

DESIGN MEMORANDUM

To: Leonard Olen Blankenship, P.E., District 04 Planning and Engineering
COPY: Rinaldo Spano, P.E., District 04 Planning and Engineering
Thomas Powell, P.E., District 04 Geotechnical Engineer
FROM: Amal A. Goza, P.E., Office of Geotechnical Engineering
DATE: November 05, 2021
SUBJECT: SUM-271-8.25, PID 111417 Foundation Design Recommendations

BRIDGE No. SUM-00271-08.530R WIDENING

PROPOSED STRUCTURE:

TYPE: Three Spans, Widen Abutments and Convert to Semi-Integral, Widen Piers, New Rolled Steel Beams and Composite Concrete Deck, Replace Approach Slabs

SPANS: 48'-6"±, 61'-0"±, 48'-6"± c/c Bearings

ROADWAY: 52'-0" TOE/TOE PARAPET

Top of Rock elevation: Not encountered.

Recommended Foundation Type: Driven Cast-In-Place Pipe Piles/Friction Piles.

DRIVEN CAST-IN-PLACE PIPE PILES/FRICTION PILES ESTIMATED AND ORDER LENGTHS:

Substructure Unit	Boring ID	Pipe Pile Diameter	Geotechnical Pile Length	Estimated Length	Pile Cap Embedment depth ¹	Order Length	Pipe Wall Thickness	Steel Grade
Rear Abut.	B-001-0-70 BMB-01	12"	54.5' 44.5'	60'	1.50' Embedment	65'	0.250"	2
Pier 1	B-012-0-65 BMB-02	12"	48.5' 36.5'	55'	1.50' Embedment	60'	0.250"	2
Pier 2	B-012-0-65 BMB-02	12"	51' 37'	55'	1.50' Embedment	60'	0.250"	2
Forward Abut.	BMB-03	12"	44'	50'	1.50' Embedment	55'	0.250"	2

¹ At the Rear and Forward Abutments: Explain the reason(s) for using Pile Cap Embedment Depth of 1.5 feet. The typical is 1.0 feet, unless it is integral, and then it needs to be 2.0 feet.

SUMMARY:

The recommendations were developed in accordance with the AASHTO LRFD Bridge Design Specifications 9th Edition (2020) (AASHTO LRFD). Historic Borings were used for the design. Top of rock was not encountered in any of the referenced borings, the lowest drilled elevation is 586.77' in BMB-02. According to the "Bedrock topography of the Northfield, Ohio, quadrangle" map published by the Department of Natural Resources, top of rock (TR) at the project site is expected at or below elevation 500 ft. Our recommended foundation type is driven cast-in-place reinforced concrete pipe piles at all four substructure units. Details are provided above in the table "Driven Cast-In-Place Pipe Piles/Friction Piles."

DRIVEN CIP PIPE PILES ANALYSIS:

Per CMS 507.06. D, the minimum wall thickness is the greater of either 0.250 inches or as calculated using the following formula:

$$t \text{ (inches)} = (\text{Ultimate Bearing Value in pounds})/900,000$$

The calculated minimum wall thicknesses for each substructure unit are summarized in the following table:

--

Substructure Unit	Factored Load (kips)	Ultimate Bearing Value (kips)	Minimum Pipe Wall Thickness	Available Pipe Wall Thickness
Abutments	127.36	181.942	0.250"	0.250"
Piers	123.86	176.942	0.250"	0.250"

GRLWEAP drivability analyses will be performed and supplied at the next project phase.

Add the following estimated quantities to the project plans:

Item	Item Description	Units	Estimated Quantities
505E11100	PILE DRIVING EQUIPMENT MOBILIZATION	LS	1
507E00500	12" CAST-IN-PLACE REINFORCED CONCRETE PILES, DRIVEN	FT	1320
507E00550	12" CAST-IN-PLACE REINFORCED CONCRETE PILES, FURNISHED	FT	1440
523E20001	DYNAMIC LOAD TESTING, AS PER PLAN	EACH	3
523E20501	RESTRIKE, AS PER PLAN	EACH	3

The estimated driving resistance as indicated by the driving losses would increase the length of the pile during driving by more than 10-ft with EOID as compared to the UBV, thus we have accounted for pile setup in the design. See BDM 2020, Section 305.3.2.4. The End of Initial Drive (EOID) and the anticipated waiting period related to the expected setup are summarized below:

Substructure Unit	Factored Load (kips)	UBV (kips)	EOID (kips)	UBV/EOID	Waiting Time (Days)
Rear Abut.	127.36	182	119	1.50	14
Pier 1	123.86	177	117	1.50	14
Pier 2	123.86	177	118	1.50	14
Forward Abut.	127.36	182	225	0.80	0

Add the plan notes provided through this design memo to the Structures General Notes. A snapshot of ODNR Bedrock topography of the Northfield, Ohio, quadrangle map at the project site, Soil Classifications for B-001-0-70 and B-012-0-65, All Historic Boring Logs, Pile Nominal Resistance versus Embedment Depth and Pile Driving Resistance versus Embedment Depth for all substructure units are included within this design memo.

If you have any questions, please feel free to contact either myself at 614-728-8814, or Alex Dettloff, at 614-275-1308.

Thank you,

AAG

pc: Reading File, File

Attachments:

- Project Geotechnical Plan Notes.
- A snapshot of ODNR Bedrock topography of the Northfield, Ohio, quadrangle map at the project site.
- Soil Classifications for B-001-0-70 and B-012-0-65.
- Boring Logs.
- , Pile Nominal Resistance versus Embedment Depth and Pile Driving Resistance versus Embedment Depth for all substructure units

Project Geotechnical Plan Notes:

PILE DESIGN LOADS (ULTIMATE BEARING VALUE):

THE ULTIMATE BEARING VALUE IS 182 KIPS PER PILE FOR THE REAR AND FORWARD ABUTMENT PILES. THE ULTIMATE BEARING VALUE IS 177 KIPS PER PILE FOR THE PIER 1 AND PIER 2 PILES.

REAR ABUTMENT PILES:

12" CAST-IN-PLACE REINFORCED CONCRETE PILES, 60 FEET LONG, ORDER LENGTH 65 FEET.

1 DYNAMIC LOAD TESTING, AS PER PLAN

1 RESTRIKE, AS PER PLAN

FORWARD ABUTMENT PILES:

12" CAST-IN-PLACE REINFORCED CONCRETE PILES, 50 FEET LONG, ORDER LENGTH 55 FEET.

PIER 1 PILES:

12" CAST-IN-PLACE REINFORCED CONCRETE PILES, 55 FEET LONG, ORDER LENGTH 60 FEET.

1 DYNAMIC LOAD TESTING, AS PER PLAN

1 RESTRIKE, AS PER PLAN

PIER 2 PILES:

12" CAST-IN-PLACE REINFORCED CONCRETE PILES, 55 FEET LONG, ORDER LENGTH 60 FEET.

1 DYNAMIC LOAD TESTING, AS PER PLAN

1 RESTRIKE, AS PER PLAN

PILES DRIVEN TO FULL ESTIMATED LENGTH WITH PILE/SOIL SETUP

THE ULTIMATE BEARING VALUE (UBV) IS 182 KIPS PER PILE FOR THE REAR ABUTMENT AND 177 KIPS PER PILE FOR THE PIER 1 AND PIER 2 PILES. PART OF THE UBV WILL BE ACHIEVED THROUGH PILE/SOIL SETUP, WHICH IS A TIME DEPENDENT INCREASE IN RESISTANCE THAT OCCURS IN SOME SOILS.

NOTIFY THE ENGINEER AT LEAST 5 DAYS BEFORE DRIVING PILES SO THAT THE ENGINEER CAN NOTIFY THE DISTRICT GEOTECHNICAL ENGINEER, THE OFFICE OF CONSTRUCTION ADMINISTRATION, AND THE OFFICE OF GEOTECHNICAL ENGINEERING.

DRIVE THE FIRST TWO PILES AT THE REAR ABUTMENT TO THE FULL ESTIMATED LENGTH OF 60 FEET AND AT THE PIER 1 AND PIER 2 TO THE FULL ESTIMATED LENGTH OF 55 FEET. PERFORM DYNAMIC LOAD TESTING ON BOTH PILES WHILE DRIVING. AFTER DRIVING AND TESTING THE FIRST TWO PILES, DRIVE THE REMAINING PILES IN THE SUBSTRUCTURE TO THE SAME DEPTH AS THE FIRST TWO PILES. AFTER DRIVING ALL PILES TO THE ESTIMATED LENGTH, CEASE ALL DRIVING OPERATIONS AT THE SUBSTRUCTURE FOR A PERIOD OF 14 DAYS. INCLUDE THE WAITING PERIOD AS A SEPARATE ACTIVITY IN THE PROGRESS SCHEDULE. AFTER THE WAITING PERIOD, PERFORM PILE RESTRIKES ON BOTH OF THE FIRST TWO PILES (ONE RESTRIKE ITEM).

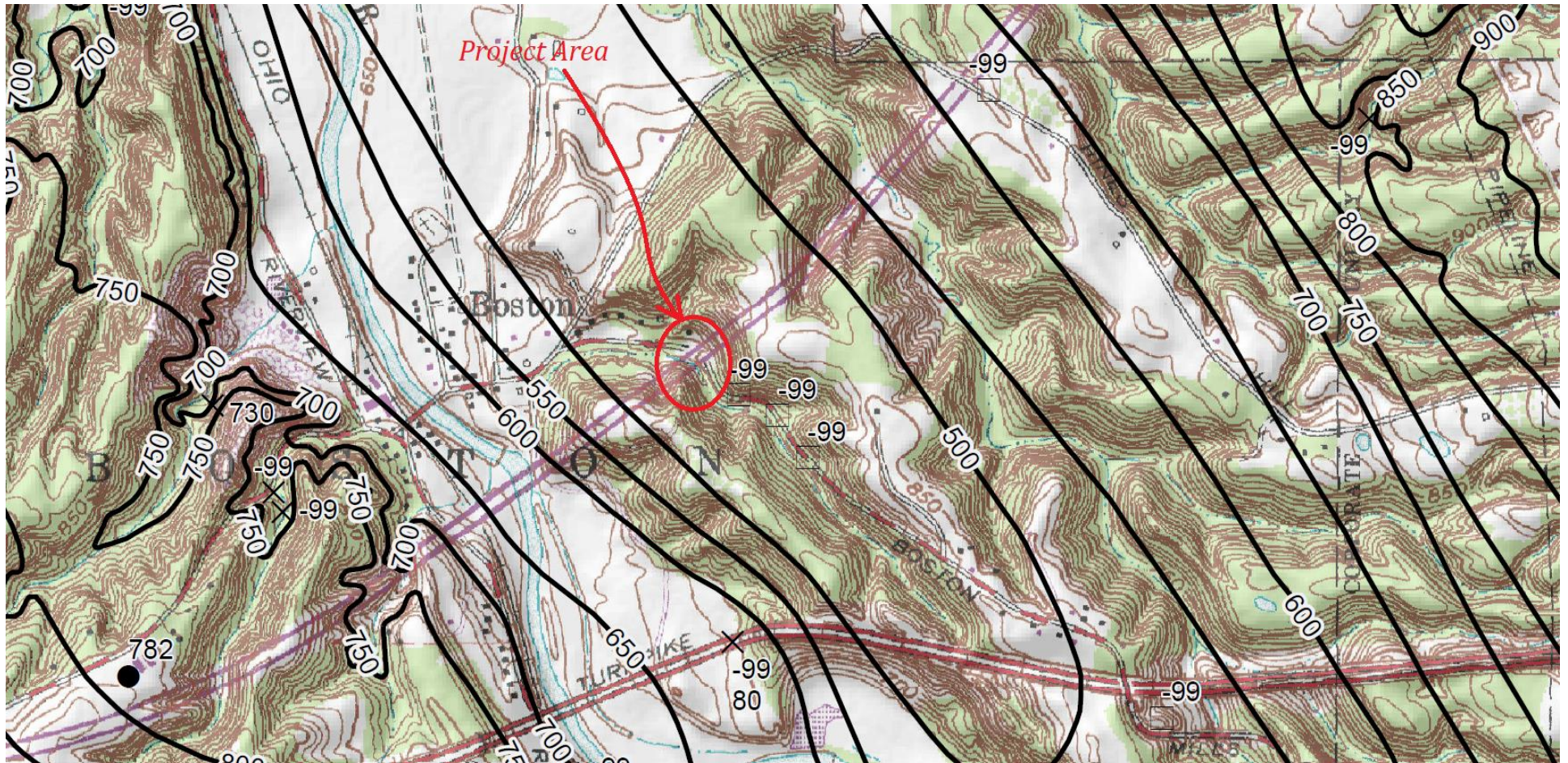
SUBMIT ALL TEST RESULTS TO THE ENGINEER. IF THE RESTRIKE TEST RESULTS INDICATE THAT BOTH PILES ACHIEVED THE REQUIRED UBV, ALL PILES IN THE SUBSTRUCTURE MAY BE ACCEPTED BY THE ENGINEER.

IF THE RESTRIKE TEST RESULTS INDICATE THAT EITHER OF THE TWO PILES DID NOT ACHIEVE THE REQUIRED UBV, IMMEDIATELY NOTIFY THE ENGINEER SO THAT THE ENGINEER CAN NOTIFY THE DISTRICT GEOTECHNICAL ENGINEER, THE OFFICE OF CONSTRUCTION ADMINISTRATION, AND THE OFFICE OF GEOTECHNICAL ENGINEERING. THE ENGINEER WILL REVIEW THE TEST RESULTS AND ESTABLISH ADDITIONAL RESTRIKE TESTING OR DRIVING CRITERIA FOR THE PILING IN THE SUBSTRUCTURE WITH THE ASSISTANCE OF THE DISTRICT GEOTECHNICAL ENGINEER, THE OFFICE OF CONSTRUCTION ADMINISTRATION, AND THE OFFICE OF GEOTECHNICAL ENGINEERING.

IF DIRECTED BY THE ENGINEER, PERFORM ADDITIONAL RESTRIKE TESTING OR DRIVE ALL PILES IN THE SUBSTRUCTURE TO THE ESTABLISHED DRIVING CRITERIA. THE DEPARTMENT WILL PAY FOR SPLICING OF THE PILES BEYOND THE ESTIMATED LENGTH PROVIDED IN THE PLANS UNDER C&MS 109.05 WITH A NEGOTIATED PRICE PER SPLICE.

THIS PLAN NOTE INCLUDES A QUANTITY OF ONE EACH ITEM 523 DYNAMIC LOAD TESTING, AS PER PLAN AND A QUANTITY OF ONE EACH ITEM 523 RESTRIKE, AS PER PLAN PER EACH SUBSTRUCTURE UNIT.

A snapshot of ODNR Bedrock topography of the Northfield, Ohio, quadrangle map at the project site



Soil Classifications for B-001-0-70 and B-012-0-65

B-001-0-70

Page 1 of 2

ODOT Soil Classification Worksheet

Ground Surface Elevation (ft), Corrected for Datum Difference. 724.168

Sample Number	Blow Count	GR	CS	FS	SI	CL	LL	PI	ODOT Class	From Depth	To Depth	Bottom of Sample Elev per Boring (ft)	Bottom of Sample Elev Corrected for Datum Change
SS-1	14	0	5	6	32	57	37	17	(COHESIVE) A-6b (11) Stiff Silty Clay Trace Gravel Little Coarse to Fine Sand	5	6	719.17	718.17
SS-2	11	0	3	5	36	58	30	11	(COHESIVE) A-6a (8) Stiff Silt and Clay Trace Gravel Trace Coarse to Fine Sand	10	11	714.17	713.17
SS-3	13	12	7	7	29	45	32	13	(COHESIVE) A-6a (9) Stiff Silt and Clay Little Gravel Little Coarse to Fine Sand	15	16	709.17	708.17
SS-4	22	9	7	8	30	46	32	12	(COHESIVE) A-6a (9) Very Stiff Silt and Clay Trace Gravel Little Coarse to Fine Sand	20	21	704.17	703.17
SS-5	16	0	4	20	46	30	NP	NP	(NON-COHESIVE) A-4a (8) Medium Dense Sandy Silt Trace Gravel Some Clay	25	26	699.17	698.17
SS-6	28	0	1	2	36	61	37	16	(COHESIVE) A-6b (10) Very Stiff Silty Clay Trace Gravel Trace Coarse to Fine Sand	30	31	694.17	693.17
SS-7	24	0	1	1	58	40	NP	NP	(NON-COHESIVE) A-4b (8) Medium Dense Silt Trace Gravel Trace Coarse to Fine Sand "And" Clay	35	36	689.17	688.17
SS-8	13	0	0	0	28	72	35	16	(COHESIVE) A-6b (10) Stiff Silty Clay Trace Gravel Trace Coarse to Fine Sand	40	41	684.17	683.17
SS-9	26	0	0	0	73	27	NP	NP	(NON-COHESIVE) A-4b (8) Medium Dense Silt Trace Gravel Trace Coarse to Fine Sand Some Clay	45	46	679.17	678.17
SS-10	35	0	1	2	73	24	NP	NP	(NON-COHESIVE) A-4b (8) Dense Silt Trace Gravel Trace Coarse to Fine Sand Some Clay	50	51	674.17	673.17
SS-11	12	0	0	0	28	72	35	16	(COHESIVE) A-6b (10) Stiff Silty Clay Trace Gravel Trace Coarse to Fine Sand	55	56.5	669.17	667.67
ST-01		0	1	0	25	74	40	18	(COHESIVE) A-6b (11) Very Soft Silty Clay Trace Gravel Trace Coarse to Fine Sand	55	56.5	669.17	667.67
SS-12		0	0	0	37	63	33	16	(COHESIVE) A-6b (10) Stiff Silty Clay Trace Gravel Trace Coarse to Fine Sand	56.5	57.5	667.67	666.67
SS-13		0	0	0	20	80	45	21	(COHESIVE) A-7-6 (13) Very Soft Clay Trace Gravel Trace Coarse to Fine Sand Little Silt	57.5	61.5	666.67	662.67
ST-02	12	0	0	0	25	75	43	23	(COHESIVE) A-7-6 (14) Very Soft Clay Trace Gravel Trace Coarse to Fine Sand Some Silt	60	61.5	664.17	662.67
ST-02A		0	0	0	27	73	41	20	(COHESIVE) A-7-6 (12) Very Soft Clay Trace Gravel Trace Coarse to Fine Sand Some Silt	60	61.5	664.17	662.67
ST-02B		0	0	0	26	74	42	22	(COHESIVE) A-7-6 (13) Very Soft Clay Trace Gravel Trace Coarse to Fine Sand Some Silt	60	61.5	664.17	662.67
SS-14		0	0	0	23	77	41	18	(COHESIVE) A-7-6 (11) Very Soft Clay Trace Gravel Trace Coarse to Fine Sand Some Silt	61.5	62.5	662.67	661.67
SS-15		0	0	0	23	77	37	17	(COHESIVE) A-6b (11) Very Soft Silty Clay Trace Gravel Trace Coarse to Fine Sand	65	66.1	659.17	658.07
ST-03		0	0	1	38	61	37	16	(COHESIVE) A-6b (10) Very Soft Silty Clay Trace Gravel Trace Coarse to Fine Sand	65	66.1	659.17	658.07
ST-03A	13	0	0	1	32	67	34	16	(COHESIVE) A-6b (10) Very Soft Silty Clay Trace Gravel Trace Coarse to Fine Sand	65	66.1	659.17	658.07
ST-03B		0	0	1	32	67	36	16	(COHESIVE) A-6b (10) Very Soft Silty Clay Trace Gravel Trace Coarse to Fine Sand	65	66.1	659.17	658.07
SS-16	13	0	0	0	21	79	44	24	(COHESIVE) A-7-6 (14) Very Soft Clay Trace Gravel Trace Coarse to Fine Sand Some Silt	66.5	67.5	657.67	656.67

B-001-0-70

Page 2 of 2

Sample Number	Blow Count	GR	CS	FS	SI	CL	LL	PI	ODOT Class	From Depth	To Depth	Bottom of Sample Elev per Boring (ft)	Bottom of Sample Elev Corrected for Datum Change
SS-17		0	0	0	21	79	46	25	(COHESIVE) A-7-6 (15) Very Soft Clay Trace Gravel Trace Coarse to Fine Sand Some Silt	67.5	71.5	656.67	652.67
ST-04		0	0	1	27	72	37	16	(COHESIVE) A-6b (10) Very Soft Silty Clay Trace Gravel Trace Coarse to Fine Sand	70	71.3	654.17	652.87
ST-04A		0	1	1	24	74	40	20	(COHESIVE) A-6b (12) Very Soft Silty Clay Trace Gravel Trace Coarse to Fine Sand	70	71.3	654.17	652.87
ST-04B	10	0	1	1	25	73	38	18	(COHESIVE) A-6b (11) Very Soft Silty Clay Trace Gravel Trace Coarse to Fine Sand	70	71.3	654.17	652.87
SS-18		0	1	2	20	77	41	21	(COHESIVE) A-7-6 (13) Very Soft Clay Trace Gravel Trace Coarse to Fine Sand Little Silt	71.5	72.5	652.67	651.67
SS-19		0	1	2	28	69	35	17	(COHESIVE) A-6b (11) Very Soft Silty Clay Trace Gravel Trace Coarse to Fine Sand	72.5	75	651.67	649.17
ST-05	20	0	0	0	43	57	30	12	(COHESIVE) A-6a (9) Very Soft Silt and Clay Trace Gravel Trace Coarse to Fine Sand	75	76.3	649.17	647.87
ST-05A		0	0	1	39	60	28	11	(COHESIVE) A-6a (8) Very Soft Silt and Clay Trace Gravel Trace Coarse to Fine Sand	75	76.3	649.17	647.87
ST-05B		0	0	0	21	79	36	14	(COHESIVE) A-6a (10) Very Soft Silt and Clay Trace Gravel Trace Coarse to Fine Sand	75	76.3	649.17	647.87
ST-05C		0	0	1	36	63	31	13	(COHESIVE) A-6a (9) Very Soft Silt and Clay Trace Gravel Trace Coarse to Fine Sand	75	76.5	649.17	647.67
SS-20		0	0	1	43	56	28	11	(COHESIVE) A-6a (8) Very Soft Silt and Clay Trace Gravel Trace Coarse to Fine Sand	76.5	77.5	647.67	646.67
SS-21		0	2	4	50	44	26	7	(COHESIVE) A-4b (8) Very Soft Silt Trace Gravel Trace Coarse to Fine Sand "And" Clay	77.5	81.5	646.67	642.67
ST-06	27	0	1	1	34	64	29	11	(COHESIVE) A-6a (8) Very Soft Silt and Clay Trace Gravel Trace Coarse to Fine Sand	80	80.7	644.17	643.47
ST-06A		0	1	1	47	51	28	9	(COHESIVE) A-4a (8) Very Soft Sandy Silt Trace Gravel "And" Clay	80	80.7	644.17	643.47
ST-06B		5	2	1	39	53	25	8	(COHESIVE) A-4a (8) Very Soft Sandy Silt Trace Gravel "And" Clay	80	80.7	644.17	643.47
ST-06C		4	2	2	37	55	26	10	(COHESIVE) A-4a (8) Very Soft Sandy Silt Trace Gravel "And" Clay	80	80.7	644.17	643.47
SS-22		0	0	1	70	29	NP	NP	(NON-COHESIVE) A-4b (8) Medium Dense Silt Trace Gravel Trace Coarse to Fine Sand Some Clay	81.5	82.5	642.67	641.67
SS-23	26	0	1	2	57	40	NP	NP	(NON-COHESIVE) A-4b (8) Medium Dense Silt Trace Gravel Trace Coarse to Fine Sand "And" Clay	85	86	639.17	638.17
SS-24	27	0	0	1	80	19	NP	NP	(NON-COHESIVE) A-4b (8) Medium Dense Silt Trace Gravel Trace Coarse to Fine Sand Little Clay	90	91	634.17	633.17
SS-25	22	0	1	3	68	28	NP	NP	(NON-COHESIVE) A-4b (8) Medium Dense Silt Trace Gravel Trace Coarse to Fine Sand Some Clay	95	96	629.17	628.17
SS-26	45	0	2	6	40	52	28	11	(COHESIVE) A-6a (8) Hard Silt and Clay Trace Gravel Trace Coarse to Fine Sand	100	101	624.17	623.17

B-012-0-65

Page 1 of 2

ODOT Soil Classification Worksheet

Ground Surface Elevation (f), Corrected for Datum Difference. 702.168

Sample Number	Blow Count	GR	CS	FS	SI	CL	LL	PI	ODOT Class	Elev per Boring	Elev Corrected for Datum Change
SS-1	9	0	4	3	40	53	36	15	(COHESIVE) A-6a (10) Stiff Silt and Clay Trace Gravel Trace Coarse to Fine Sand	697.9	697.168
SS-2	10	0	4	6	48	42	32	11	(COHESIVE) A-6a (8) Stiff Silt and Clay Trace Gravel Trace Coarse to Fine Sand	695.4	694.668
SS-3	5	25	30	11	21	13	NP	NP	(NON-COHESIVE) A-2-4 (0) Loose Gravel and/or Stone Fragments with sand and Silt Little Clay	692.9	692.168
SS-4	4	0	3	11	60	26	31	7	(COHESIVE) A-4b (8) Soft Silt Trace Gravel Little Coarse to Fine Sand Some Clay	690.4	689.668
SS-5	7	40	35	7	6	12	22	7	(NON-COHESIVE) A-2-4 (0) Loose Gravel and/or Stone Fragments with sand and Silt Little Clay	687.9	687.168
SS-6	16	0	2	4	34	60	38	15	(COHESIVE) A-6a (10) Very Stiff Silt and Clay Trace Gravel Trace Coarse to Fine Sand	685.4	684.668
SS-7	16	22	8	3	37	30	30	9	(COHESIVE) A-4a (6) Very Stiff Sandy Silt Some Gravel Some Clay	682.9	682.168
SS-8	18	0	1	4	39	56	35	15	(COHESIVE) A-6a (10) Very Stiff Silt and Clay Trace Gravel Trace Coarse to Fine Sand	677.9	677.168
SS-9	35	9	1	1	63	26	NP	NP	(NON-COHESIVE) A-4b (8) Dense Silt Trace Gravel Trace Coarse to Fine Sand Some Clay	672.9	672.168
SS-10	22	0	1	0	17	82	44	19	(COHESIVE) A-7-6 (12) Very Stiff Clay Trace Gravel Trace Coarse to Fine Sand Little Silt	667.9	667.168
SS-11	20	0	0	0	40	60	34	13	(COHESIVE) A-6a (9) Very Stiff Silt and Clay Trace Gravel Trace Coarse to Fine Sand	662.9	662.168
SS-12	20	0	0	0	37	63	37	17	(COHESIVE) A-6b (11) Very Stiff Silty Clay Trace Gravel Trace Coarse to Fine Sand	657.9	657.168
SS-13	19	0	0	0	22	78	37	15	(COHESIVE) A-6a (10) Very Stiff Silt and Clay Trace Gravel Trace Coarse to Fine Sand	652.9	652.168
SS-14	13	0	1	0	25	74	43	23	(COHESIVE) A-7-6 (14) Stiff Clay Trace Gravel Trace Coarse to Fine Sand Some Silt	647.9	647.168
SS-15	18	0	0	1	35	64	38	15	(COHESIVE) A-6a (10) Very Stiff Silt and Clay Trace Gravel Trace Coarse to Fine Sand	642.9	642.168
SS-16	20	0	1	1	34	64	33	12	(COHESIVE) A-6a (9) Very Stiff Silt and Clay Trace Gravel Trace Coarse to Fine Sand	637.9	637.168
SS-17	25	0	0	0	36	64	32	12	(COHESIVE) A-6a (9) Very Stiff Silt and Clay Trace Gravel Trace Coarse to Fine Sand	632.9	632.168

B-012-0-65

Page 2 of 2

Sample Number	Blow Count	GR	CS	FS	SI	CL	LL	PI	ODOT Class	Elev per Boring	Elev Corrected for Datum Change
SS-18	39	0	0	1	59	40	NP	NP	(NON-COHESIVE) A-4b (8) Dense Silt Trace Gravel Trace Coarse to Fine Sand "And" Clay	627.9	627.168
SS-19	44	0	0	1	85	14	NP	NP	(NON-COHESIVE) A-4b (8) Dense Silt Trace Gravel Trace Coarse to Fine Sand Little Clay	622.9	622.168
SS-20	36	0	2	6	72	20	26	8	(COHESIVE) A-4b (8) Hard Silt Trace Gravel Trace Coarse to Fine Sand Little Clay	617.9	617.168
SS-21	46	0	0	1	60	39	NP	NP	(NON-COHESIVE) A-4b (8) Dense Silt Trace Gravel Trace Coarse to Fine Sand "And" Clay	612.9	612.168
SS-22	48	0	1	1	56	42	NP	NP	(NON-COHESIVE) A-4b (8) Dense Silt Trace Gravel Trace Coarse to Fine Sand "And" Clay	607.9	607.168
SS-23	75	15	3	2	32	48	31	9	(COHESIVE) A-4a (8) Hard Sandy Silt Little Gravel "And" Clay	602.9	602.168
SS-24	65	9	4	5	33	49	29	11	(COHESIVE) A-6a (8) Hard Silt and Clay Trace Gravel Trace Coarse to Fine Sand	602.1	601.368

Boring Logs:

FIELD DATA - SOIL LOG

Location No. 1 County: SUM-271-
 MAY 5 Pier-Abut. Bridge No. 8.29
 Station: 449+25 Over: _____
 Offset: 2
 Started: 4-29-70 Equipment: 4520001 CORE DRILL
 Completed: 5-1-70 Diameter _____

Proposed Footer: _____

Water Level: _____

Depth Feet	Log	Elevation	Ground Line
0		724.9	
5			CLAY WITH SAND AND GRAVEL (FILL)
10		1719.9	DSFROM-5'-6' BLOWS-6-8
15			SAND AND GRAVEL WITH CLAY (FILL)
20		2714.9	DSFROM-11'-11' BLOWS-5-6
25			SAND AND GRAVEL WITH CLAY (FILL)
30		3709.9	DSFROM-15'-16' BLOWS-5-8
35			SAND AND GRAVEL WITH CLAY (FILL)
40		4704.9	DSFROM-20'-21' BLOWS-11-11
45			CLAY WITH SAND AND GRAVEL (FILL)
50		5699.9	DSFROM-25'-26' BLOWS-7-9

Form TE-6

26	699.9	HARD SILTY CLAY
30	664.9	(FILL) DSFROM-30'-31' BLOWS-12-16
35	668.9	GRAY AND BROWN SILTY CLAY (FILL) DSFROM-35'-36' BLOWS-11-13
40	664.9	GRAY AND BROWN SILTY CLAY (FILL) DSFROM-40'-41' BLOWS-6-7
45	679.9	GRAY SILTY CLAY NATURAL GROUND DSFROM-45'-46' BLOWS-12-14
50	674.9	GRAY SILTY SAND AND SILTY CLAY COULD NOT PRESS DSFROM-50'-51' BLOWS-17-18
55	669.9	BOF PRESS #1 AT 56.5 55-56.5 REC. 1.0 SILTY CLAY SILTY CLAY - TORQUE 3/2 DSFROM-56'-57' BLOWS-6-6
60	664.9	BOF PRESS #2 AT 61.5 60-61.5 REC. 1.5 SILTY CLAY SILTY CLAY TORQUE 3/2 DSFROM-61'-62' BLOWS-5-7

Remarks: _____

Party EBLEN EMMERT

Chief of Party BROWN

FIELD DATA - SOIL LOG

Location No. 1 County: SUM. 271-8.29
 MAY 01 REC'D Pier-Abut. Bridge No. _____
 Station: 449+25 Over: _____
 Offset: 4
 Started: 4-29-70 Equipment: CORE DRILL
 Completed: 5-1-70 Diameter: _____

Proposed Footer: _____

Water Level: _____

Depth Feet	Log	Samples	Elevation	
0			664.9	Ground Line
				SILTY CLAY
				B.O.F. PRESS #3 AT 66.5
				PRESS #3 65-66.5 REC. 1.5 SILTY CLAY
				SILTY CLAY TORVANE 4
65			665.9	D.S. FROM 66.8-67.8 BLOWS - 6-7
				SILTY CLAY
				B.O.F. PRESS #4 AT 71.4
				PRESS #4 71.4-71.5 REC. 1.5 SILTY CLAY
				SILTY CLAY TORVANE 5
70			665.4	D.S. FROM 71.4-72.4 BLOW - 5-5
				SILTY CLAY
				B.O.F. PRESS #5
				PRESS #5 75-76.5 REC. 1.5 SILTY CLAY
				SILTY CLAY TORVANE 5
75			664.9	D.S. FROM 76.4-77.4 BLOWS - 9-11
				SILTY CLAY WITH SAND
				B.O.F. PRESS #6
				PRESS #6 80-81.5 REC. 1.0 SILTY CLAY & SAND
				SILTY SAND AND CLAY TORVANE 4
80			664.9	D.S. FROM 81.4-82.4 BLOWS - 13-14
				SILTY CLAY AND SILTY SAND
				COULD NOT PRESS
85			663.9	D.S. FROM 85-86 BLOWS - 12-14

Form TE-6

	639.9	GRAY SILTY SAND
90	634.9	D.S. FROM 90-91 BLOWS - 12-15
		SILTY CLAY - SILTY SAND
95	629.9	D.S. FROM 95-96 BLOWS - 9-13
		HARD GRAY TILL
100	624.9	D.S. FROM 100-101 BLOWS - 19-26
	623.9	
105		END OF BORING CALLED OFF BY HALL
110		
115		
120		

Remarks: 60' CASING IN HOLE
 WATER LEVEL #2

Party EBLEN EMMERT

Chief of Party BROOKIN

SUMMARY OF TESTS ON SOIL PROFILE SAMPLES

County, Rt. No., & Section

SUM-271-8.25



Lab. No. So.-	Sample No.	Station	Depth in Feet	Mechanical Analysis					Physical Charact.				Density	SHTL Class	Remarks
				Agg. %	C Sand %	F Sand %	Silt %	Clay %	L.L.	P.I.	Water Cont. %	Opt.	Max. Dry Wt.		
10631	0.1	44.9+25	55-56	0	1	0	25	74	40	18	30			A66	GR-MIC
10632	0.2	"	60-61.2	0	0	0	25	75	43	23	28			A76	GR-MIC
10632	A	"	60-61.2	0	0	0	27	73	41	20	29			A76	GR-MIC
10632	B	"	60-61.2	0	0	1	25	74	42	22	29			A76	GR-MIC
10633	0.3	"	65-66.1	0	0	0	26	74	42	22	29			A76	GR-MIC
10633	A	"	65-66.1	0	0	1	38	61	37	16	26			A66	GR-MIC
10633	B	"	65-66.1	0	0	1	32	67	34	16	25			A66	GR-MIC
10633	B	"	65-66.1	0	0	0	27	73	37	17	27			A66	GR-MIC
10634	0.4	"	70-71.3	0	0	1	32	67	36	16	26			A66	GR-MIC
10634	A	"	70-71.3	0	0	1	27	72	37	16	29			A66	GR-MIC
10634	A	"	70-71.3	0	1	1	24	74	40	20	30			A66	GR-MIC
10634	B	"	70-71.3	0	1	1	23	75	38	17	28			A66	GR-MIC
10635	0.5	"	75-76.3	0	1	1	25	73	38	18	29			A66	GR-MIC
10635	A	"	75-76.3	0	0	0	43	57	30	12	27			A62	GR-MIC
10635	A	"	75-76.3	0	0	1	39	60	28	11	21			A62	GR-MIC
10635	B	"	75-76.3	0	0	0	21	79	36	14	28			A62	GR-MIC

7
2

Sum. 27/ 8.29

Lab. No. So.-	Sample No.	Station	Depth in Feet	Mechanical Analysis					Physical Charact.				Density	SHTL Class	Remarks
				Agg. %	C Sand %	F Sand %	Silt %	Clay %	L.L.	P.I.	Water Cont. %	Opt.	Max. Dry Wt.		
10635	C	449+25 d	75-76.3	0	0	1	42	57	28	12	23			A-6a	
				0	0	1	36	63	31	13	25			A-6a	
10636	OL	11	80-80.7	0	1	1	34	54	29	11	22			A-6a	GR - m c
10636	A	11	80-80.7	0	1	1	47	51	28	9	20			A-4a	GR - m c
10636	F	11	80-80.7	5	2	1	39	53	25	8	20			A-4a	GR - m c
10636	E	11	80-80.7	4	2	2	37	53	26	10	20			A-4a	GR - m c
				2	2	1	39	56	21	10	20				

SUMMARY OF TESTS ON SOIL PROFILE SAMPLES

County, Rt. No., & Section

SUM-271-8.25

1
2

Lab. No. So.-	Sample No.	Station	Depth in Feet	Mechanical Analysis					Physical Charact.				Density	SHTL Class	Remarks
				Agg. %	C Sand %	F Sand %	Silt %	Clay %	L.L.	P.I.	Water Cont. %	Opt.	Max. Dry Wt.		
9928	1	449+25 E	5-6	0	5	6	32	57	37	17	19			A66	BR GR-MC 8 ² / ₃ +
	9	"	10-11	0	3	5	36	53	30	11	15			A62	BR-SMC +
9930	3	"	15-16	12	7	7	29	45	32	10	17			A62	BR GR-SMC 6 +
	1	"	20-21	9	7	8	30	46	32	12	18			A62	BR-MC 8 +
	2	"	25-26	0	4	20	46	30	N-P		17			A42	BR GR-SMC +
	3	"	30-31	0	1	2	36	61	37	16	20			A66	BR GR-MC 8 ² / ₃ +
	4	"	35-36	0	1	1	58	40	N-P		31			A46	BR GR-SMC +
	5	"	40-41	0	1	1	54	44	N-P		27			A46	GR-SMC +
	6	"	45-46	0	0	0	72	27	N-P		24			A46	GR-SMC +
	7	"	50-51	0	1	2	73	24	N-P		21			A46	GR-SMC not
	8	"	56-57	0	0	0	28	72	35	16	26			A66	GR-MC +
	9	"	62-63	0	0	0	37	63	33	16	27			A66	GR-SMC +
9940	13	"	68-69	0	0	0	20	80	45	21	31			A76	GR-MC +

SUMMARY OF TESTS ON SOIL PROFILE SAMPLES

County, Rt. No., & Section

SUM-271-8.25

2

2

Lab. No. So.-	Sample No.	Station	Depth in Feet	Mechanical Analysis					Physical Charact.				Density		SHTL Class	Remarks
				Agg. %	C Sand %	F Sand %	Silt %	Clay %	L.L.	P.I.	Water Cont. %	Opt.	Max. Dry Wt.			
9941	14	448122 E	61.5625	0	0	0	23	77	41	18	33			A7.6	GR-MC	+
2	15	"	66.5						27	17	27			-	GR-MC	+
3	16	"	66.5625	0	0	0	21	79	41	21	29			A7.6	GR-MC	+
4	17	"	71.5						46	25	31			-	GR-MC	+
5	18	"	71.5625	0	1	2	20	77	41	21	27			A7.6	GR-MC	+
6	19	"	76.5	0	1	2	28	69	35	17	24			A6.6	GR-MC	+
7	20	"	76.5625	0	0	1	43	56	28	11	23			A5.2	GR-SMC	+
8	21	"	81.5	0	2	4	50	44	26	7	18			A4.6	GR-SMC	+
9	22	"	81.5625	0	0	1	70	29	15	12	23			A4.6	GR-SMC	+
9950	23	"	85.56	0	1	2	57	40	15	12	23			A4.6	GR-SMC	+
1	24	"	90.51	0	0	1	80	19	15	12	26			A4.6	GR-SMC	10.5
2	25	"	95.96	0	1	3	68	28	1	1	22			A4.6	GR-SMC	+
3	26	"	100.101	0	2	6	40	52	28	11	17			A3.2	GR-SMC	+

SO-8

Date: November 5, 2021

Subject: SUM-271-8.25, PID 111417 Foundation Design Recommendations

LOG OF BORING															
Date Started 4-28-65		Sampler Type SS		Dia. 1 3/8"		Water Elev. _____									
Date Completed 4-28-65		Casing Length 25'		Dia. 3 1/2"		Surface Elev. 702.9'									
Boring No. B-12		Station & Offset 450+50.37' Rt (FORWARD PIER)													
Elev.	Depth	Std. Pen. (N)	Rea. ft.	Loss ft.	Description	Sample No.	% Agg.	% C.S.	% F.S.	% Silt	% Clay	L.L.	P.I.	W.C.	SHTL Class.
702.9	0														
700.4	2														
	4	5/3			Brown and Gray Silt and Clay	1	0	4	3	40	53	36	15	28	
697.9	6	5/3			Brown Silt and Clay	2	0	4	6	48	42	32	11	23	
695.4	8	3/2			Gray Silty Gravelly Sand	3	25	30	11	21	13	NP	NP	17	
692.9	10	3/1			Gray Clayey Silt, Trace of Organic	4	0	3	11	60	26	31	7	30	
690.4	12	3/4			Gray Silty Gravelly Sand	5	40	35	7	6	12	22	7	21	
687.9	14	6/10			Gray Silt and Clay	6	0	2	4	34	60	38	15	22	
685.4	16	6/10			Brown and Gray Gravelly Silt	7	22	8	3	37	30	30	9	23	
682.9	18	7/11			Brown and Gray Silt and Clay	8	0	1	4	39	56	35	15	21	
	20														
	22														
677.9	24	21/14			Gray Silt	9	9	1	1	63	26	NP	NP	23	
	26														
	28														
672.9	30	12/10			Gray Silty Clay	10	0	1	0	17	82	44	19	34	
	32														
	34														
667.9	36	9/11			Gray Silt and Clay	11	0	0	0	40	60	34	13	26	
	38														
662.9	40	8/12			Gray Silty Clay	12	0	0	0	37	63	37	17	32	
	42														
	44														
657.9	46	8/11			Gray Silt and Clay	13	0	0	0	22	78	37	15	33	
	48														
652.9	50	6/p			Gray Clay	14	0	1	0	25	74	43	23	34	
	52														
	54														
647.9	56	7/11			Gray Silt and Clay	15	0	0	1	35	64	38	15	28	
	58														
642.9	60	10/10			Gray Silt and Clay	16	0	1	1	34	64	33	12	23	
	62														
	64														
637.9	66	12/13			Gray Silt and Clay	17	0	0	0	36	64	32	12	23	
	68														
632.9	70	18/21			Gray Silt	18	0	0	1	59	40	NP	NP	32	
	72														
	74														
627.9	76	21/23			Gray Silt	19	0	0	1	85	14	NP	NP	18	
	78														
622.9	80	16/20			Gray Clayey Silt	20	0	2	6	72	20	26	8	17	
	82														
	84														
617.9	86	24/22			Gray Silt	21	0	0	1	60	39	NP	NP	21	
	88														
612.9	90	22/26			Gray Silt	22	0	1	1	56	42	NP	NP	21	
	92														
	94														
607.9	96	50* (0.7')			Gray Gravelly Silt	23	15	3	2	32	48	31	9	13	
	98														
602.9	100	50* (0.8')			Gray Silt and Clay	24	9	4	5	33	49	29	11	15	
602.1															

BOTTOM OF BORING

*Refusal

TEST BORING No.: **BMB-01**

STA. & OFFSET: 449+01.48, 27.73' Lt

ELEVATION: 731.4ft

CLIENT: Richland Engineering Ltd.

PROJECT: Bridge No. SUM-271-0854 Lt. over BM Road

PROJECT No.: 03001g

LOCATION: Summit County, OH

DATE STARTED: 2/26/03 DATE COMPLETED: 2/27/03

SAMPLER DIAM: 2.0" TYPE: SS HAMMER WT.: 140lb FALL: 30"

CASING DIAM: 3.25" TYPE: HSA OTHER:

DRILLING INFORMATION:

North America Drilling, Inc. using a CME 55 Truck Mounted Drill Rig

GROUNDWATER INFORMATION:

Groundwater was encountered at 45.0 feet during and 45.0 feet upon completion of drilling operations.

GROUNDWATER DURING DRILLING

GROUNDWATER UPON COMPLETION

EXTENDED GROUNDWATER READING

ELEV (ft.)	DEPTH (ft.)	Soil/Rock Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE DEPTH	BLOWS/6 INCHES N-VALUE (BLOWS/FT) OR REC%/ (RQD%)	PENETROMETER (tons/ft²)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%)			AGGREGATE (%)	COARSE AND FINE SAND (%)	SILT AND CLAY COMBINED (%) OR SILT (%)/CLAY (%)	CLASSIFICATION SYMBOL
									LL	PL	PI				
731.1	0.3		TOPSOIL Medium stiff to stiff, brown SILT AND CLAY (A-6a), trace sand, trace to no rock fragments (fill).	SS 1	1.0	8	3.75	23	35	22	13	0	5	94	A-6a
				SS 2	3.5	10	1.75	23	-	-	-	-	-	-	VISUAL
725.4	6.0		Stiff, brown SANDY SILT (A-4a), some clay, trace rock fragments (fill).	SS 3	6.0	15	2.5	16	-	-	-	-	-	-	VISUAL
				SS 4	8.5	13	1.5	15	-	-	-	-	-	-	VISUAL
720.4	11.0		Stiff to hard, brown SILT AND CLAY (A-6a), trace sand, trace rock fragments, moist (fill).	SS 5	11.0	10	1.5	23	-	-	-	-	-	-	VISUAL
				SS 6	13.5	14	3.0	23	-	-	-	-	-	-	VISUAL
				SS 7	16.0	14	4.0	19	-	-	-	-	-	-	VISUAL
				SS 8	18.5	16	4.5	18	-	-	-	-	-	-	VISUAL
				SS 9	21.0	12	3.25	19	-	-	-	-	-	-	VISUAL
				SS 10	23.5	19	4.5	18	-	-	-	-	-	-	VISUAL
				SS 11	26.0	38	4.5+	17	-	-	-	-	-	-	VISUAL
702.3	29.1		Very stiff, brown SANDY SILT (A-4a), little clay, trace rock fragments, moist. (fill)	SS 12A	28.5	25	3.75	19	-	-	-	-	-	-	VISUAL
701.4	30.0		Very stiff, brown SILT AND CLAY (A-6a), trace sand, trace rock fragments, moist (fill).	SS 12B	29.1	15	1.25	16	-	-	-	-	-	-	VISUAL
				SS 13	33.5	25	4.5+	19	-	-	-	-	-	-	VISUAL
692.9	38.5			SS 14	38.5	16	3.0	23	29	21	8	0	11	43/45	A-4a

NOTES/REMARKS: SS = Split Spoon, HSA = Hollow Stem Augur, ST = Shelby Tube, NP = Non Plastic, WOH = Weight Of Hammer

BMB-01: PAGE 1 OF 3

TEST BORING No.: **BMB-01**

STA. & OFFSET: 449+01.48, 27.73' Lt.

ELEVATION: 731.4ft

PROJECT: Bridge No. SUM-271-0854 Lt. over BM Road

PROJECT No.: 03001g

DRILLING INFORMATION:

North America Drilling, Inc. using a CME 55 Truck Mounted Drill Rig

GROUNDWATER INFORMATION:

Groundwater was encountered at 45.0 feet during and 45.0 feet upon completion of drilling operations.

GROUNDWATER DURING DRILLING
 GROUNDWATER UPON COMPLETION
 EXTENDED GROUNDWATER READING

ELEV (ft.)	DEPTH (ft.)	Soil/Rock Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE DEPTH	BLOWS/6 INCHES N-VALUE (BLOWS/FT) OR REC%/ (RQD%)	PENETROMETER (tons/ft²)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%)			AGGREGATE (%)	COARSE AND FINE SAND (%)	SILT AND CLAY COMBINED (%) OR SILT (%) / CLAY (%)	CLASSIFICATION SYMBOL
									L	P	I				
			Very stiff to stiff, brown to gray SANDY SILT (A-4a), some clay, trace to no rock fragments, moist. (continued)	SS 15	43.5	5 29 11 18	1.75	19	-	-	-	-	-	-	VISUAL
				SS 16	48.5	8 20 11 11	2.25	20	-	-	-	-	-	-	VISUAL
			Note: Color changed to gray at approximately 53.5 feet.	SS 17	53.5	4 16 6 10	1.25	27	28	19	9	0	1	37/62	A-4a
				SS 18	58.5	7 18 8 10	1.0	27	-	-	-	-	-	-	VISUAL
				ST 19	63.5	ST		29	-	-	-	-	-	-	VISUAL
				SS 20	68.5	4 12 7 7	0.75	28	-	-	-	-	-	-	VISUAL
				SS 21	73.5	2 10 4 9	0.5	29	-	-	-	-	-	-	VISUAL
				SS 22	78.5	5 25 11 14	0.5	28	-	-	-	-	-	-	VISUAL
647.9	83.5		Very stiff to hard, gray SILT (A-4b), some clay, trace to no sand, moist.	SS 23	83.5	5 23 10 13	0.5	23	-	-	-	-	-	-	VISUAL

NOTES/REMARKS: SS = Split Spoon, HSA = Hollow Stem Augur, ST = Shelby Tube, NP = Non Plastic, WOH = Weight Of Hammer

BMB-01: PAGE 2 OF 3

TEST BORING No.: **BMB-01**

STA. & OFFSET: 449+01.48, 27.73' Lt.

ELEVATION: 731.4ft

PROJECT: Bridge No. SUM-271-0854 Lt. over BM Road

PROJECT No.: 03001g

DRILLING INFORMATION:

North America Drilling, Inc. using a CME 55 Truck Mounted Drill Rig

GROUNDWATER INFORMATION:

Groundwater was encountered at 45.0 feet during and 45.0 feet upon completion of drilling operations.

GROUNDWATER DURING DRILLING
 GROUNDWATER UPON COMPLETION
 EXTENDED GROUNDWATER READING

ELEV (ft.)	DEPTH (ft.)	Soil/ Rock Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE DEPTH	BLOWS/6 INCHES N-VALUE (BLOWS/FT) OR REC%/100 (%)	PENETROMETER (tons/ft ²)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%)			AGGREGATE (%)	COARSE AND FINE SAND (%)	SILT AND CLAY COMBINED (%) OR SILT (%) / CLAY (%)	CLASSIFICATION SYMBOL
									LL	PL	PI				
		++	Very stiff to hard, gray SILT (A-4b), some clay, trace to no sand, moist. (continued)	SS 24	88.5	15	1.75	22	25	20	5	0	0	52/48	A-4b
		++		SS 25	93.5	12	1.25	22	-	-	-	-	-	-	VISUAL
		++		SS 26	98.5	15	0.75	23	-	-	-	-	-	-	VISUAL
627.9	103.5	++	Hard, gray SILT AND CLAY (A-6a), trace sand, trace to no rock fragments, moist.	SS 27	103.5	32	3.0	17	-	-	-	-	-	-	VISUAL
		++		SS 28	108.5	59	4.5+	16	-	-	-	-	-	-	VISUAL
		++		SS 29	113.5	85	4.5+	15	-	-	-	-	-	-	VISUAL
		++		SS 30	118.5	89	4.5+	16	-	-	-	-	-	-	VISUAL
611.4	120.0	++	TERMINATION DEPTH = 120.0 FEET												

NOTES/REMARKS: SS = Split Spoon, HSA = Hollow Stem Augur, ST = Shelby Tube, NP = Non Plastic, WOH = Weight Of Hammer

BMB-01: PAGE 3 OF 3

TEST BORING No.: **BMB-02**

STA. & OFFSET: 450+35.89, 29.32' Lt

ELEVATION: 702.5ft

CLIENT: Richland Engineering Ltd.

PROJECT: Bridge No. SUM-271-0854 Lt. over BM Road

PROJECT No.: 03001g

LOCATION: Summit County, OH

DATE STARTED: 2/7/03 DATE COMPLETED: 2/10/03

SAMPLER DIAM: 2.0" TYPE: SS HAMMER WT.: 140lb FALL: 30"

CASING DIAM: 325" TYPE: HSA OTHER:

DRILLING INFORMATION:

North America Drilling, Inc. using a CME 55 Truck Mounted Drill Rig

GROUNDWATER INFORMATION:

Groundwater was encountered at 11.5 feet during and at 26.0 feet upon completion of drilling operations.

GROUNDWATER DURING DRILLING
 GROUNDWATER UPON COMPLETION
 EXTENDED GROUNDWATER READING

ELEV (ft.)	DEPTH (ft.)	Soil/Rock Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE DEPTH	BLOWS/6 INCHES N-VALUE (BLOWS/FT) OR REC% (RCD%)	PENETROMETER (tons/ft)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%)			AGGREGATE (%)	COARSE AND FINE SAND (%)	SILT AND CLAY COMBINED (%) OR SILT%/CLAY(%)	CLASSIFICATION SYMBOL
									LL	PL	PI				
701.8	0.7		TOPSOIL Stiff, brown SILT AND CLAY (A-6a), little sand, trace to no rock fragments, trace roots (fill).	SS 1	1.0	14	4.5+	17	-	-	-	-	-	-	VISUAL
699.0	3.5		Very stiff to soft, brown SILTY CLAY (A-6b), trace sand, trace to no rock fragments, moist to wet.	SS 2	3.5	18	2.75	23	-	-	-	-	-	-	VISUAL
				SS 3	6.0	10	1.75	28	40	24	16	0	3	97	A-6b
				SS 4	8.5	4	-	28	-	-	-	-	-	-	VISUAL
691.5	11.0		Medium stiff to stiff, brown SILT (A-4b), some clay, trace sand, moist to wet.	SS 5	11.0	5	-	26	-	-	-	-	-	-	VISUAL
				SS 6	13.5	9	4.5+	23	-	-	-	-	-	-	VISUAL
				ST 7	16.0	ST	-	-	-	-	-	-	-	-	VISUAL
684.0	18.5		Medium dense, brown COARSE AND FINE SAND (A-3a), trace rock fragments, moist.	SS 8	18.5	11	-	20	-	-	-	-	-	-	VISUAL
681.5	21.0		Very stiff to hard, brown SILT (A-4b), some clay, trace sand, moist.	SS 9	21.0	25	2.5	22	-	-	-	-	-	-	VISUAL
				SS 10	23.5	27	1.25	22	26	17	9	0	3	52/46	A-4b
				SS 11	26.0	50	4.5+	18	-	-	-	-	-	-	VISUAL
674.3	28.2		Very stiff, gray SILT AND CLAY (A-6a), trace sand, trace to no rock fragments, moist.	SS 12	28.5	16	1.5	25	-	-	-	-	-	-	VISUAL
				SS 13	33.5	18	1.0	26	-	-	-	-	-	-	VISUAL
				SS 14	38.5	18	1.5	23	-	-	-	-	-	-	VISUAL

NOTES/REMARKS: SS = Split Spoon, HSA = Hollow Stem Augur, ST = Shelby Tube, NP = Non Plastic, WOH = Weight Of Hammer

BMB-02: PAGE 1 OF 3

TEST BORING No.: **BMB-02**

STA. & OFFSET: 450+35.89, 29.32' Lt.

ELEVATION: 702.5ft

PROJECT: Bridge No. SUM-271-0854 Lt. over BM Road

PROJECT No.: 03001g

DRILLING INFORMATION:

North America Drilling, Inc. using a CME 55 Truck Mounted Drill Rig

GROUNDWATER INFORMATION:

Groundwater was encountered at 11.5 feet during and at 26.0 feet upon completion of drilling operations.

GROUNDWATER DURING DRILLING
 GROUNDWATER UPON COMPLETION
 EXTENDED GROUNDWATER READING

LOGS 03007GBMR.GPJ PRIMENG.GUT 4/17/03															
ELEV (ft.)	DEPTH (ft.)	Soil/ Rock Symbol	MATERIAL DESCRIPTION	SAMPLE	SAMPLE	BLOW N-VALUE OR R	PENE	MOIS	LIQ	PL	PI	AGG	COAR	SILT OR SI	CLAS SYMB
			Very stiff, gray SILT AND CLAY (A-6a), trace sand, trace to no rock fragments, moist. (continued)	SS 15	43.5	15	1.0	25	-	-		-	-		VISUAL
				SS 16	48.5	18	0.75	26	-	-		-	-		VISUAL
				SS 17	53.5	17	0.75	28	-	-		-	-		VISUAL
				SS 18	58.5	19	0.75	25	-	-		-	-		VISUAL
				SS 19	63.5	24	1.5	21	31	19	12	0	1	98	A-6a
634.0	68.5		Stiff, gray SILT (A-4b), some clay, trace sand, moist.	SS 20	68.5	13	1.5	23	-	-		-	-		VISUAL
				SS 21	73.5	14	-	24	-	-		-	-		VISUAL
624.0	78.5		Hard, gray SILT AND CLAY (A-6a), trace sand, trace to no rock fragments, moist.	SS 22	78.5	34	2.5	18	-	-		-	-		VISUAL
				SS 23	83.5	41	4.0	20	-	-		-	-		VISUAL

NOTES/REMARKS: SS = Split Spoon, HSA = Hollow Stem Augur, ST = Shelby Tube, NP = Non Plastic, WOH = Weight Of Hammer

BMB-02: PAGE 2 OF 3

TEST BORING No.: **BMB-02**

STA. & OFFSET: 450+35.89, 29.32' Lt.

ELEVATION: 702.5ft

PROJECT: Bridge No. SUM-271-0854 Lt. over BM Road

PROJECT No.: 03001g

DRILLING INFORMATION:

North America Drilling, Inc. using a CME 55 Truck Mounted Drill Rig

GROUNDWATER INFORMATION:

Groundwater was encountered at 11.5 feet during and at 26.0 feet upon completion of drilling operations.

GROUNDWATER DURING DRILLING
 GROUNDWATER UPON COMPLETION
 EXTENDED GROUNDWATER READING

ELEV (ft.)	DEPTH (ft.)	Soil/ Rock Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE DEPTH	BLOWS/6 INCHES N-VALUE (BLOWS/FT) OR REC%/ (RQD%)	PENETROMETER (tons/ft²)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%)			AGGREGATE (%)	COARSE AND FINE SAND (%)	SILT AND CLAY COMBINED (%) OR SILT (%) / CLAY (%)	CLASSIFICATION SYMBOL
									LL	PL	P				
			Hard, gray SILT AND CLAY (A-6a), trace sand, trace to no rock fragments, moist. (continued)	SS 24	88.5	144	4.5+	13	-	-	-	-	-	-	VISUAL
609.0	93.5		Hard, gray SILT AND CLAY (A-6a), little to trace sand, trace rock fragments, moist.	SS 25	93.5	79	4.5+	15	32	18	14	8	13	78	A-6a
				SS 26	98.5	55	4.5+	14	-	-	-	-	-	-	VISUAL
				SS 27	103.5	53	3.5	18	-	-	-	-	-	-	VISUAL
				SS 28	108.5	49	4.25	18	-	-	-	-	-	-	VISUAL
587.5	115.0		TERMINATION DEPTH = 115.0 FEET	SS 29	113.5	44	4.5+	19	-	-	-	-	-	-	VISUAL

NOTES/REMARKS: SS = Split Spoon, HSA = Hollow Stem Augur, ST = Shelby Tube, NP = Non Plastic, WOH = Weight Of Hammer

BMB-02: PAGE 3 OF 3

TEST BORING No.: **BMB-03**

STA. & OFFSET: 451+20.60, 27.62' Lt.

ELEVATION: 735.6ft

CLIENT: Richland Engineering Ltd.

PROJECT: Bridge No. SUM-271-0854 Lt. over BM Road

PROJECT No.: 03001g

LOCATION: Summit County, OH

DATE STARTED: 2/28/03 DATE COMPLETED: 3/4/03

SAMPLER DIAM: 2.0" TYPE: SS HAMMER WT.: 140lb FALL: 30"

CASING DIAM: 3.25" TYPE: HSA OTHER:

DRILLING INFORMATION:

North America Drilling, Inc. using a CME 55 Truck Mounted Drill Rig

GROUNDWATER INFORMATION:

Groundwater was encountered at 32.0 feet during and at 25.8 feet upon completion of drilling operations.

GROUNDWATER DURING DRILLING
 GROUNDWATER UPON COMPLETION
 EXTENDED GROUNDWATER READING

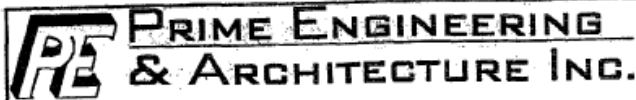
ELEV (ft.)	DEPTH (ft.)	Soil/Rock Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE DEPTH	BLOWS/6 INCHES N-VALUE (BLOWS/FT) OR REC%/ (RQD%)	PENETROMETER (tons/ft²)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%)			AGGREGATE (%)	COARSE AND FINE SAND (%)	SILT AND CLAY COMBINED (%) OR SILT (%)/CLAY (%)	CLASSIFICATION SYMBOL
									LL	PL	PI				
735.3	0.3		TOPSOIL												
			Very stiff to stiff, brown SILT AND CLAY (A-6a), trace sand, trace rock fragments, moist (fill).	SS 1	1.0	4 18		17	37	22	15	2	10	88	A-6a
				SS 2	3.5	5 14		21	-	-	-	-	-	-	VISUAL
				SS 3	6.0	7 17		19	-	-	-	-	-	-	VISUAL
				SS 4	8.5	8 16		20	-	-	-	-	-	-	VISUAL
				SS 5	11.0	9 9		21	-	-	-	-	-	-	VISUAL
				SS 6	13.5	10 16		21	-	-	-	-	-	-	VISUAL
				SS 7	16.0	12 12		22	-	-	-	-	-	-	VISUAL
				SS 8	18.5	11 19		25	-	-	-	-	-	-	VISUAL
			Note: Dark brown organic layer encountered at 19.8 feet.	SS 9	21.0	13 23		21	-	-	-	-	-	-	VISUAL
			Hard to medium stiff, brown CLAY (A-7-6), trace sand, trace rock fragments, moist to wet.	SS 10	23.5	16 24		19	-	-	-	-	-	-	VISUAL
				SS 11	26.0	18 31		24	48	26	22	2	1	97	A-7-6
				SS 12	28.5	1 6		30	-	-	-	-	-	-	VISUAL
				SS 13A	33.5	7		18	-	-	-	-	-	-	VISUAL
			Brown gravel with sand and silt layer, wet.	13B	34.0	11		28	-	-	-	-	-	-	VISUAL
			Medium dense to very dense, gray SILT (A-4b), trace clay, trace sand, moist.	SS 14	38.5	11		25	NP	NP	NP	0	1	63/36	A-4b

NOTES/REMARKS: SS = Split Spoon, HSA = Hollow Stem Augur, ST = Shelby Tube, NP = Non Plastic, WOH = Weight Of Hammer

BMB-03: PAGE 1 OF 3

TEST BORING LOG33 03001GBMR GP-J PRIMENG.GDT 4/17/03

TEST BORING LOG# 02001 GBRB GP.1 PRIMENG.GDT 4/17/03

TEST BORING No.: **BMB-03**

STA. & OFFSET: 451+20.60, 27.62' Lt.

ELEVATION: 735.6ft

PROJECT: Bridge No. SUM-271-0854 Lt. over BM Road

PROJECT No.: 03001g

DRILLING INFORMATION:

North America Drilling, Inc. using a CME 55 Truck Mounted Drill Rig

GROUNDWATER INFORMATION:

Groundwater was encountered at 32.0 feet during and at 25.8 feet upon completion of drilling operations.

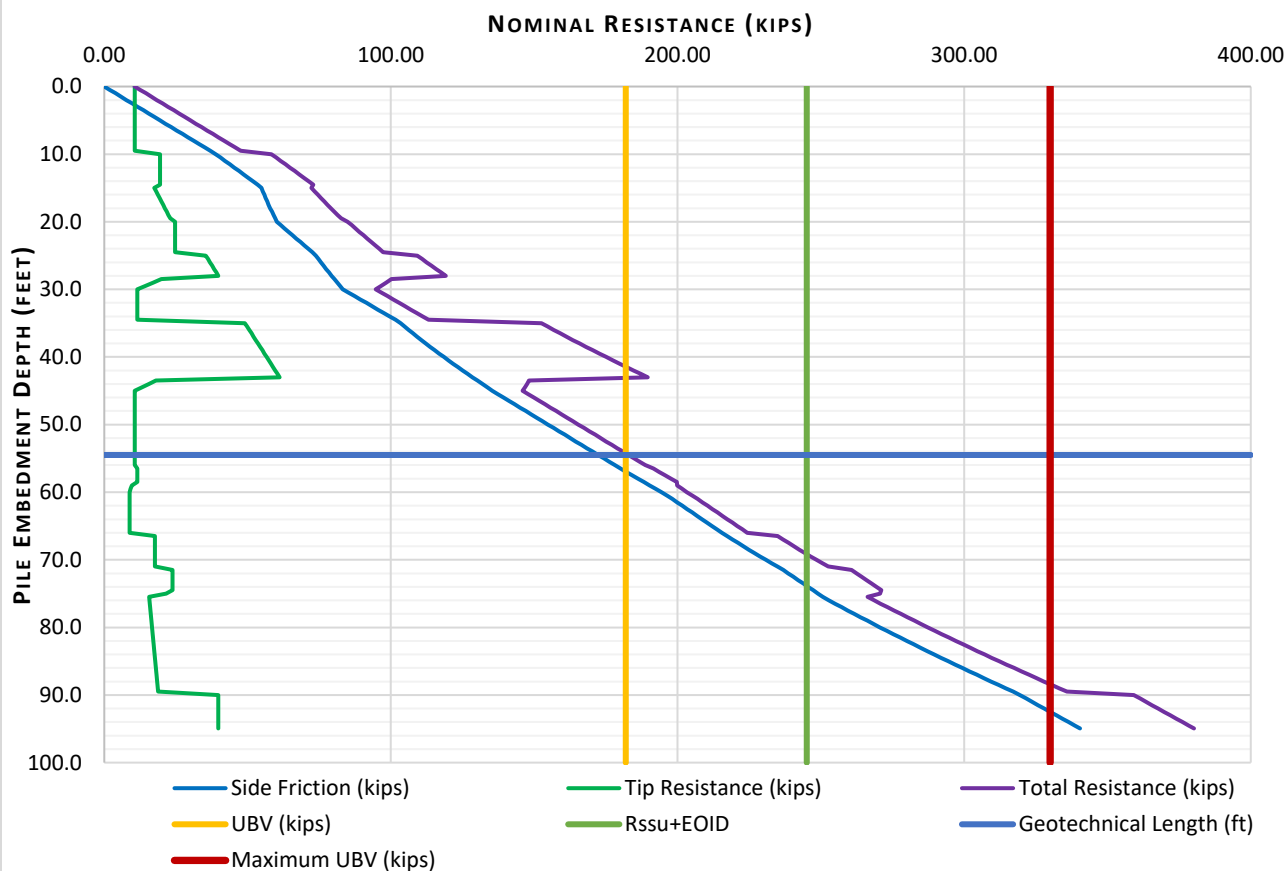
GROUNDWATER DURING DRILLING
 GROUNDWATER UPON COMPLETION
 EXTENDED GROUNDWATER READING

ELEV (ft.)	DEPTH (ft.)	Soil/ Rock Symbol	MATERIAL DESCRIPTION	SAMPLE NUMBER	SAMPLE DEPTH	BLOWS/8 INCHES N-VALUE (BLOWS/FT) OR REC%/ (RQD%)	PENETROMETER (tons/ft)	MOISTURE CONTENT (%)	ATTERBERG LIMITS (%)			AGGREGATE (%)	COARSE AND FINE SAND (%)	SILT AND CLAY COMBINED (%) OR SILT (%) / CLAY (%)	CLASSIFICATION SYMBOL
									L	PL	PI				
			Very stiff to hard, gray SILT AND CLAY (A-6a), trace sand, trace to no rock fragments, moist. (continued)	SS 24	88.5	7 9 10	19	0.75	26	-	-	-	-	-	VISUAL
				SS 25	93.5	8 11 12	23	1.0	27	-	-	-	-	-	VISUAL
			Note: Occasional silt lenses encountered at 98.5 feet.	SS 26	98.5	8 14 19	33	2.25	23	-	-	-	-	-	VISUAL
632.1	103.5		Hard to very stiff, gray SILT (A-4b), some clay, trace sand, trace to no rock fragments, moist.	SS 27	103.5	9 17 19	36	4.5+	21	-	-	-	-	-	VISUAL
				SS 28	108.5	10 21 24	45	3.0	21	-	-	-	-	-	VISUAL
				SS 29	113.5	7 14 15	29	3.5	21	-	-	-	-	-	VISUAL
615.6	120.0		TERMINATION DEPTH = 120.0 FEET	SS 30	118.5	10 28 32	60	3.5	21	-	-	-	-	-	VISUAL

NOTES/REMARKS: SS = Split Spoon, HSA = Hollow Stem Augur, ST = Shelby Tube, NP = Non Plastic, WOH = Weight Of Hammer

BMB-03: PAGE 3 OF 3

PILE NOMINAL RESISTANCE VERSUS EMBEDMENT DEPTH -REAR ABUTMENT (B-001-0-70)



PILE DRIVING RESISTANCE VERSUS EMBEDMENT DEPTH -REAR ABUTMENT (B-001-0-70)

