

November 19, 2015

EMH&T, Inc.
5500 New Albany Road
Columbus, Ohio 43054

Attention: Mr. Michael R. Brehm, P.E.

Reference: Geotechnical Exploration – Additional Services
City of Columbus - Hayden Run Boulevard, Part 2
Columbus, Ohio
CTL Project No. 09050029COLB

Dear Mr. Brehm:

CTL Engineering, Inc. has completed the Geotechnical Subsurface Exploration for the above referenced project. A PDF copy of the report is being submitted.

Thank you for the opportunity to work with you on this project. If you have any questions or need further information, please feel free to contact our office.

Respectfully Submitted

CTL ENGINEERING, INC.



Joe Grani, P.E.
Project Engineer

GEOTECHNICAL EXPLORATION-ADDITIONAL SERVICES

**CIT OF COLUMBUS-HAYDEN RUN BLVD. PART 2
COLUMBUS, OHIO
CTL PROJECT NO. 09050029COLB**

PREPARED FOR:

**EMH&T, INC.
5500 NEW ALBANY ROAD
COLUMBUS, OHIO 43054**

PREPARED BY:

**CTL ENGINEERING, INC.
2860 FISHER ROAD
COLUMBUS, OHIO 43204
Phone 614-276-8123
Fax 614-276-6377**

November 19, 2015



TABLE OF CONTENTS

	<u>PAGE</u>
I. PROJECT LOCATION AND DESCRIPTION	1
II. SUBSURFACE EXPLORATION	1
III. FINDINGS	1
IV. ANALYSIS AND RECOMMENDATIONS	2
A. Detention/Retention Basin	2
B. Suitability of Soils for Use as Embankment Fill	3
V. CHANGED CONDITIONS	3
VI. TESTING AND OBSERVATION	4
VII. CLOSING	4
APPENDIX A	BORING LOCATION PLAN/SOIL PROFILE SHEETS
APPENDIX B	TEST BORING RECORDS
APPENDIX C	LABORATORY TESTING



I. PROJECT LOCATION AND DESCRIPTION

The project involves the construction of new retention/detention basins, located east of Avery Road and the railroad tracks, and north of Hayden Run Road in Dublin, Ohio. The westernmost basin is identified as HRB2. The proposed basin to the east is identified as Riggins 3 Basin.

This report also addresses the suitability of the excavated material from the basins for use as embankment fill.

II. SUBSURFACE EXPLORATION

One (1) new test boring, identified as B-009-0-15, was performed within the limits of the proposed Riggins 3 basin. Data from boring B-008-0-12, drilled in the vicinity of the HRB2 basin in 2012, is also included with this report. The borings were drilled at the approximate locations shown on the appended plan and profile sheets.

The test borings were performed with a truck-mounted drill rig utilizing hollow stem augers (HSA). B-008-0-12 was drilled on 25th October 2012. B-009-0-15 was drilled on 14th October 2015. Standard penetration tests were conducted in the borings using 140-pound automatic hammers falling 30 inches to drive a 2-inch O.D. split barrel samplers.

Soil samples obtained were preserved in glass jars, visually classified in the field and laboratory, and tested for natural moisture content. Representative soil samples were subjected to laboratory testing including grain size distribution and Atterberg limits. Standard proctor tests, as per ASTM D698 Method A, were performed on bulk samples of auger cuttings collected at both boring locations.

Survey information at the test boring locations was provided by EMH&T personnel.

III. FINDINGS

The borings exhibited 3 to 9 inches of topsoil at the surface. Below the topsoil, the test borings generally exhibited silt and clay (A-6a) and clay (A-7-6) to a depth of 3.5 feet. These upper soils exhibited standard penetration N_{60} values ranging from 11 to 17 blows per foot (bpf), with natural moisture content values ranging from 26 to 28 percent.

The borings then exhibited gravel and/or stone fragments (A-1-a), sandy silt (A-4a) and silt and clay (A-6a) to drilled depths. These soils exhibited penetration N_{60} values ranging from 12 bpf to in excess of 50 bpf, and natural moisture content values ranging from 7 to 14 percent. These soils were further classified as glacial tills.

The results of the standard proctor testing are tabulated below:

Boring No.	Depth (ft)	Natural Moisture Content (%)	Optimum Moisture Content (%)	Maximum Dry Density (pcf)
B-008-0-12	2.0 - 10.0	14.2	13.5	119.3
B-009-0-15	15.0 - 20.0	12.6	12.0	122.7

No groundwater was noted in the borings. Soil cave-in was recorded at depths ranging from 13.5 to 14.9 feet.

IV. ANALYSIS AND RECOMMENDATIONS

A. Detention/Retention Basin

According to the exhibits provided to us, the proposed basins will be 11 to 15 feet deep. The test borings generally exhibited sandy silt (A-4a), silt and clay (A-6a), and clay (A-7-6) to drilled depths. A gravel layer was noted between depths of 8.5 and 11.0 feet in boring B-008-0-12.

Published values of permeability for silt and clay soils are generally about 1×10^{-7} cm/sec. Permeability values for sandy silt soils are generally in the range of 1×10^{-4} cm/sec to 1×10^{-6} cm/sec. The gravel layer encountered would have a much higher permeability than the surrounding cohesive soils.

In the event that the basin is being designed as a retention basin with a normal pool elevation, then a liner will need to be installed. The liner may consist of approved and properly compacted clay soils, a geomembrane with a soil cover or other approved liner systems. If soil is used as the liner, the soils should be kept moist until the basin is filled with water. If the liner soils are allowed to dry, cracks may form causing the liner system to leak.

In the event that the basin is being designed as a detention basin to temporarily hold the water, then no liner would be required.

The basin sidewalls should be laid back at a slope rate no steeper than 3:1 H:V (Horizontal to Vertical). The slopes should be seeded and vegetation growth permitted or another suitable form of erosion protection should be provided.

B. Suitability of Soils for Use as Embankment Fill

It is planned to use the soils excavated from the basins for embankment fill. The borings encountered soils characterized as gravel and/or stone fragments (A-1-a), sandy silt (A-4a), silt and clay (A-6a), and clay (A-7-6) extending downwards to a depth of 15 feet.

The soils in the upper 3 feet exhibit natural moisture content values of about 13 to 15 percent above the estimated optimum moisture content. These soils which have excessive moisture would need to be dried prior to being used as embankment fill.

The soils encountered below a depth of 3 feet exhibit natural moisture content values equal to or less than the optimum moisture content. These soils are suitable for use as embankment fill material.

All fill materials should be observed and approved by the Engineer prior to fill placement.

Please refer to the revised geotechnical exploration report dated February 21, 2014, for general construction and earthwork recommendations.

V. CHANGED CONDITIONS

The evaluations, conclusions, and recommendations in this report are based on our interpretation of the field and laboratory data obtained during the exploration, our understanding of the project and our experience with similar sites and subsurface conditions using generally accepted geotechnical engineering practices. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates drilled, they are not necessarily representative of the subsurface conditions between boring locations or subsurface conditions during other seasons of the year.

In the event that changes in the project are proposed, additional information becomes available, or if it is apparent that subsurface conditions are different from those provided in this report, CTL Engineering should be notified so that our recommendations can be modified, if required.

VI. TESTING AND OBSERVATION

During the design process, it is recommended that CTL Engineering work with the project designers to confirm that the geotechnical recommendations are properly incorporated into the final plans and specifications, and to assist with establishing criteria for the construction observation and testing.

CTL Engineering is not responsible for independent conclusions, opinions and recommendations made by others based on the data and recommendations provided in this report. It is recommended that CTL be retained to provide construction quality control services on this project. If CTL Engineering is not retained for these services, CTL shall assume no responsibility for compliance with the design concepts or recommendations provided.

VII. CLOSING

The report was prepared by CTL Engineering, Inc. (Consultant) solely for the use of the Client in accordance with an executed contract. The Client's use of or reliance on this report is limited by the terms and conditions of the contract and by the qualifications and limitations stated in the report. It is also acknowledged that the Client's use of and reliance of this report is limited for reasons which include: actual site conditions that may change with time; hidden conditions, not discoverable within the scope of the assessment, may exist at the site; and the scope of the investigation may have been limited by time, budget and other constraints imposed by the Client.

Neither the report, nor its contents conclusions or recommendations, are intended for the use of any party other than the Client. Consultant and the Client assume no liability for any reliance placed on this report by such party. The rights of the Client under contract may not be assigned to any person or entity, without the consent of the Consultant which consent shall not be unreasonably withheld.

This geotechnical report does not address the environmental conditions of the site. The Consultant is not responsible for consequences or conditions arising from facts that were concealed, withheld, or not fully disclosed at the time the assessment was conducted.

To the fullest extent permitted by law, the Consultant and Client agree to indemnify and hold each other, and their officers and employees harmless from and against claims, damages, losses and expenses arising out of unknown or concealed conditions. Furthermore, neither the Consultant nor its employees shall be liable to the Owner in an amount in excess of the available professional liability insurance coverage of the Consultant. In addition, Client and Consultant agree neither shall be liable for any special, indirect or consequential damages of any kind or nature.

The Consultant's services have been provided consistent with its professional standard of care. No other warranties are made, either expressed or implied.

Respectfully Submitted,

CTL ENGINEERING, INC.



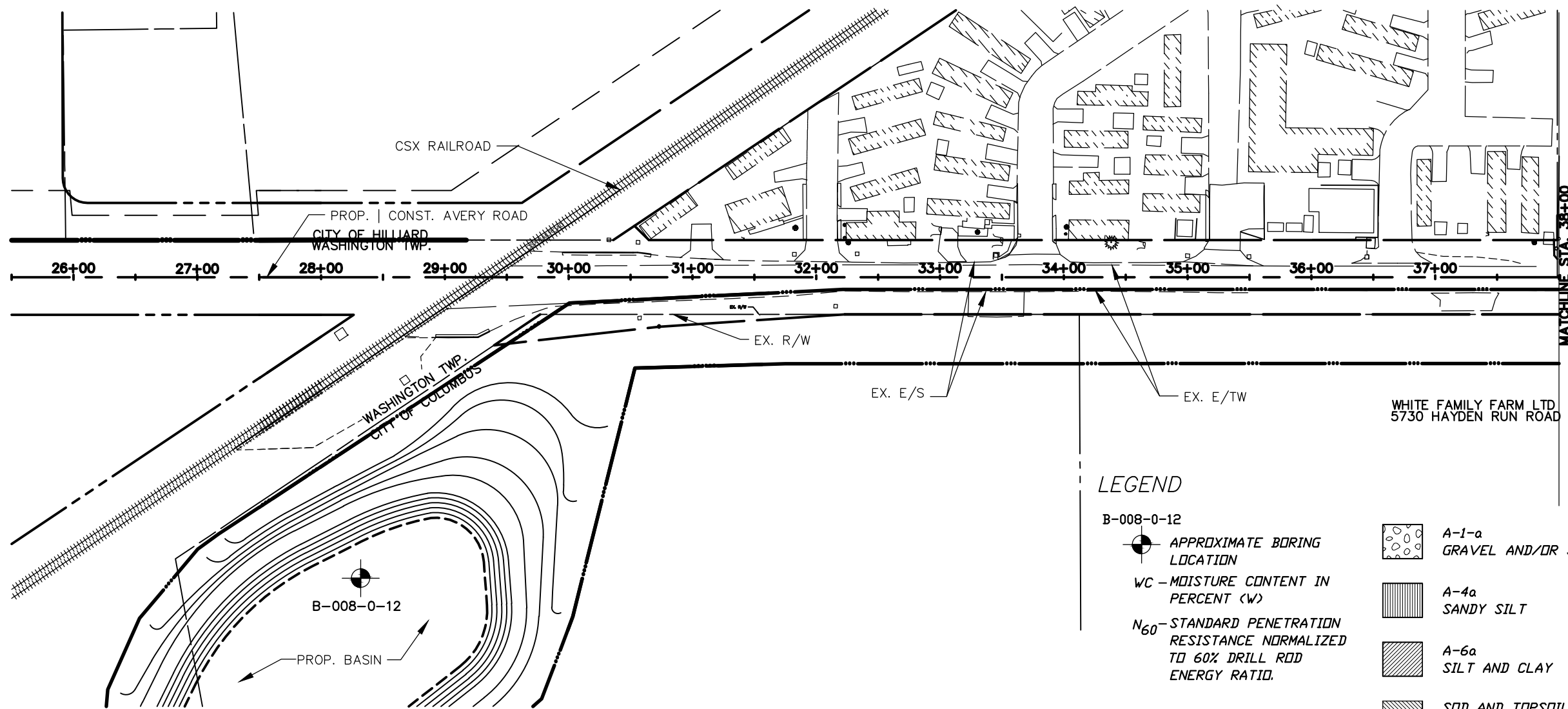
Anuj Choudhari, E.I.
Staff Engineer



Joe Grani, P.E.
Project Engineer

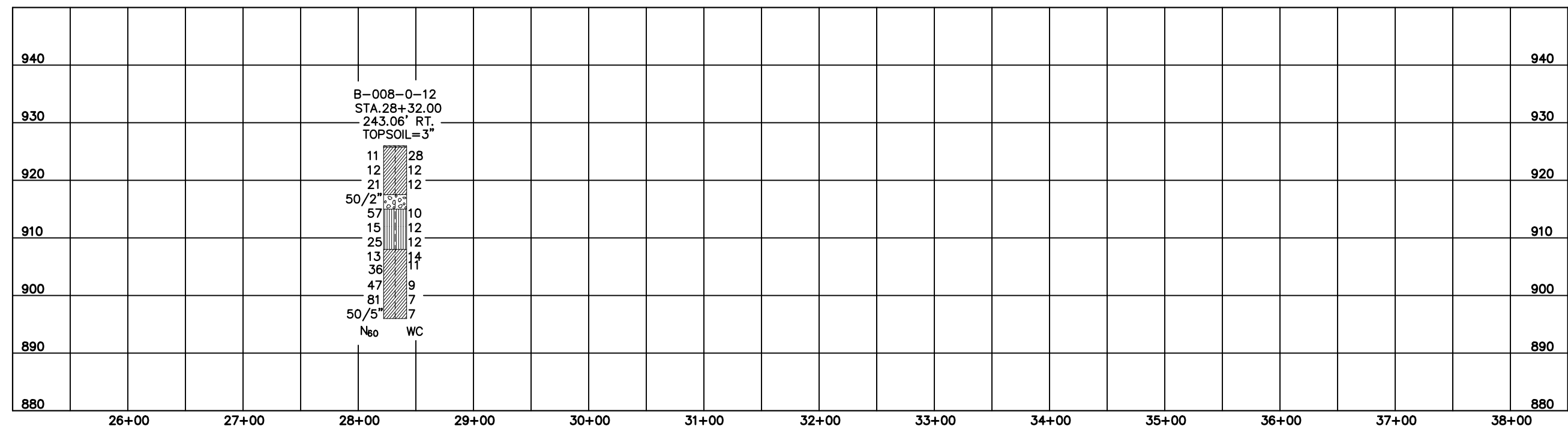
APPENDIX A
BORING LOCATION PLAN/SOIL PROFILE
SHEETS





LEGEND

- B-008-0-12
- APPROXIMATE BORING LOCATION
- WC - MOISTURE CONTENT IN PERCENT (W)
- N₆₀ - STANDARD PENETRATION RESISTANCE NORMALIZED TO 60% DRILL ROD ENERGY RATIO.
- A-1-a GRAVEL AND/OR STONE FRAGMENTS
- A-4a SANDY SILT
- A-6a SILT AND CLAY
- SOD AND TOPSOIL



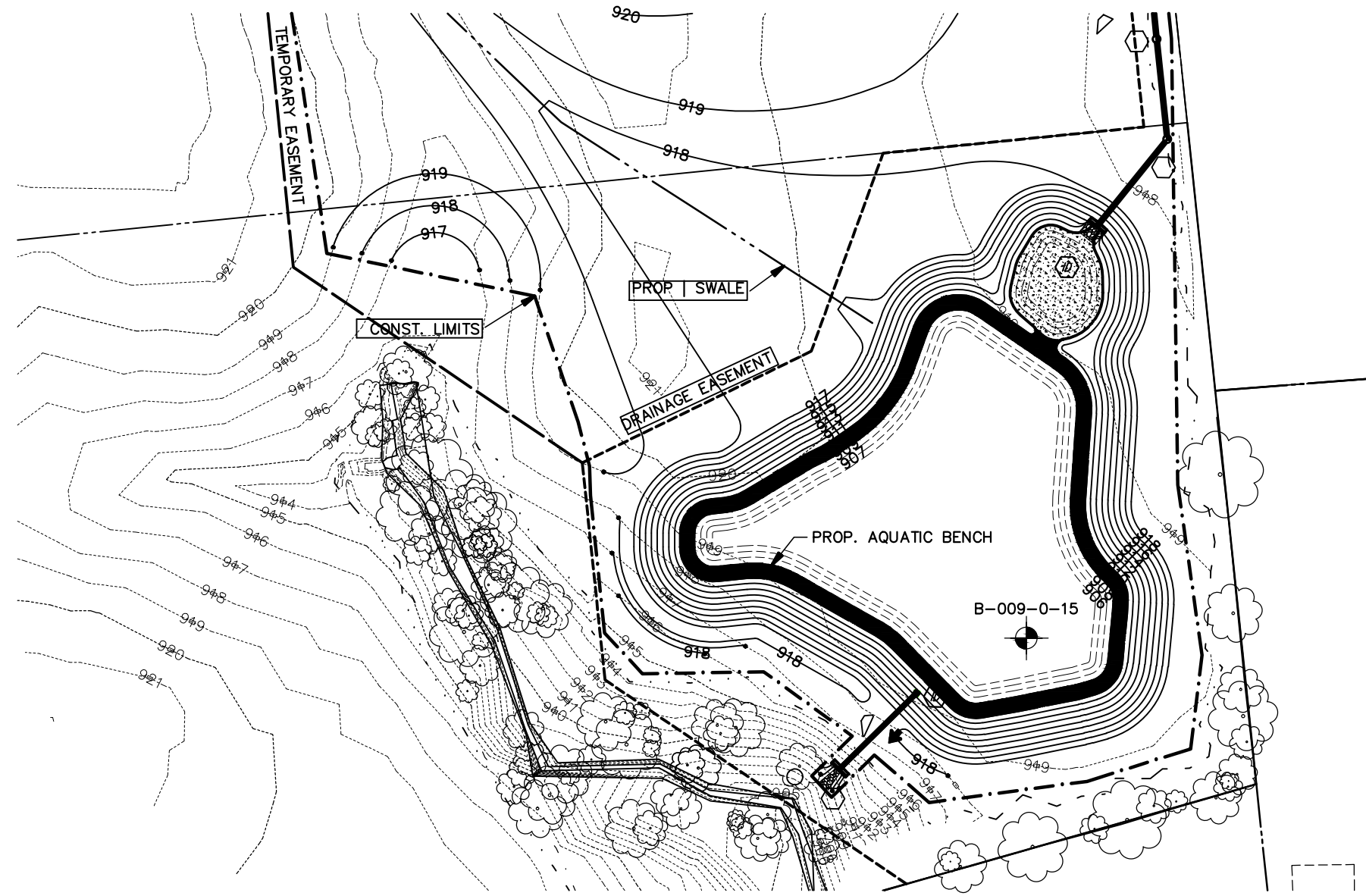
B-008-0-12
 STA. 28+32.00
 243.06' RT.
 TOPSOIL=3"



DRAWN: N.K.S.
 CHECKED: SM

PLAN AND PROFILE - DETENTION BASIN
 STA. 25+50 TO STA. 38+00

HRB2 BASIN
 PHASE 2



LEGEND

- B-009-0-15
 ◉ APPROXIMATE BORING LOCATION
 WC - MOISTURE CONTENT IN PERCENT (W)
 N₆₀ - STANDARD PENETRATION RESISTANCE NORMALIZED TO 60% DRILL ROD ENERGY RATIO.
- ▨ A-6a SILT AND CLAY
 ▩ A-7-6 CLAY
 ▨ SOD AND TOPSOIL



 HORIZONTAL SCALE IN FEET
 DRAWN BY: B.R.U.
 CHECKED BY: AC

930																		930
920																		920
910																		910
900																		900
890																		890
880																		880

B-009-0-15
TOPSOIL=9"

17	26
31	14
23	14
31	13
31	10
28	13
28	12
34	11
N ₆₀	WC

PLAN AND PROFILE - DETENTION BASIN

RIGGINS 3 BASIN
PHASE 3

APPENDIX B
TEST BORING RECORDS



SOIL DESCRIPTION

Descriptors for soil consistency used in this report are based upon the Standard Penetration Test (SPT), ASTM D 1587, with the penetration (N) values corrected to N_{60} , based upon the efficiency of the SPT Hammer used for the soil sampling.

Descriptors for both non-cohesive and cohesive soils are presented below, with the corresponding range of corrected penetration values.

<u>NON-COHESIVE SOIL DESCRIPTION</u>	<u>CORRECTED PENETRATION VALUES BLOWS PER FOOT (BPF)</u>
Very Loose.....	0 – 4
Loose.....	5 – 10
Medium Dense.....	11- 30
Dense.....	31 – 50
Very Dense.....	Over 50

<u>COHESIVE SOIL DESCRIPTION</u>	<u>CORRECTED PENETRATION VALUES BLOWS PER FOOT (BPF)</u>
Very Soft.....	0 – 1
Soft.....	2 – 4
Medium Stiff.....	5 – 8
Stiff.....	9 – 15
Very Stiff.....	16 –30
Hard.....	Over 30

Moisture term descriptors for both non-cohesive and cohesive soils are presented below.

<u>NON-COHESIVE SOIL DESCRIPTION</u>	<u>MOISTURE TERMS</u>	<u>COHESIVE SOIL DESCRIPTION</u>
Powdery.....	Dry.....	Powdery
Some Moisture.....	Damp.....	Below Plastic Limit
Damp to the Touch.....	Moist.....	Above Plastic, Below Liquid Limit
Free Water.....	Wet.....	Above Liquid Limit



STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 10/28/15 15:11 - J:\DEPTH5\ACTIVE\OLDERPROJECTS\09050029\COLB-EMH-T-HAYDEN RUN II-ADDITIONAL\REPORTS\LOGS\0905

PROJECT: <u>HAYDEN RUN BLVD, PART II</u>	DRILLING FIRM / OPERATOR: <u>CTL / JP</u>	DRILL RIG: <u>0305R333-11</u>	STATION / OFFSET: <u>28+32, 243' RT.</u>	EXPLORATION ID <u>B-008-0-12</u>
TYPE: <u>ROADWAY</u>	SAMPLING FIRM / LOGGER: <u>CTL / JP</u>	HAMMER: <u>CME AUTOMATIC</u>	ALIGNMENT: <u>Avery Road</u>	PAGE 1 OF 1
PID: _____ SFN: _____	DRILLING METHOD: <u>3.25" HSA</u>	CALIBRATION DATE: <u>10/4/11</u>	ELEVATION: <u>926.0 (MSL)</u> EOB: <u>30.0 ft.</u>	
START: <u>10/25/12</u> END: <u>10/25/12</u>	SAMPLING METHOD: <u>SPT</u>	ENERGY RATIO (%): <u>80.1</u>	COORD: <u>Not Recorded</u>	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTH	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	ABAN- DONED
								GR	CS	FS	SI	CL	LL	PL	PI			
Topsoil (3")	926.0																	
VERY STIFF, BROWN, SILT AND CLAY , SOME SAND, LITTLE GRAVEL, DAMP @ 2.0'-10.0' Max Dry Density = 119.3 pcf, OMC = 13.5 %	925.8	1	1															
		2	3	5	11	78	SS-1	2.00	-	-	-	-	-	-	-	-	28	A-6a (V)
		3					AS-2	-	15	11	15	30	29	29	16	13	14	A-6a (6)
		4	3	2	12	78	SS-3	1.62	11	11	18	38	22	29	17	12	12	A-6a (6)
		5																
@6.0'; SOME GRAVEL		6	5	7	21	100	SS-4	2.50	-	-	-	-	-	-	-	-	12	A-6a (V)
		7																
		8																
VERY DENSE, GRAY, GRAVEL AND/OR STONE FRAGMENTS, DRY	917.5	9	8	50/2"	-	13	SS-5	-	-	-	-	-	-	-	-	-	-	A-1-a (V)
		10																
		11	14	24	57	67	SS-6	0.50	35	8	12	30	15	23	14	9	10	A-4a (2)
MEDIUM STIFF, BROWN, SANDY SILT , LITTLE CLAY, SOME GRAVEL, DAMP	915.0	12																
@13.5'; VERY STIFF, SOME CLAY, TRACE GRAVEL		13																
		14	2	5	15	78	SS-7	3.00	6	5	15	43	31	26	16	10	12	A-4a (8)
		15																
		16	5	8	25	83	SS-8	2.50	-	-	-	-	-	-	-	-	12	A-4a (V)
		17																
		18																
VERY STIFF, GRAY, SILT AND CLAY , SOME SAND, TRACE GRAVEL, DAMP	908.0	19	2	3	13	100	SS-9	2.00	5	7	16	43	29	28	16	12	14	A-6a (8)
		20																
		21	11	10	36	100	SS-10	3.00	-	-	-	-	-	-	-	-	11	A-6a (V)
		22																
@23.5'; HARD		23																
		24	13	15	47	100	SS-11	4.50	6	8	16	37	33	27	14	13	9	A-6a (8)
		25																
		26	15	20	81	100	SS-12	4.50	-	-	-	-	-	-	-	-	7	A-6a (V)
		27																
		28																
@28.5'; VERY STIFF		29	50		-	100	SS-13	2.00	-	-	-	-	-	-	-	-	7	A-6a (V)
	896.0																	

EOB

NOTES: CAVED AT 14.9'; AS-2 WAS COLLECTED ON 10/14/15 AND CONSISTS OF AUGER CUTTINGS FROM 2.0' TO 10.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES:

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 11/11/15 13:53 - J:\DEPT\5\ACTIVE\OLDERPROJECTS\09050029\COLB-EMH-T-HAYDEN RUN II-ADDITIONAL\REPORTS\LOGS\0905

PROJECT: <u>HAYDEN RUN BLVD, PART II</u>	DRILLING FIRM / OPERATOR: <u>CTL / BK</u>	DRILL RIG: <u>CME 75/# 333</u>	STATION / OFFSET: _____	EXPLORATION ID <u>B-009-0-15</u>
TYPE: <u>ROADWAY</u>	SAMPLING FIRM / LOGGER: <u>CTL / BK</u>	HAMMER: <u>CME AUTOMATIC</u>	ALIGNMENT: _____	PAGE 1 OF 1
PID: _____ SFN: _____	DRILLING METHOD: <u>3.25" HSA</u>	CALIBRATION DATE: <u>10/6/15</u>	ELEVATION: <u>919.8 (MSL)</u> EOB: <u>20.0 ft.</u>	
START: <u>10/14/15</u> END: <u>10/14/15</u>	SAMPLING METHOD: <u>SPT</u>	ENERGY RATIO (%): <u>85</u>	LAT / LONG: <u>40.058575, -83.154488</u>	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTH	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	ABAN- DONED
								GR	CS	FS	SI	CL	LL	PL	PI			
Topsoil (9")	919.8																	
STIFF, BROWN, CLAY , SOME SILT, LITTLE SAND, TRACE GRAVEL, MOIST	919.1	1	3															
		2	5	17	78	SS-1	1.75	4	4	11	29	52	53	21	32	26	A-7-6 (19)	
		3	7															
VERY STIFF, BROWN AND GRAY, SILT AND CLAY , SOME SAND, LITTLE GRAVEL, TRACE SAND, CONTAINS ROCK FRAGMENTS, DAMP @4.0'; TRACE COBBLES @6.0'; STIFF	916.3	4	24	31	33	SS-2	-	-	-	-	-	-	-	-	-	14	A-6a (V)	
		5	11															
		6	7															
		7	8	23	33	SS-3	1.75	-	-	-	-	-	-	-	-	14	A-6a (V)	
		8																
		9	7															
		10	10	31	67	SS-4	1.75	15	10	13	34	28	28	16	12	13	A-6a (6)	
		11	12															
@11.0'; VERY STIFF		12	8	31	78	SS-5	-	-	-	-	-	-	-	-	-	10	A-6a (V)	
		13	11															
VERY STIFF, GRAY, SILT AND CLAY , SOME SAND, TRACE GRAVEL, DAMP @ 15.0'-20.0' Max Dry Density = 122.7 pcf, OMC = 12.0 %	906.3	14	7	28	56	SS-6	2.00	-	-	-	-	-	-	-	-	13	A-6a (V)	
		15	10															
		16				AS-7	-	9	9	18	34	30	25	14	11	13	A-6a (6)	
		17	6	28	78	SS-8	2.00	10	9	19	34	28	27	14	13	12	A-6a (7)	
		18	8															
		19	12															
	899.8	20	6	34	100	SS-9	2.25	-	-	-	-	-	-	-	-	11	A-6a (V)	
		EOB	12															

NOTES: CAVED AT 13.5'; AS-7 CONSISTS OF AUGER CUTTINGS FROM 15.0' TO 20.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES:

APPENDIX C
LABORATORY TESTING



PROCTOR TEST RESULTS

Client: EMH&T

Project: Hayden Run Blvd, Part II

Location: Columbus, OH

Sample ID: B-008, 2'-10'

Classification: A-6a(6)

CTL ENGINEERING, INC.

2860 Fisher Road
Columbus, Ohio 43204
(614) 276 - 8123

Project No. 09050029COLB
Lab Code No. 09050029COLB
Date: 10/16/2015

Method A

Standard Proctor (ASTM D698)

Max. Dry Density (pcf) 119.3
Optimum Moisture (%) 13.5

Grading (ASTM D422)

% Gravel 15
% Coarse Sand 11
% Fine Sand 15
% Silt 30
% Clay 29

Atterberg Limits (ASTM D 4318)

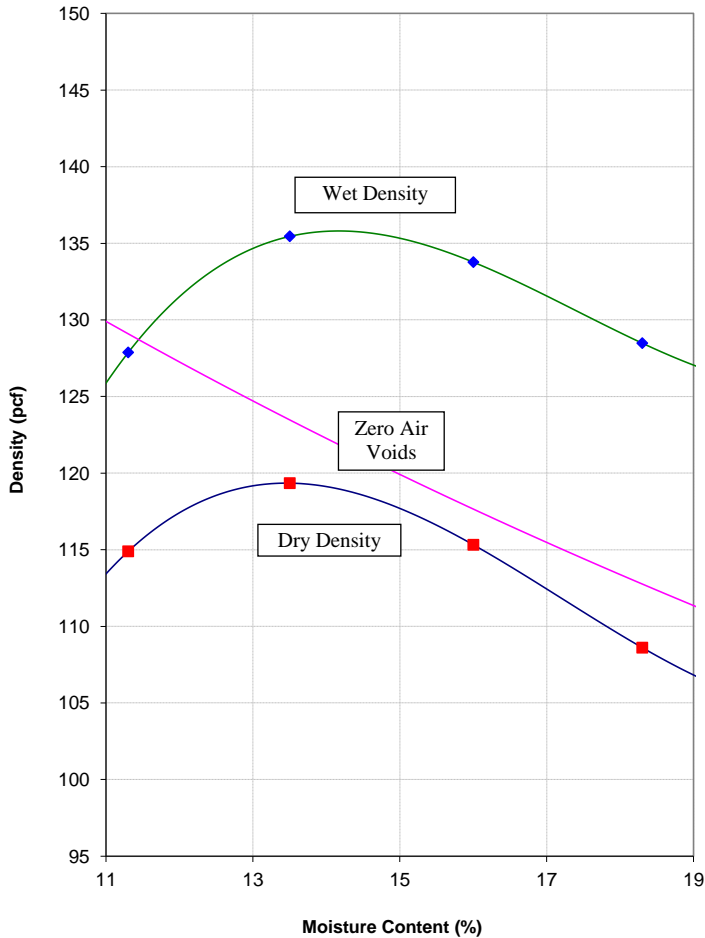
Liquid Limit 29
Plastic Limit 16
Plasticity Index 13

Natural Moisture Content

(ASTM D2216) 14.2 %

Specific Gravity (ASTM D854)

S.G. 2.70
(Assumed)



R = 1.000

Reviewed by: JG



PROCTOR TEST RESULTS

Client: EMH&T

Project: Hayden Run Blvd, Part II

Location: Columbus, OH

Sample ID: B-009, 15'-20'

Classification: A-6a(6)

CTL ENGINEERING, INC.

2860 Fisher Road
Columbus, Ohio 43204
(614) 276 - 8123

Project No. 09050029COLB
Lab Code No. 09050029COLB
Date: 10/16/2015

Method A

Standard Proctor (ASTM D698)

Max. Dry Density (pcf) 122.7
Optimum Moisture (%) 12.0

Grading (ASTM D422)

% Gravel 9
% Coarse Sand 9
% Fine Sand 18
% Silt 34
% Clay 30

Atterberg Limits (ASTM D 4318)

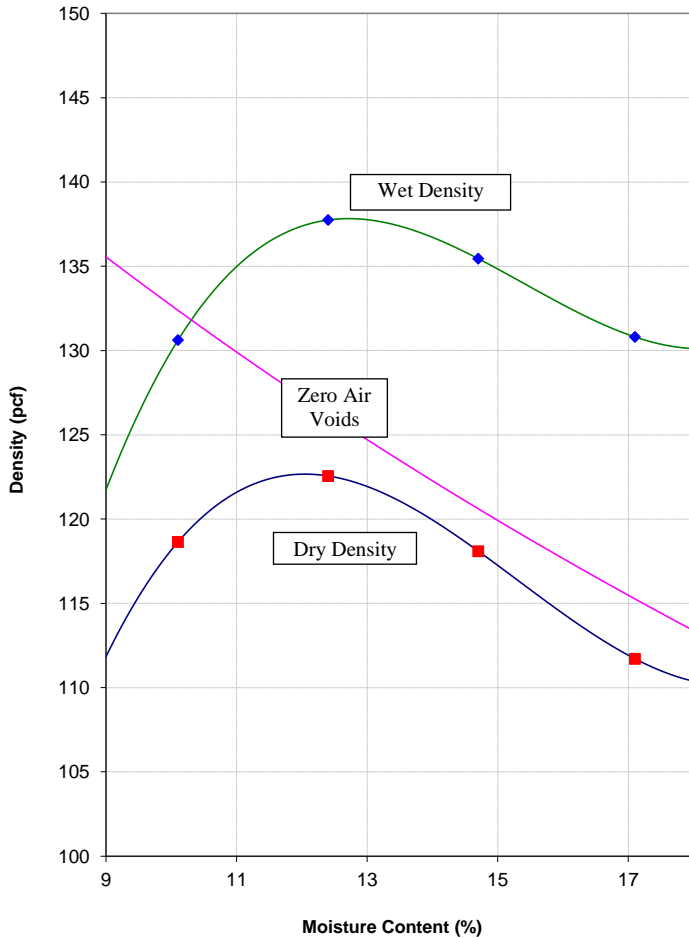
Liquid Limit 25
Plastic Limit 14
Plasticity Index 11

Natural Moisture Content

(ASTM D2216) 12.6 %

Specific Gravity (ASTM D854)

S.G. 2.70
(Assumed)



R = 1.000

Reviewed by: JG

