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REFERENCE: B-4943

PROJECT: 40110

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**STATE OF NORTH CAROLINA**  
**DEPARTMENT OF TRANSPORTATION**  
**DIVISION OF HIGHWAYS**  
**GEOTECHNICAL ENGINEERING UNIT**

**STRUCTURE**  
**SUBSURFACE INVESTIGATION**

COUNTY DURHAM  
 PROJECT DESCRIPTION BRIDGE NO. 20 ON SR 1616  
OVER DIAL CREEK

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B-4943	1	12

**CAUTION NOTICE**

THE SUBSURFACE INFORMATION AND THE SUBSURFACE INVESTIGATION ON WHICH IT IS BASED WERE MADE FOR THE PURPOSE OF STUDY, PLANNING AND DESIGN, AND NOT FOR CONSTRUCTION OR PAY PURPOSES. THE VARIOUS FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA AVAILABLE MAY BE REVIEWED OR INSPECTED IN RALEIGH BY CONTACTING THE N. C. DEPARTMENT OF TRANSPORTATION, GEOTECHNICAL ENGINEERING UNIT AT 1919 TOT-6850. THE SUBSURFACE PLANS AND REPORTS, FIELD BORING LOGS, ROCK CORES AND SOIL TEST DATA ARE NOT PART OF THE CONTRACT.

GENERAL SOIL AND ROCK STRATA DESCRIPTIONS AND INDICATED BOUNDARIES ARE BASED ON A GEOTECHNICAL INTERPRETATION OF ALL AVAILABLE SUBSURFACE DATA AND MAY NOT NECESSARILY REFLECT THE ACTUAL SUBSURFACE CONDITIONS BETWEEN BORINGS OR BETWEEN SAMPLED STRATA WITHIN THE BOREHOLE. THE LABORATORY SAMPLE DATA AND THE IN SITU (IN-PLACE) TEST DATA CAN BE RELIED ON ONLY TO THE DEGREE OF RELIABILITY INHERENT IN THE STANDARD TEST METHOD. THE OBSERVED WATER LEVELS OR SOIL MOISTURE CONDITIONS INDICATED IN THE SUBSURFACE INVESTIGATIONS ARE AS RECORDED AT THE TIME OF THE INVESTIGATION. THESE WATER LEVELS OR SOIL MOISTURE CONDITIONS MAY VARY CONSIDERABLY WITH TIME ACCORDING TO CLIMATIC CONDITIONS INCLUDING TEMPERATURES, PRECIPITATION AND WIND, AS WELL AS OTHER NON-CLIMATIC FACTORS.

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- NOTES:
1. THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS ACCURATE NOR IS IT CONSIDERED PART OF THE PLANS, SPECIFICATIONS OR CONTRACT FOR THE PROJECT.
  2. BY HAVING REQUESTED THIS INFORMATION, THE CONTRACTOR SPECIFICALLY WAIVES ANY CLAIMS FOR INCREASED COMPENSATION OR EXTENSION OF TIME BASED ON DIFFERENCES BETWEEN THE CONDITIONS INDICATED HEREIN AND THE ACTUAL CONDITIONS AT THE PROJECT SITE.

PERSONNEL

J.R. SWARTLEY

O.B. OTI

D.G. PINTER

R.E. SMITH

J.M. EDMONSON

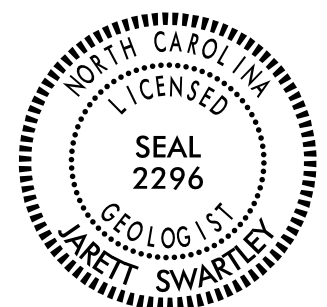
INVESTIGATED BY J.R. SWARTLEY

DRAWN BY J.R. SWARTLEY

CHECKED BY N.T. ROBERSON

SUBMITTED BY N.T. ROBERSON

DATE OCTOBER 2016



DocuSigned by:  
Jarett Swartley 11/22/2016

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 SIGNATURE DATE

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NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT
SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

Table with 4 main columns: SOIL DESCRIPTION, GRADATION, ROCK DESCRIPTION, and TERMS AND DEFINITIONS. Includes sub-sections like SOIL LEGEND AND AASHTO CLASSIFICATION, CONSISTENCY OR DENSENESS, TEXTURE OR GRAIN SIZE, SOIL MOISTURE - CORRELATION OF TERMS, PLASTICITY, COLOR, MISCELLANEOUS SYMBOLS, RECOMMENDATION SYMBOLS, ABBREVIATIONS, EQUIPMENT USED ON SUBJECT PROJECT, FRACTURE SPACING, BEDDING, and INDURATION.

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION  
DIVISION OF HIGHWAYS  
GEOTECHNICAL ENGINEERING UNIT

**SUBSURFACE INVESTIGATION**

SUPPLEMENTAL LEGEND, GEOLOGICAL STRENGTH INDEX (GSI) TABLES  
FROM AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS

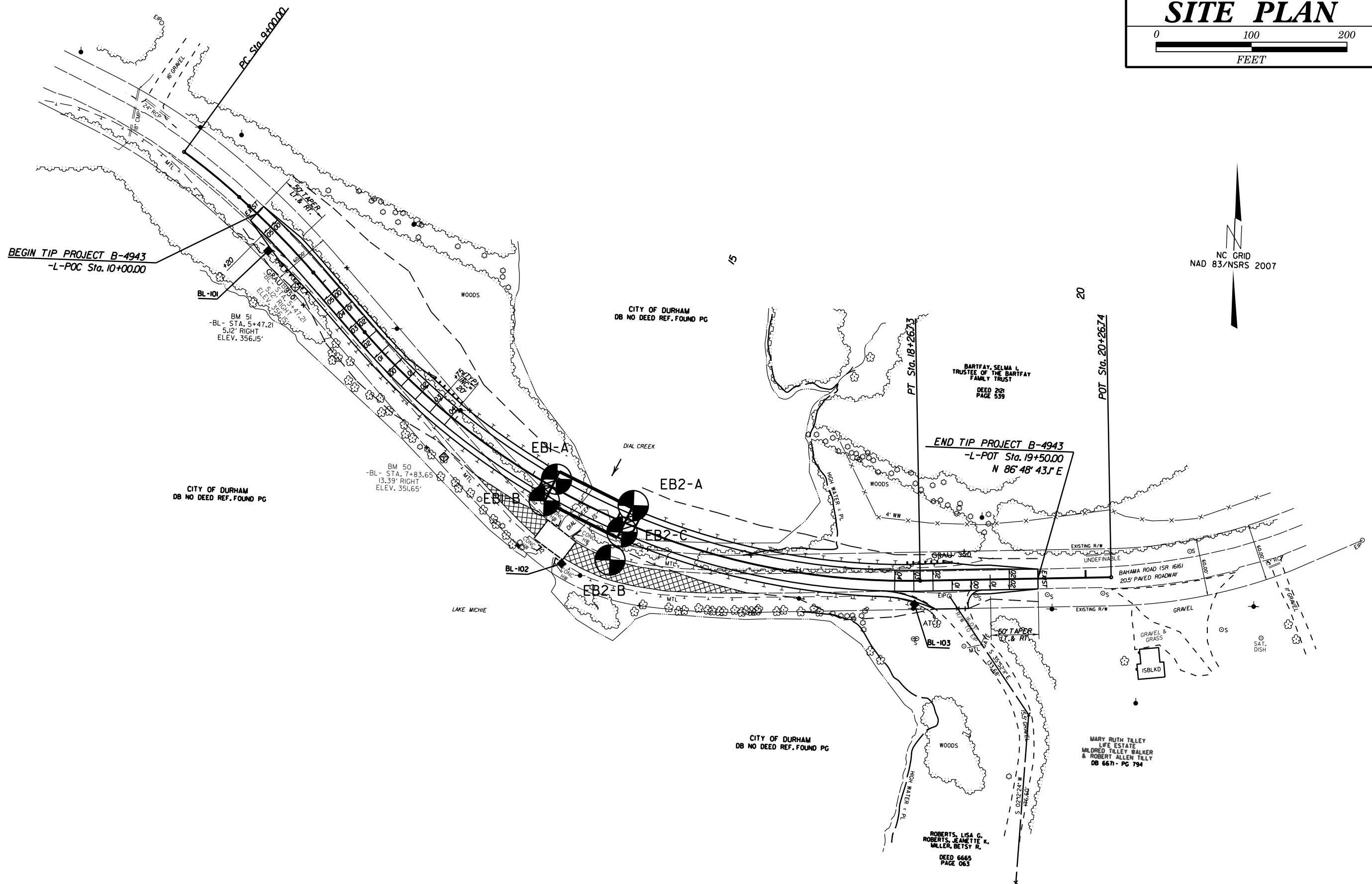
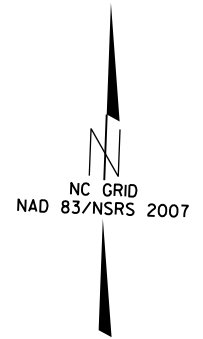
AASHTO LRFD Figure 10.4.6.4-1 — Determination of GSI for Jointed Rock Mass (Marinos and Hoek, 2000)

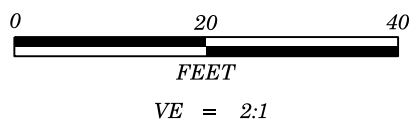
AASHTO LRFD Figure 10.4.6.4-2 — Determination of GSI for Tectonically Deformed Heterogeneous Rock Masses (Marinos and Hoek, 2000)

GEOLOGICAL STRENGTH INDEX (GSI) FOR JOINTED ROCKS (Hoek and Marinos, 2000)		SURFACE CONDITIONS					GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos, P and Hoek E., 2000)		SURFACE CONDITIONS OF DISCONTINUITIES (Predominantly bedding planes)				
From the lithology, structure and surface conditions of the discontinuities, estimate the average value of GSI. Do not try to be too precise. Quoting a range from 33 to 37 is more realistic than stating that GSI = 35. Note that the table does not apply to structurally controlled failures. Where weak planar structural planes are present in an unfavorable orientation with respect to the excavation face, these will dominate the rock mass behaviour. The shear strength of surfaces in rocks that are prone to deterioration as a result of changes in moisture content will be reduced if water is present. When working with rocks in the fair to very poor categories, a shift to the right may be made for wet conditions. Water pressure is dealt with by effective stress analysis.		VERY GOOD Very rough, fresh unweathered surfaces	GOOD Rough, slightly weathered, iron stained surfaces	FAIR Smooth, moderately weathered and altered surfaces	POOR Slickensided, highly weathered surfaces with compact coatings or fillings or angular fragments	VERY POOR Slickensided, highly weathered surfaces with soft clay coatings or fillings	From a description of the lithology, structure and surface conditions (particularly of the bedding planes), choose a box in the chart. Locate the position in the box that corresponds to the condition of the discontinuities and estimate the average value of GSI from the contours. Do not attempt to be too precise. Quoting a range from 33 to 37 is more realistic than giving GSI = 35. Note that the Hoek-Brown criterion does not apply to structurally controlled failures. Where unfavourably oriented continuous weak planar discontinuities are present, these will dominate the behaviour of the rock mass. The strength of some rock masses is reduced by the presence of groundwater and this can be allowed for by a slight shift to the right in the columns for fair, poor and very poor conditions. Water pressure does not change the value of GSI and it is dealt with by using effective stress analysis.		VERY GOOD - Very Rough, fresh unweathered surfaces	GOOD - Rough, slightly weathered surfaces	FAIR - Smooth, moderately weathered and altered surfaces	POOR - Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments	VERY POOR - Very smooth, slickensided or highly weathered surfaces with soft clay coatings or fillings
STRUCTURE		DECREASING SURFACE QUALITY →					COMPOSITION AND STRUCTURE						
INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities		90			N/A	N/A	<b>A. Thick bedded, very blocky sandstone</b> The effect of pelitic coatings on the bedding planes is minimized by the confinement of the rock mass. In shallow tunnels or slopes these bedding planes may cause structurally controlled instability.	70					
BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets		80					<b>B. Sandstone with thin inter-layers of siltstone</b>	60					
VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets			70				<b>C. Sandstone and siltstone in similar amounts</b>		50				
BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity			60				<b>D. Siltstone or silty shale with sandstone layers</b>			40			
DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces				50			<b>E. Weak siltstone or clayey shale with sandstone layers</b>				30		
LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes					40		<b>F. Tectonically deformed, intensively folded/faulted, sheared clayey shale or siltstone with broken and deformed sandstone layers forming an almost chaotic structure</b>					20	
					30		<b>G. Undisturbed silty or clayey shale with or without a few very thin sandstone layers</b>						10
					20		<b>H. Tectonically deformed silty or clayey shale forming a chaotic structure with pockets of clay. Thin layers of sandstone are transformed into small rock pieces.</b>						
					10								
		N/A	N/A										

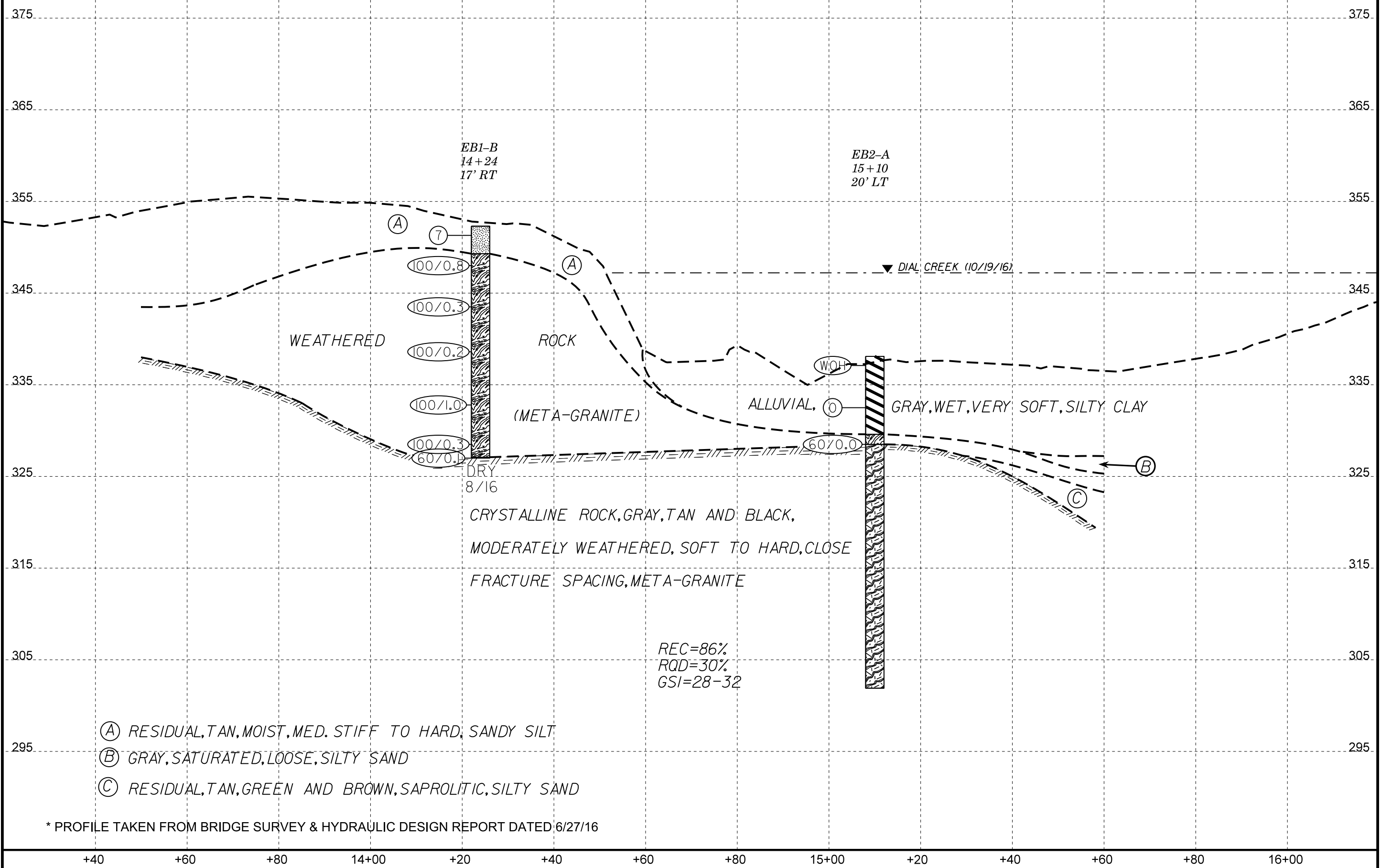
→ Means deformation after tectonic disturbance

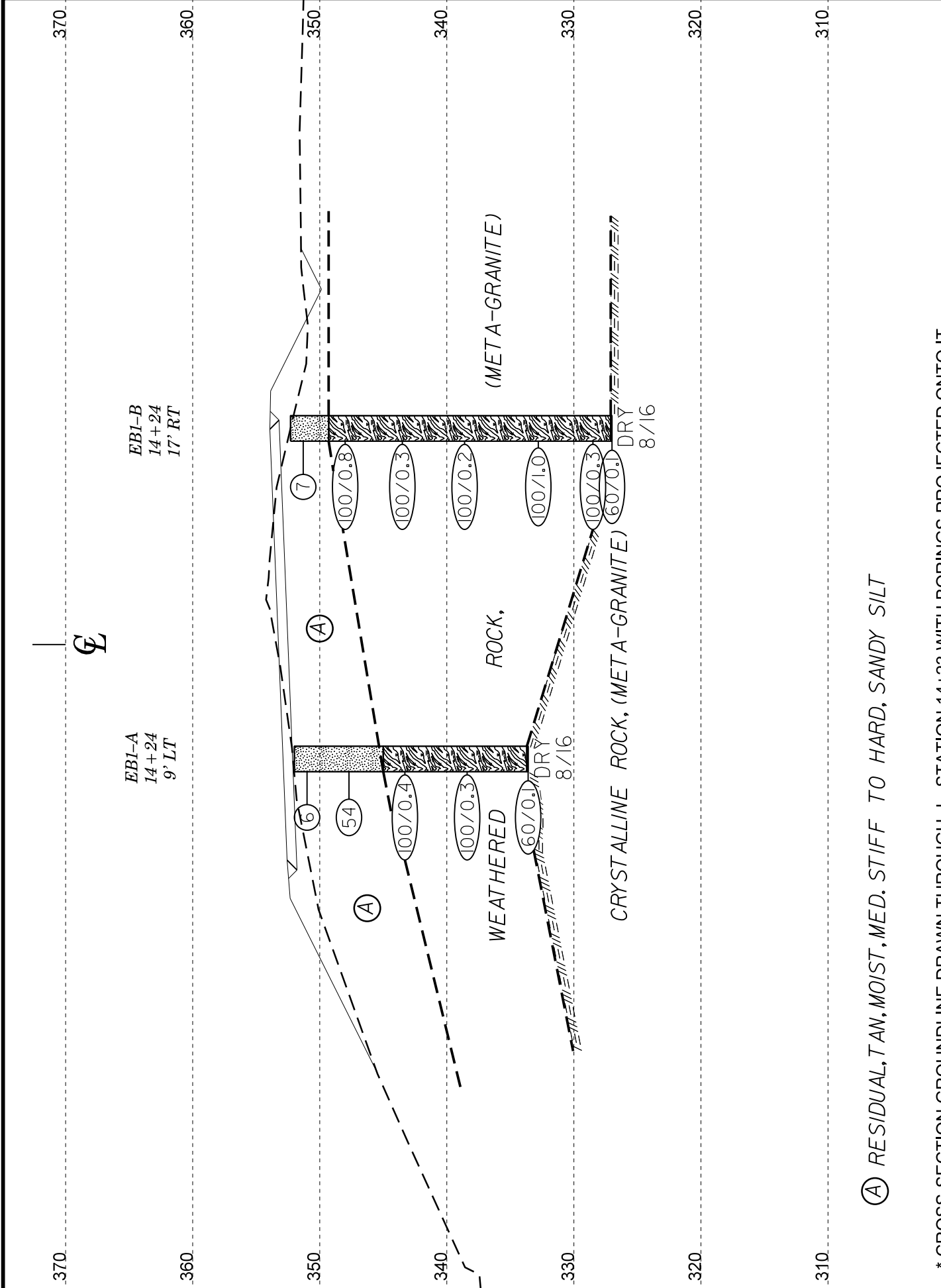
# SITE PLAN





<b>PROJECT REFERENCE NO.</b>	<b>SHEET NO.</b>
B-4943	4
<b>BORINGS PROJECTED ALONG -L- PROFILE</b>	



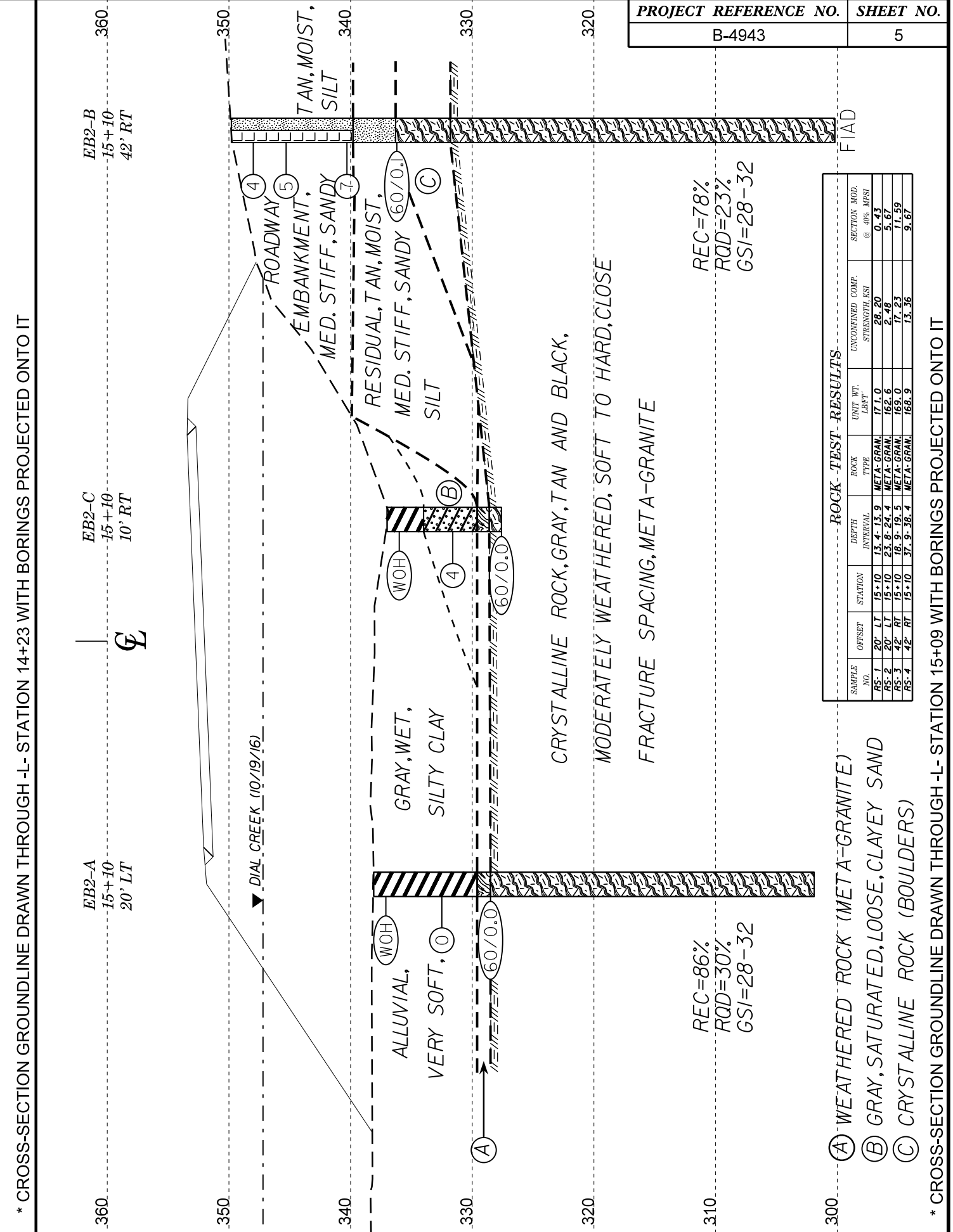


HORIZ. SCALE 0 10 20 (FEET)

VE = 1:1

**CROSS SECTION THROUGH EBI**

Ⓐ RESIDUAL, TAN, MOIST, MED. STIFF TO HARD, SANDY SILT



HORIZ. SCALE 0 10 20 (FEET)

VE = 1:1

**CROSS SECTION THROUGH EB2**

REC=78%  
RQD=23%  
GSI=28-32

REC=86%  
RQD=30%  
GSI=28-32

**ROCK-TEST-RESULTS**

SAMPLE NO.	OFFSET	STATION	DEPTH INTERVAL	ROCK TYPE	UNIT WT. LB/FT	UNCONFINED COMP. STRENGTH KSI	SECTION MOD. @ 40% MPSI
RS-1	20' LT	15+10	13'-4" - 13'-9"	META-GRAN	171.0	28.20	0.43
RS-2	20' LT	15+10	23'-8" - 24'-4"	META-GRAN	166.0	27.40	5.67
RS-3	42' RT	15+10	18'-9" - 19'-5"	META-GRAN	166.0	17.23	11.59
RS-4	42' RT	15+10	37'-9" - 38'-4"	META-GRAN	168.9	13.36	9.67

- Ⓐ WEATHERED ROCK (META-GRANITE)
- Ⓑ GRAY, SATURATED, LOOSE, CLAYEY SAND
- Ⓒ CRYSTALLINE ROCK (BOULDERS)

\* CROSS-SECTION GROUNDLINE DRAWN THROUGH -L- STATION 15+09 WITH BORINGS PROJECTED ONTO IT

# GEOTECHNICAL BORING REPORT

## BORE LOG

WBS 40110.1.1		TIP B-4943		COUNTY DURHAM		GEOLOGIST Swartley, J. R.										
SITE DESCRIPTION BRIDGE NO. 20 ON SR 1616 OVER DIAL CREEK							GROUND WTR (ft)									
BORING NO. EB1-A		STATION 14+24		OFFSET 9 ft LT		ALIGNMENT -L-										
COLLAR ELEV. 352.0 ft		TOTAL DEPTH 18.4 ft		NORTHING 881,858		EASTING 2,041,782										
DRILL RIG/HAMMER EFF./DATE RFO0074 CME-55 89% 02/09/2015			DRILL METHOD H.S. Augers		HAMMER TYPE Automatic											
DRILLER Pinter, D. G.		START DATE 08/31/16		COMP. DATE 08/31/16		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
355																
	352.0	0.0	2	3	3									352.0	GROUND SURFACE	0.0
350	348.7	3.3	7	14	40										RESIDUAL TAN, SANDY SILT	
	343.7	8.3	100/0.4											345.0	WEATHERED ROCK (META-GRANITE)	7.0
340	338.7	13.3	100/0.3													
335	333.7	18.3	60/0.1											333.7	CRYSTALLINE ROCK (META-GRANITE)	18.3
														333.6		18.4
Boring Terminated WITH STANDARD PENETRATION TEST REFUSAL at Elevation 333.6 ft IN CRYSTALLINE ROCK																

WBS 40110.1.1		TIP B-4943		COUNTY DURHAM		GEOLOGIST Swartley, J. R.										
SITE DESCRIPTION BRIDGE NO. 20 ON SR 1616 OVER DIAL CREEK							GROUND WTR (ft)									
BORING NO. EB1-B		STATION 14+24		OFFSET 17 ft RT		ALIGNMENT -L-										
COLLAR ELEV. 352.3 ft		TOTAL DEPTH 25.3 ft		NORTHING 881,835		EASTING 2,041,770										
DRILL RIG/HAMMER EFF./DATE RFO0074 CME-55 89% 02/09/2015			DRILL METHOD H.S. Augers		HAMMER TYPE Automatic											
DRILLER Pinter, D. G.		START DATE 08/31/16		COMP. DATE 08/31/16		SURFACE WATER DEPTH N/A										
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	DEPTH (ft)		
			0.5ft	0.5ft	0.5ft	0	25	50	75	100						
355																
	352.3	0.0	2	4	3									352.3	GROUND SURFACE	0.0
350	348.8	3.5	55	45/0.3										349.3	RESIDUAL TAN, SANDY SILT	3.0
	343.8	8.5	100/0.3												WEATHERED ROCK (META-GRANITE)	
340	338.8	13.5	100/0.2													
335	333.8	18.5	36	64/0.5												
330	328.8	23.5	100/0.3													
	327.1	25.2	60/0.1											327.1	CRYSTALLINE ROCK (META-GRANITE)	25.2
														327.0		25.3
Boring Terminated WITH STANDARD PENETRATION TEST REFUSAL at Elevation 327.0 ft IN CRYSTALLINE ROCK																

NCDOT BORE DOUBLE B4943\_GEO\_BRDG0020\_SPT\_BORINGS.GPJ\_NC\_DOT.GDT 11/11/16



# GEOTECHNICAL BORING REPORT

## BORE LOG

# GEOTECHNICAL BORING REPORT

## CORE LOG

WBS 40110.1.1		TIP B-4943		COUNTY DURHAM		GEOLOGIST Swartley, J. R.								
SITE DESCRIPTION BRIDGE NO. 20 ON SR 1616 OVER DIAL CREEK							GROUND WTR (ft)							
BORING NO. EB2-A		STATION 15+10		OFFSET 20 ft LT		ALIGNMENT -L-								
COLLAR ELEV. 338.1 ft		TOTAL DEPTH 36.2 ft		NORTHING 881,834		EASTING 2,041,863								
DRILL RIG/HAMMER EFF./DATE HFO0065 CME-45C 85% 05/20/2016		DRILL METHOD NW Casing W/SPT & Core		HAMMER TYPE Automatic										
DRILLER Pinter, D. G.		START DATE 10/19/16		COMP. DATE 10/20/16		SURFACE WATER DEPTH 9.1ft								
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	DEPTH (ft)
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				
340	338.1	0.0	WOH	WOH	WOH							W	GROUND SURFACE	0.0
335	333.5	4.6										W	ALLUVIAL GRAY, SILTY CLAY	
330	328.5	9.6	1	0	0								WEATHERED ROCK (META-GRANITE)	8.5
325												RS-1	CRYSTALLINE ROCK GRAY, TAN AND BLACK, MODERATELY WEATHERED, SOFT TO HARD, CLOSE FRACTURE SPACING, META-GRANITE	9.6
320														
315												RS-2		
310														
305														
														Boring Terminated at Elevation 301.9 ft IN CRYSTALLINE ROCK

WBS 40110.1.1		TIP B-4943		COUNTY DURHAM		GEOLOGIST Swartley, J. R.						
SITE DESCRIPTION BRIDGE NO. 20 ON SR 1616 OVER DIAL CREEK							GROUND WTR (ft)					
BORING NO. EB2-A		STATION 15+10		OFFSET 20 ft LT		ALIGNMENT -L-						
COLLAR ELEV. 338.1 ft		TOTAL DEPTH 36.2 ft		NORTHING 881,834		EASTING 2,041,863						
DRILL RIG/HAMMER EFF./DATE HFO0065 CME-45C 85% 05/20/2016		DRILL METHOD NW Casing W/SPT & Core		HAMMER TYPE Automatic								
DRILLER Pinter, D. G.		START DATE 10/19/16		COMP. DATE 10/20/16		SURFACE WATER DEPTH 9.1ft						
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		LOG	DESCRIPTION AND REMARKS	DEPTH (ft)
					REC. (ft) %	RQD (ft) %		REC. (ft) %	RQD (ft) %			
328.5	328.5	9.6	1.6	N=60/0.0 52/0.6 1:45/1.0	(1.5)	(0.0)		(23.0)	(8.0)		Begin Coring @ 9.6 ft	9.6
325	326.9	11.2	5.0	1:45/1.0 2:00/1.0 3:22/1.0 4:45/1.0 4:15/1.0 3:35/1.0	(4.4)	(3.8)	RS-1	86%	30%		CRYSTALLINE ROCK GRAY, TAN AND BLACK, MODERATELY WEATHERED, SOFT TO HARD, CLOSE FRACTURE SPACING, META-GRANITE	
320	321.9	16.2	5.0	1:16/1.0 3:06/1.0 2:46/1.0 4:02/1.0 5:43/1.0	(3.4)	(0.0)					REC = 86 % RQD = 30 % GSI =28-32	
315	316.9	21.2	5.0	1:30/1.0 1:43/1.0 2:32/1.0 4:00/1.0 2:45/1.0	(4.6)	(0.5)	RS-2					
310	311.9	26.2	5.0	1:15/1.0 3:45/1.0 6:45/1.0 5:20/1.0 7:00/1.0	(4.7)	(2.8)						
305	306.9	31.2	5.0	2:15/1.0 10:02/1.0 5:30/1.0 10:20/1.0 5:10/1.0	(4.4)	(0.9)						
	301.9	36.2									Boring Terminated at Elevation 301.9 ft IN CRYSTALLINE ROCK	36.2

NCDOT BORE DOUBLE B4943\_GEO\_BRDG0020\_SPT\_BORINGS.GPJ\_NC\_DOT.GDT 11/8/16



WBS 40110.1.1		TIP B-4943		COUNTY DURHAM		GEOLOGIST Swartley, J. R.								
SITE DESCRIPTION BRIDGE NO. 20 ON SR 1616 OVER DIAL CREEK							GROUND WTR (ft)							
BORING NO. EB2-C		STATION 15+10		OFFSET 10 ft RT		ALIGNMENT -L-	0 HR. N/A							
COLLAR ELEV. 337.0 ft		TOTAL DEPTH 9.4 ft		NORTHING 881,806		EASTING 2,041,853	24 HR. N/A							
DRILL RIG/HAMMER EFF./DATE HFO0065 CME-45C 85% 05/20/2016				DRILL METHOD NW Casing w/ Advancer		HAMMER TYPE Automatic								
DRILLER Pinter, D. G.		START DATE 10/19/16		COMP. DATE 10/19/16		SURFACE WATER DEPTH 4.3ft								
ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION	
			0.5ft	0.5ft	0.5ft	0	25	50	75	100				
340														
	337.0	0.0												337.0 GROUND SURFACE 0.0
335			WOH	WOH	WOH	0							W	334.0 ALLUVIAL GRAY, SILTY CLAY 3.0
	332.6	4.4											Sat.	334.0 TAN, CLAYEY SAND 3.0
330			3	2	2									329.6 WEATHERED ROCK (META-GRANITE) 7.4
	328.6	8.4												328.6 CRYSTALLINE ROCK (META-GRANITE) 8.4
	327.6	9.4	60/0.0							60/0.0				327.6 Boring Terminated WITH STANDARD PENETRATION TEST REFUSAL at Elevation 327.6 ft IN CRYSTALLINE ROCK 9.4

# **SOIL TEST RESULTS**

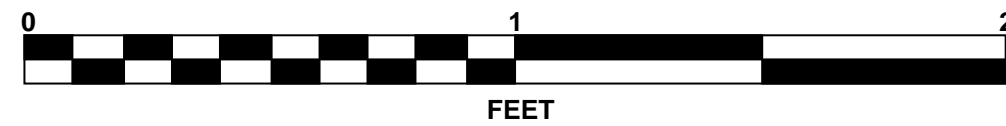
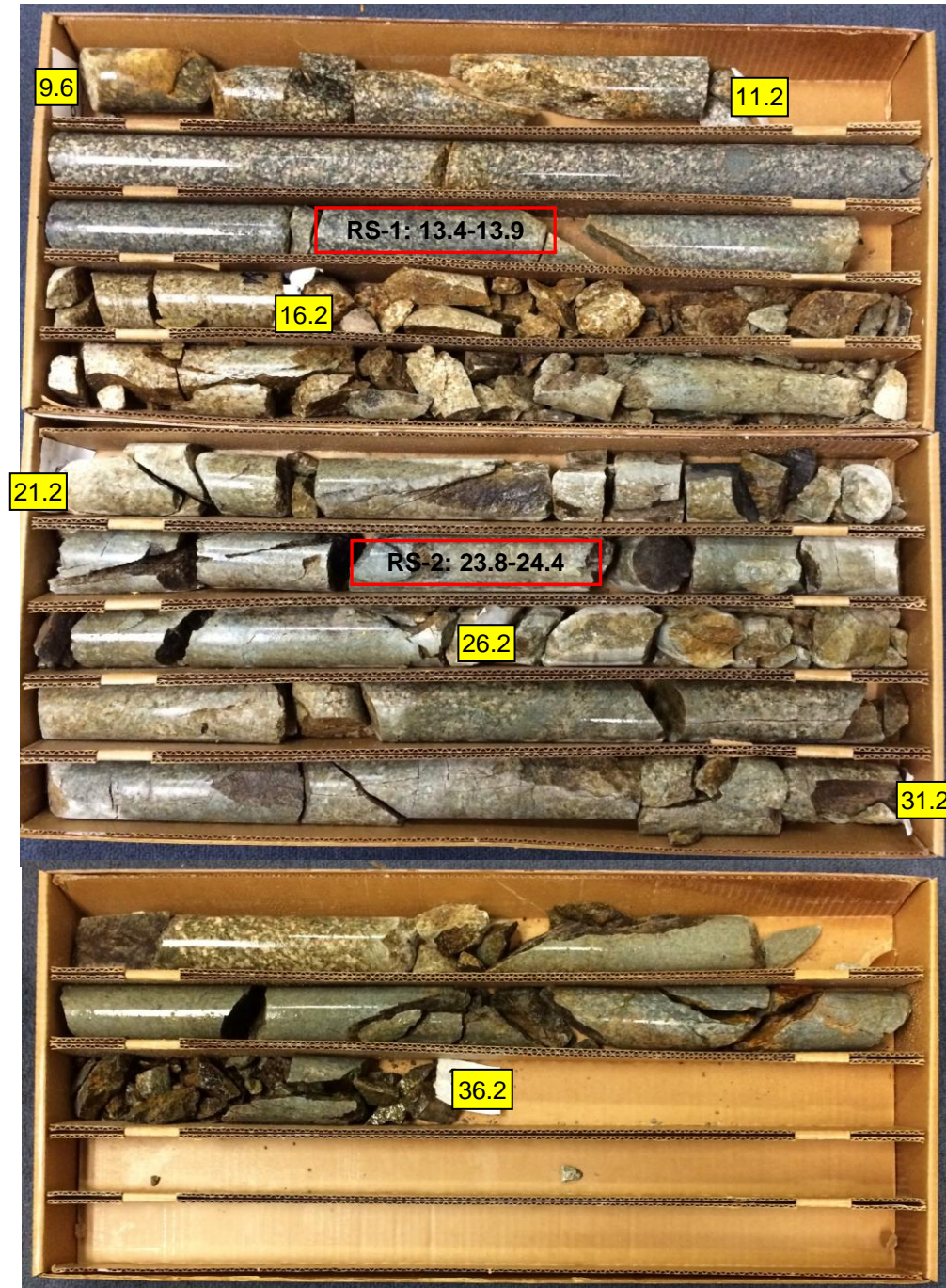
<b>SOIL TEST RESULTS</b>															
<i>SAMPLE NO.</i>	<i>OFFSET</i>	<i>STATION</i>	<i>DEPTH INTERVAL</i>	<i>AASHTO CLASS.</i>	<i>L.L.</i>	<i>P.I.</i>	<i>% BY WEIGHT</i>				<i>% PASSING (SIEVES)</i>			<i>% MOISTURE</i>	<i>% ORGANIC</i>
							<i>C.SAND</i>	<i>F.SAND</i>	<i>SILT</i>	<i>CLAY</i>	<i>10</i>	<i>40</i>	<i>200</i>		
<i>SS- 4</i>	<i>10' LT</i>	<i>14+24</i>	<i>0.0-0.0</i>	<i>A- 4(0)</i>	<i>28</i>	<i>7</i>	<i>39.4</i>	<i>26.1</i>	<i>14.4</i>	<i>20.1</i>	<i>98</i>	<i>73</i>	<i>39</i>	<i>-</i>	<i>-</i>



# CORE PHOTOGRAPHS

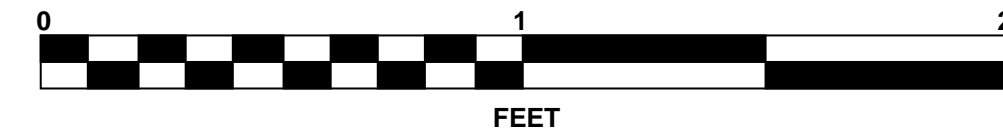
## EB2-A

BOXES 1, 2 & 3: 9.6'-36.2'



## EB2-B

BOXES 1, 2 & 3: 18.0'-49.6'





# SITE PHOTOGRAPH

Bridge No. 20 on -L- (SR 1616) over Dial Creek



Looking Northwest towards End Bent 1