

PROJECT: 15005.1032011 REFERENCE: 310072

CONTENTS

<u>SHEET NO.</u>	<u>DESCRIPTION</u>
1	TITLE SHEET
2	LEGEND (SOIL & ROCK)
2A	SUPPLEMENTAL LEGEND (GSI)
3	SITE PLAN
4	PROFILE(S)
5	CROSS SECTION(S)
6-7	BORE LOG(S)
8	SITE PHOTOGRAPH(S)

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

STRUCTURE
SUBSURFACE INVESTIGATION

COUNTY DURHAM
 PROJECT DESCRIPTION BRIDGE NO. 72 ON SR 1637
OVER FINGER TO FALLS LAKE

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	310072	1	9

CAUTION NOTICE

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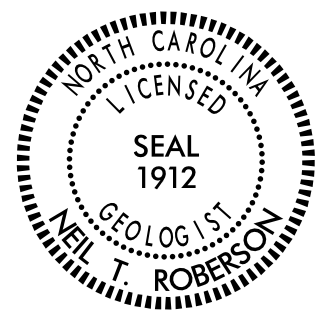
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- THE INFORMATION CONTAINED HEREIN IS NOT IMPLIED OR GUARANTEED BY THE N. C. DEPARTMENT OF TRANSPORTATION AS ACCURATE NOR IS IT CONSIDERED PART OF THE PLANS, SPECIFICATIONS OR CONTRACT FOR THE PROJECT.
 - BY HAVING REQUESTED THIS INFORMATION, THE CONTRACTOR 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

INVESTIGATED BY N. T. ROBERSON
 DRAWN BY A. N. KINTNER
 CHECKED BY J. L. LOVE
 SUBMITTED BY N. T. ROBERSON
 DATE JANUARY 2018



DocuSigned by:
Neil Roberson
 4061D9A8C6C649C
 SIGNATURE

1/11/2018
 DATE

**DOCUMENT NOT CONSIDERED FINAL
 UNLESS ALL SIGNATURES COMPLETED**

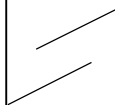
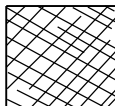
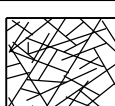

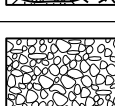

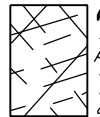
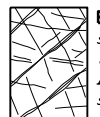

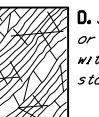


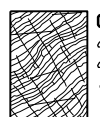

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
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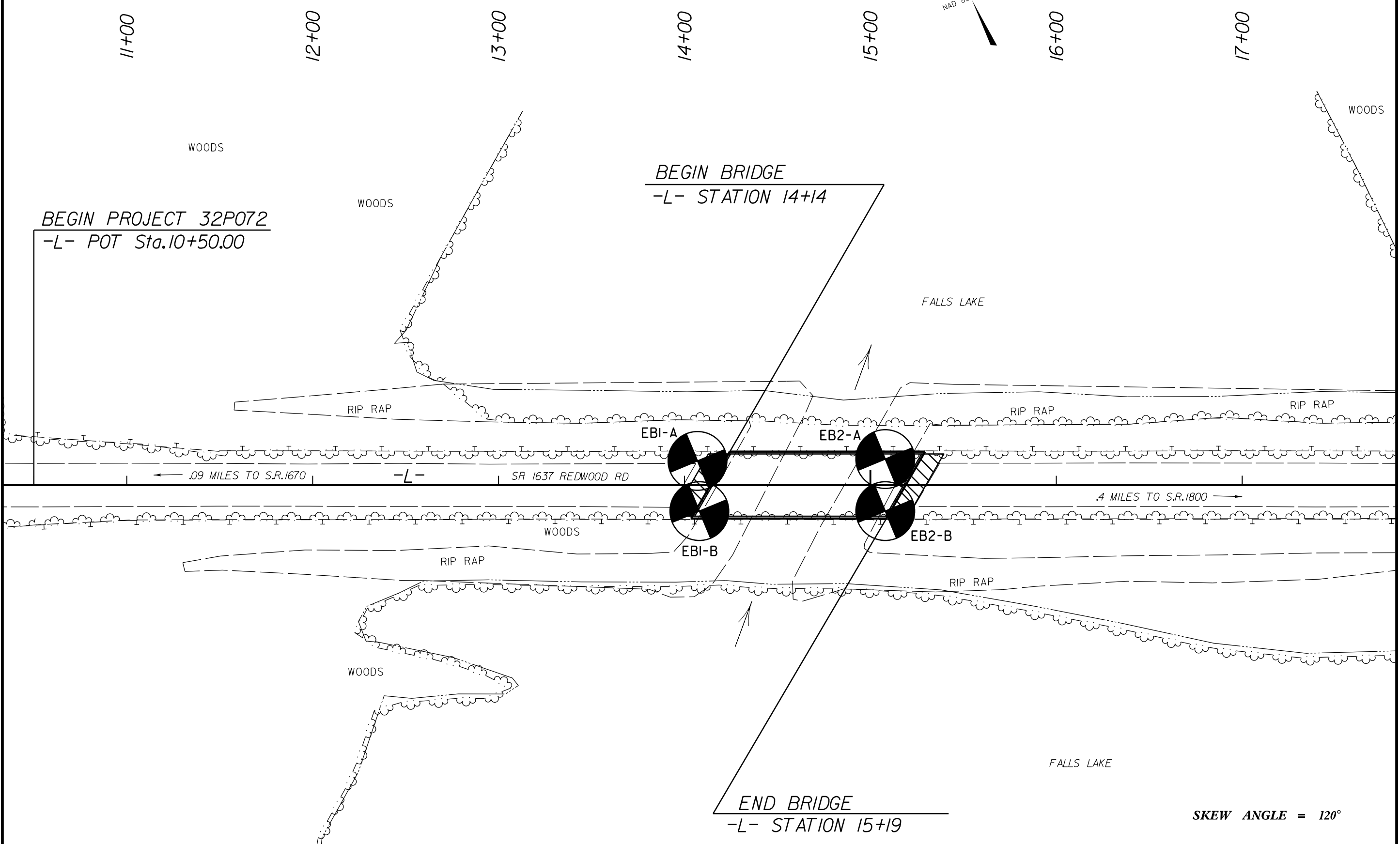
SUBSURFACE INVESTIGATION

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

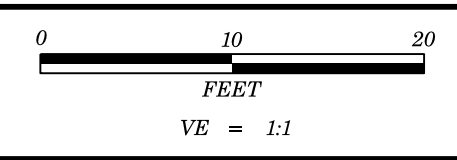
AASHTO LRFD Figure 10.4.6.4-1 — Determination of GSI for Jointed Rock Mass (Marinos and Hoek, 2000)

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

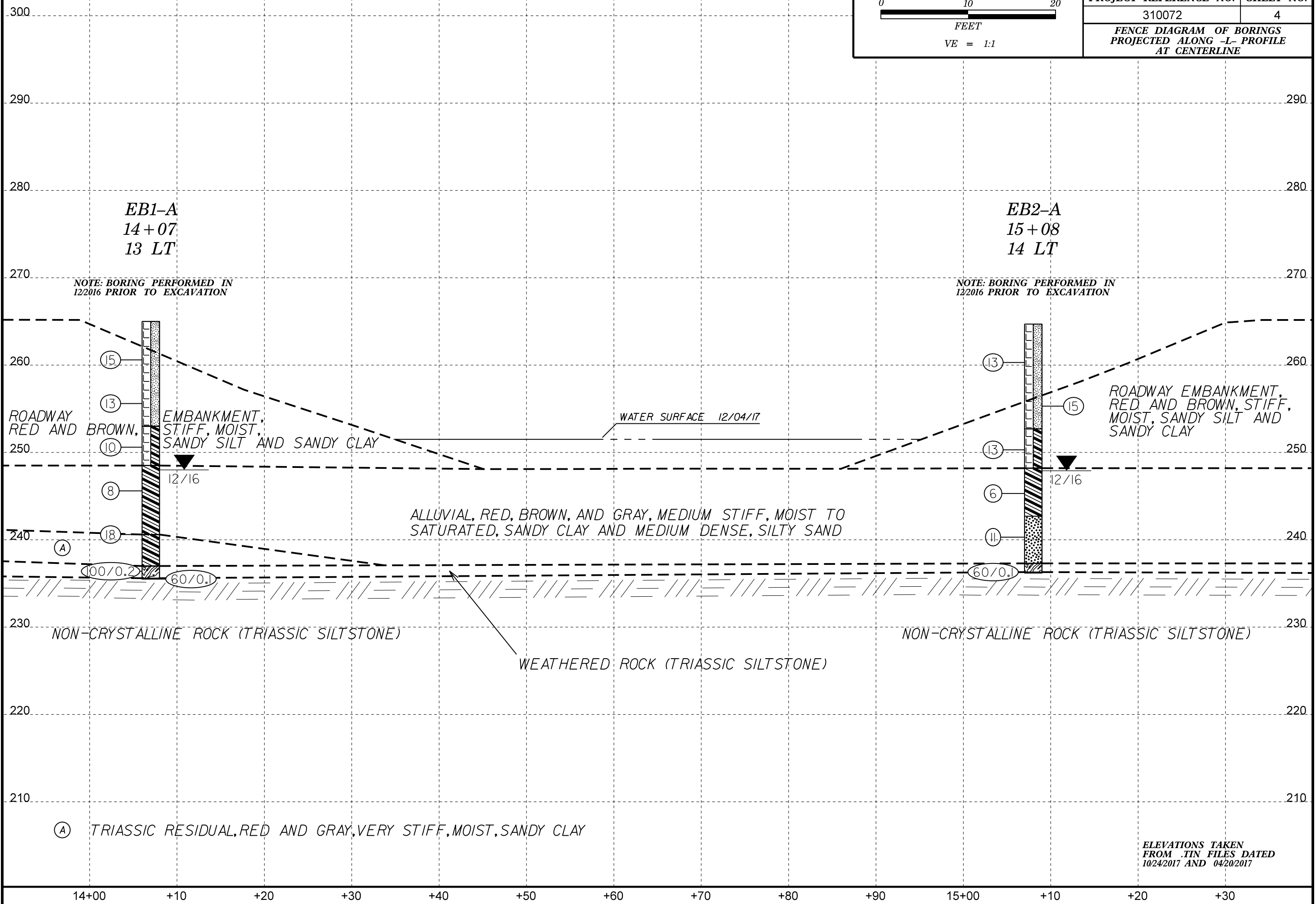
<p>GEOLOGICAL STRENGTH INDEX (GSI) FOR JOINTED ROCKS (Hoek and Marinos, 2000)</p> <p>From the lithology, structure and surface conditions of the discontinuities, estimate the average value of GSI. Do not try to be too precise. Quoting a range from 33 to 37 is more realistic than stating that GSI = 35. 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.</p> <p>STRUCTURE</p>	<p>SURFACE CONDITIONS</p> <p>VERY GOOD Very rough, fresh unweathered surfaces</p> <p>GOOD Rough, slightly weathered, iron stained surfaces</p> <p>FAIR Smooth, moderately weathered and altered surfaces</p> <p>POOR Slickensided, highly weathered surfaces with compact coatings or fillings or angular fragments</p> <p>VERY POOR Slickensided, highly weathered surfaces with soft clay coatings or fillings</p> <p>DECREASING SURFACE QUALITY →</p>					<p>GSI FOR HETEROGENEOUS ROCK MASSES SUCH AS FLYSCH (Marinos, P and Hoek E., 2000)</p> <p>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.</p> <p>COMPOSITION AND STRUCTURE</p>	<p>SURFACE CONDITIONS OF DISCONTINUITIES (Predominantly bedding planes)</p> <p>VERY GOOD - Very Rough, fresh unweathered surfaces</p> <p>GOOD - Rough, slightly weathered surfaces</p> <p>FAIR - Smooth, moderately weathered and altered surfaces</p> <p>POOR - Very smooth, occasionally slickensided surfaces with compact coatings or fillings with angular fragments</p> <p>VERY POOR - Very smooth, slickensided or highly weathered surfaces with soft clay coatings or fillings</p>																		
<p>DECREASING INTERLOCKING OF ROCK PIECES</p> <p>↓</p> <p> INTACT OR MASSIVE - intact rock specimens or massive in situ rock with few widely spaced discontinuities</p> <p> BLOCKY - well interlocked undisturbed rock mass consisting of cubical blocks formed by three intersecting discontinuity sets</p> <p> VERY BLOCKY - interlocked, partially disturbed mass with multi-faceted angular blocks formed by 4 or more joint sets</p> <p> BLOCKY/DISTURBED/SEAMY - folded with angular blocks formed by many intersecting discontinuity sets. Persistence of bedding planes or schistosity</p> <p> DISINTEGRATED - poorly interlocked, heavily broken rock mass with mixture of angular and rounded rock pieces</p> <p> LAMINATED/SHEARED - Lack of blockiness due to close spacing of weak schistosity or shear planes</p>	90	80	70	60	50	N/A	N/A	N/A	N/A	N/A	<p> A. Thick bedded, very blocky sandstone 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.</p> <p> B. Sandstone with thin inter-layers of siltstone</p> <p> C. Sandstone and siltstone in similar amounts</p> <p> D. Siltstone or silty shale with sandstone layers</p> <p> E. Weak siltstone or clayey shale with sandstone layers</p> <p> F. Tectonically deformed, intensively folded/faulted, sheared clayey shale or siltstone with broken and deformed sandstone layers forming an almost chaotic structure</p> <p> G. Undisturbed silty or clayey shale with or without a few very thin sandstone layers</p> <p> 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.</p> <p>→ Means deformation after tectonic disturbance</p>	70	60	50	40	30	A	B	C	D	E	F	G	H	10



SKEW ANGLE = 120°



PROJECT REFERENCE NO.	SHEET NO.
310072	4
FENCE DIAGRAM OF BORINGS PROJECTED ALONG -L- PROFILE AT CENTERLINE	



EB1-A
14+07
13 LT

EB2-A
15+08
14 LT

NOTE: BORING PERFORMED IN
12/2016 PRIOR TO EXCAVATION

NOTE: BORING PERFORMED IN
12/2016 PRIOR TO EXCAVATION

ROADWAY
RED AND BROWN,
250

EMBANKMENT,
STIFF, MOIST,
SANDY SILT AND SANDY CLAY

WATER SURFACE 12/04/17

ROADWAY EMBANKMENT,
RED AND BROWN, STIFF,
MOIST, SANDY SILT AND
SANDY CLAY

ALLUVIAL, RED, BROWN, AND GRAY, MEDIUM STIFF, MOIST TO
SATURATED, SANDY CLAY AND MEDIUM DENSE, SILTY SAND

NON-CRYSTALLINE ROCK (TRIASSIC SILTSTONE)

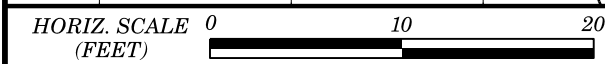
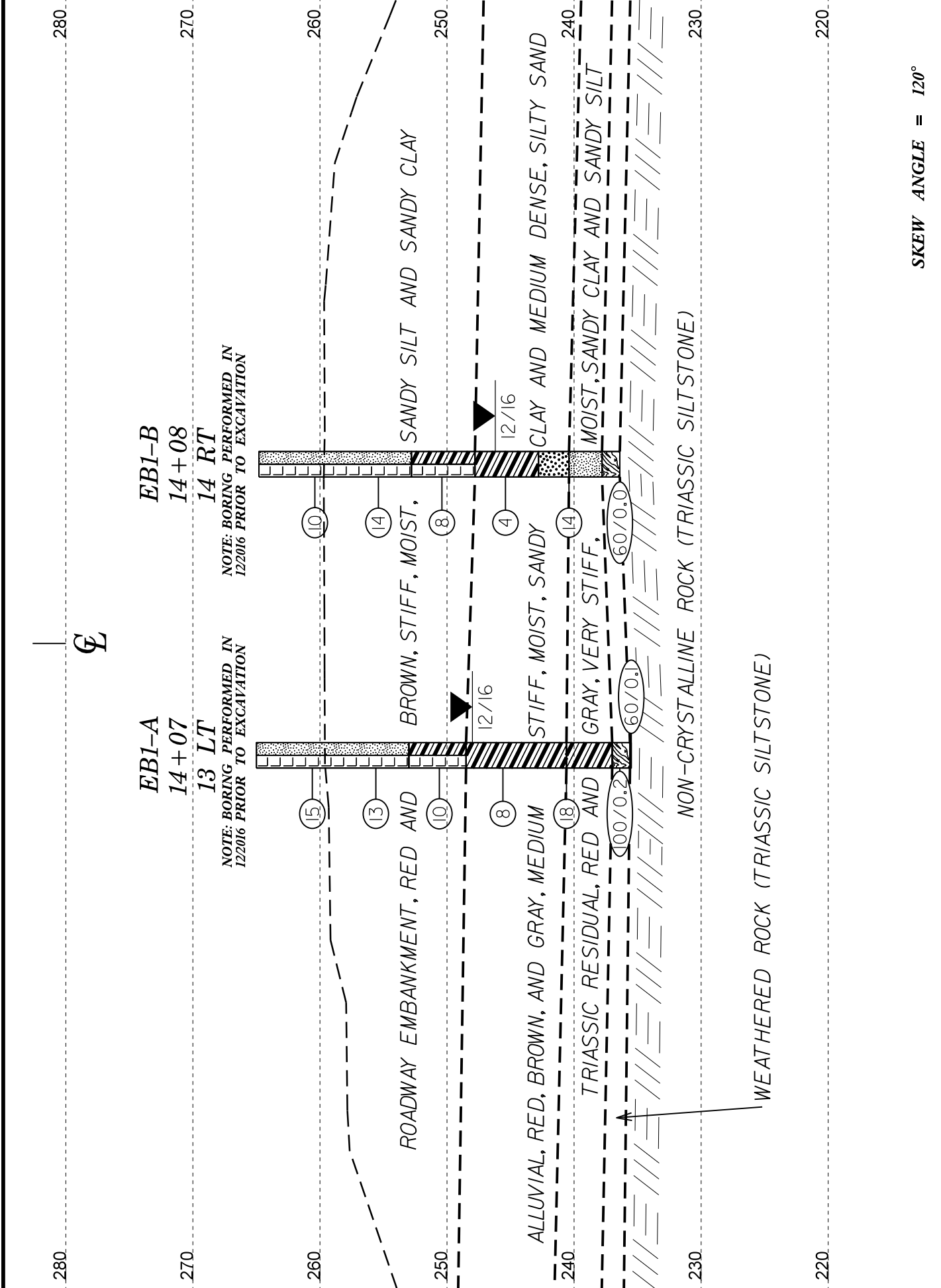
NON-CRYSTALLINE ROCK (TRIASSIC SILTSTONE)

WEATHERED ROCK (TRIASSIC SILTSTONE)

(A) TRIASSIC RESIDUAL, RED AND GRAY, VERY STIFF, MOIST, SANDY CLAY

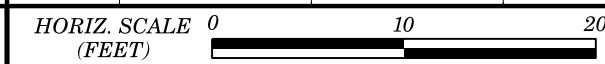
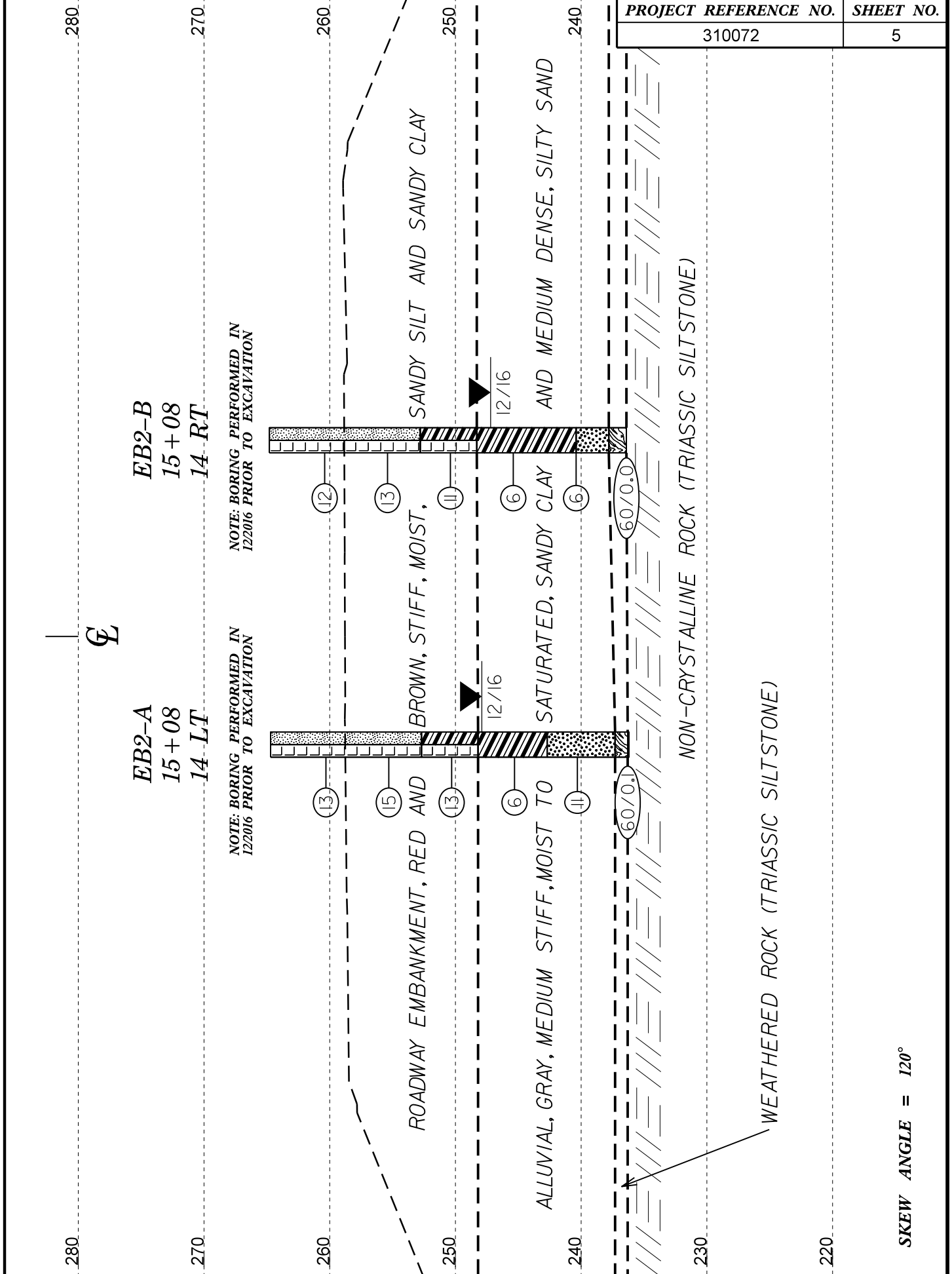
ELEVATIONS TAKEN
FROM TIN FILES DATED
10/24/2017 AND 04/20/2017

14+00 +10 +20 +30 +40 +50 +60 +70 +80 +90 15+00 +10 +20 +30



VE = 1:1

CROSS SECTION THROUGH EB1



VE = 1:1

CROSS SECTION THROUGH EB2

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 15005.1032011		TIP 310072		COUNTY DURHAM		GEOLOGIST Swartley, J. R.										
SITE DESCRIPTION BRIDGE NO. 72 ON SR 1637 OVER FINGER TO FALLS LAKE							GROUND WTR (ft)									
BORING NO. EB1-A		STATION 14+07		OFFSET 13 ft LT		ALIGNMENT -L-										
COLLAR ELEV. 265.0 ft		TOTAL DEPTH 29.5 ft		NORTHING 837,794		EASTING 2,066,459										
DRILL RIG/HAMMER EFF./DATE RFO0074 CME-55 90% 07/12/2016		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic												
DRILLER Pinter, D. G.		START DATE 12/20/16		COMP. DATE 12/20/16		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						
265														265.0	GROUND SURFACE	0.0
	261.6	3.4	7	7	8								M	ROADWAY EMBANKMENT RED AND BROWN, SANDY SILT		
260																
	256.6	8.4	5	6	7								M			
255														253.0	RED AND BROWN, SANDY CLAY	12.0
	251.6	13.4	4	4	6								M			
250														248.5	ALLUVIAL RED AND BROWN, SANDY CLAY	16.5
	246.6	18.4	2	3	5								M			
245														240.6	TRIASSIC RESIDUAL RED AND GRAY, SANDY CLAY	24.4
	241.6	23.4	4	5	13								M			
240														237.0	WEATHERED ROCK (TRIASSIC SILTSTONE)	28.0
	236.6	28.4	100/0.2											235.6	NON-CRYSTALLINE ROCK (TRIASSIC SILTSTONE)	29.4
	235.6	29.4	60/0.1											235.5	NON-CRYSTALLINE ROCK (TRIASSIC SILTSTONE)	29.5
															Boring Terminated with Standard Penetration Test Refusal at Elevation 235.5 ft IN NON-CRYSTALLINE ROCK (TRIASSIC SILTSTONE)	

WBS 15005.1032011		TIP 310072		COUNTY DURHAM		GEOLOGIST Swartley, J. R.										
SITE DESCRIPTION BRIDGE NO. 72 ON SR 1637 OVER FINGER TO FALLS LAKE							GROUND WTR (ft)									
BORING NO. EB1-B		STATION 14+08		OFFSET 14 ft RT		ALIGNMENT -L-										
COLLAR ELEV. 264.8 ft		TOTAL DEPTH 28.4 ft		NORTHING 837,768		EASTING 2,066,449										
DRILL RIG/HAMMER EFF./DATE RFO0074 CME-55 90% 07/12/2016		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic												
DRILLER Pinter, D. G.		START DATE 12/20/16		COMP. DATE 12/20/16		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						
265														264.8	GROUND SURFACE	0.0
	261.4	3.4	4	5	5								M	ROADWAY EMBANKMENT RED AND BROWN, SANDY SILT		
260																
	256.4	8.4	6	6	8								M			
255														252.8	RED AND BROWN, SANDY CLAY	12.0
	251.4	13.4	3	4	4								M			
250														247.8	ALLUVIAL RED AND BROWN, SANDY CLAY	17.0
	246.4	18.4	2	2	2								M			
245														242.8	GRAY, SILTY SAND	22.0
	241.4	23.4	4	6	8								M	TRIASSIC RESIDUAL GRAY, SANDY SILT	24.4	
240														237.8	TRIASSIC RESIDUAL GRAY, SANDY SILT	27.0
	236.4	28.4	60/0.0											236.4	WEATHERED ROCK (TRIASSIC SILTSTONE)	28.4
															Boring Terminated with Standard Penetration Test Refusal at Elevation 236.4 ft ON NON-CRYSTALLINE ROCK (TRIASSIC SILTSTONE)	

GEOTECHNICAL BORING REPORT

BORE LOG

WBS 15005.1032011		TIP 310072		COUNTY DURHAM		GEOLOGIST Swartley, J. R.										
SITE DESCRIPTION BRIDGE NO. 72 ON SR 1637 OVER FINGER TO FALLS LAKE							GROUND WTR (ft)									
BORING NO. EB2-A		STATION 15+08		OFFSET 14 ft LT		ALIGNMENT -L-										
COLLAR ELEV. 264.7 ft		TOTAL DEPTH 28.5 ft		NORTHING 837,756		EASTING 2,066,553										
DRILL RIG/HAMMER EFF./DATE RFO0074 CME-55 90% 07/12/2016			DRILL METHOD H.S. Augers			HAMMER TYPE Automatic										
DRILLER Pinter, D. G.		START DATE 12/20/16		COMP. DATE 12/20/16		SURFACE WATER DEPTH N/A										
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						
265														264.7	GROUND SURFACE	0.0
	261.3	3.4	8	6	7								M	ROADWAY EMBANKMENT RED AND BROWN, SANDY SILT		
260																
	256.3	8.4	6	6	9								M			
255																
	251.3	13.4	3	6	7								M	RED AND BROWN, SANDY CLAY	12.0	
250																
	246.3	18.4	2	3	3								M	ALLUVIAL GRAY, SANDY CLAY	16.5	
245																
	241.3	23.4	3	5	6								Sat.	GRAY, SILTY SAND	22.0	
240																
	236.3	28.4	60/0.1			60/0.1										
														237.3	WEATHERED ROCK (TRIASSIC SILTSTONE)	27.4
														236.3	NON-CRYSTALLINE ROCK (TRIASSIC SILTSTONE)	28.4
														236.2	Boring Terminated with Standard Penetration Test Refusal at Elevation 236.2 ft IN NON-CRYSTALLINE ROCK (TRIASSIC SILTSTONE)	

WBS 15005.1032011		TIP 310072		COUNTY DURHAM		GEOLOGIST Swartley, J. R.										
SITE DESCRIPTION BRIDGE NO. 72 ON SR 1637 OVER FINGER TO FALLS LAKE							GROUND WTR (ft)									
BORING NO. EB2-B		STATION 15+08		OFFSET 14 ft RT		ALIGNMENT -L-										
COLLAR ELEV. 264.8 ft		TOTAL DEPTH 28.4 ft		NORTHING 837,730		EASTING 2,066,542										
DRILL RIG/HAMMER EFF./DATE RFO0074 CME-55 90% 07/12/2016			DRILL METHOD H.S. Augers			HAMMER TYPE Automatic										
DRILLER Pinter, D. G.		START DATE 12/20/16		COMP. DATE 12/20/16		SURFACE WATER DEPTH N/A										
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						
265														264.8	GROUND SURFACE	0.0
	261.4	3.4	4	4	8								M	ROADWAY EMBANKMENT RED AND BROWN, SANDY SILT		
260																
	256.4	8.4	7	6	7								M			
255																
	251.4	13.4	4	5	6								M	RED AND BROWN, SANDY CLAY	12.0	
250																
	246.4	18.4	3	2	4								W	ALLUVIAL GRAY, SANDY CLAY	16.5	
245																
	241.4	23.4	3	2	4								W	GRAY, SILTY SAND	24.4	
240																
	236.4	28.4	60/0.0			60/0.0										
														237.8	WEATHERED ROCK (TRIASSIC SILTSTONE)	27.0
														236.4	Boring Terminated with Standard Penetration Test Refusal at Elevation 236.4 ft ON NON-CRYSTALLINE ROCK (TRIASSIC SILTSTONE)	

SITE PHOTOGRAPH

Bridge No. 72 on -L- (SR 1637) over Finger to Falls Lake



Looking West towards End Bent 1