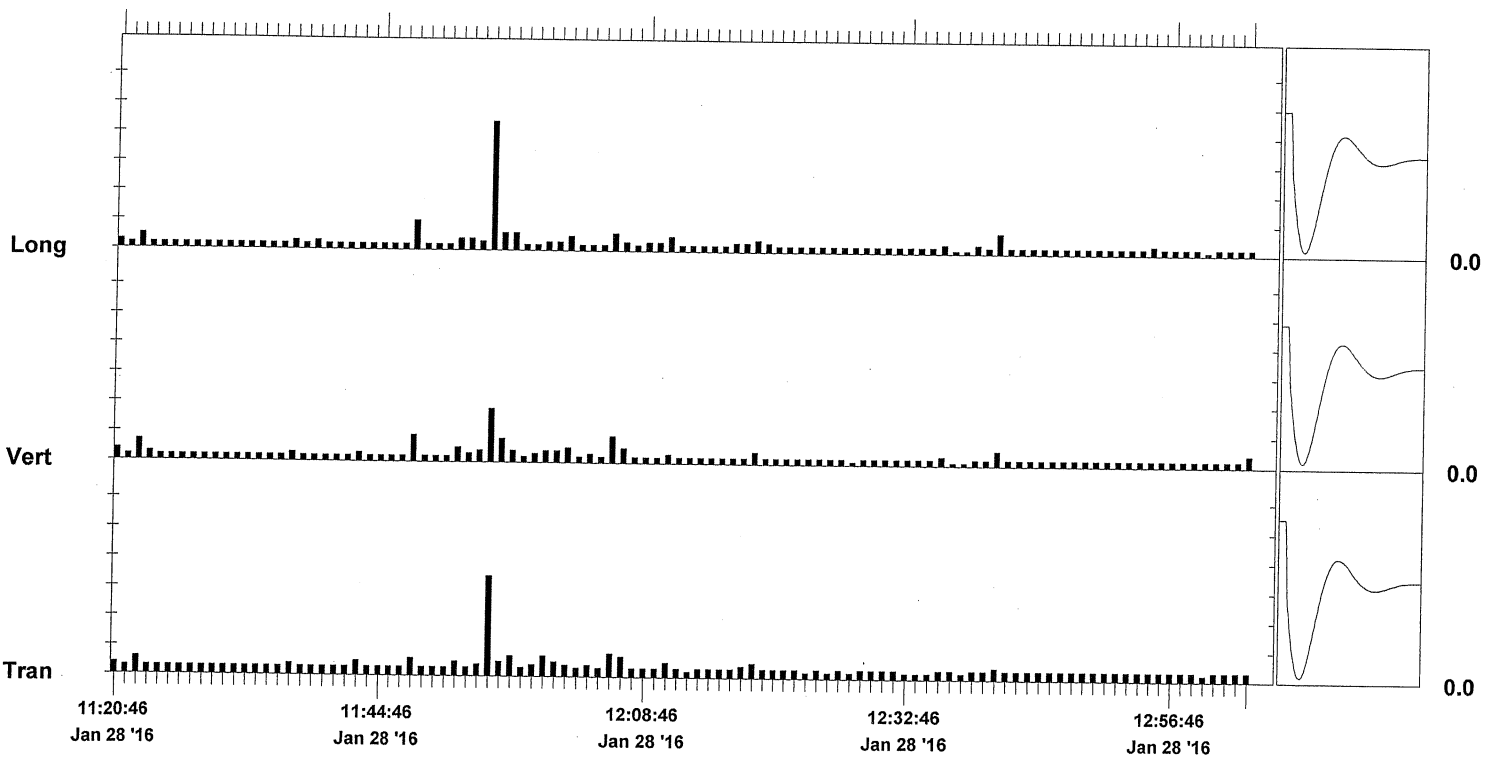
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.170	0.0900	0.220	in/s
ZC Freq	73	64	64	Hz
Date	Jan 28 '16	Jan 28 '16	Jan 28 '16	
Time	11:54:01	11:54:01	11:54:01	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.8	7.6	7.6	Hz
Overswing Ratio	3.9	3.7	4.2	

Peak Vector Sum 0.227 in/s on January 28, 2016 at 11:54:01

N/A: Not Applicable



Time Scale: 1 minute /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	13:04:37 January 28, 2016	**Serial Number**	BB8334 V 7.04-8.0 EVERLERT III
Histogram Finish Time	14:34:51 January 28, 2016	**Battery Level**	6.1 Volts
Number of Intervals	360 at 15 seconds	**Calibration**	July 20, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J334G7TO.BP1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name.
General:

Extended Notes

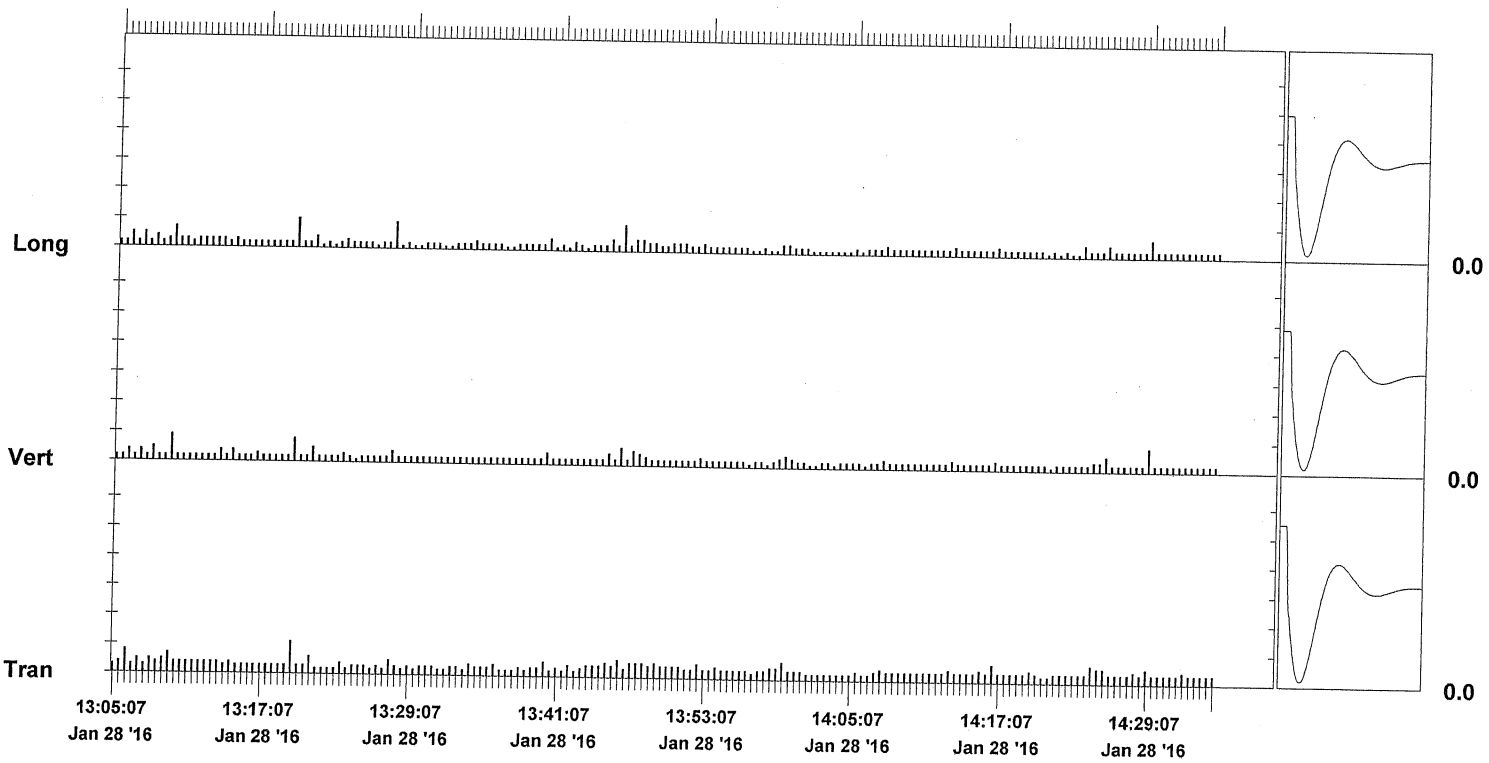
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0550	0.0450	0.0500	in/s
ZC Freq	>100	85	>100	Hz
Date	Jan 28 '16	Jan 28 '16	Jan 28 '16	
Time	13:19:37	13:09:37	13:19:37	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.7	7.6	7.6	Hz
Overswing Ratio	3.9	3.7	4.2	

Peak Vector Sum 0.0709 in/s on January 28, 2016 at 13:19:37

N/A: Not Applicable



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

VIBRA-TECH
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Event Report

Histogram Start Time	14:35:48 January 28, 2016	**Serial Number**	BB8334 V 7.04-8.0 EVERLERT III
Histogram Finish Time	15:22:32 January 28, 2016	**Battery Level**	6.1 Volts
Number of Intervals	186 at 15 seconds	**Calibration**	July 20, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J334G7TS.JO1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name:
General:

Extended Notes

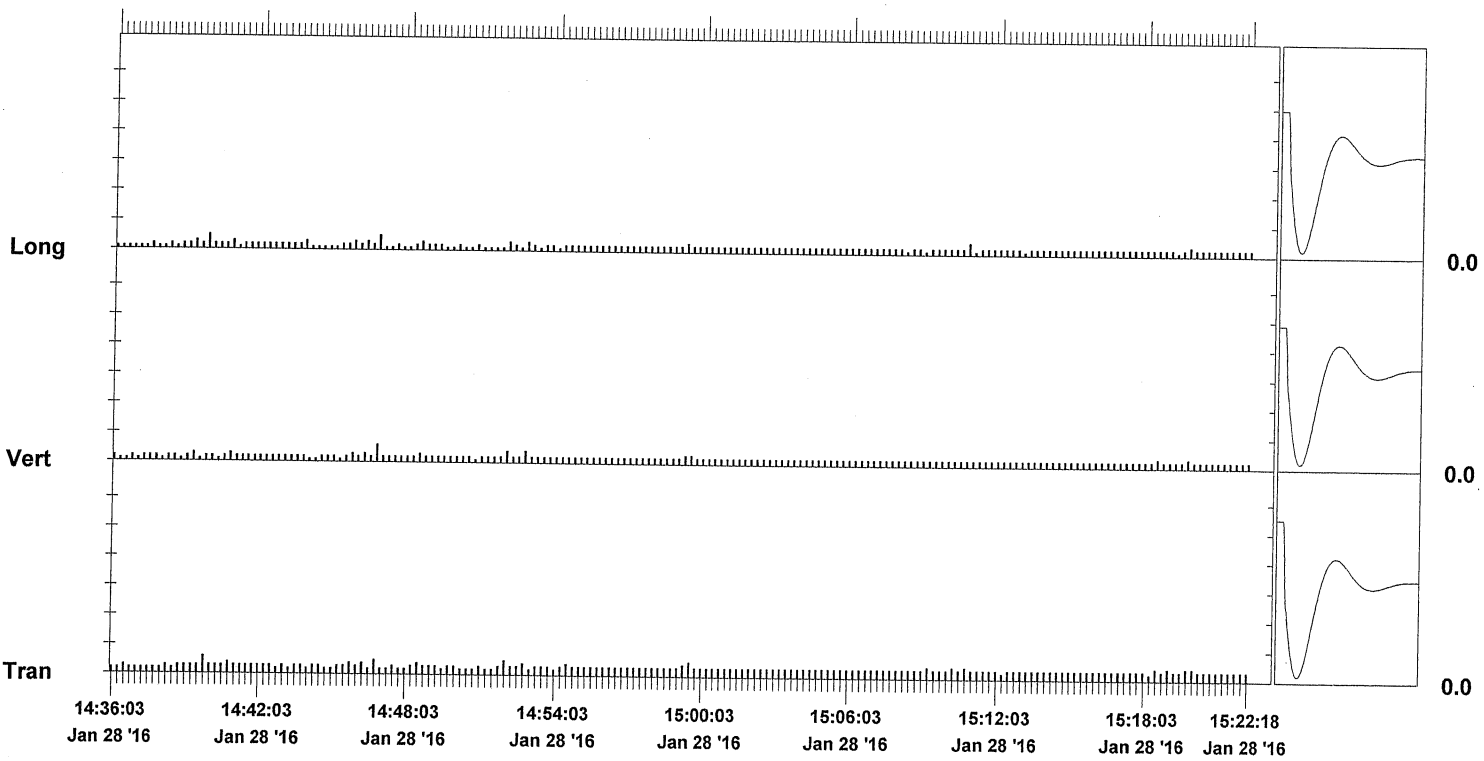
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0300	0.0300	0.0250	in/s
ZC Freq	51	57	64	Hz
Date	Jan 28 '16	Jan 28 '16	Jan 28 '16	
Time	14:39:48	14:46:48	14:39:48	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.8	7.6	7.6	Hz
Overswing Ratio	3.9	3.7	4.2	

Peak Vector Sum 0.0439 in/s on January 28, 2016 at 14:46:48

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

Vibra-Tech

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VIBRATION MONITORING REPORT

Client: Craig

Project: 11160540 Pipeline

Vibration Source: Drill Rig CME 750X

Specification/Limit: 0.75 in/sec

Caution Level: 0.6 in/sec

Event No.	Activity	Pile No.*	Start	Stop	Work Location	Seismograph Location	Distance (ft)	Results (cm/sec)
1	Rock coring	B-15	8:25			~15' north of boring, ~35' south of pipe	~30	0.12
2	"	↓	9:10			↓	↓	0.34
3	"	↓	10:35			↓	↓	0.06

*___Actual pile #s from pile plan
___Not actual pile #s; for tracking only.

__Measured distan
__Estimated distan

Seismograph: BB 8334

Range: 0-10 in/sec

Field Technician: David Caldwell

Date: 1/29/16

Downloaded by:

Printed by:

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	08:25:08 January 29, 2016	**Serial Number**	BB8334 V 7.04-8.0 EVERLERT III
Histogram Finish Time	09:08:29 January 29, 2016	**Battery Level**	6.2 Volts
Number of Intervals	173 at 15 seconds	**Calibration**	July 20, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J334G7V6.1W1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name:
General:

Extended Notes

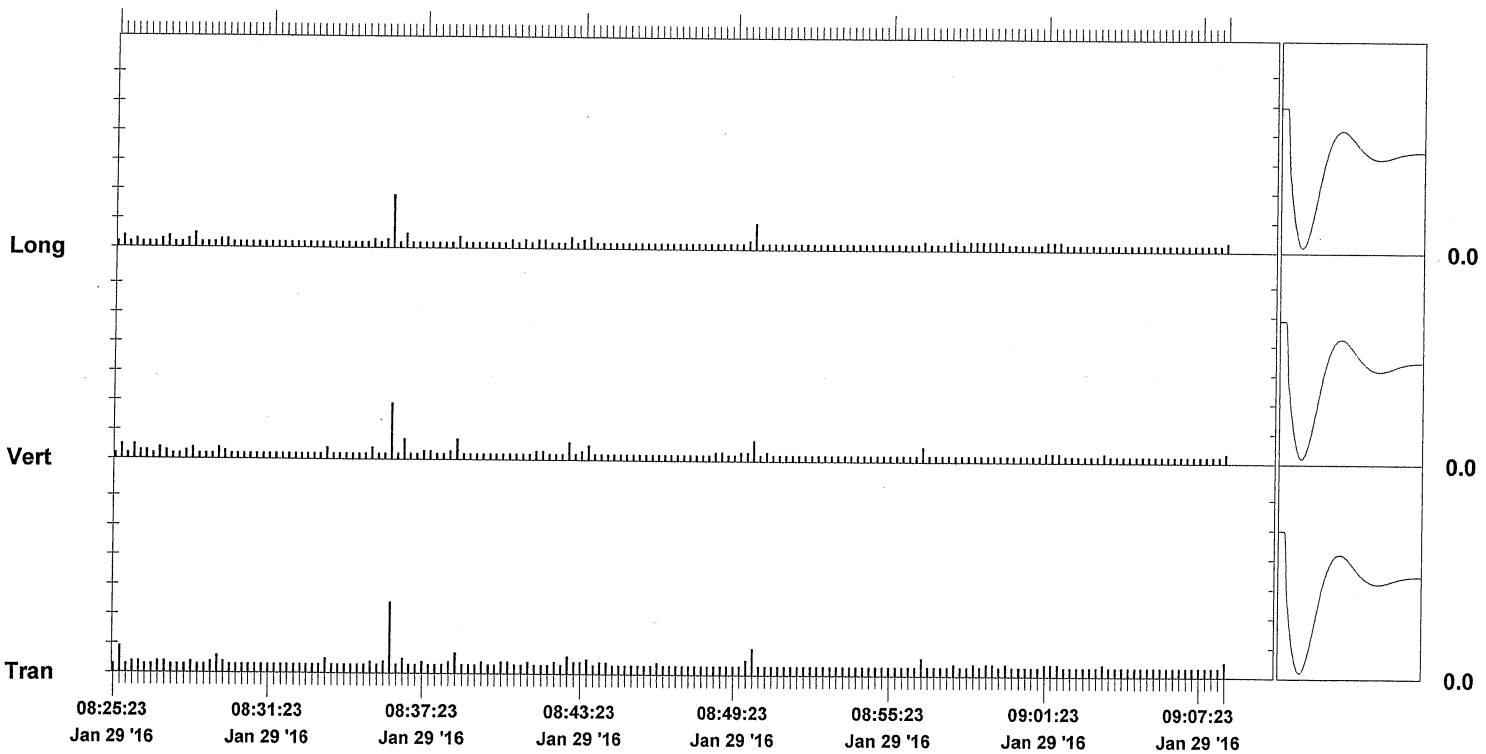
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.120	0.0950	0.0900	in/s
ZC Freq	73	>100	>100	Hz
Date	Jan 29 '16	Jan 29 '16	Jan 29 '16	
Time	08:36:08	08:36:08	08:36:08	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	4.0	3.7	4.1	

Peak Vector Sum 0.168 in/s on January 29, 2016 at 08:36:08

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	09:09:21 January 29, 2016	**Serial Number**	BB8334 V 7.04-8.0 EVERLERT III
Histogram Finish Time	12:35:16 January 29, 2016	**Battery Level**	6.1 Volts
Number of Intervals	823 at 15 seconds	**Calibration**	July 20, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J334G7V8.3L1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name:
General:

Extended Notes

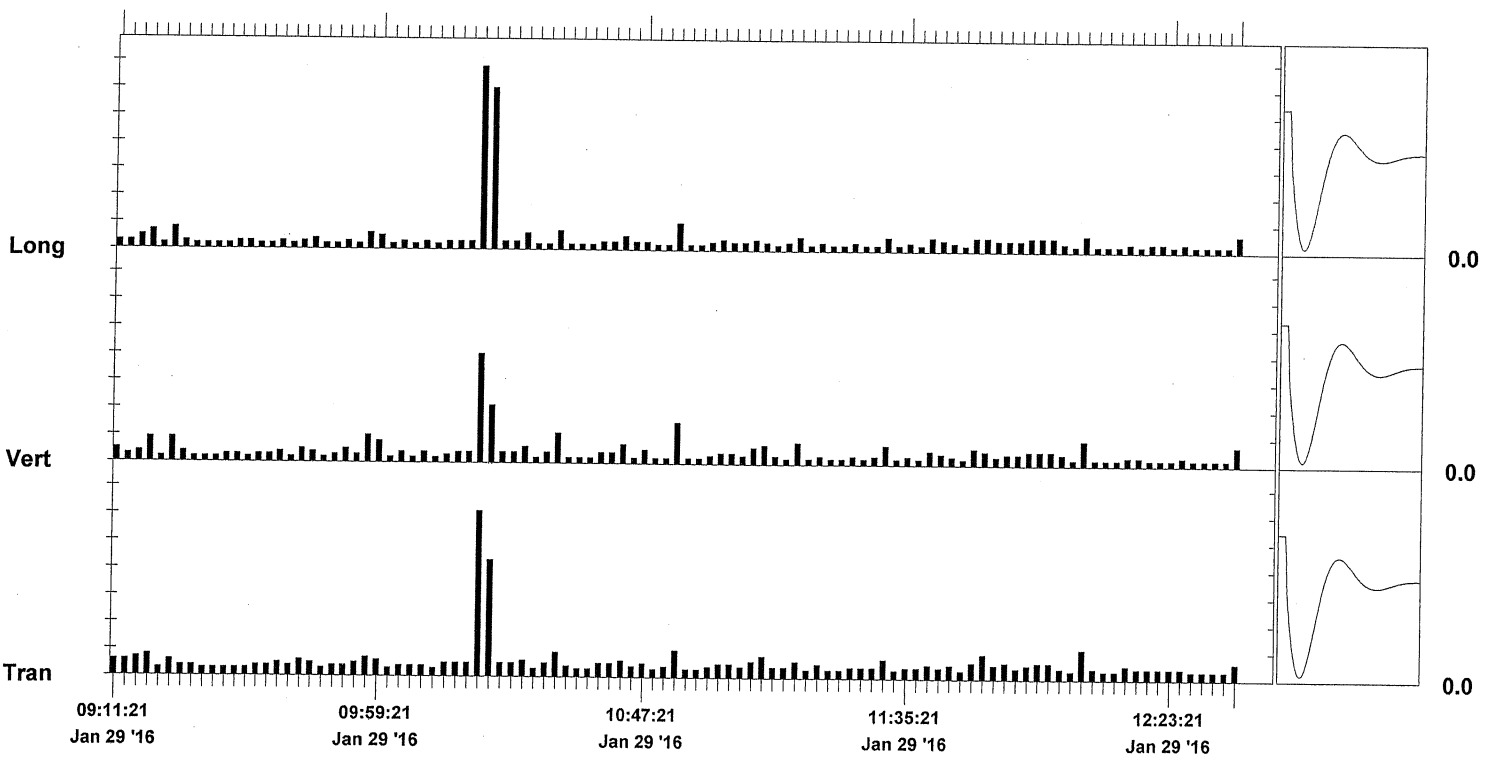
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.305	0.200	0.340	in/s
ZC Freq	57	>100	51	Hz
Date	Jan 29 '16	Jan 29 '16	Jan 29 '16	
Time	10:17:21	10:17:21	10:17:21	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.7	7.6	7.6	Hz
Overswing Ratio	4.0	3.7	4.2	

Peak Vector Sum 0.384 in/s on January 29, 2016 at 10:17:21

N/A: Not Applicable



Time Scale: 2 minutes /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	12:36:30 January 29, 2016	**Serial Number**	BB8334 V 7.04-8.0 EVERLERT III
Histogram Finish Time	14:28:33 January 29, 2016	**Battery Level**	6.1 Volts
Number of Intervals	448 at 15 seconds	**Calibration**	July 20, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J334G7VH.OU1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name:
General:

Extended Notes

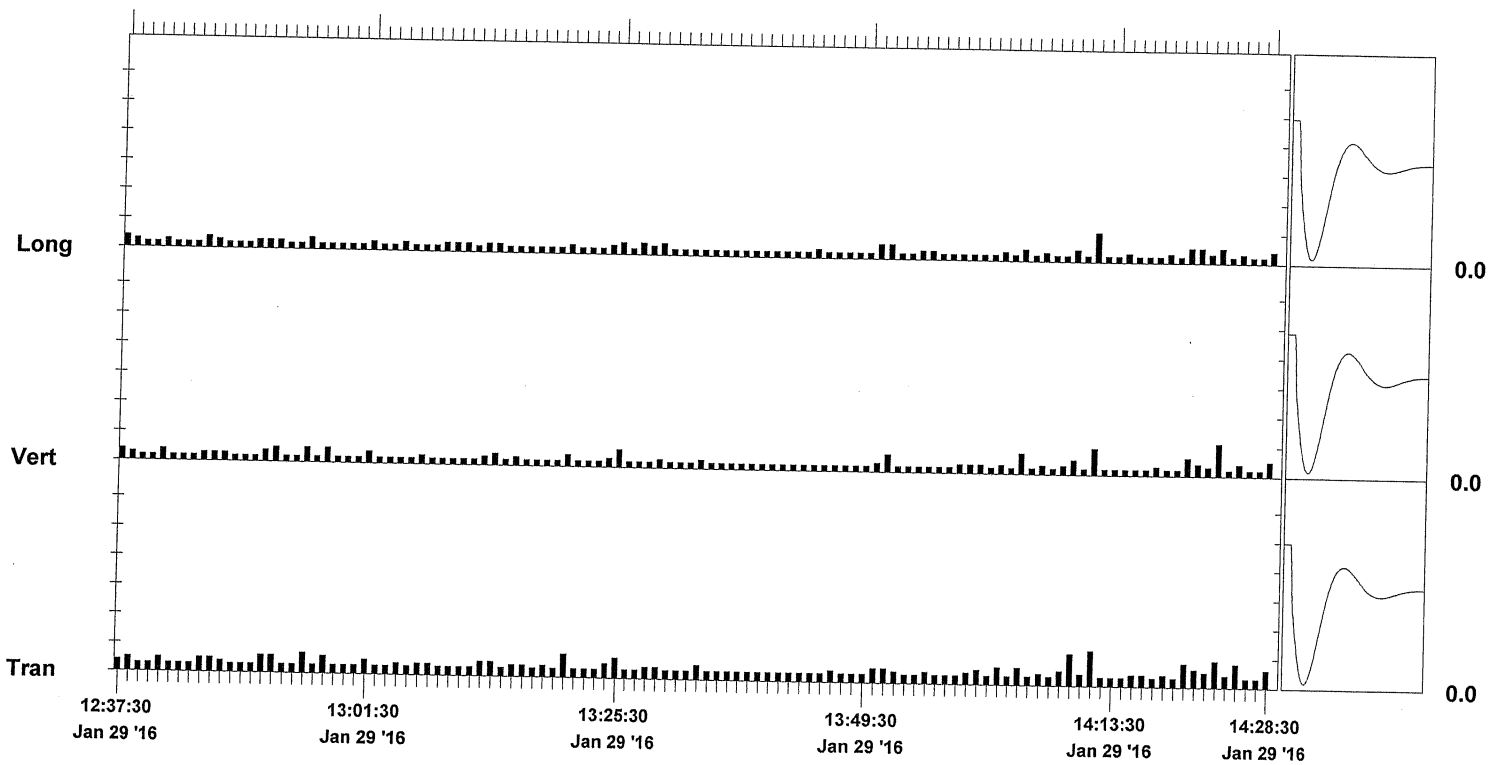
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0600	0.0550	0.0500	in/s
ZC Freq	85	>100	64	Hz
Date	Jan 29 '16	Jan 29 '16	Jan 29 '16	
Time	14:11:30	14:23:00	14:11:30	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.6	7.6	7.6	Hz
Overswing Ratio	4.0	3.7	4.1	

Peak Vector Sum 0.0673 in/s on January 29, 2016 at 14:11:30

N/A: Not Applicable



Time Scale: 1 minute /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts
109 E FIRST ST
HAZLETON, PA 18201
(570)455-5861

VIBRATION MONITORING REPORT

Client: CRAIG GEOTECHNICAL DRILLING

Project: 11160540 PIPELINE

Vibration Source: CME 750X DRILL RIG

Specification: 0.6 IN/SEC WARNING LEVEL / 0.75 IN/SEC LIMIT

Test #	Activity	Exact Seismograph Location	Distance (ft.)	Results
1	ROCK CORING (DRILLING)	15 FT NORTH OF B ORE HOLE # B-15 AND 35 FT SOUTH OF EXHISTING PIPELINE.	145 FT - DEEP TO	0.025
	8:18 - 9:01		155 FT - DEEP	
2	REMOVE & STACK 155 FT OF STEEL		155 FT to 0 FT - DEEP	0.050
	CASING & REPLACE DRILL BIT.			
	9:03 - 9:41			
3	ROCK CORING (DRILLING)		155 FT - DEEP	
	9:44 - 11:23		175 FT TO - DEEP	0.025
4	REMOVE & STACK 175 FT OF STEEL CASING		175 FT - 0 FT - DEEP	0.020
	11:25 - 11:47			

Seis: BB 8602

Range: 0 - 10.0 IN/SEC

Field Technician: ROBERT C PERILLA

Date: 02/01/06

Downloaded by: RCP
Printed by: RCP

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

VIBRA-TECH
The Vibration Monitoring Experts

Histogram Start Time	08:05:16 February 1, 2016	**Serial Number**	BB8602 V 7.04-8.0 EVERLERT III
Histogram Finish Time	09:01:21 February 1, 2016	**Battery Level**	6.1 Volts
Number of Intervals	224 at 15 seconds	**Calibration**	May 6, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J602G80P.4S1
Sample Rate	1024sps		

Notes
Location: 1116540 PIPELINE
Client: CRAIG GEOTECHNICAL DRILLING
User Name: VIBRA-TECH ENGINEERS
General:

Extended Notes

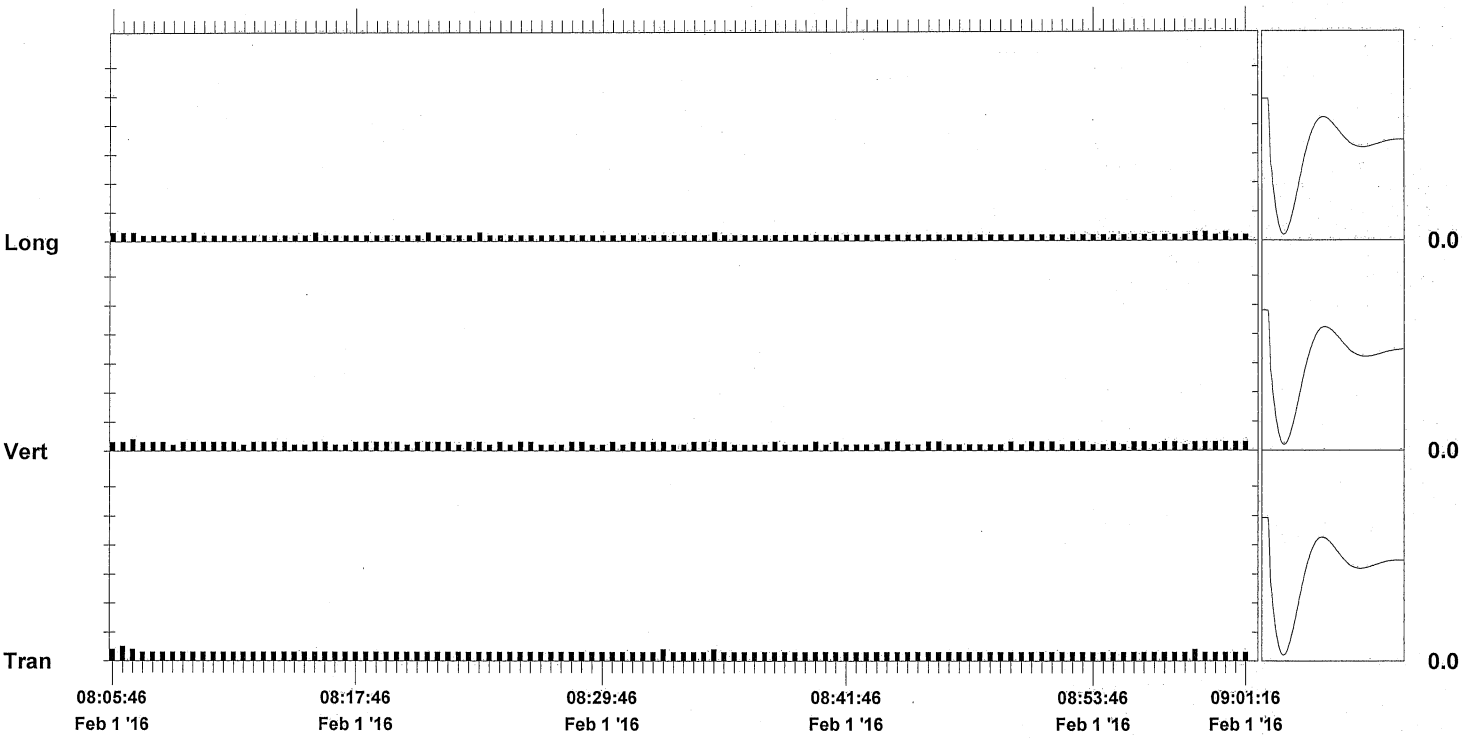
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0250	0.0200	0.0150	in/s
ZC Freq	73	>100	>100	Hz
Date	Feb 1 '16	Feb 1 '16	Feb 1 '16	
Time	08:06:16	08:06:31	08:05:31	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.6	7.3	7.5	Hz
Overswing Ratio	3.8	3.9	3.9	

Peak Vector Sum 0.0274 in/s on February 1, 2016 at 08:06:16

N/A: Not Applicable



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

VIBRA-TECH
The Vibration Monitoring Experts

Histogram Start Time	09:03:16 February 1, 2016	**Serial Number**	BB8602 V 7.04-8.0 EVERLERT III
Histogram Finish Time	09:41:27 February 1, 2016	**Battery Level**	6.1 Volts
Number of Intervals	152 at 15 seconds	**Calibration**	May 6, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J602G80R.TG1
Sample Rate	1024sps		

Notes
Location: 1116540 PIPELINE
Client: CRAIG GEOTECHNICAL DRILLING
User Name: VIBRA-TECH ENGINEERS
General:

Extended Notes

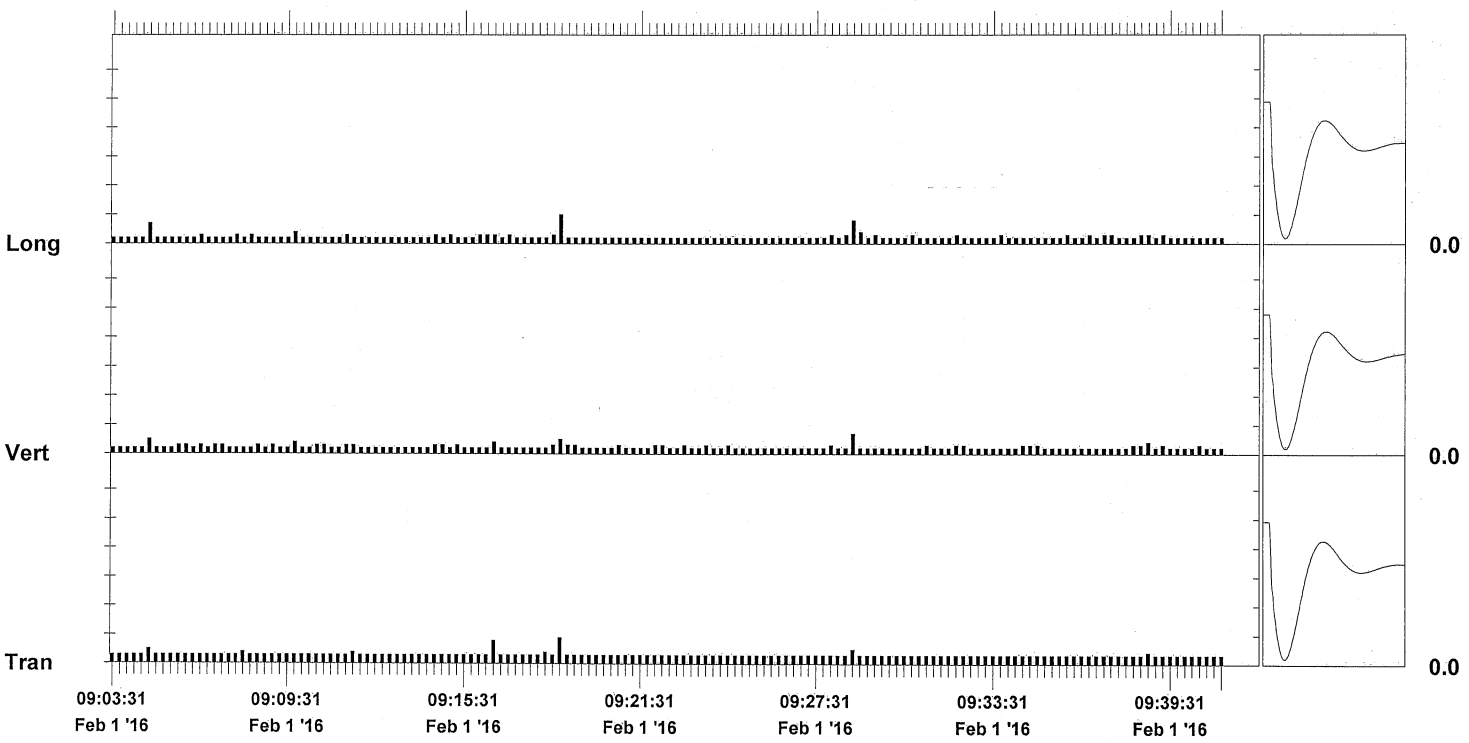
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0450	0.0350	0.0500	in/s
ZC Freq	47	73	57	Hz
Date	Feb 1 '16	Feb 1 '16	Feb 1 '16	
Time	09:18:46	09:28:46	09:18:46	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.6	7.2	7.5	Hz
Overswing Ratio	3.7	3.9	3.9	

Peak Vector Sum 0.0660 in/s on February 1, 2016 at 09:18:46

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

VIBRA-TECH
The Vibration Monitoring Experts

Histogram Start Time	09:43:17 February 1, 2016	**Serial Number**	BB8602 V 7.04-8.0 EVERLERT III
Histogram Finish Time	11:24:14 February 1, 2016	**Battery Level**	6.1 Volts
Number of Intervals	403 at 15 seconds	**Calibration**	May 6, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J602G80T.O51
Sample Rate	1024sps		

Notes
Location: 1116540 PIPELINE
Client: CRAIG GEOTECHNICAL DRILLING
User Name: VIBRA-TECH ENGINEERS
General:

Extended Notes

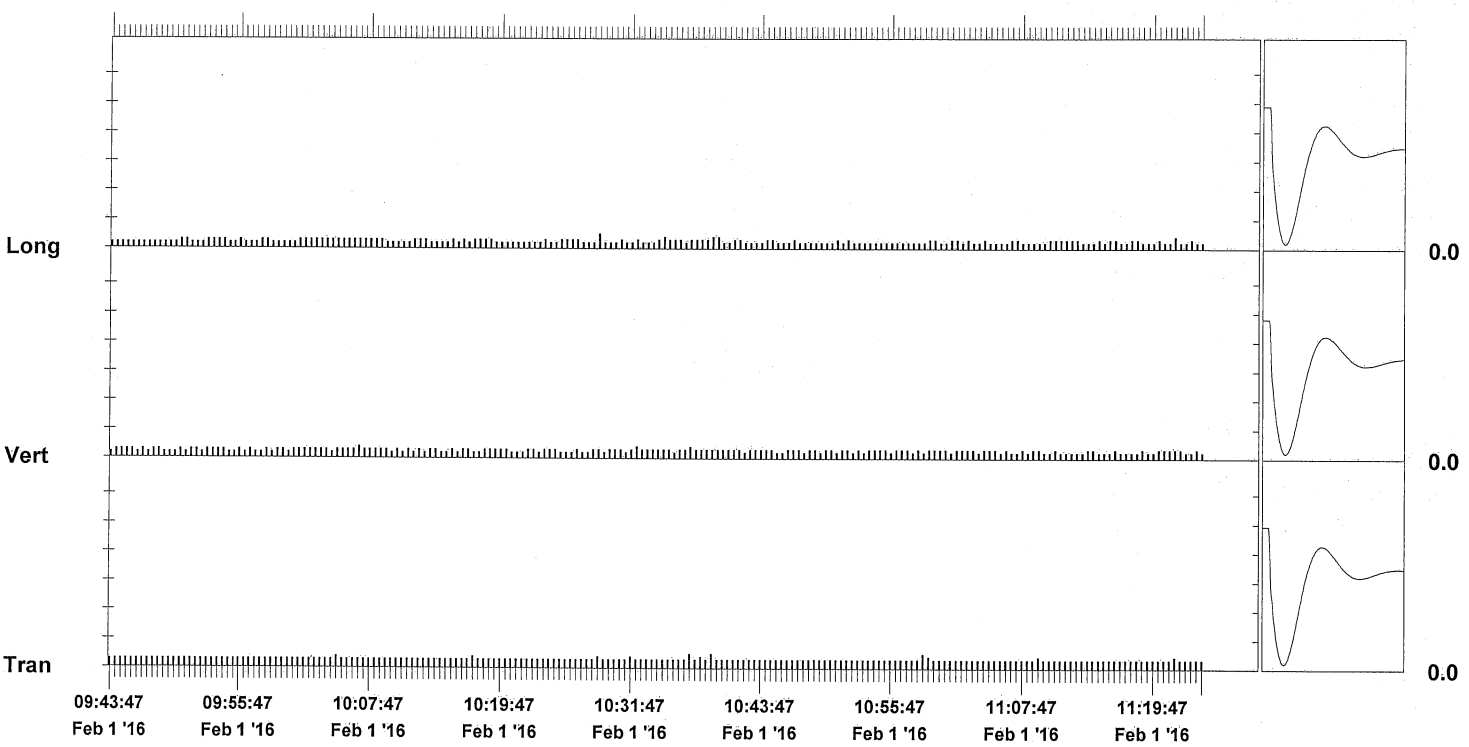
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0250	0.0200	0.0250	in/s
ZC Freq	57	>100	43	Hz
Date	Feb 1 '16	Feb 1 '16	Feb 1 '16	
Time	10:37:17	10:06:32	10:28:32	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.7	7.3	7.5	Hz
Overswing Ratio	3.7	3.9	3.8	

Peak Vector Sum 0.0320 in/s on February 1, 2016 at 10:37:17

N/A: Not Applicable



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

VIBRA-TECH
The Vibration Monitoring Experts

Histogram Start Time	11:25:18 February 1, 2016	**Serial Number**	BB8602 V 7.04-8.0 EVERLERT III
Histogram Finish Time	11:46:48 February 1, 2016	**Battery Level**	6.1 Volts
Number of Intervals	85 at 15 seconds	**Calibration**	May 6, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	J602G80Y.E61
Sample Rate	1024sps		

Notes
Location: 1116540 PIPELINE
Client: CRAIG GEOTECHNICAL DRILLING
User Name: VIBRA-TECH ENGINEERS
General:

Extended Notes

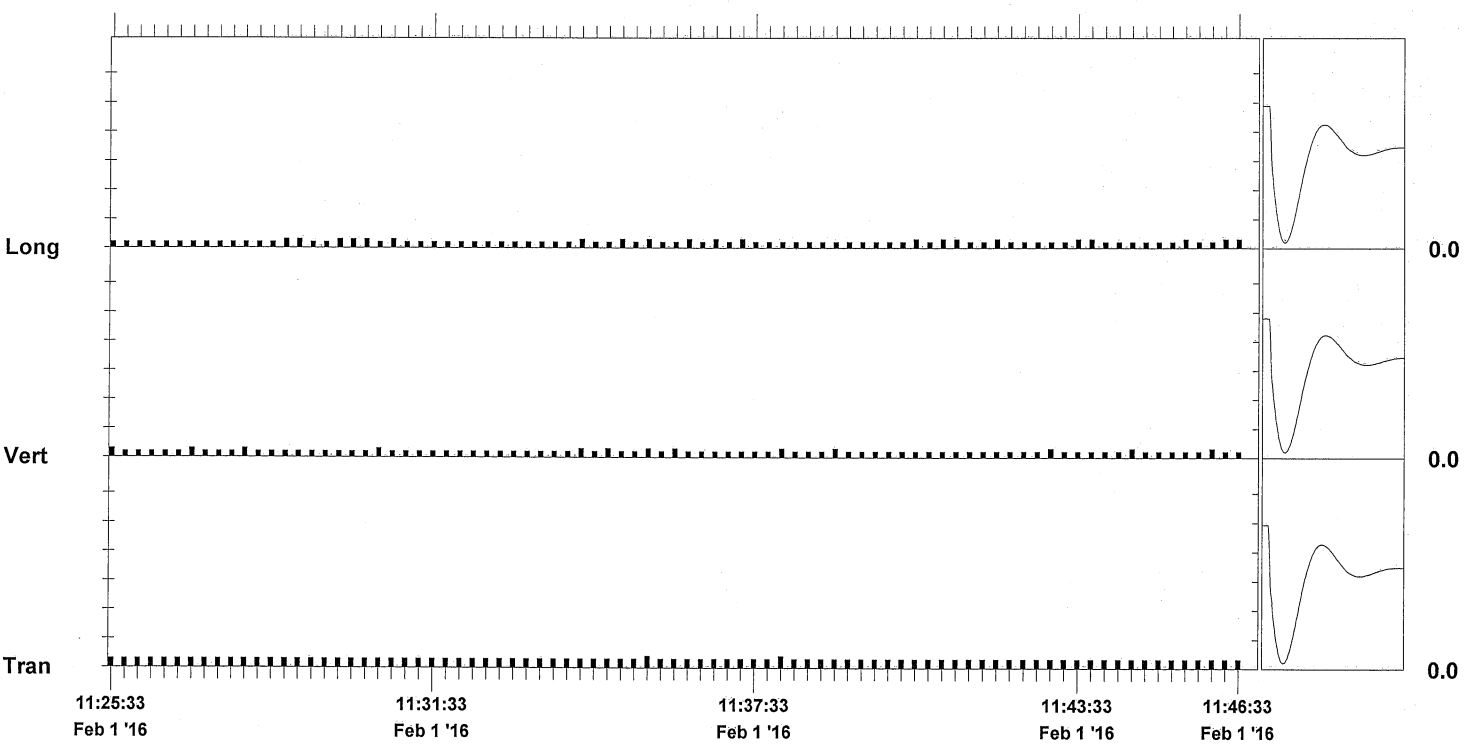
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0200	0.0150	0.0150	in/s
ZC Freq	57	>100	>100	Hz
Date	Feb 1 '16	Feb 1 '16	Feb 1 '16	
Time	11:35:33	11:25:33	11:28:48	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.7	7.3	7.5	Hz
Overswing Ratio	3.7	3.9	3.8	

Peak Vector Sum 0.0212 in/s on February 1, 2016 at 11:35:33

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

Vibra-Tech

REPORT

TO

Craig Testing Laboratories, Inc.
5439 Harding Highway
P O Box 427
Mays Landing, New Jersey 08330

Attn: Mr. Eduardo Freire, P.E.

DATE January 19, 2016

SUBJECT **Vibration Monitoring Report for Craig Testing Laboratories, Inc.**
Penn East Pipeline project
Lehighton, Pennsylvania
January 6, 7, 8 and 11, 2016

Re: Core Drilling Activities for Boring #B-16

COPY NUMBER 1 **OF** 3

Vibra-Tech

VibraTechinc.com

109 East First Street
P.O. Box 577
Hazleton, PA 18201

Phone 570.455.5861
Fax 570.455.0626

January 19, 2016

Mr. Eduardo Freire, P.E.
Craig Testing Laboratories, Inc.
5439 Harding Highway P O Box 427
Mays Landing, New Jersey 08330

Re: Penn East Pipeline project
Core Drilling Activities for Boring #B-16
Lehighton, Pennsylvania

Dear Mr. Freire:

The following report is based upon the results of vibration monitoring results of the core drilling activities for Boring #B-16 conducted on January 6, 7, 8 and 11, 2016 at the above referenced project. The recorded vibration levels were compared to the 0.75 in/sec vibration criteria provided to Vibra-Tech Engineers, Inc., by Mr. Eduardo Freire, P. E., of Craig Testing Laboratories, Inc..

The report contains the original seismograph records obtained during the core drilling activities for Boring #B-16. All of the recorded vibration levels were below and in conformance with the above mentioned vibration criteria.

Please refer to our report, the individual report forms and the original seismograph records in the appendix of this report for specific recording locations and intensities.

Respectfully submitted,

VIBRA-TECH ENGINEERS, INC.

Marc Blasko
Field Representative

Douglas Rudenko
Vice President

MEB/ly

VT#11160540

January 19, 2016

Vibration Monitoring Report for
Craig Testing Laboratories, Inc.

Penn East Pipeline project
Lehighton, Pennsylvania
January 6, 7, 8 and 11, 2016

Introduction

Vibration monitoring authorized by Craig Testing Laboratories, Inc. was conducted by Vibra-Tech Engineers, Inc., at the above referenced project. Ground vibrations resulting from the core drilling activities for Boring #B-16 were monitored on January 6, 7, 8 and 11, 2016. The recorded vibration levels were compared to the 0.75 in/sec vibration criteria provided to Vibra-Tech Engineers, Inc., by Mr. Eduardo Freire, P. E., of Craig Testing Laboratories, Inc..

Scope and Condition of Study

Vibra-Tech Engineers, Inc., conducted on-site vibration monitoring of the core drilling activities for Boring #B-16 (N40°52.953 W075°33.134) on the Penn East Pipeline project Lehighton, Pennsylvania. The core boring tests were in conjunction with the proposed pipeline construction.

Vibration Monitoring

A vibration monitoring seismograph equipped with a triaxial geophone was utilized to monitor ground vibrations between the core boring activities and an existing water pipeline located adjacent to the activities. The seismograph was programmed to continuously record and store the highest peak particle velocity at 15 second intervals.

Instrumentation

The seismographs used for this project directly measure particle velocity in three mutually perpendicular planes of motion. The seismographs have a dynamic range of 10 in/sec and a sample rate of 1,024 samples per second per channel. The entire system is calibrated internally prior to and after each monitoring period in addition to an annual shake table calibration.

The Vibra-Tech seismographs are four channel recorders that directly measure particle velocity in three mutually perpendicular directions. "Particle Velocity" is defined as "how fast a particle is moved by

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passing waves, measured in inches per second". The fourth channel employed for monitoring air overpressure is not applicable for this study.

The data is stored on the seismograph's internal memory, (when trigger levels are exceeded) and processed into analog printouts. Analog representations of this data are included in the appendix at the end of this report. The three (3) ground vibration traces are individually labeled. The trace labeled "longitudinal" represents horizontal motion along a line between the recorder and the energy source. The trace labeled "transverse" represents horizontal motion at right angles to the energy source. The "vertical" trace represents particle velocity in that plane of motion.

Vibration and Vibration Measurements

The measurement of vibration involves quantifying the rate and amount of oscillation occurring in a vibrating body. The rate of motion, or the number of vibrations occurring in a given time frame, usually one second, is called the frequency of the motion, which is described as the number of cycles/second (cps) or Hertz (Hz).

The amount of movement associated with a vibration can be measured in terms of displacement, velocity, or acceleration. Displacement is a measure of the physical distance traveled from a position of equilibrium or base line. Velocity is a measure of the speed at which the displacement occurred and acceleration is a measure of the change in velocity occurring during the vibration event. The relationships between displacement, velocity, and acceleration are also dependent upon the frequency of the motions measured. The seismograph used to record at this site measures vibration in velocity.

Results of the Monitoring

Monitoring information including the equipment used in the core drilling activities, the vibration monitoring location, distance from the core drilling activities and recorded peak particle velocity histogram charts are included in the appendix of this report. Each histogram contains three plots representing vibration amplitudes for each plane of motion.

Conclusions

All of the recorded vibrations were below and in conformance with the limit 0.75 in/sec vibration criteria provided to Vibra-Tech Engineers, Inc., by Mr. Eduardo Freire, P. E., of Craig Testing Laboratories, Inc..

If you have any questions, or if we may be of further assistance, please feel free to contact our office.

Respectfully submitted,

VIBRA-TECH ENGINEERS, INC.

Marc Blasko
Field Representative

Douglas Rudenko
Vice President

HJB/ly

VT#11160443

Vibra-Tech Engineers, Inc. shall not be liable for any claims of tangible property damage where such damage is not solely, directly, and physically caused by Vibra-Tech Engineers, Inc. Additionally, Vibra-Tech Engineers, Inc. shall not be liable, in whole or in part, for any claims of tangible property damage brought by or on behalf of third-party claims.

APPENDIX

Vibra-Tech
109 E. First Street
Hazleton, PA 18201
***Phone** 570.455.5861*
***Office Fax** 570.455.0626*

VIBRA-TECH
The Vibration Monitoring Experts
109 E FIRST ST
HAZLETON, PA 18201
(570)455-5861

VIBRATION MONITORING REPORT

Client: Craig Testing Laboratories, Inc

Project: Penn East Pipeline Project B-16

Vibration Source: CME 750x

Specification: 0.75 in/s limit, regardless of ground frequency

Test #	Activity	Exact Seismograph Location	Distance (ft.)	Results
B-16	Set up	N40° 52.953' x W075° 33.134'	30'	0.025
	11:16 am	15' from water line, 30' from hole B-16		
	11:19 am stop	(measured)		
	Start Drill			0.025
	11:19 am			
	-11:38 drill down			
	hole			
	-12:22 pm start			
	drilling in bedrock			
	(rock core)			
	-2:29 pm			
	Stop			

Seis: BB9277

Range: 0-10 in/s

Downloaded by: Ryan Jubran
Printed by: Ryan Jubran

Field Technician: Ryan Jubran

Date: 1/6/16

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	11:16:20 January 6, 2016	**Serial Number**	BB9277 V 7.04-8.0 EVERLERT III
Histogram Finish Time	11:19:10 January 6, 2016	**Battery Level**	6.3 Volts
Number of Intervals	11 at 15 seconds	**Calibration**	November 23, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	K277G6OS.N81
Sample Rate	1024sps		

Notes
Location:
Client:
User Name: Vibra Tech Engineers
General:

Extended Notes

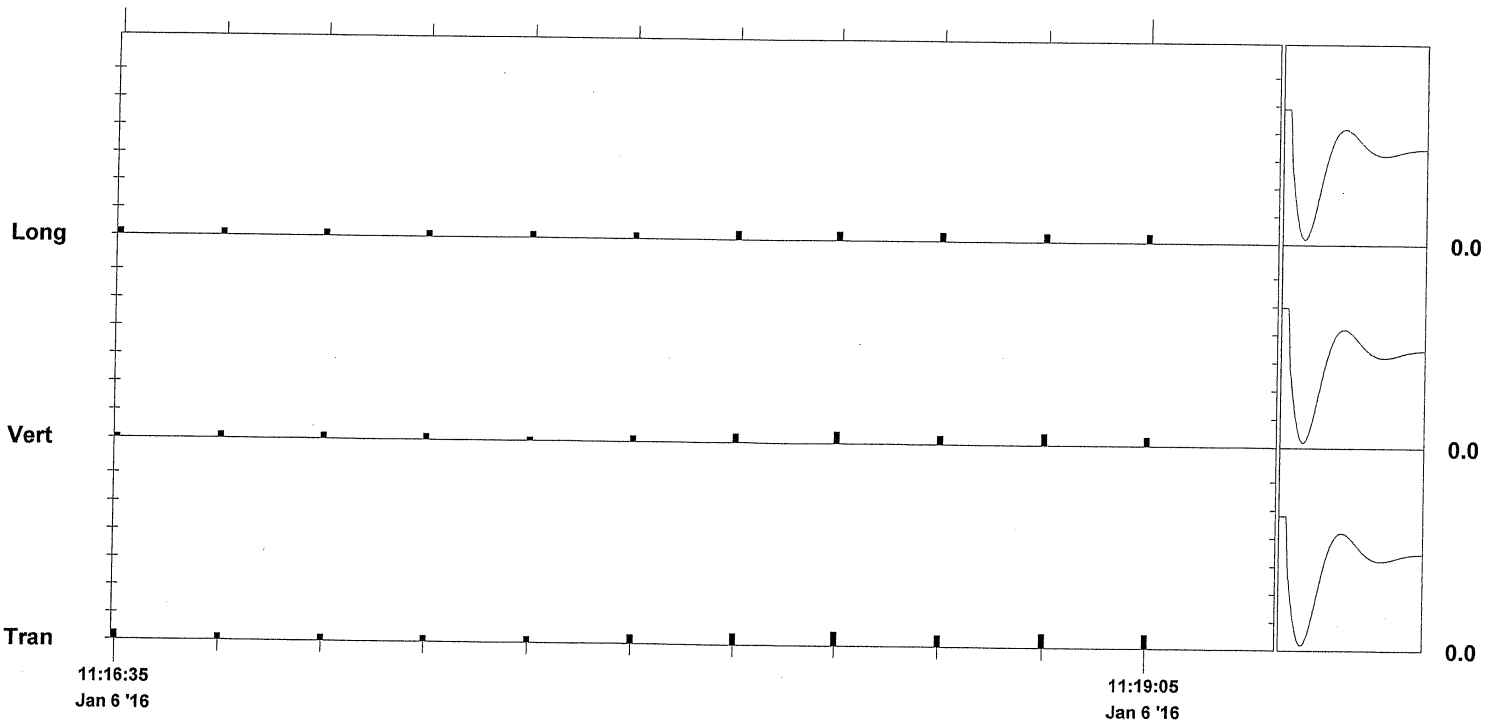
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0250	0.0200	0.0150	in/s
ZC Freq	>100	>100	>100	Hz
Date	Jan 6 '16	Jan 6 '16	Jan 6 '16	
Time	11:18:20	11:18:20	11:18:05	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.4	7.4	7.4	Hz
Overswing Ratio	4.0	4.0	4.2	

Peak Vector Sum 0.0287 in/s on January 6, 2016 at 11:18:50

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

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Event Report

Histogram Start Time	11:19:39 January 6, 2016	**Serial Number**	BB9277 V 7.04-8.0 EVERLERT III
Histogram Finish Time	14:29:18 January 6, 2016	**Battery Level**	6.3 Volts
Number of Intervals	758 at 15 seconds	**Calibration**	November 23, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	K277G6OS.SR1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name: Vibra Tech Engineers
General:

Extended Notes

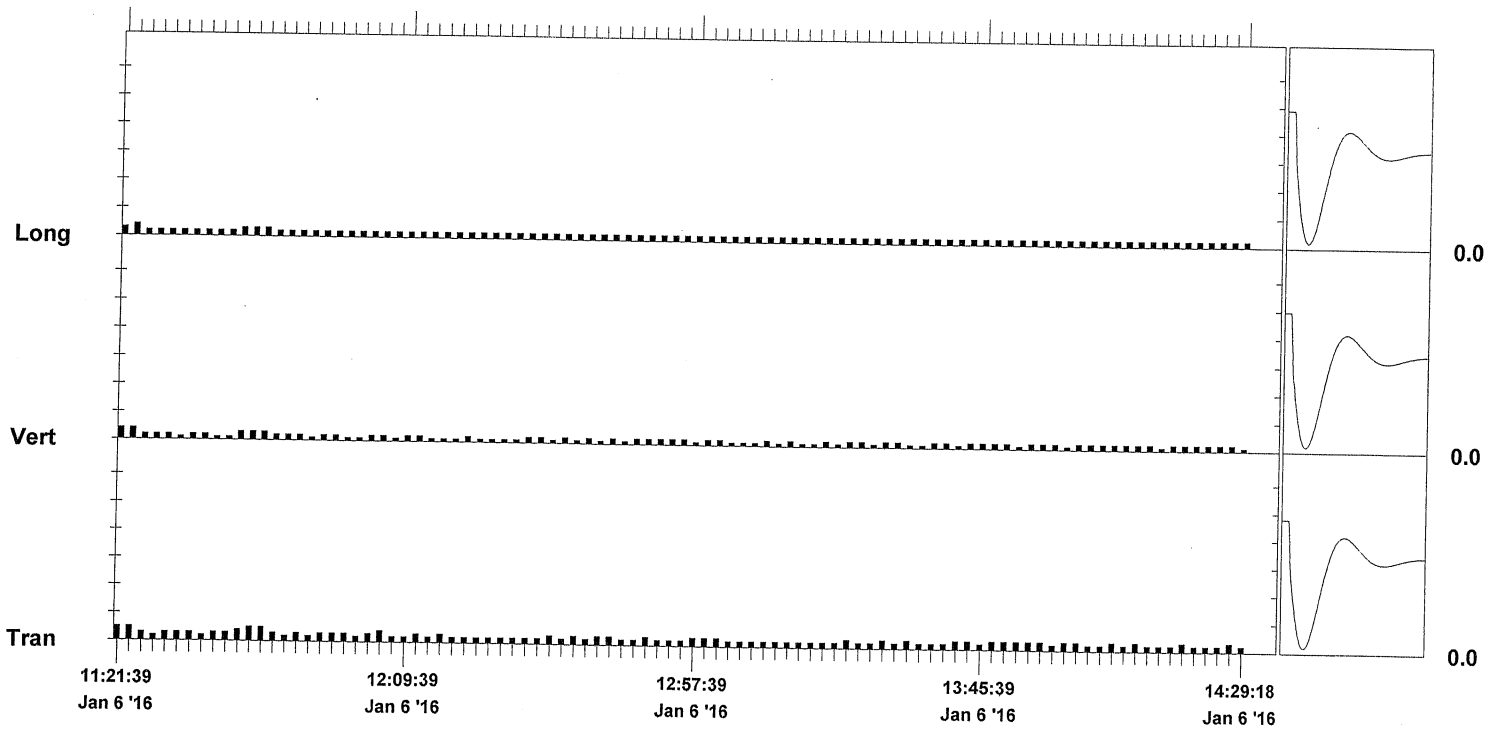
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0250	0.0200	0.0200	in/s
ZC Freq	>100	>100	>100	Hz
Date	Jan 6 '16	Jan 6 '16	Jan 6 '16	
Time	11:20:09	11:19:54	11:21:54	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.4	7.4	7.4	Hz
Overswing Ratio	4.0	4.0	4.2	

Peak Vector Sum 0.0308 in/s on January 6, 2016 at 11:22:39

N/A: Not Applicable



Time Scale: 2 minutes /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

Vibra-Tech

109 E. First Street
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Hazelton, PA 18201
570-455-5861 fax: 570-455-0626

VIBRATION MONITORING REPORT

Client: CRAIG TESTING LAB

Project: PENN EAST PIPELINE PROJECT HOLE # B-16

Vibration Source: CME 750X BORING MACHINE

Specification/Limit: 0.75 IN/SEC LIMIT

Caution Level: IN/SEC

Event No.	Activity	Pile No.*	Start	Stop	Work Location	Seismograph Location	Distance (ft)	Results ~~(cm/sec)~~
1	AMBIENT	—	8:05	8:31		ON GROUND SPIKED + WEIGHTED	30'	0.015
2	CORE BORING	—	8:32	10:15		15' FROM WATERLINE		0.015
3		—	11:18	11:33				0.010
4		—	12:24	4:47				0.015

*___Actual pile #s from pile plan
___Not actual pile #s; for tracking only.

X Measured distance
__Estimated distance

Seismograph: BB 9277

Range: 10.0 IN/SEC

Field Technician: MB

Date: 1-7-16

Downloaded by:
Printed by:

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The Vibration Monitoring Experts

Event Report

Histogram Start Time	08:05:52 January 7, 2016	**Serial Number**	BB9277 V 7.04-8.0 EVERLERT III
Histogram Finish Time	08:31:12 January 7, 2016	**Battery Level**	6.2 Volts
Number of Intervals	101 at 15 seconds	**Calibration**	November 23, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	K277G6QE.HS1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name: Vibra Tech Engineers
General:

Extended Notes

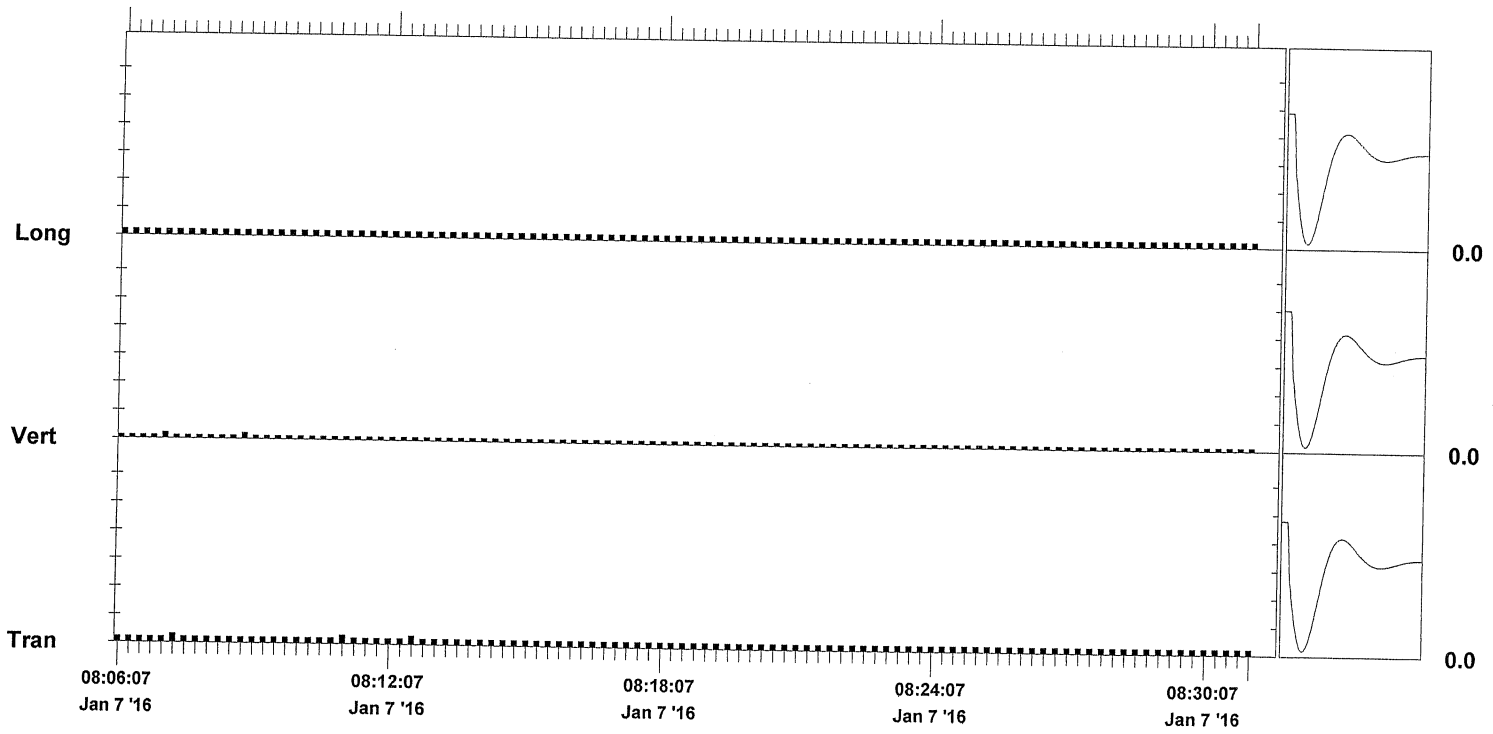
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0150	0.01000	0.01000	in/s
ZC Freq	47	>100	>100	Hz
Date	Jan 7 '16	Jan 7 '16	Jan 7 '16	
Time	08:07:22	08:07:07	08:06:07	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.4	7.3	7.5	Hz
Overswing Ratio	4.0	4.0	4.2	

Peak Vector Sum 0.0166 in/s on January 7, 2016 at 08:07:22

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div

Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	08:32:06 January 7, 2016	**Serial Number**	BB9277 V 7.04-8.0 EVERLERT III
Histogram Finish Time	10:16:39 January 7, 2016	**Battery Level**	6.2 Volts
Number of Intervals	418 at 15 seconds	**Calibration**	November 23, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	K277G6QF.PI1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name: Vibra Tech Engineers
General:

Extended Notes

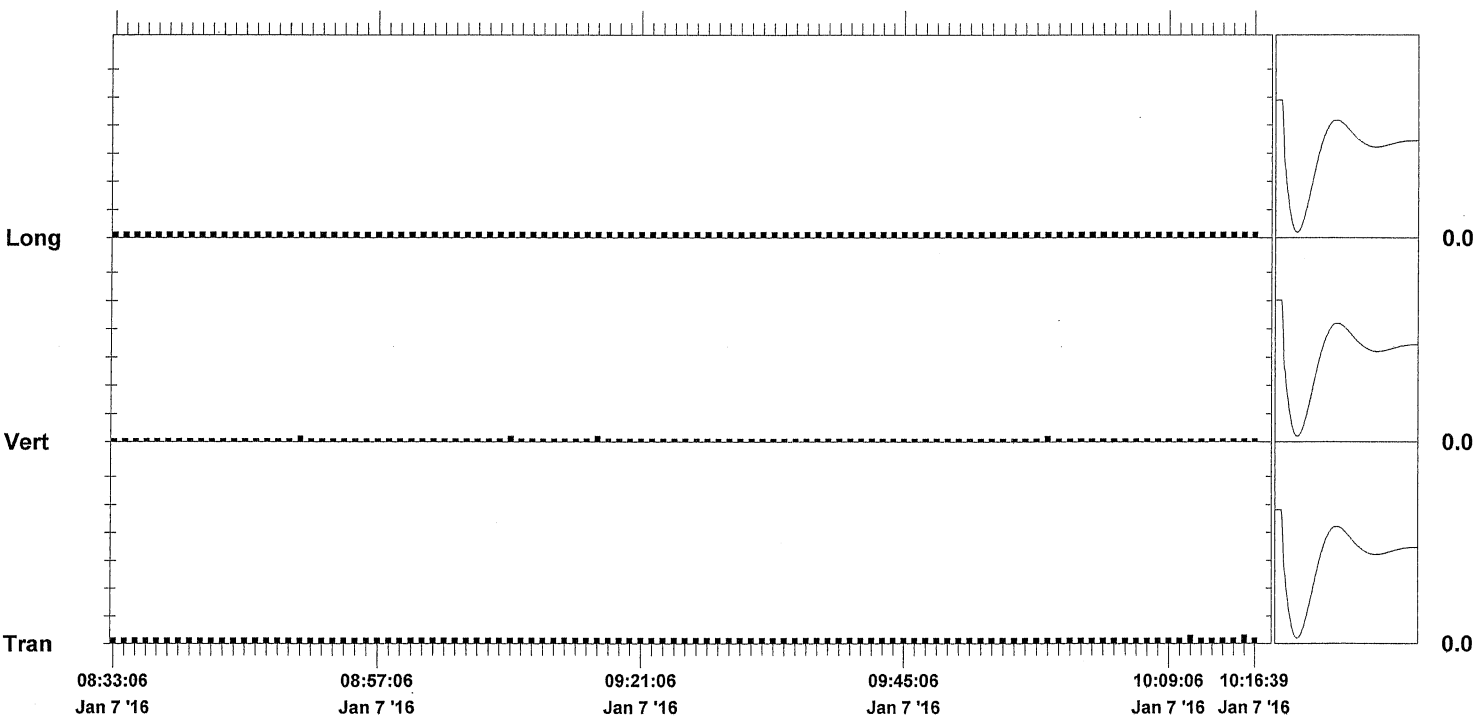
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0150	0.01000	0.01000	in/s
ZC Freq	>100	>100	>100	Hz
Date	Jan 7 '16	Jan 7 '16	Jan 7 '16	
Time	10:10:21	08:49:36	08:32:21	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.4	7.3	7.5	Hz
Overswing Ratio	4.0	4.1	4.2	

Peak Vector Sum 0.0158 in/s on January 7, 2016 at 10:10:21

N/A: Not Applicable



Time Scale: 1 minute /div **Amplitude Scale:** Geo: 0.0500 in/s/div Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	11:18:55 January 7, 2016	**Serial Number**	BB9277 V 7.04-8.0 EVERLERT III
Histogram Finish Time	11:33:34 January 7, 2016	**Battery Level**	6.3 Volts
Number of Intervals	58 at 15 seconds	**Calibration**	November 23, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	K277G6QN.FJ1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name: Vibra Tech Engineers
General:

Extended Notes

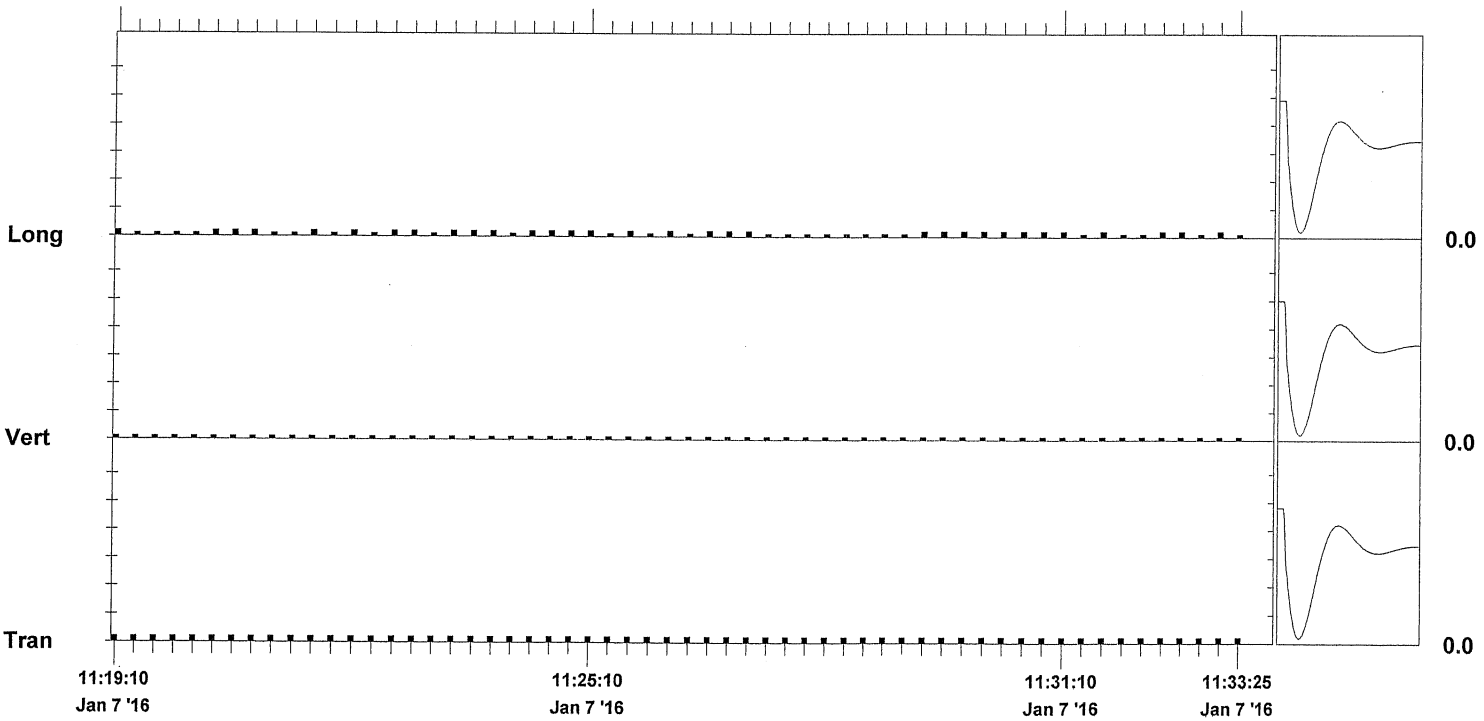
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.01000	0.00500	0.01000	in/s
ZC Freq	N/A	>100	>100	Hz
Date	Jan 7 '16	Jan 7 '16	Jan 7 '16	
Time	11:19:10	11:19:10	11:19:10	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.4	7.3	7.5	Hz
Overswing Ratio	4.0	4.0	4.2	

Peak Vector Sum 0.0122 in/s on January 7, 2016 at 11:19:10

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	12:25:09 January 7, 2016	**Serial Number**	BB9277 V 7.04-8.0 EVERLERT III
Histogram Finish Time	16:47:34 January 7, 2016	**Battery Level**	6.3 Volts
Number of Intervals	1049 at 15 seconds	**Calibration**	November 23, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	K277G6QQ.HX1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name: Vibra Tech Engineers
General:

Extended Notes

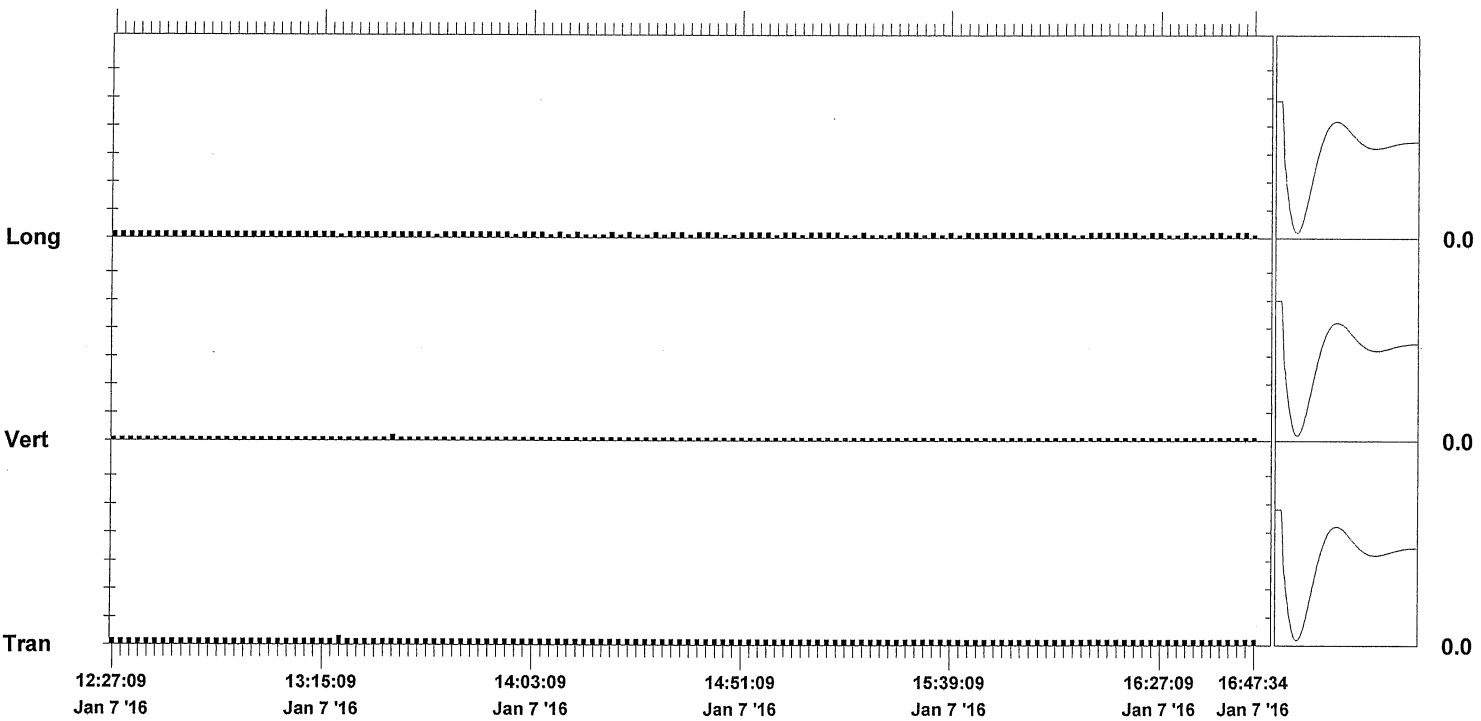
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0150	0.01000	0.01000	in/s
ZC Freq	>100	>100	>100	Hz
Date	Jan 7 '16	Jan 7 '16	Jan 7 '16	
Time	13:17:24	13:29:24	12:27:09	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.4	7.4	7.5	Hz
Overswing Ratio	4.0	4.0	4.2	

Peak Vector Sum 0.0158 in/s on January 7, 2016 at 13:17:24

N/A: Not Applicable



Time Scale: 2 minutes /div **Amplitude Scale:** Geo: 0.0500 in/s/div Dynamic Geo Cal.

Vibra-Tech

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VIBRATION MONITORING REPORT

Client: CRAIG TESTING LAB

Project: PENN EAST PIPELINE PROJ HOLE # B-16

Vibration Source: CME 750X BORING MACHINE

Specification/Limit: 0.75 IN/SEC LIMIT

Caution Level: IN/SEC

Event No.	Activity	Pile No.*	Start	Stop	Work Location	Seismograph Location	Distance (ft)	Results (cm/sec)
1	AMBIENT	—	8:00	8:10		ON GROUND SPIKED +	30	0.010
2	CORE BORING	—	8:11	10:29		WEIGHTED 15' FROM	"	0.015
3	"	—	10:44	12:04		WATER LINE	"	0.010

*___Actual pile #s from pile plan
___Not actual pile #s; for tracking only.

X Measured distance
__Estimated distance

Seismograph: BB 9277

Range: 10.0 IN/SEC

Field Technician: MB

Date: 1-8-16

Downloaded by:

Printed by:

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	07:59:36 January 8, 2016	**Serial Number**	BB9277 V 7.04-8.0 EVERLERT III
Histogram Finish Time	08:10:28 January 8, 2016	**Battery Level**	6.1 Volts
Number of Intervals	43 at 15 seconds	**Calibration**	November 23, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	K277G6S8.VC1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name: Vibra Tech Engineers
General:

Extended Notes
521 Yanak Street

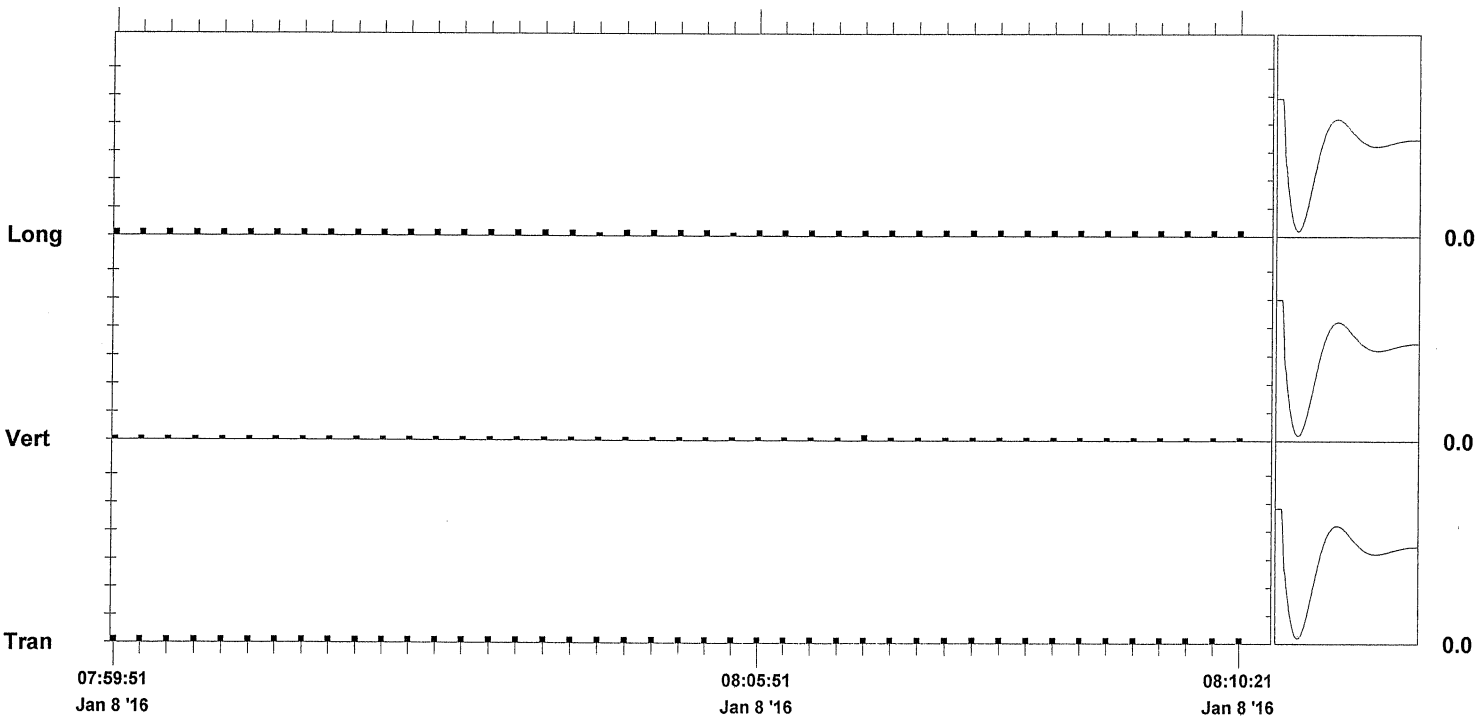
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.01000	0.01000	0.01000	in/s
ZC Freq	57	>100	>100	Hz
Date	Jan 8 '16	Jan 8 '16	Jan 8 '16	
Time	07:59:51	08:06:51	07:59:51	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.4	7.3	7.5	Hz
Overswing Ratio	4.0	4.0	4.1	

Peak Vector Sum 0.0150 in/s on January 8, 2016 at 08:03:21

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	08:11:16 January 8, 2016	**Serial Number**	BB9277 V 7.04-8.0 EVERLERT III
Histogram Finish Time	10:29:24 January 8, 2016	**Battery Level**	6.1 Volts
Number of Intervals	552 at 15 seconds	**Calibration**	November 23, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	K277G6S9.ES1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name: Vibra Tech Engineers
General:

Extended Notes

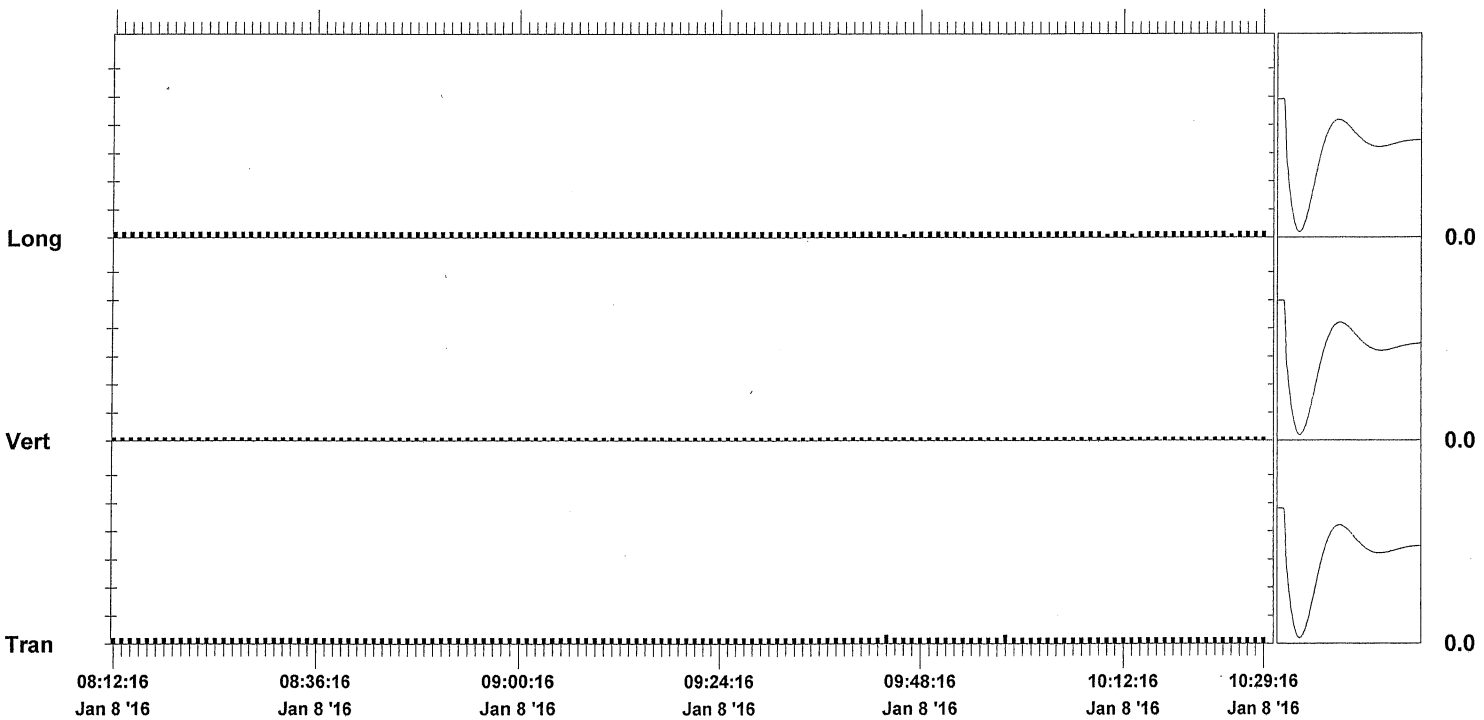
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.0150	0.00500	0.01000	in/s
ZC Freq	>100	>100	>100	Hz
Date	Jan 8 '16	Jan 8 '16	Jan 8 '16	
Time	09:43:31	08:11:31	08:11:46	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.4	7.3	7.5	Hz
Overswing Ratio	4.0	4.1	4.1	

Peak Vector Sum 0.0166 in/s on January 8, 2016 at 09:57:31

N/A: Not Applicable



Time Scale: 1 minute /div **Amplitude Scale:** Geo: 0.0500 in/s/div Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	10:44:50 January 8, 2016	**Serial Number**	BB9277 V 7.04-8.0 EVERLERT III
Histogram Finish Time	12:04:31 January 8, 2016	**Battery Level**	6.1 Volts
Number of Intervals	318 at 15 seconds	**Calibration**	November 23, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	K277G6SG.IQ1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name: Vibra Tech Engineers
General:

Extended Notes

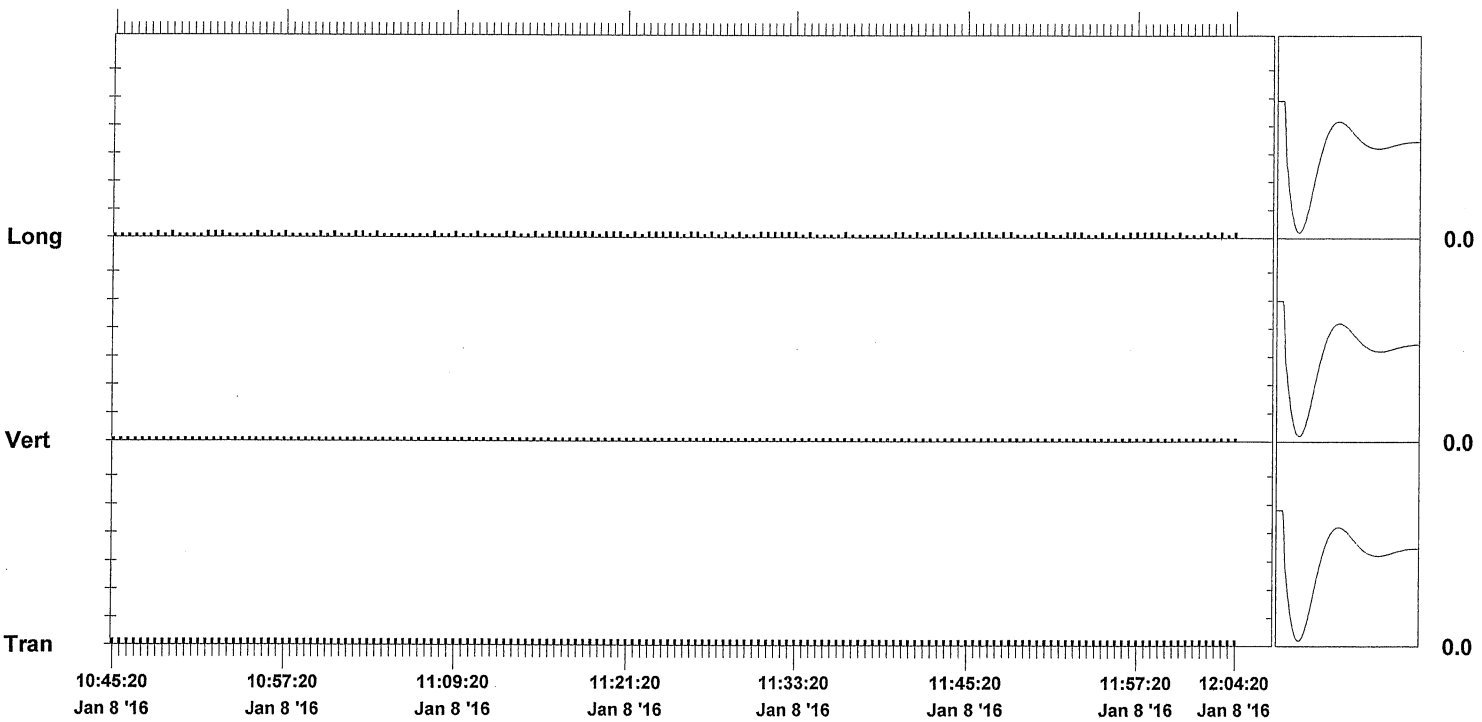
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.01000	0.00500	0.01000	in/s
ZC Freq	>100	>100	>100	Hz
Date	Jan 8 '16	Jan 8 '16	Jan 8 '16	
Time	10:45:05	10:45:05	10:48:05	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.4	7.3	7.5	Hz
Overswing Ratio	4.0	4.1	4.2	

Peak Vector Sum 0.0122 in/s on January 8, 2016 at 10:45:05

N/A: Not Applicable



Time Scale: 30 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div Dynamic Geo Cal.

Vibra-Tech

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VIBRATION MONITORING REPORT

Client: CRAIG TESTING LAB

Project: PENN EAST PIPELINE PROJ HOLE # B-16

Vibration Source: CME 750 X BORING MACHINE

Specification/Limit: 0.75 IN/SEC LIMIT

Caution Level:

Event No.	Activity	Pile No.*	Start	Stop	Work Location	Seismograph Location	Distance (ft)	Results (cm/sec)
1	CORE BORING	—	1:20	1:48		ON GROUND SPIKED +	30	0.010
2	"	—	1:58	2:24		WEIGHTED 15' FROM WATER	"	0.010
3	"	—	2:41	3:00		LINE	"	0.010

*___Actual pile #s from pile plan
___Not actual pile #s; for tracking only.

___Measured distance
___Estimated distance

Seismograph: BB 9277

Range: 10.0 IN/SEC

Field Technician: MB

Date: 1-11-16

Downloaded by:
Printed by:

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	13:20:44 January 11, 2016	**Serial Number**	BB9277 V 7.04-8.0 EVERLERT III
Histogram Finish Time	13:48:48 January 11, 2016	**Battery Level**	6.0 Volts
Number of Intervals	112 at 15 seconds	**Calibration**	November 23, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	K277G6Y7.QK1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name: Vibra Tech Engineers
General:

Extended Notes

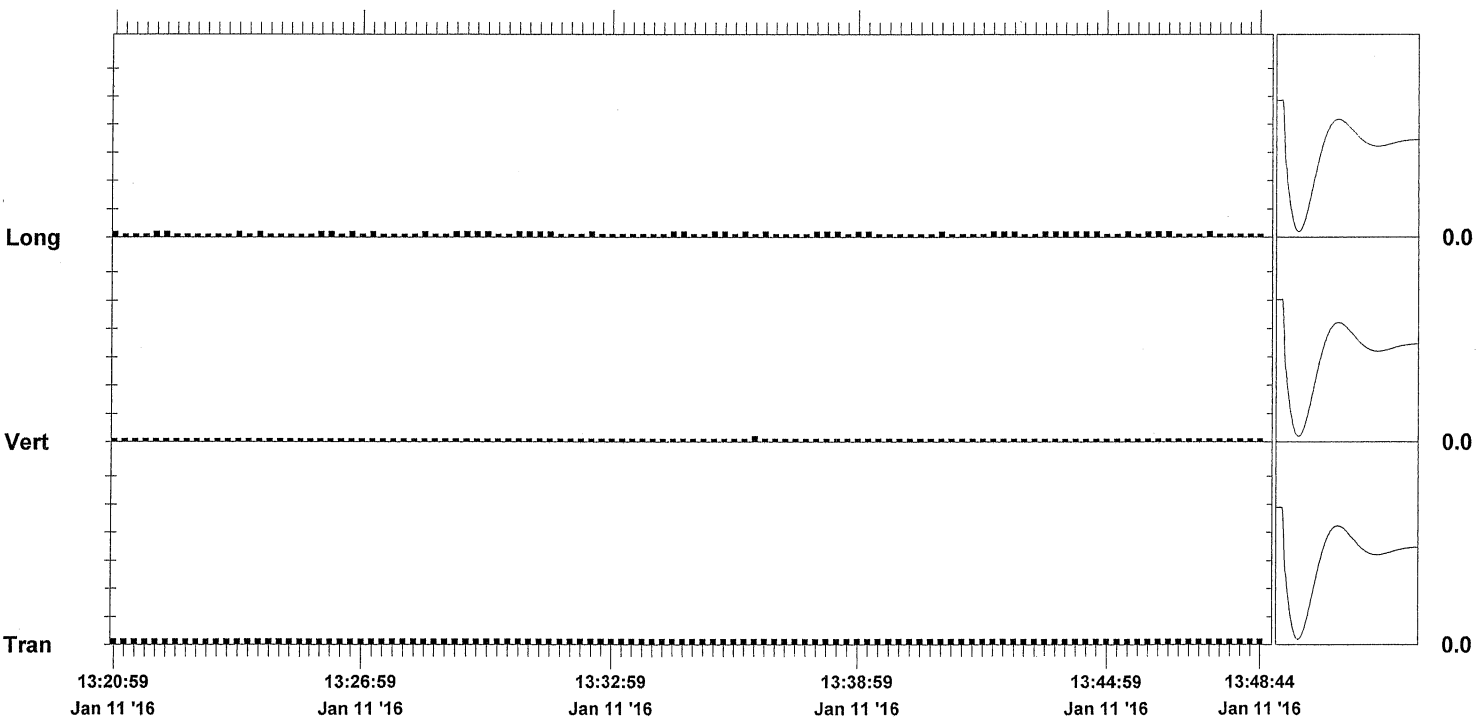
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.01000	0.01000	0.01000	in/s
ZC Freq	>100	>100	>100	Hz
Date	Jan 11 '16	Jan 11 '16	Jan 11 '16	
Time	13:20:59	13:36:29	13:20:59	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.5	7.4	7.4	Hz
Overswing Ratio	3.9	4.0	4.2	

Peak Vector Sum 0.0122 in/s on January 11, 2016 at 13:20:59

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	13:58:36 January 11, 2016	**Serial Number**	BB9277 V 7.04-8.0 EVERLERT III
Histogram Finish Time	14:24:00 January 11, 2016	**Battery Level**	6.1 Volts
Number of Intervals	101 at 15 seconds	**Calibration**	November 23, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	K277G6Y9.HO1
Sample Rate	1024sps		

Notes
Location:
Client:
User Name: Vibra Tech Engineers
General:

Extended Notes

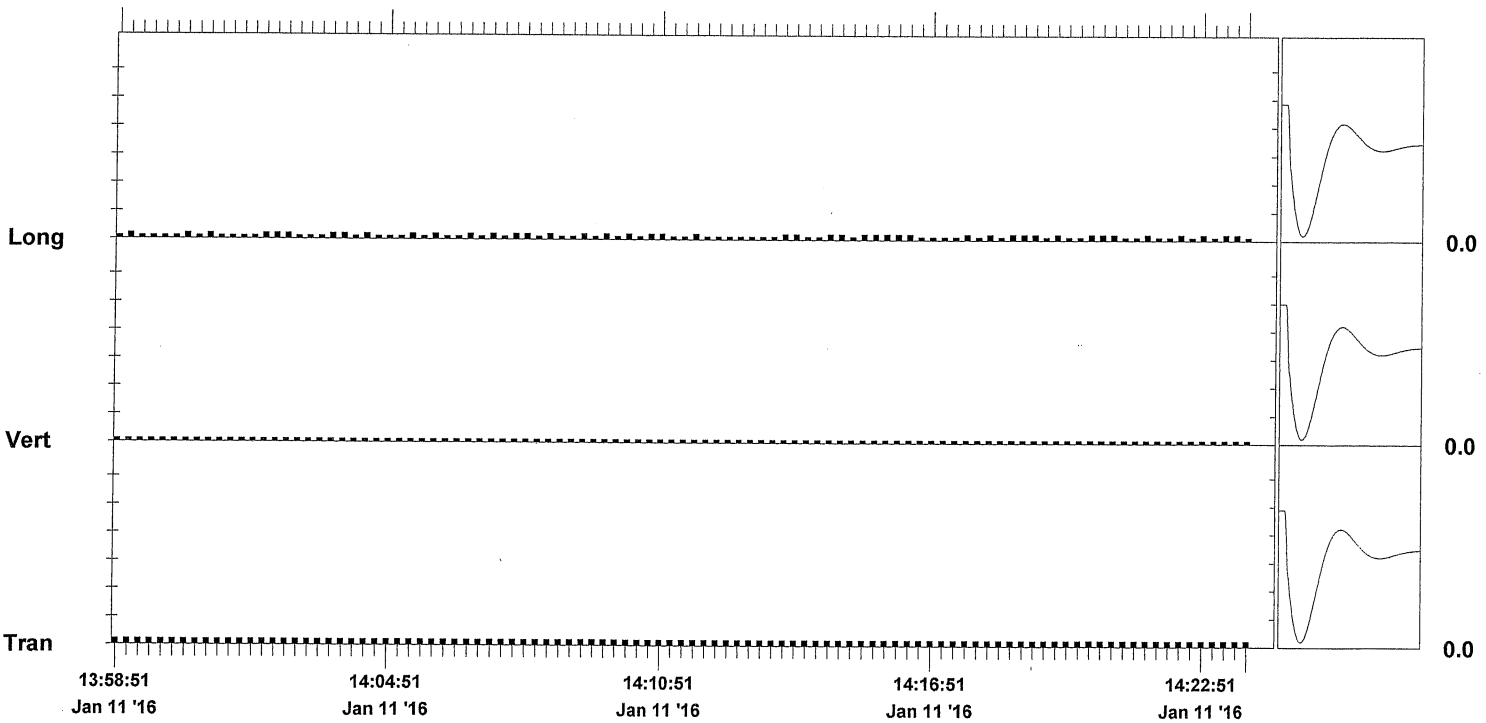
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.01000	0.00500	0.01000	in/s
ZC Freq	>100	>100	>100	Hz
Date	Jan 11 '16	Jan 11 '16	Jan 11 '16	
Time	13:58:51	13:58:51	13:59:06	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.5	7.4	7.4	Hz
Overswing Ratio	3.9	4.0	4.2	

Peak Vector Sum 0.0122 in/s on January 11, 2016 at 13:58:51

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div Dynamic Geo Cal.

VIBRA-TECH
The Vibration Monitoring Experts

Event Report

Histogram Start Time	14:40:55 January 11, 2016	**Serial Number**	BB9277 V 7.04-8.0 EVERLERT III
Histogram Finish Time	15:00:08 January 11, 2016	**Battery Level**	6.2 Volts
Number of Intervals	76 at 15 seconds	**Calibration**	November 23, 2015 by Vibra-Tech Inc.
Range	Geo :10.00 in/s	**File Name**	K277G6YB.G71
Sample Rate	1024sps		

Notes
Location:
Client:
User Name: Vibra Tech Engineers
General:

Extended Notes

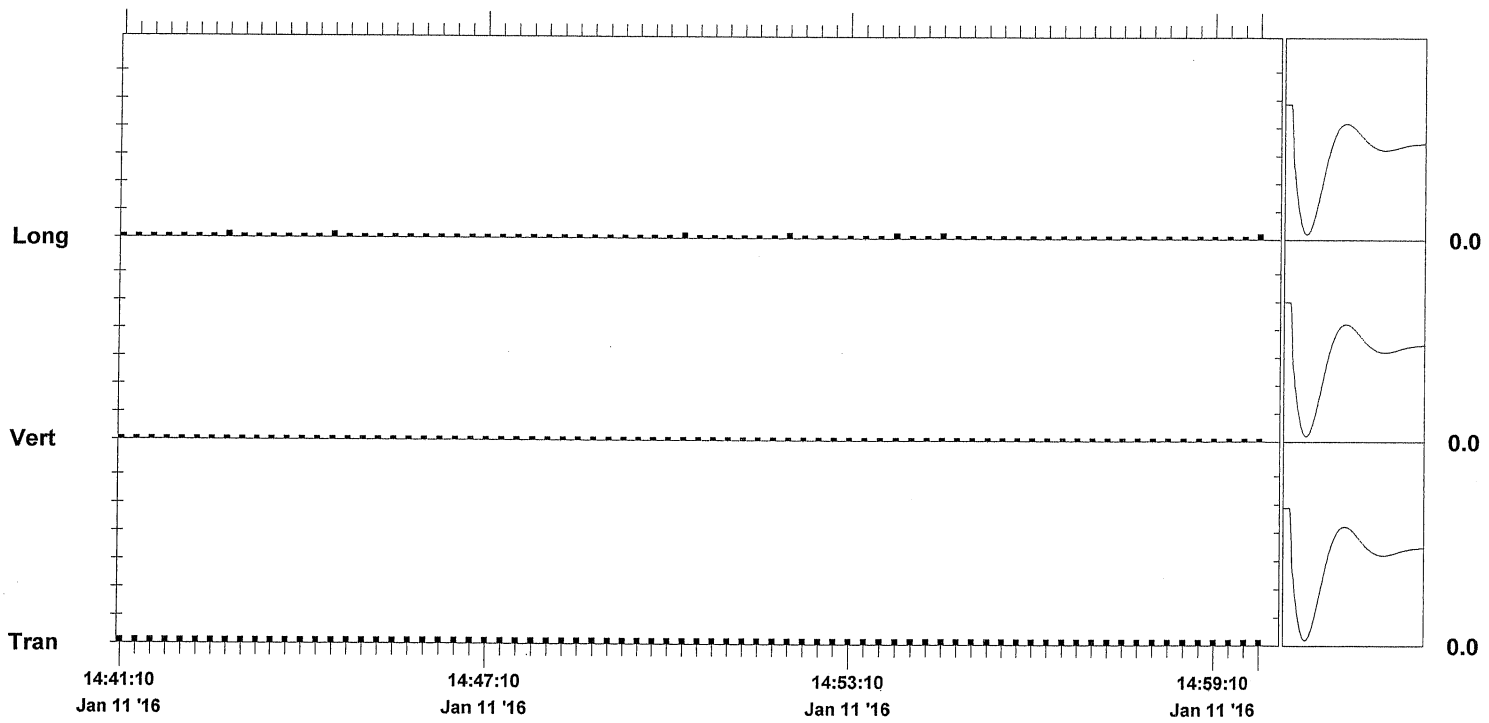
Post Event Notes

Microphone	Disabled
PSPL	N/A
ZC Freq	N/A
Channel Test	N/A

	Tran	Vert	Long	
PPV	0.01000	0.00500	0.01000	in/s
ZC Freq	>100	>100	>100	Hz
Date	Jan 11 '16	Jan 11 '16	Jan 11 '16	
Time	14:41:10	14:41:10	14:42:55	
Dynamic Geo Cal.	Passed	Passed	Passed	
Frequency	7.5	7.4	7.4	Hz
Overswing Ratio	3.9	4.0	4.2	

Peak Vector Sum 0.0122 in/s on January 11, 2016 at 14:41:10

N/A: Not Applicable



Time Scale: 15 seconds /div **Amplitude Scale:** Geo: 0.0500 in/s/div Dynamic Geo Cal.

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