Washington County
MARYLAND
DIVISION OF ENGINEERING

ADDENDUM NO. 2

TO:	Interested Parties
FROM:	Pamela Mohn Chief of Design, Division of Engineering
DATE:	Thursday, March 28, 2024
RE:	PSTC Tactical Village - Geotech

Acknowledge receipt of this **Addendum No. 2** by signing in the space provided below and returning with your Bid.

Failure to sign and return with your Bid may subject the Bidder to disqualification. This Addendum No. 2 forms a part of the Bid Documents, it supplements and modifies them as outlined herein.

This **Addendum No. 2** consists of _114_ pages, including this page and attachments.

I hereby acknowledge receipt of Addendum No. 2:

By: ________________________ Date____________________
Signed Name

____
Typed Name

____
Title

For: ________________________
Firm

ADDENDUM NO. 2

PSTC Tactical Village – Geotechnical Services

Date Issued: March 28, 2024

Bids Due: April 5, 2024
2:00 p.m.

The following addendum material is hereby made a part of the Bid Documents. Please note the following changes, information, and/or instructions in connection with the proposed work and submit proposals accordingly.

By Authority of:
Board of County Commissioners
Washington County, Maryland

Scott Hobbs

Scott Hobbs, P.E.
Director
Division of Engineering

ADDENDUM NO. 2

PSTC Tactical Village – Geotechnical Services

To: All prime Contractors and all others to whom specifications have been issued.

Item 1.01 **CONFIRMATION OF QUOTATION DUE DATE**
FRIDAY, APRIL 5, 2024 (2:00 PM)

Item 1.02 **REPLACEMENT OF ATTACHMENT 2**
DELETE in its entirety.
REPLACE with Revised Attachment 2 to include proposed elevations of boring and test pit locations.

Item 1.03 **PREVIOUS GEOTECH REPORT**
ADD ATTACHMENT 5
ECS Geotech Report for Public Safety Training Center 2018

Item 1.04 QUESTIONS THAT WERE SUBMITTED BY FRIDAY, MARCH 15, 2024 (4:00PM)

Q.1 Please confirm a geophysical investigation is not included in the scope of work – per Appendix D.2 of the MDE Stormwater Design Manual, a geophysical survey is often required in areas of suspected karst as part of SWM design.
Response: A geophysical survey is not included in the scope of work.

Q.2 Please confirm rock coring is not included in the scope of work after auger refusal is achieved.
Response: Confirmed. Rock coring is not included in the scope of work after augur refusal is achieved.

Q.3 Per Section 2 – Scope of Work – Item B and C, soil borings test pits are to be performed to auger/bucket refusal. Is there a maximum depth that the soil borings/test pits would be performed to in the event early refusal is not achieved?
Response: Borings should be to 40 feet or auger refusal and test pits should be to 10 feet or bucket refusal.

Q.4 The scope of work notes laboratory testing but not a specific amount of tests, can you please confirm a minimum quantity of tests requested?
Response: The water content and classification should be documented for all borings and test pits. We expect representative testing as determined by the geotechnical engineer for the other testing scope of work items.

Q.5 Please confirm excess drilling/test pit cuttings can remain on-site (either mounded at test locations or placed at a staging area designated by the site owner), which is allowable per MDE regulations.
Response: Confirmed. Excess drilling/test pit cuttings can remain on-site.

Q.6 Is there any geotechnical/environmental information available for the site or overall PTSCS development (e.g. previous geotechnical/environmental reports, as-built drawings of existing training center)?
Response: The previous geotechnical report is provided in this addendum as Attachment 5.

Q.7 Are there as-built surveys of the existing utilities on-site available?
Response: There are no known existing utilities in the survey area.

Q.8 Will application for any specialized permits/requesting sidewalk closing, street closing, tree clearing and/or fire hydrant access permits be necessary?
Response: No.

Q.9 Will additional documentation/administrative items (e.g. background checks) be required for on-site personnel?
Response: As this work is outside of the existing Public Safety Training Center Building, no additional information is required for on-site personnel.

Q.10 Will water be able to be obtained at the project site?
Response: Yes.

Q.11 Will removal of fences and/or other obstructive objects be required in order to enable access?
Response: Some trees will need to be removed.

Q.12 Will equipment utilized in the exploration (e.g. drill rig, support vehicles) be allowed to stay at a designated area overnight to avoid remobilization on a daily basis?
Response: Yes.

Q.13 Will additional site restoration beyond the backfilling of borings/test pits and cold-patching of asphalt in pavement areas be required?
Response: No, there are no paved areas to be bored/test pitted.

Q.14 If adjustments to terms and conditions are proposed, should they be included with the bid submission?
Response: No adjustments to the terms and conditions on the bid will be entertained.

Q.15 The scope of work does not include attendance of meetings outside of the performance of the proposed exploration. Should the attendance of additional meetings outside the scope be budgeted for? If so, how many hours?
Response: There are no formal meetings planned; however, time should be allotted to answer questions from the County after report is completed and reviewed.

Q.16 Are proposed grading plans available for the proposed development?
Response: The Proposed Boring Drawing, Attachment 2 has been updated to include the proposed elevations at each boring / test pit.

Q.17 Are maximum service loads available for the proposed structures?
Response: Concepts have been shown for the buildings, however, no design or service loads are available.

Q.18 Are pavement loading parameters (maximum ESALs) available for the proposed pavement sections?
Response: We anticipate the pavement design to be a commercial / industrial usage which is equivalent to 9,000,000 ESALs per County pavement standards.

Q.19 Are both light and heavy duty pavement section recommendations required to be included in the engineering report?
Response: A heavy duty pavement section should be recommended for the entire project.

Attachments:
Tab A: Attachment 2 – Boring Location Map (1 Page)
Tab B: Attachment 5 – 2018 ECS Geotech Report (106 Pages)

END ADDENDUM NO. 2

TAB A

PSTC Tactical Village - Geotech

Attachment 2

FOUNDATION BORING POINT TABLE

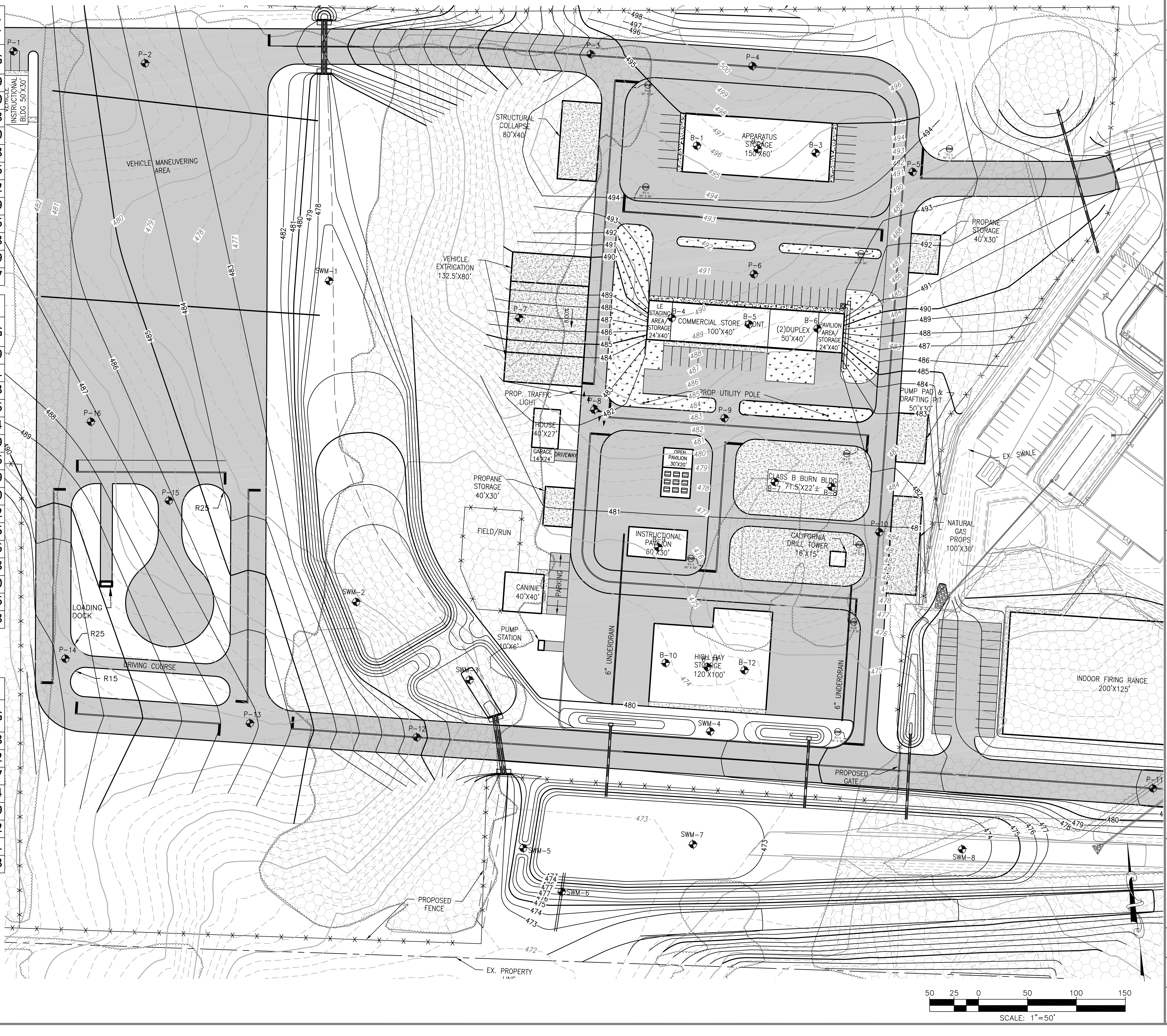
POINT#	EX ELEV.	PROP.ELEV	NORTHING	EASTING
B-1	495.70	494.60	693536	1105339
B-2	496.50	494.60	693525	1105400
B-3	494.20	494.60	693513	1105458
B-4	489.90	482.00	693365	1105290
B-5	487.70	482.00	693348	1105368
B-6	484.90	482.00	693335	1105436
B-7	480.00	481.35	693185	1105372
B-8	482.10	481.35	693173	1105429
B-9	475.30	480.85	693135	1105246
B-10	473.90	480.25	693017	1105238
B-11	474.20	480.25	693007	1105279
B-12	473.90	480.25	692999	1105317

PAVEMENT TEST PITS POINT TABLE

POINT#	EX ELEV.	PROP.ELEV	NORTHING	EASTING
P-1	487.00	486.50	693724	1104659
P-2	483.40	483.75	693694	1104791
P-3	496.80	494.25	693643	1105243
P-4	500.00	495.75	693610	1105406
P-5	490.80	493.70	693481	1105554
P-6	490.70	493.30	693399	1105379
P-7	488.10	486.70	693386	1105136
P-8	482.50	482.50	693283	1105199
P-9	481.60	481.60	693257	1105330
P-10	483.90	480.95	693120	1105472
P-11	476.00	482.10	692824	1105715
P-12	484.70	480.50	692975	1104976
P-13	490.30	487.20	693011	1104808
P-14	490.70	491.75	693101	1104630
P-15	482.60	486.20	693248	1104756
P-16	486.00	487.30	693338	1104688

SWM TEST PITS POINT TABLE

POINT#	EX ELEV.	PROP.ELEV	NORTHING	EASTING
SWM-1	476.60	477.25	693449	1104948
SWM-2	480.70	473.00	693120	1104932
SWM-3	476.50	474.75	693026	1105037
SWM-4	473.70	478.40	692941	1105274
SWM-5	472.70	476.00	692848	1105069
SWM-6	472.40	477.00	692799	1105102
SWM-7	473.30	473.00	692829	1105241
SWM-8	474.50	474.45	692788	1105513



PUBLIC SAFTEY TRAINING CENTER

SOIL BORINGS

WASHINGTON COUNTY, MARYLAND
DIVISION OF ENGINEERING

Washington County Administrative Annex. Building
747 Northern Ave., Hagerstown, MD 21742
Phone: 240-313-2460 Fax: 240-313-2401

DESIGNED BY:	LRB
DRAWN BY:	LRB
CHECKED BY:	PJM
DATE:	MAR 2024

NO.	REVISION DESCRIPTION	BY	DATE

SCALE
1:50

SHEET NO.
1 OF 1

PROJECT NO.
28-266

PLOT DATE: 3/26/2024 10:50 AM

FILE PATH: C:\USERS\LBEATTY\WASHINGTON COUNTY COMMISSIONERS\ENGINEERING - CADD\28-266 PUBLIC SAFETY TRAINING CTR\DESIGN BASE AND XREFS\P-SOIL BORINGS.DWG

TAB B

PSTC Tactical Village - Geotech

Attachment 5

ECS Mid-Atlantic, LLC

Geotechnical Engineering Report

Washington County Public Safety Training Center

9238 Sharpsburg Pike
Hagerstown, Maryland

ECS Project Number 13:8269

September 19, 2018

ECS MID-ATLANTIC, LLC

"Setting the Standard for Service"

Geotechnical • Construction Materials • Environmental • Facilities

September 19, 2018

Mr. John Pryor
Crabtree Rohrbaugh & Associates Architects
401 East Winding Hill Road
Mechanicsburg, Pennsylvania 17055

ECS Project No. 13:8269

Reference: Geotechnical Engineering Report
Washington County Public Safety Training Center
9238 Sharpsburg Pike
Hagerstown, Washington County, Maryland

Dear Mr. Pryor:

ECS Mid-Atlantic, LLC (ECS) has completed the subsurface exploration, laboratory testing, and geotechnical engineering analyses for the Washington County Public Safety Training Center (PSTC) project. Our services were performed in general accordance with the signed agreement between ECS and CRA, dated June 8, 2017. This report presents our understanding of the geotechnical aspects of the project, the results of the field exploration and laboratory testing conducted, and our design and construction recommendations.

It has been our pleasure to be of service to Crabtree Rohrbaugh & Associates Architects during the design phase of this project. We would appreciate the opportunity to remain involved during the continuation of the design phase, and we would like to provide our services during construction phase operations as well to verify the assumptions of subsurface conditions made for this report. Should you have any questions concerning the information contained in this report, or if we can be of further assistance to you, please contact us.

Respectfully submitted,
ECS Mid-Atlantic, LLC

Gregory A. Ratkowski, P.E.
Geotechnical Department Manager
gratkowski@ecslimited.com

JEFFREY A. McGREGOR
No. 30901

Jeffrey A. McGregor, P.E.
Principal Engineer
jmcgregor@ecslimited.com

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland.

License No.: 30901 Expiration Date: 08/15/2020

5112 Pegasus Court, Suite S, Frederick, Maryland 21704 • T: 301-668-4303 • F: 301-668-3519 • www.ecslimited.com
ECS Capitol Services, PLLC • ECS Florida, LLC • ECS Mid-Atlantic, LLC • ECS Midwest, LLC • ECS Southeast, LLP • ECS Texas, LLP

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- California Bearing Ratios

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EXECUTIVE SUMMARY

The following summarizes the main findings of the exploration, particularly those that may have a cost impact on the planned development. Further, our principal foundation recommendations are summarized. Information gleaned from the executive summary should not be utilized in lieu of reading the entire geotechnical report.

- **The geotechnical exploration performed for the planned development included fifteen (15) soil test borings drilled to depths between approximately 3.4 and 31.5 feet.**
- **Natural soils were encountered beneath the surface cover and extended to depths of up to 31.5 feet. The natural soils were classified as CLAY (CL, CL/ML, CL/CH, CH), SILT (ML, ML/CL), SAND (SP-SM, SC, SC-SM), and GRAVEL (GC/CH).**
- **Auger refusal was encountered in eleven (11) borings (B-1 through B-3, B-5 through B-8, P-3, SWM-1, SWM-3, and SWM-4) at depths of 3.4 to 31.5 feet below existing grades (EL 489.0 to EL 450.5). Given the auger refusal depths encountered and the variable bedrock encountered at the site, excavation issues related to rock are likely, particularly in deeper utility excavations and possibly footing excavations.**
- **Groundwater was encountered at four (4) boring locations (B-6, SWM-1, SWM-2, and SWM-4) at depths of 13.5 to 28.0 feet below existing grades (EL 468.5 to EL 454.0). The remaining borings were observed to be dry. Considering an assumed finished floor level at or near EL 486, groundwater is not expected to be a significant factor for the planned at-grade development.**
- **Most of the on-site low-plasticity CLAY (CL, CL/ML), SILT (ML, ML/CL) and SAND (SP-SM, SC, SC-SM) soils described above may be suitable for reuse as engineered fill. Moisture conditioning is likely to be necessary based on the measured in-situ moisture contents.**
- **Laboratory testing indicates that portions of the on-site soils exhibit elevated plasticity outside of the suitable limits for immediate reuse in structural areas. These higher plasticity clay soils (CH, CL/CH) may be suitable for reuse in non-structural areas or be used as liner material in the SWM facilities. Please refer to the earthwork recommendations contained herein for further details.**
- **The planned one to two-story training center facility can be supported by conventional shallow foundations consisting of shallow spread footings on natural soils or new structural fills. Foundations can be designed for a net allowable bearing pressure of 3,000 psf. Details of the assumed foundation subgrade elevations and loads are contained in the body of the report. Undercutting of soft or otherwise unsuitable soils (highly plastic CLAY) should be expected and budgeted for.**
- **Highly plastic CLAY (CL/CH, CH) souls are expected to be encountered at footing subgrade elevations in some areas. When encountered, the subgrade will require undercutting to competent material or undercut and restored to foundation elevations with lean concrete.**

- **The site is located within an area of karst limestone geology with mapped sinkholes and closed depressions being mapped in the vicinity of the site. The borings at locations B-6, SWM-1, and SWM-2 show deep soils with low N-values at depth, which may indicate the presence of karst conditions at those locations. Repair of karst features during construction should be expected and budgeted for.**

1.0 INTRODUCTION

1.1 GENERAL

The purpose of this study was to provide geotechnical information for the design of building foundations, roadways, parking areas, and stormwater management facilities for the proposed PSTC building and associated site improvements. The building, drive lanes, parking areas, and stormwater facility locations discussed in this report are part of the larger planned Washington County PSTC complex.

The recommendations developed for this report are based on project information and plans supplied to ECS by Crabtree Rohrbaugh & Associates Architects and ADTEK. We have also reviewed the Phase I Environmental Assessment performed on the property by ECS in 2016. This report contains the results of our subsurface explorations and field and laboratory testing programs, site characterization, engineering analyses, and recommendations for the design and construction of planned development.

1.2 SCOPE OF SERVICES

To obtain the necessary geotechnical information required for design of building foundations, roads, parking areas, and stormwater management facilities, fifteen (15) soil test borings were performed at locations selected by the design team and field located by ECS. These borings were located within the footprint of the proposed building, within planned pavement areas, and stormwater management facility locations. A laboratory-testing program was also implemented to characterize the physical and engineering properties of the subsurface soils.

This report discusses our exploratory and testing procedures, presents our findings and evaluations and includes the following.

- A brief review and description of our field and laboratory test procedures and the results of testing conducted.
- A review of surface topographical features and site conditions.
- A review of area and site geologic conditions.
- A review of subsurface soil stratigraphy with pertinent available physical properties.
- Final copies of our test boring logs.
- Recommendations for site preparation and construction of compacted fills, including an evaluation of on-site soils for use as compacted fills and delineation of potentially unsuitable soils and/or soils exhibiting excessive moisture at the time of sampling.
- Recommended foundation type(s).
- General recommendations for pavement design, including a recommended design CBR value.
- Evaluation and recommendations relative to groundwater control.
- An evaluation of soil and rock excavation issues.
- Recommendations for design and construction within karst geologic conditions, including repair of sinkholes.

1.3 AUTHORIZATION

Our services were provided in accordance with Washington County PUR-1339 and the AIA C727 agreement between ECS Mid-Atlantic, LLC and Crabtree Rohrbaugh & Associates Architects, dated June 8, 2017, which includes the Terms and Conditions of Service.

2.0 PROJECT INFORMATION

2.1 PROJECT LOCATION

The project site is located along the west side of Sharpsburg Pike approximately one mile north of the intersection of Sharpsburg Pike and Lappans Road in Hagerstown, Maryland. Specifically, the site is bounded to the east by Sharpsburg Pike, to the south by single family homes (located along Sharpsburg Pike) and farm fields, to the west by farm fields, and to the north by a fence enclosed utility compound and single family homes associated with the Westfields community development.

Figure 2.1.1 below, shows the approximate project location. A Site Location Diagram has been included as Figure 1 in Appendix A.

Figure 2.1.1 Site Location

2.2 PAST SITE HISTORY/USES

Based on a review of available online historical photographs and topographic maps, as well as the Phase I Environmental report prepared by ECS in 2016, the site has been in use as farmed land since the 1890's. There was previously a residence and what appeared to be a barn and shed structure located along the north property boundary. These structures are reported to have been demolished in 2010. The topographic maps show an intermittent stream extending northeast to southwest through the center of the site. Small orchards were also mapped on some of the historic topographic maps.

2.3 CURRENT SITE CONDITIONS

A majority of the site currently consists of a farm fields and wooded land. Rock outcrops are visible on aerial photography of the site and were observed during our site visit. A dry retention pond remains present on the north side of the property along with the remnants of the single family home and out buildings that were reportedly demolished in 2010.

The site can be considered gently to moderately sloping. In general, the site slopes from the northwest and southeast toward the center of the site and then toward the southwest. Site elevations range from about EL 500.0 along the north and east sides of the site, to about EL 473.0 at the southwest corner of the site. Existing grades within the planned building footprint range from about EL 490.5 to EL 482.0.

2.4 PROPOSED CONSTRUCTION

The project will consist of the construction of a two-story training center at the site along with new paved roads, parking areas, and stormwater management facilities.

Based on an assumed finished floor at or near EL 486, cuts and fills will be limited to about three to four feet within the building footprint.

2.4.1 Structural Information/Loads

The following information explains our understanding of the structures and their loads:

Table 2.4.1.1

SUBJECT	DESIGN INFORMATION / EXPECTATIONS
Building Footprint	The central portion of the building will be about 27,087 square feet in plan view and southwest and northeast wings (future additions) are 7,157 square feet and 6,887 square feet in plan view respectively.
# of Stories	2-story above grade (no below grade levels).
Usage	Training Center Building
Framing	Slab on grade with steel framing and masonry bearing walls.
Column Loads	80 kips (provided by ADTEK)
Wall Loads	9 kips per linear foot (klf) (provided by ADTEK)
Lowest Finish Floor Elevation	Approximately EL 486 (Assumed by ECS)

3.0 FIELD EXPLORATION

3.1 FIELD EXPLORATION PROGRAM

The field exploration was planned with the objective of characterizing the project site in general geotechnical and geological terms and to evaluate subsequent field and laboratory data to assist in the determination of geotechnical recommendations.

3.1.1 Test Borings

The subsurface conditions were explored by drilling eight (8) soil test borings within the proposed building footprint, three (3) soil test borings within planned surface parking areas, and four (4) soil test borings within proposed stormwater management facility locations. A track mounted drill rig was utilized to drill the soil test borings. Borings were generally advanced to depths of 3.4 to 31.5 feet below the current ground surface. Subsurface explorations were completed under the general supervision of an ECS geotechnical engineer or geologist.

Boring locations were identified in the field by ECS using GPS prior to mobilization of our drilling equipment. The approximate as-drilled boring locations are shown on the Location Diagram in Appendix A. Ground surface elevations noted on our boring logs were interpolated from the topographic site plan provided by Crabtree Rohrbaugh & Associates Architects.

Standard penetration tests (SPTs) were conducted in the borings at regular intervals in general accordance with ASTM D 1586. Small representative samples were obtained during these tests and were used to classify the soils encountered. The standard penetration resistances obtained provide a general indication of soil shear strength and compressibility. Bulk samples from several boring locations were obtained for subsequent laboratory testing.

3.2 REGIONAL/SITE GEOLOGY

According to the Physiographic Map of Maryland (2008) [1], the site is located within the Charles Town District of the Ridge and Valley Province. The ridge and Valley province has an "accordion-like" topography composed of alternating, subparallel ridges and valleys resulting from differential erosion of various folded and faulted lithologies. The Charles Town District is described as a broad, open, gently rolling karstic plain underlain by limestones and dolomites. Pinnacle karst and sinkholes are fairly common. Limestone outcrops common to abundant.

Based upon the Karst Features of the Funkstown Quadrangle, Washington County, Maryland (2009)[2], the site is located within the Middle Member (Ccm) of the Conococheague Formation and Alluvium (QAL). The Middle Member is described as being predominately cyclically bedded, medium- to dark-gray, thrombolytic limestone and gray, ribbony and laminated limestone and tan laminated dolomite. Thrombolites range in thickness from 3 to 6 feet within thrombolitic intervals to less than 1 foot within the ribbony intervals. Several dark-gray, oolitic intervals are present in the upper part of this member.

---

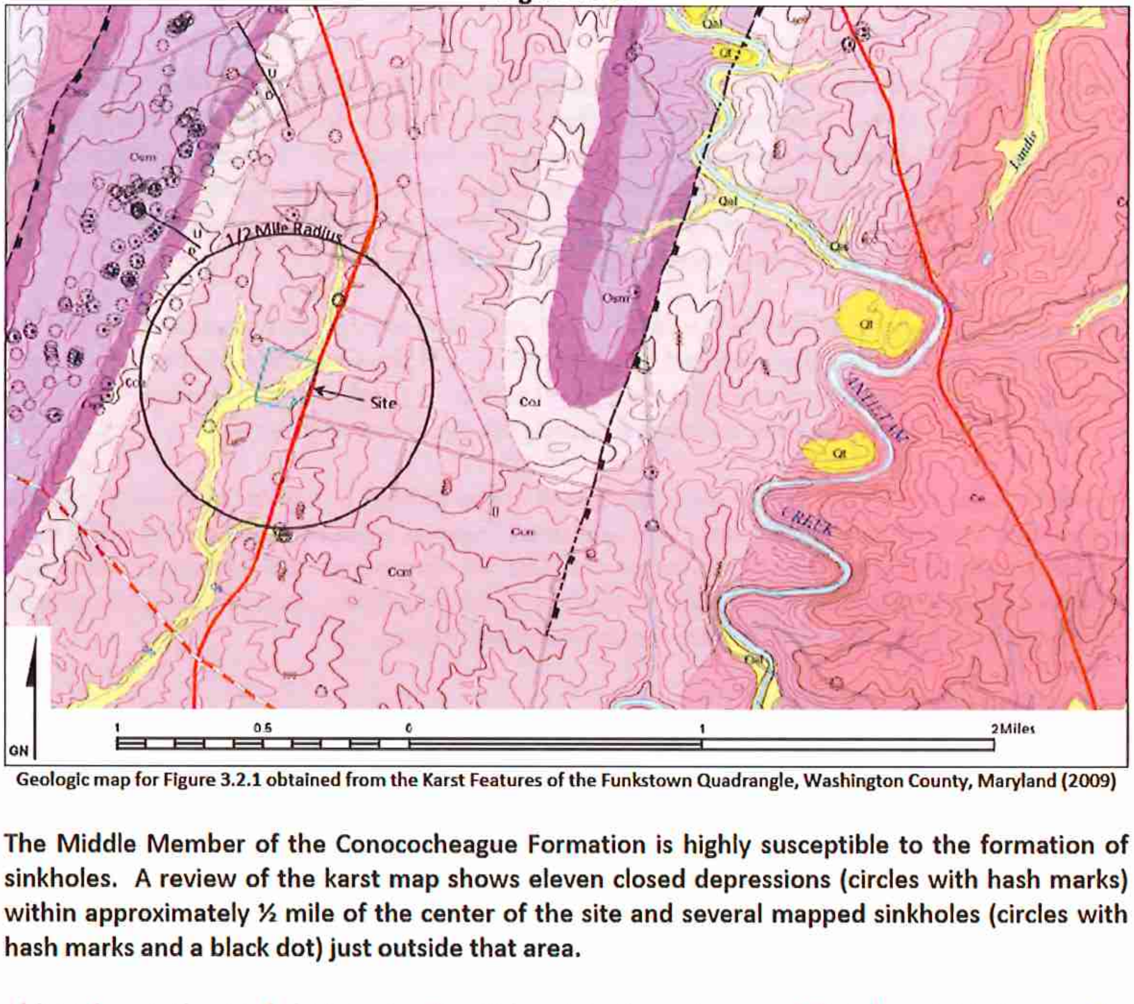
[1] James P. Reger and Emery T. Cleaves. *Physiographic Map of Maryland.* 1:250,000. Maryland Geological Survey, 2008.

[2] David K. Brezinski. *Karst Features of the Funkstown Quadrangle, Washington County, Maryland.* 1:24,000. Department of Natural Resources and Maryland Geological Survey, 2004.

The Alluvium is described as poorly sorted, unconsolidated, tan, reddish brown, to dark-gray mud, silt, sand, and pebbles, deposited within the channel of streams and on the flood plain adjacent to streams. Thickness is estimated at 3 to 10 feet.

An overview of the general site geology is illustrated in Figure 3.2.1.

Figure 3.2.1



Geologic map for Figure 3.2.1 obtained from the Karst Features of the Funkstown Quadrangle, Washington County, Maryland (2009)

The Middle Member of the Conococheague Formation is highly susceptible to the formation of sinkholes. A review of the karst map shows eleven closed depressions (circles with hash marks) within approximately ½ mile of the center of the site and several mapped sinkholes (circles with hash marks and a black dot) just outside that area.

Although not observed during our site exploration, there is a possibility that sinkholes may be encountered during construction. A deep zone of soft, wet soil was encountered at borings B-6, SWM-1, and SWM-2, which may be indicative of solution features. Typical sinkholes in this area are approximately 4 to 6 feet in diameter and 6 to 10 feet deep; however, based upon available data, estimating the quantity and size of potential sinkholes cannot be accurately performed at this time. The elevation of bedrock in Karst areas can be highly variable. Due to differential weathering of the limestone, solution channels, rock pinnacles, float rocks and other features can cause significant variation in the depth to bedrock over short lateral distances.

3.3 SOIL SURVEY MAPPING

Based on our review of the Soil Survey [USDA - Natural Resources Conservation Service (websoilsurvey.ncrs.usda.gov)], the site soils are mapped as Funkstown silt loam (Ft), Hagerstown silt loams (HaB, HaC), Hagerstown silty clay loam (HbB), Hagerstown-Rock outcrop complex (HcB, HcC), Swanpond silt loam (SpA), and Swanpond-Funkstown silt loams (SsA).

These soil types are described with properties as illustrated in Table 3.3.1.

Table 3.3.1

Unit Name		Typical Profile	Natural Drainage Class	Runoff Class	Depth to Groundwater Table	Depth to Restrictive Feature
Funkstown silt loam (Ft)		0-12" Silt loam	Moderately well drained	Low	About 24" to 42"	More than 80"
Hagerstown silt loam (HaB)		0-10" Silt loam 10"-21" Silty clay loam 21"-56" Silty clay 56"-73" Silty clay loam 73"-83" Bedrock	Well drained	Medium	More than 80"	43" to 98" to lithic bedrock
Hagerstown silt loam (HaC)		0-8" Silt loam 8"-19" Silty clay loam 19"-54" Silty clay 54"-71" Silty clay loam 71"-81" Bedrock	Well drained	Medium	More than 80"	43" to 98" to lithic bedrock
Hagerstown silty clay loam (HbB)		0-7" Silty clay loam	Well drained	Medium	More than 80"	60" to 99" to lithic bedrock
Hagerstown-Rock outcrop complex (HcB)	Hagerstown	0-5" Silty clay loam	Well drained	Medium	More than 80"	60" to 99" to lithic bedrock
	Rock outcrop	0-60" Unweathered bedrock	---	Low	---	0 inches to lithic bedrock
Hagerstown-Rock outcrop complex (HcC)	Hagerstown	0-5" Silty clay loam	Well drained	Medium	More than 80"	60" to 99" to lithic bedrock
	Rock outcrop	0-60" Unweathered bedrock	---	Low	---	0" to lithic bedrock
Swanpond silt loam (SpA)		0-8" Silty loam	Moderately well drained	Medium	About 30" to 42"	More than 80"
Swanpond-Funkstown silt loams (SsA)	Swanpond	0-7" Silt loam	Moderately well drained	Medium	About 30"-42"	More than 80"
	Funkstown	0-12" Silt loam	Moderately well drained	Low	About 24"-42"	More than 80"

Soil mapping of the site vicinity is presented in Figure 3.3.2.

Figure 3.3.2

Soil Survey for Figure 3.3.2 obtained from USDA – Natural Resources Conservation Service; websoilsurvey.nrcs.usda.gov

3.4 SUBSURFACE CHARACTERIZATION

The subsurface conditions encountered were generally consistent with published geological mapping. The following sections provide generalized characterizations of the soil and rock strata encountered during our subsurface exploration. For subsurface information at a specific location, refer to the Boring Logs in Appendix B.

Table 3.4.1 Subsurface Stratigraphy

Approximate Depth Range (ft)	Elevation (ft)	Stratum	Description	Ranges of SPT$^{(1)}$ N-values (bpf)
0-0.9 ft (Surface Cover)	EL 494.0-477.1	n/a	One (1) to eleven (11) inches of topsoil was encountered at the boring locations. As the non-wooded areas of the site are currently in use as a farm field, organic laden "plow zone" soils are expected to be present to typical depths of about 12 to 18 inches below grade. These soils can have deep root zones, are disturbed, and are often fairly soft and wet.	N/A
1.0-31.5 ft	EL 493.8-450.5	I	Very Soft to Stiff CLAY (CL, CL/ML, CL/CH, CH) and SILT (ML/CL) and Very Loose to Medium Dense SILT (ML), SAND (SP-SM, SC, SC-SM), and GRAVEL (GC/CH), moist.	0-17
3.0-23.5 ft	EL 483.5-458.5	II	Weathered rock materials that exhibit rock like qualities. Portions of the weathered rock will require rock excavation methods for removal (B-3, B-8, P-3, SWM-1, SWM-4 only).	>60
3.4-31.5 ft	EL 489.0-450.5	III	Auger refusal encountered at the boring locations. The auger refusal depths encountered are assumed to be the depth to bedrock (B-1 through B-3, B-5 through B-8, P-3, SWM-1, SWM-3 and SWM-4 only).	N/A

3.5 GROUNDWATER OBSERVATIONS

Groundwater seepage was encountered in four (4) borings at depths ranging from 13.5 to 28.0 feet below existing grades (EL 468.5 to EL 454.0). Groundwater was not encountered at the remaining boring locations to the depths explored. We did observe borehole caving at depths of 1.3 to 12.6 feet which may be an indicator of groundwater presence. Table 3.5.1 outlines the depth and elevation groundwater was encountered at the boring locations.

Table 3.5.1 Groundwater Levels

Boring Location	Depth Groundwater Encountered (ft)	Approximate Elevation Groundwater Encountered (ft)
B-6	28.0	454.0
SWM-1	23.0	459.0
SWM-2	18.5	459.5
SWM-4	13.5	468.5

It should be noted that fluctuations in the location of ground water conditions can occur as a result of seasonal variations in evaporation, precipitation, surface water run-off, localized perched water tables, and other factors not present at the time of the subsurface exploration. Perched

water may be encountered at the interface of fill and natural soils, at the interface of the clayey soil horizons, or at the interface of soils and bedrock.

Based upon our interpretation of the boring data, it appears that the seasonal high groundwater level is located a depth of approximately 13.5 feet below existing grade (EL 468.5). As no below grade levels are planned, special underslab sub-drainage systems are not expected to be necessary.

4.0 LABORATORY TESTING

The laboratory testing performed by ECS for this project consisted of selected tests performed on samples obtained during our field exploration operations. The following paragraphs briefly discuss the results of the completed laboratory testing program. Classification and index property tests were performed on representative soil samples obtained from the test borings in order to aid in classifying soils according to the Unified Soil Classification System and to quantify and correlate engineering properties.

Laboratory testing included moisture content testing, Atterberg Limits, washed sieve gradation analyses, washed sieve gradation analyses with hydrometer, and moisture-density relationships (Proctor), and California Bearing Ratio tests. The results of the laboratory testing program are included in Appendix C.

An experienced geotechnical engineer/engineering geologist visually classified each soil sample from the test borings on the basis of texture and plasticity in accordance with the Unified Soil Classification System (USCS) and ASTM D-2488 (Description and Identification of Soils-Visual/Manual Procedures). After classification, the geotechnical engineer/engineering geologist grouped the various soil types into the major zones noted on the boring logs in Appendix B. The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs are approximate; in situ, the transitions may be gradual.

5.0 DESIGN RECOMMENDATIONS

5.1 BUILDING DESIGN

The following sections provide recommendations for foundation design, soil supported slabs, stormwater management facilities, pavements, and seismic design parameters.

5.1.1 Foundations

Provided subgrades and structural fills are prepared as discussed herein, the proposed structures can be supported by conventional shallow foundations consisting of individual column footings and continuous wall footings. The design of the foundation shall utilize the following parameters:

Table 5.1.1.1 Foundation Design

Design Parameter	Shallow Spread Footings
Net Allowable Bearing Pressure[1]	3,000 psf
Acceptable Bearing Soil Material (Assumed Bottom of Footing = EL 483)	Stratum I, Stratum II, Stratum III, or New Compacted Fill (Minimum SPT N-value = 7 bpf)
Minimum Width	30 inches (columns) 18 inches (walls)
Minimum Footing Embedment Depth (below slab or finished grade)	30 inches (exterior walls/all columns) 18 inches (interior walls)
Estimated Total Settlement	1 inch
Estimated Differential Settlement	Less than 0.5 inches between adjacent columns Less than 0.5 inches over 50 feet (walls)

1. Net allowable bearing pressure is the applied pressure in excess of the surrounding overburden soils above the base of the foundation.

It is anticipated that footing subgrades will generally be supported on natural ground or new compacted fill. However, the bases of all foundation excavations should be observed and tested by the Geotechnical Engineer.

Highly plastic FAT CLAY (CH, CL/CH, GC/CH) soils were encountered in borings B-1, B-2, B-5, and B-8 and are likely to be encountered in other areas of the site. **These materials are unsuitable for direct foundation support.** Additionally, a zone of deep, soft soils was encountered within the planned building footprint at boring location B-6. Some undercutting of materials not exhibiting the necessary minimum SPT N-value outlined above should be expected.

When highly plastic soils, existing fill (if encountered), or other unsuitable soils are encountered at planned subgrade levels for any footing, the unsuitable soils shall be undercut to suitable bearing materials. The footing can be directly supported on competent soils at greater depths or, alternatively, the design footing bearing level can be restored through placement of lean (2,500 psi) concrete or engineered fill materials. If highly plastic soils are to remain under the footing, the foundation excavation should be lowered an additional four (4) feet below the design footing subgrade elevation prior to being restored to footing bearing levels.

If lean concrete is to be used to restore foundation bearing levels, the undercut excavations can be made "neat" with the dimension of the footing. Lean concrete shall conform to Maryland State Highway Mix No. 1. If the design bearing level is restored using engineered fill, however, then the excavation to remove the unsuitable soils shall extend at least 0.5 foot laterally beyond the bottom edge of the footing for each 1 foot of vertical undercut below the footing bearing level. All foundations should be constructed with Type I Portland cement concrete.

Footings on Rock: Shallow auger refusal was encountered within some the borings completed within the planned building footprint. The encountered auger refusal levels are assumed to bedrock. As the site is located within a karst area, varying rock depths should be expected and shallow rock may be encountered in areas of the site that were not explored. Should rock be encountered at footing subgrade levels, the footing subgrade must be properly prepared to prevent an uneven bearing surface or the formation of a "hard spot" that could result in unacceptable differential settlement. If rock is encountered at footing subgrade levels, we recommend that the rock be removed to create a level bearing surface and replaced with a compacted CR-6 crushed stone cushion to a depth of 6 inches below foundation subgrade levels to minimize excessive differential settlements that may occur between those portions of the footing bearing on rock and soil. Since the rock is generally not frost-susceptible, it is not necessary to excavate rock to the design frost depth of 30 inches below exterior grades, but only enough to satisfy structural design thickness of concrete plus the cushion mentioned above.

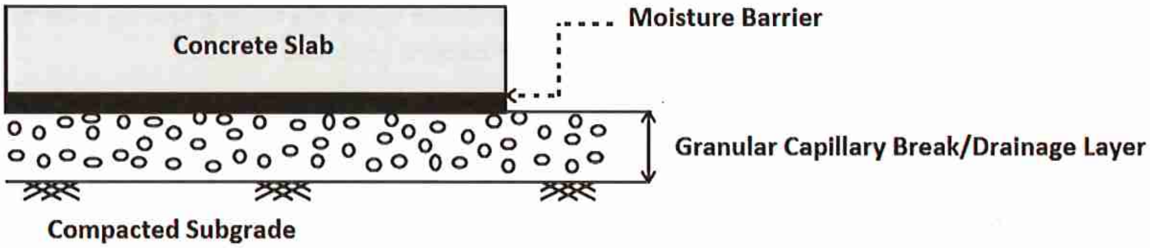
5.1.2 Floor Slabs

The on-site soils are generally considered suitable for support of the lowest floor slabs, although moisture control during earthwork operations, including the use of discing or appropriate drying equipment, may be necessary. Assuming a finished floor level at or near EL 486, the floor slabs for the planned office building will likely bear on the Stratum I natural soils, Stratum II weathered rock, or new compacted fill material. The Stratum I materials are likely suitable for the support of a slab-on-grade, however, there may be areas of soft or yielding soils that should be removed and replaced with compacted structural fill in accordance with the recommendations included in this report.

Where highly plastic clay (CH, CL/CH, GC/CH) soils are encountered at slab subgrades, they should be undercut a minimum of 2 feet and replaced with approved compacted structural fill. When encountered at floor slab subgrade levels, any existing fill should be thoroughly evaluated by the Geotechnical Engineer via test pits, observation of utility excavations, and hand auger borings.

The following graphic depicts our soil-supported slab recommendations:

Figure 5.1.2.1



1. Drainage Layer Thickness: 4 inches
2. Drainage Layer Material: GRAVEL (GP, GW)
3. Subgrade compacted to ***98%*** maximum dry density per ASTM D698

Subgrade Modulus: Provided the placement of Structural Fill and Granular Drainage Layer per the recommendations discussed herein, the slab may be designed assuming a modulus of subgrade reaction, k_1 of 100 pci (lbs/cu. inch). The modulus of subgrade reaction value is based on a 1 ft by 1 ft plate load test basis.

Slab Isolation: Ground-supported slabs should be isolated from the foundations and foundation-supported elements of the structure so that differential movement between the foundations and slab will not induce excessive shear and bending stresses in the floor slab. Where the structural configuration prevents the use of a free-floating slab, the slab should be designed with suitable reinforcement and load transfer devices to preclude overstressing of the slab. Maximum differential settlement of soils supporting interior slabs is anticipated to be less than 1 inch in 40 feet.

5.1.3 Seismic Design Considerations

Seismic Site Classification: The International Building Code (IBC) 2015 requires site classification for seismic design based on the upper 100 feet of a soil profile. Three methods are utilized in classifying sites, namely the shear wave velocity (v_s) method; the unconfined compressive strength (s_u) method; and the Standard Penetration Resistance (N-value) method. The latter method (N-value method) was used in classifying this site.

The seismic site class definitions for the weighted average of shear wave velocity or SPT N-value in the upper 100 feet of the soil profile are shown in the following table:

Table 5.1.3.1: Seismic Site Classification

Site Class	Soil Profile Name	Shear Wave Velocity, Vs, (ft./s)	N value (bpf)
A	Hard Rock	Vs > 5,000 fps	N/A
B	Rock	2,500 < Vs ≤ 5,000 fps	N/A
C	Very dense soil and soft rock	1,200 < Vs ≤ 2,500 fps	>50
D	Stiff Soil Profile	600 ≤ Vs ≤ 1,200 fps	15 to 60
E	Soft Soil Profile	Vs < 600 fps	<15

Utilizing the data obtained from the on-site boring exploration and our previous experience at neighboring sites, a mean SPT "N"-value between 15 and 50 blows per foot (bpf) is anticipated within 100 feet of the ground surface; therefore, the Seismic Site Class is D.

If it is determined that significant advantage could be gained with an improved Site Class, additional site testing could be performed to measure actual shear wave velocities using ReMi test methods along with a site specific analysis. ECS can provide additional consultation upon request.

Liquefaction: The subsurface profile consists primarily of residual soils derived from the in-place weathering of limestone rock. The subsurface conditions do not appear to exhibit liquefaction potential; therefore, it is our opinion that additional investigation regarding liquefaction potential is not necessary.

Ground Motion Parameters: In addition to the seismic site classification noted above, ECS has determined the design spectral response acceleration parameters following the IBC 2015 methodology. The Mapped Reponses were estimated from the free Java Ground Motion Parameter Calculator available from the USGS website (http://earthquake.usgs.gov/designmaps/us/application.php). The design responses for the short (0.2 sec, S_{DS}) and 1-second period (S_{D1}) are noted in bold at the far right end of the following table.

Table 5.1.3.2: Ground Motion Parameters *(IBC 2015 Method)*

Period (sec)	Mapped Spectral Response Accelerations (g)		Values of Site Coefficient for Site Class		Maximum Spectral Response Acceleration Adjusted for Site Class (g)		Design Spectral Response Acceleration (g)	
Reference	Figures 1613.3.1 (1) & (2)		Tables 1613.3.3 (1) & (2)		Eqs. 16-37 & 16-38		Eqs. 16-39 & 16-40	
0.2	S_S	0.128	F_a	1.6	$S_{MS}=F_aS_s$	0.204	$S_{DS}=2/3\,S_{MS}$	0.136
1.0	S_1	0.052	F_v	2.4	$S_{M1}=F_vS_1$	0.125	$S_{D1}=2/3\,S_{M1}$	0.083

The Site Class definition should not be confused with the Seismic Design Category designation, which the Structural Engineer typically assesses. If a higher site classification is beneficial to the project, ECS would be pleased to discuss additional testing capabilities in this regard.

5.2 SITE DESIGN CONSIDERATIONS

5.2.1 Pavement Design

The current phase of the project is to include a paved road on the north side of the proposed training center building and paved roads and parking lots on the northwest and southeast sides of the training center. The following sections outline our pavement recommendations.

Subgrade Characteristics: Based on the results of our soil test borings, it appears that the soils that will be present at pavement subgrades will consist mainly of silts (ML/CL) and medium to high plasticity clay (CL, CH) soil materials. These materials are expected to provide poor pavement support. It should be noted that a significant portion of the site soils encountered at the site

exhibit high plasticity (CH soils) and are considered unsuitable for direct pavement support. These higher plasticity soils should be undercut to a depth of 12 inches below pavement subgrades and replaced with more granular non-plastic materials.

Laboratory CBR testing was completed on bulk samples from borings P-2 and P-3. The test results indicate CBR values of 10.2 and 8.7, respectively, at 97% compaction. Considering our previous experience and knowledge of the geology in the area of the project site and the results of the laboratory CBR testing, we recommend utilizing a California Bearing Ratio (CBR) value of 5 for pavement design.

If materials are encountered near the surface that could exhibit a CBR value of less than 5, it is recommended that the upper 12 inches of this subgrade be undercut and replaced with suitable fill material exhibiting a CBR value of 5 or more. The pavement design assumes subgrades consist of suitable materials evaluated by ECS and placed and compacted to at least 98 percent of the maximum dry density as determined by the Standard Proctor test (ASTM D 698) in accordance with the project specifications. Additional CBR testing should be completed during construction when pavement subgrades are exposed in larger areas to confirm the recommendations included in this section.

Once the design pavement subgrade elevation is reached, the subgrade should be proofrolled and carefully observed at the time of construction in order to aid in identifying any localized soft or unsuitable materials. Soils which are still unstable after proofrolling will require undercutting and replacement with Engineered Fill. If site work is performed during the wetter winter months, the cohesive and moisture-sensitive subgrade soils subjected to wet conditions and/or ponding water may become unstable and require undercuts and replacement with dryer, suitable material. Exposed subgrade soils should be graded to drain surface moisture and covered as soon as possible with engineered fill compacted in accordance with project requirements. Construction traffic should be confined to specific stabilized construction roads and not be allowed to degrade the pavement subgrade or new pavement section once it is placed.

Anticipated Vehicular Traffic: Based on review of the provided site plans, the new pavements will be constructed to provide parking and site access for the planned facility. It is anticipated that the pavements at this site will be subjected to passenger vehicles and a significant amount of heavy truck (fire/emergency vehicle) traffic. We have assumed a daily traffic volume of 100 vehicles per day with approximately 25% heavy trucks, which equates to approximately 275,000 ESALs over a 20 year design life.

The traffic assumptions outlined above DO NOT account for construction traffic. Construction traffic should be confined to specific stabilized construction roads and not be allowed to degrade the pavement subgrade or new pavement section once it is placed.

Asphalt Pavement Section: Based on a maximum traffic load of 275,000 ESALs and a 20 year design life, we have developed the following asphalt pavement sections using the AASHTO 1993 pavement design method.

Table 5.2.1.1 Asphalt Pavement Section

Recommended Pavement Section (CBR=5)	Pavement Thickness (inches) (275,000 ESALs)
Bituminous concrete surface course (Typ. 12.5mm Superpave)	2.0
Bituminous base course (Typ. 25.0mm Superpave)	3.5
Graded Aggregate Subbase (GAB)	6.0
Total Pavement Thickness	**11.5**

Rigid Concrete Pavements: For heavy-duty traffic areas, such as loading docks, truck turn-around areas, dumpster or container storage yards, and unloading zones, the Portland cement concrete pavement section should consist of 5 inches of air-entrained Portland cement concrete having a minimum 28-day compressive strength of 4,000 psi, underlain by a minimum of 6 inches of compacted dense-graded aggregate subbase (CR-6 or GAB). The rigid pavement section should be provided with construction joints at appropriate intervals per PCA requirements. The construction joints should be reinforced with dowels to transfer loads across the joints.

Weather Restrictions: In this region, asphalt plants may close during the months of December, January, and/or February if particularly cold weather conditions prevail. However, this can change based on year to year temperature fluctuations. Daily temperatures from December to February will often stay below 40°F, limiting the days that asphalt placement can occur.

5.2.2 Stormwater Management Facilities

New stormwater management features will be constructed in the areas northeast and southeast of the proposed building location as well as in other areas of the site not included during this study. The SWM features will likely consist of bioswales and/or micro bio-retention areas. A drainage channel is also planned for the site and will flow through the PSTC complex at two locations, including through the current study area on the southeast side of the proposed building and parking area.

The project site is located within a known area of karst limestone geology, with active karst features mapped within ½ mile of the site and potential karst features (deep soft soils) encountered at boring locations B-6, SWM-1, and SWM-2. Additionally, shallow bedrock was encountered at some of the boring locations and may be encountered within the proposed stormwater management areas. Blasting and rock removal may exacerbate any existing karst features. It is recommended that an impervious liner be installed within the SWM facilities.

A majority of the on-site soils are classified as CL, CL/ML, ML/CL, or more granular materials per USCS. It is unlikely that these materials will exhibit a hydraulic conductivity (permeability) low enough to be considered for use as liner material. Some higher plasticity clay (CH, CL/CH) soils were encountered at boring locations B-1, B-2, B-5, B-8; and SWM-3, however these materials may only be present on-site in isolated quantities, making if potentially inefficient to construct the anticipated liners. As an alternative, we recommend the use of a 30-mil PVC geomembrane liner. We have outlined some construction considerations below. We recommend that the liner be installed in accordance with the recommendations below as well as the guidelines provided in the manufacturer's recommendations.

Subgrade Preparation: Surfaces to be lined should be smooth and free of all rocks and stones greater than 1/2" diameter, sticks, sharp objects, or debris of any kind to a depth of at least 6 inches below the surface. The surface should provide a smooth, flat, firm, unyielding foundation for the membrane with no sudden, sharp or abrupt changes or break in grade. No standing water, mud, snow and excessive moisture should be present prior to placement of the membrane.

Cover Soil: We recommend that the PVC liner be covered with a minimum of 12 inches of soil. Cover soil should not contain any angular stone or any objects that could damage the liner. Maximum allowable particle size of soil cover should be 3/8-inch, unless the liner is cushioned by an 8-ounce or greater needle punched, non-woven geotextile padding material. Cover materials should also be stable against slippage down the slope under all operational and exposure conditions. Based upon the soils anticipated at the site and a factor of safety of 1.5, we recommend that the side slopes of the pond not exceed 3H:1V. Steeper slopes could result in sloughing of the cover soil.

Anchor Trench: An anchor trench will be necessary in order to hold the liner in place. We recommend that the anchor trench be a minimum of 12 inches deep and 6 inches wide, and be located a minimum of 24 inches outside the top edge of the pond. An anchor trench detail should be included on the construction drawings. The anchor trench should be excavated to the line, grade and width shown on the construction drawings, prior to liner placement. The owner or geotechnical engineer should verify that the anchor trench has been constructed according to construction drawings prior to placement of the liner. Slightly rounded corners will be provided in the trench where the geomembrane adjoins the trench so as to avoid sharp bends in the geomembrane. No loose soil or rocks will be allowed to underlie the geomembrane in the anchor trench. Leading edges of the anchor trench should be smooth and even.

6.0 SITE CONSTRUCTION RECOMMENDATIONS

6.1 SUBGRADE PREPARATION

6.1.1 Demolition

Any remaining demolition of the residential structure, barns, out-buildings, driveways, and other features related to previous site usage will need to be performed prior to the start of new construction. During site demolition existing utilities and/or other subsurface structures related to the existing site usage are expected to have been removed and the resulting voids backfilled, per project recommendations using well-compacted engineered fill. Abandoned pipes should not remain beneath the building pad.

6.1.2 Stripping and Grubbing

The subgrade preparation should consist of stripping all demolition debris, vegetation, rootmat, topsoil, plow zone materials, and any other soft or unsuitable materials from the 10-foot expanded building and 5-foot expanded pavement limits and to 5 feet beyond the toe of structural fills. We recommend budgeting for a minimum stripping depth of at least 12 inches. ECS should be called on to verify that topsoil and unsuitable surficial materials have been completely removed prior to the placement of Structural Fill or construction of structures.

6.1.3 Proofrolling

After removing all unsuitable surface materials, cutting to the proposed grade, and prior to the placement of any structural fill or other construction materials, the exposed subgrade should be examined by the Geotechnical Engineer or authorized representative. The exposed subgrade should be thoroughly proofrolled with previously approved construction equipment having a minimum axle load of 10 tons (e.g. fully loaded tandem-axle dump truck). The areas subject to proofrolling should be traversed by the equipment in two perpendicular (orthogonal) directions with overlapping passes of the vehicle under the observation of the Geotechnical Engineer or authorized representative. This procedure is intended to assist in identifying any localized yielding materials. In the event that unstable or "pumping" subgrade is identified by the proofrolling, those areas should be marked for repair prior to the placement of any subsequent structural fill or other construction materials. Methods of repair of unstable subgrade, such as undercutting or moisture conditioning or chemical stabilization, should be discussed with the Geotechnical Engineer to determine the appropriate procedure with regard to the existing conditions causing the instability. A test pit(s) may be excavated to explore the shallow subsurface materials in the area of the instability to help in determined the cause of the observed unstable materials and to assist in the evaluation of the appropriate remedial action to stabilize the subgrade.

6.1.4 Site Temporary Dewatering

General Groundwater Conditions: Groundwater observations are described in Section 3.5 of this report. Groundwater on this site can generally be characterized as being deeper than the anticipated excavation limits, though there may be some areas of the site where perched groundwater is encountered.

Subsurface Water: Based upon our subsurface exploration at this site, as well as significant experience on sites in nearby areas of similar geologic setting, we believe construction dewatering at this site will be limited to mainly removing isolated pockets of perched water, accumulated rain water, and some minor seepage into excavations.

Deep wells will not be required for the temporary dewatering system. However, the dewatering operations can be handled by the use of conventional submersible pumps directly in the excavation or temporary trenches or French drains consisting of free draining granular stone wrapped in filter fabric to direct the flow of water and to remove water from the excavation. If temporary sump pits are used, we recommend they be established at an elevation 3 to 5 feet below the bottom of the excavation subgrade or bottom of footing. A perforated 55 gallon drum or other temporary structure could be used to house the pump.

Details of a typical french drainage installation are included as an attachment to this report. If utilized, the french drain should consist of a filter fabric lined trench filled with No. 57 stone or equivalent open graded stone. A minimum of 4-inch diameter PVC pipe should be placed in the stone bed to enhance water flow. After this installation has been completed, the filter fabric should be wrapped over the top of the gravel and pipe whereupon placement of fill may proceed to grade.

6.1.5 Subgrade Stabilization

Subgrade Benching: Fill should not be placed on ground with a slope steeper than 5H:1V, unless the fill is confined by an opposing slope, such as in a ravine. Otherwise, where steeper slopes exist, the ground should be benched so as to allow for fill placement on a horizontal surface.

Subgrade Compaction: Upon completion of subgrade documentation, the exposed subgrade within the 10-foot expanded building and 5-foot expanded pavement and embankment limits should be moisture conditioned to within -1 and +3 % of the soil's optimum moisture content and be compacted with suitable equipment (minimum 10-ton roller) to a depth of 10 inches. Subgrade compaction within the expanded building, pavement, and embankment limits should be to a dry density of at least 98% of the Standard Proctor maximum dry density (ASTM D698). Beyond these areas, compaction of at least 95% should be achieved. ECS should be called on to document that proper subgrade compaction has been achieved.

Subgrade Compaction Control: The expanded limits of the proposed construction areas should be well defined, including the limits for buildings, pavements, fills, and slopes, etc. Field density testing of subgrades will be performed at frequencies in Table 6.1.5.1

Table 6.1.5.1 Frequency of Subgrade Compaction Testing

Location	Frequency of Tests
Expanded Building Limits	1 test per 2,500 sq. ft.
Pavement Areas	1 test per 10,000 sq. ft.
Outparcels/SWM Facilities	1 test per 2,500 sq. ft.
All Other Non-Critical Areas	1 test per 10,000 sq. ft.

Subgrade Stabilization: Is some areas, undercutting of excessively soft materials may be considered inefficient. In such areas the use of a reinforcing geotextile or geogrid might be employed, under the advisement of ECS. Suitable stabilization materials may include medium duty woven geotextile fabrics or geogrids. The suitability and employment of reinforcing or stabilization products should be determined in the field by ECS personnel, in accordance with project specifications.

6.2 EARTHWORK OPERATIONS

6.2.1 Existing Man-Placed Fill

Fill Content: Existing fill materials were not encountered in the borings performed during this investigation but fill materials may be encountered in areas not explored such as in the vicinity of the previously demolished residence and outbuildings.

Fill Removal in Non-Building Areas: If encountered, any existing fill should be thoroughly evaluated by the Geotechnical Engineer via proofrolling. Any fill deemed unstable via the results of a proofroll should be removed from below the expanded fill removal limits of pavements and Structural Fill embankments. The expanded fill removal limits of pavements and Structural Fill embankments should be defined as that area directly below pavements and Structural Fill embankments, and extending horizontally beyond the edge of these a distance of 1 horizontal foot for every vertical foot of Structural Fill depth above natural subgrade, but not less than 5 feet. ECS personnel should ascertain that fill removal has been suitably accomplished.

Fill Removal in Building Areas: Fill materials are not expected within or surrounding the footprint of the proposed building. Any undocumented or unsuitable fill encountered within foundation excavations should be removed per the recommendations provided in Section 5.1.1. Existing fills within planned slab on grade areas should be thoroughly evaluated during construction by the Geotechnical Engineer via proofrolling.

6.2.2 High Plasticity Soils

Cuts: High plasticity soils are those soil materials classified as Elastic SILT (MH) and Fat CLAY (CH, CL/CH, GC/CH). High plasticity soils were encountered at borings B-1, B-2, B-5, B-8; and SWM-3, and are extremely common within the site geology. Where high plasticity soils are encountered at design subgrade elevations in slab and pavement areas, the subgrade should be undercut two (2) feet and grades restored with approved Structural Fill. Where high plasticity soils are encountered at foundation bearing elevations, the foundation excavation should be lowered an additional four (4) feet below the design footing subgrade elevation and the design elevation restored by backfilling the excavation with DOT Type 1 Size 21A/CR-6 stone placed and compacted with a vibratory plate compactor in maximum 12-inch lifts or with Flowable Fill having a minimum 28-day compressive strength of 2,000 psi.

Structural Fills: High plasticity soils do not satisfy the specification criteria for satisfactory materials. Given the presence of high plasticity soils on this site, and to reduce the amount of import material to the site, the Owner can consider allowing soils with a maximum Liquid Limit of 60 and maximum Plasticity Index of 30 to be used as Structural Fill at depths greater than 4 feet below pavement subgrades outside the expanded building limits and within non-structural areas.

6.2.3 Structural Fill Materials

Product Submittals: Prior to placement of Structural Fill, representative bulk samples (about 50 pounds) of on-site and off-site borrow should be submitted to ECS for laboratory testing, which will include Atterberg limits, natural moisture content, grain-size distribution, and moisture-density relationships for compaction. Import materials should be tested prior to being hauled to the site to determine if they meet project specifications.

Satisfactory Structural Fill Materials: Materials satisfactory for use as Structural Fill should consist of inorganic soils classified as CL, ML, SM, SC, SW, SP, GW, GP, GM, and GC, or a combination of these group symbols, per ASTM D 2487. The materials should be free of organic matter, debris, and should contain no particle sizes greater than 4 inches in the largest dimension. Open graded materials, such as Gravels (GW and GP), which contain void space in their mass should not be used in structural fills unless properly encapsulated with filter fabric. Suitable Structural Fill material should have the index properties shown in Table 6.2.3.1.

Table 6.2.3.1 Structural Fill Index Properties

Location with Respect to Final Grade	LL	PI
Building Areas, upper 4 feet	40 max	20 max
Building Areas, below upper 4 feet	50 max	20 max
Pavement Areas, upper 2 feet	40 max	20 max
Pavement Areas, below upper 2 feet	50 max	20 max

Unsatisfactory Materials: Unsatisfactory fill materials include materials which do not satisfy the requirements for suitable materials, as well as topsoil and organic materials (OH, OL), elastic Silt (MH), and high plasticity Clay (CH, CL/CH, GC/CH). The Owner can consider allowing soils with a maximum Liquid Limit of 60 and Plasticity Index of 30 to be used as Structural Fill at depths greater than 4 feet below pavement subgrades outside the expanded building limits and within non-structural areas.

On-Site Borrow Suitability: Significant natural deposits of soils considered unsuitable by virtue of their plasticity are present on the site. However, portions of the low- to medium-plasticity clayey soils meeting the guidelines in Table 6.2.3.1 are expected to be suitable for reuse, with moisture adjustment during placement.

Optimum moisture contents of the three Proctor samples tested was between 14.9% and 21.3%. As indicated on the Laboratory Test Results Summary of Appendix C, all of the natural moisture contents of the samples tested were observed to have moisture contents above 20%. Therefore, moisture conditioning of subgrades and fill lifts will be required, especially in the wetter months. The on-site clay soils will be difficult to moisture condition via mechanical methods and chemical modification should be considered and budgeted for. Soil modification with Quick Lime or Calciment® should prove effective in reducing moisture contents of subgrades and fills.

6.2.4 Compaction

Structural Fill Compaction: Structural Fill within the expanded building, pavement, and embankment limits should be placed in maximum 8-inch loose lifts, moisture conditioned as necessary to within -1 and +3 % of the soil's optimum moisture content, and be compacted with suitable equipment to a dry density of at least 98% of the Standard Proctor maximum dry density (ASTM D698). Beyond these areas, compaction of at least 90% should be achieved. ECS should be called on to document that proper fill compaction has been achieved.

Fill Compaction Control: The expanded limits of the proposed construction areas should be well defined, including the limits of the fill zones for buildings, pavements, and slopes, etc., at the time of fill placement. Grade controls should be maintained throughout the filling operations. All filling operations should be observed on a full-time basis by a qualified representative of the construction testing laboratory to determine that the minimum compaction requirements are being achieved. Field density testing of fills will be performed at the frequencies shown in Table 6.2.4.1, but not less than 1 test per lift

Table 6.2.4.1 Frequency of Compaction Tests in Fill Areas

Location	Frequency of Tests
Expanded Building Limits	1 test per 2,500 sq. ft. per lift
Pavement Areas	1 test per 10,000 sq. ft. per lift
Utility Trenches	1 test per 200 linear ft. per lift
Outparcels/SWM Facilities	1 test per 5,000 sq. ft. per lift
All Other Non-Critical Areas	1 test per 10,000 sq. ft. per lift

Compaction Equipment: Compaction equipment suitable to the soil type being compacted should be used to compact the subgrades and fill materials. Sheepsfoot compaction equipment should be suitable for the fine-grained soils (Clays and Silts). A vibratory steel drum roller should be used for compaction of coarse-grained soils (Sands) as well as for sealing compacted surfaces.

Fill Placement Considerations: Fill materials should not be placed on frozen soils, on frost-heaved soils, and/or on excessively wet soils. Borrow fill materials should not contain frozen materials at the time of placement, and all frozen or frost-heaved soils should be removed prior to placement of Structural Fill or other fill soils and aggregates. Excessively wet soils or aggregates should be scarified, aerated, and moisture conditioned.

At the end of each work day, all fill areas should be graded to facilitate drainage of any precipitation and the surface should be sealed by use of a smooth-drum roller to limit infiltration of surface water. During placement and compaction of new fill at the beginning of each workday, the Contractor may need to scarify existing subgrades to a depth on the order of 4 inches so that a weak plane will not be formed between the new fill and the existing subgrade soils.

Drying and compaction of wet soils is typically difficult during the cold, winter months. Accordingly, earthwork should be performed during the warmer, drier times of the year, if practical. Proper drainage should be maintained during the earthwork phases of construction to prevent ponding of water which has a tendency to degrade subgrade soils. Alternatively, if these

soils cannot be stabilized by conventional methods as previously discussed, additional modifications to the subgrade soils such as lime or cement stabilization may be utilized to adjust the moisture content. If lime or cement is utilized to control moisture contents and/or for stabilization, Quick Lime, Calciment® or regular Type 1 cement can be used. The construction testing laboratory should evaluate proposed lime or cement soil modification procedures, such as quantity of additive and mixing and curing procedures, before implementation. The contractor should be required to minimize dusting or implement dust control measures, as required.

Where fill materials will be placed to widen existing embankment fills, or placed up against sloping ground, the soil subgrade should be scarified and the new fill benched or keyed into the existing material. Fill material should be placed in horizontal lifts. In confined areas such as utility trenches, portable compaction equipment and thin lifts of 3 inches to 4 inches may be required to achieve specified degrees of compaction.

We recommend that the grading contractor have equipment on site during earthwork for both drying and wetting fill soils. We do not anticipate significant problems in controlling moisture within the fill during dry weather, but moisture control may be difficult during winter months or extended periods of rain. The control of moisture content of higher plasticity soils is difficult when these soils become wet. Further, such soils are easily degraded by construction traffic when the moisture content is elevated.

6.2.5 Rock Excavation

Based on the soil boring results and as the site is located in a karst area, rock materials may be encountered within the planned excavation limits at the site, particularly at deeper utility excavations. The weathering profile of the bedrock at the site varies and rock materials may be encountered at shallow depths in areas not explored during this study.

For design and construction purposes, excavation difficulty may be correlated to SPT results. Materials having SPT N-values of 60 or fewer blows per foot penetration should be readily excavated with conventional earthwork equipment, while materials having SPT N-values in the range of 60 bpf to 50 blows per 3 inches may require ripping for removal. The excavation of materials having SPT N-values of 50 blows per 3 inches or less penetration or at auger/bucket refusal levels will most likely require hoe-ramming, particularly in narrow trench excavations. We recommend that the following definition be used to define hard rock excavation material.

> **"Rock shall be defined as those natural materials which cannot be excavated in an open excavation with a Caterpillar Model D-8, heavy duty track-type tractor, weighted at not less than 285 hp flywheel power and equipped with a single-shank hydraulic ripper, capable of exerting not less than 45,000 lbs. breakout force, or equivalent machinery. For trenches and pits, rock shall be defined as those materials that cannot be excavated with a Caterpillar Model No. 345 L track-type hydraulic excavator, weighing not less than 99,000 lbs., equipped with a 30-inch wide short-tip radius rock bucket, rated at not less than 345 hp flywheel power with bucket-digging force of not less than 39,000 lbs, or equivalent machinery. Boulders or masses of rock exceeding one-half cubic yard in volume shall also be considered rock excavation. This classification does not include materials such as loose rock, concrete, or other materials that can be removed by**

> **means other than drilling and blasting, rock trenching, or hoe-ramming, but which for reasons of economy in excavating, the contractor chooses to remove by drilling and blasting, rock trenching, or hoe-ramming techniques."**

Based on the boring results, materials requiring rock removal may be encountered within the planned excavations within the building footprint, at stormwater management facility locations and in other areas of the site where deeper cuts are planned such as at deeper utility installations. The following table outlines the depth and elevation at which rock excavation (hoe-ramming or blasting) is expected to be necessary:

Table 6.2.5.1 Rock Excavation Depths

Boring Location	Rock Excavation Required (SPT N-value = 50/3" or less)	
	Depth Below Grade (feet)	Approximate Elevation (EL)
B-1	22.0	463
B-2	6.7	480
B-3	3.4	482
B-4	Not encountered to EL 471	
B-5	7.1	480
B-6	31.5	451
B-7	10.0	479
B-8	4.0	483
P-1	Not encountered to EL 474	
P-2	Not encountered to EL 470	
P-3	6.0	475
SWM-1	24.0	458
SWM-2	Not encountered to EL 458	
SWM-3	12.4	466
SWM-4	14.5	468

Though rock may be encountered, highly weathered and fractured bedrock may be somewhat excavatable with conventional equipment, but deeper excavations into competent rock will require hoe-ramming or blasting.

The Contractor shall be prepared to hoe-ram or blast to remove rock that cannot be excavated by conventional methods. Also, the excavation of any rock shall be performed in accordance with the project specifications and the contract documents should include unit costs for the removal of rock based on the definition of rock in the project specifications.

6.3 SOLUTION ACTIVITY

This site is located within a karst geologic setting with mapped sinkhole activity and solution features within the surrounding areas. Additionally, a zone of deep, soft soil was encountered at boring B-6, which may be indicative of a solution feature. As such, it should be noted that sinkholes may develop during construction as it is not possible to predict how construction activities will impact the existing karst conditions at the site.

If an active sinkhole forms during construction activity, immediate remediation will be necessary to eliminate and/or minimize any subsequent subsidence in the same area. Remediation of the feature will most likely involve the excavation of a test pit to verify that the origin of the collapse feature is natural and not from previously buried debris. Once it has been verified that the feature is natural, the sinkhole should be excavated and field probing should be accomplished to locate and determine the path of the collapse and location of the throat of the sinkhole. If the sinkhole is in a non-structural area, a crushed stone plug, or inverted filter may be suitable to seal the feature. The size of the crushed stone plug will be based on the actual size of the throat and will generally be 12 to 18-inches thick and extend 2 to 4 feet beyond the collapse path area. The size of the crushed stone will depend on the size of the throat, but will typically consist of 2 to 6-inch surge stone. In addition, the crushed stone should be wrapped with Mirafi 140N or equivalent Geotextile fabric to prevent migration of soil through the stone and into the throat. The location of the concrete cap will be based upon the final grades that will not comprise the proposed buildings. If a sinkhole occurs in a structural area, it will likely need to be remediated by the use of grout.

Since the site is located within a geologic formation prone to sinkhole development, we recommend that the following criteria be followed to minimize the potential for future development of sinkholes within the development area.

- **provide water-tight, gasketed joints for all utilities that carry fluids, or encase such utilities with flowable fill;**
- **provide positive drainage away from structural areas (i.e., at least 3% slope for first 10 feet along building);**
- **collection of all storm water from roof drains, sidewalks, parking lots, drive lanes, and other impervious surfaces directly into SWM facilities or the storm drain system to minimize the infiltration of water into the subsurface soils and/or rock;**
- **minimize stone bedding below utility pipes to minimize water flow;**
- **during construction, care must be taken to minimize and/or eliminate the ponding of surface water in and adjacent to the planned building and pavement areas;**
- **provide joints in masonry/brick walls with a spacing not greater than 20 feet and reinforcement in all masonry walls;**
- **construct buildings of well braced structural framework.**

It is recommended that in the areas where rock has been exposed through excavation or blasting, a Geotechnical Engineer and/or Engineering Geologist be permitted to examine the exposed surface for any existing solution features. After a complete examination of the exposed rock surface, in the excavated portion of the project site, for solution features, the predominantly fine-grained and cohesive on-site soils should be used to seal all exposed rock surfaces and return those portions of the project site to planned subgrade levels as discussed previously.

Consideration should be given to thoroughly compacting a 12-inch layer of fine-grained and cohesive on-site soils beneath any topsoil veneer within any planned pavement island and adjacent landscaped areas in order to minimize the infiltration of future precipitation into the underlying soils.

We recommend that all of the exposed subgrade soils in the structural and pavement areas must be proofrolled and densified in-place with approved compaction equipment, such as a minimum 10-ton roller. This treatment will assist in increasing the supportive capacity of the subgrade soils for the placement of new fill, building foundations, slab, or pavements. Also, proofrolling and densification may denote any near surface collapse features should they exist near the surface.

It should be noted that the recommendations and measures outlined above will not completely eliminate the risk of future development of depressions, but by including these recommendations/measures in the overall design of the project, the probability of the formation of depressions in developed areas can be reduced. Consequently, it should be realized that development of this site will always involve some degree of risk of the occurrence of depressions, but it is our opinion that inclusion of these recommendations/measures will significantly reduce the degree of risk to the acceptable tolerance levels.

6.4 FOUNDATION AND SLAB OBSERVATIONS

Protection of Foundation Excavations: Exposure to the environment may weaken the soils at the footing bearing level if the foundation excavations remain open for too long a time. Therefore, foundation concrete should be placed the same day that excavations are made. If the bearing soils are softened by surface water intrusion or exposure, the softened soils must be removed from the foundation excavation bottom immediately prior to placement of concrete. If the excavation must remain open overnight, or if rainfall becomes imminent while the bearing soils are exposed, a 1 to 3-inch thick "mud mat" of "lean" concrete should be placed on the bearing soils before the placement of reinforcing steel.

Footing Subgrade Observations: The soils at foundation bearing elevations are anticipated to be suitable for support of the proposed structure. Some undercutting on unsuitable soils should be budgeted for. It will be important to have the geotechnical engineer of record observe the foundation subgrade prior to placing foundation concrete, to confirm the bearing soils are what was anticipated. If soft or unsuitable soils are observed at the footing bearing elevations, the unsuitable soils should be undercut and removed. Any undercut should be backfilled with lean concrete ($f'_c \geq 2{,}500$ psi at 28 days) up to the original design bottom of footing elevation; the original footing shall be constructed on top of the hardened lean concrete.

Slab Subgrade Verification: A representative of ECS should be called on to observe exposed subgrades within the expanded building limits prior to Structural Fill Placement to assure that adequate subgrade preparation has been achieved. A proofrolling using a drum roller or loaded dump truck should be performed in their presence at that time. Once subgrades have been prepared to the satisfaction of ECS, subgrades should be properly compacted and new Structural Fill can be placed. Existing subgrades to a depth of at least 10 inches and all Structural Fill should be moisture conditioned to within -1/+3 percentage points of optimum moisture content then be compacted to the required density. If there will be a significant time lag between the site grading work and final grading of concrete slab areas prior to the placement of the subbase stone and concrete, a representative of ECS should be called on to verify the condition of the prepared subgrade. Prior to final slab construction, the subgrade may require scarification, moisture conditioning, and re-compaction to restore stable conditions.

6.5 UTILITY INSTALLATIONS

Utility Subgrades: The soils encountered in our exploration are expected to be generally suitable for support of utility pipes. The pipe subgrade should be observed and probed for stability by ECS to evaluate the suitability of the materials encountered. Any loose or unsuitable materials encountered at the utility pipe subgrade elevation should be removed and replaced with suitable compacted Structural Fill or pipe bedding material.

Utility Backfilling: The granular bedding material should be at least 4 inches thick, but not less than that specified by the project drawings and specifications. Fill placed for support of the utilities, as well as backfill over the utilities, should satisfy the requirements for Structural Fill given in this report. Compacted backfill should be free of topsoil, roots, ice, or any other material designated by ECS as unsuitable. The backfill should be moisture conditioned, placed, and compacted in accordance with the recommendations of this report.

Utility Excavation Dewatering: It is possible that perched water may be encountered by utility excavations which extend below existing grades. It is expected that removal of perched water which seeps into excavations could be accomplished by pumping from sumps excavated in the trench bottom and which are backfilled with DOT Size No. 57 Stone or open graded bedding material. Should water conditions beyond the capability of sump pumping be encountered, the contractor should submit a Dewatering Plan in accordance with project specifications.

Excavation Safety: All excavations and slopes should be made and maintained in accordance with OSHA excavation safety standards. The contractor is solely responsible for designing and constructing stable, temporary excavations and slopes and should shore, slope, or bench the sides of the excavations and slopes as required to maintain stability of both the excavation sides and bottom. The contractor's responsible person, as defined in 29 CFR Part 1926, should evaluate the soil exposed in the excavations as part of the contractor's safety procedures. In no case should slope height, slope inclination, or excavation depth, including utility trench excavation depth, exceed those specified in local, state, and federal safety regulations. ECS is providing this information solely as a service to our client. ECS is not assuming responsibility for construction site safety or the contractor's activities; such responsibility is not being implied and should not be inferred.

6.6 GENERAL CONSTRUCTION CONSIDERATIONS

Moisture Conditioning: During the cooler and wetter periods of the year, delays and additional costs should be anticipated. At these times, reduction of soil moisture may need to be accomplished by a combination of mechanical manipulation and the use of chemical additives, such as lime or cement, in order to lower moisture contents to levels appropriate for compaction. Alternatively, during the drier times of the year, such as the summer months, moisture may need to be added to the soil to provide adequate moisture for successful compaction according to the project requirements.

Subgrade Protection: Measures should also be taken to limit site disturbance, especially from rubber-tired heavy construction equipment, and to control and remove surface water from development areas, including structural and pavement areas. It would be advisable to designate a haul road and construction staging area to limit the areas of disturbance and to prevent construction traffic from excessively degrading sensitive subgrade soils and existing pavement areas. Haul roads and construction staging areas could be covered with excess depths of aggregate to protect those subgrades. The aggregate can later be removed and used in pavement areas.

Surface Drainage: Surface drainage conditions should be properly maintained. Surface water should be directed away from the construction area, and the work area should be sloped away from the construction area at a gradient of 1 percent or greater to reduce the potential of ponding water and the subsequent saturation of the surface soils. At the end of each work day, the subgrade soils should be sealed by rolling the surface with a smooth drum roller to minimize infiltration of surface water.

Excavation Safety: Cuts or excavations associated with utility excavations may require forming or bracing, slope flattening, or other physical measures to control sloughing and/or prevent slope failures. Contractors should be familiar with applicable OSHA codes to ensure that adequate protection of the excavations and trench walls is provided.

Erosion Control: The surface soils may be erodible. Therefore, the Contractor should provide and maintain good site drainage during earthwork operations to maintain the integrity of the surface soils. All erosion and sedimentation controls should be in accordance with sound engineering practices and local requirements.

7.0 CLOSING

ECS has prepared this report of findings, evaluations, and recommendations to guide geotechnical-related design and construction aspects of the project.

The description of the proposed project is based on information provided to ECS by Crabtree Rohrbaugh & Associates Architects. If any of this information is inaccurate, either due to our interpretation of the documents provided or site or design changes that may occur later, ECS should be contacted immediately in order that we can review the report in light of the changes and provide additional or alternate recommendations as may be required to reflect the proposed construction.

We recommend that ECS be allowed to review the project's plans and specifications pertaining to our work so that we may ascertain consistency of those plans/specifications with the intent of the geotechnical report.

Field observations, monitoring, and quality assurance testing during earthwork and foundation installation are an extension of and integral to the geotechnical design recommendation. We recommend that the owner retain these quality assurance services and that ECS be allowed to continue our involvement throughout these critical phases of construction to provide general consultation as issues arise. ECS is not responsible for the conclusions, opinions, or recommendations of others based on the data in this report.

APPENDIX A – Drawings & Reports

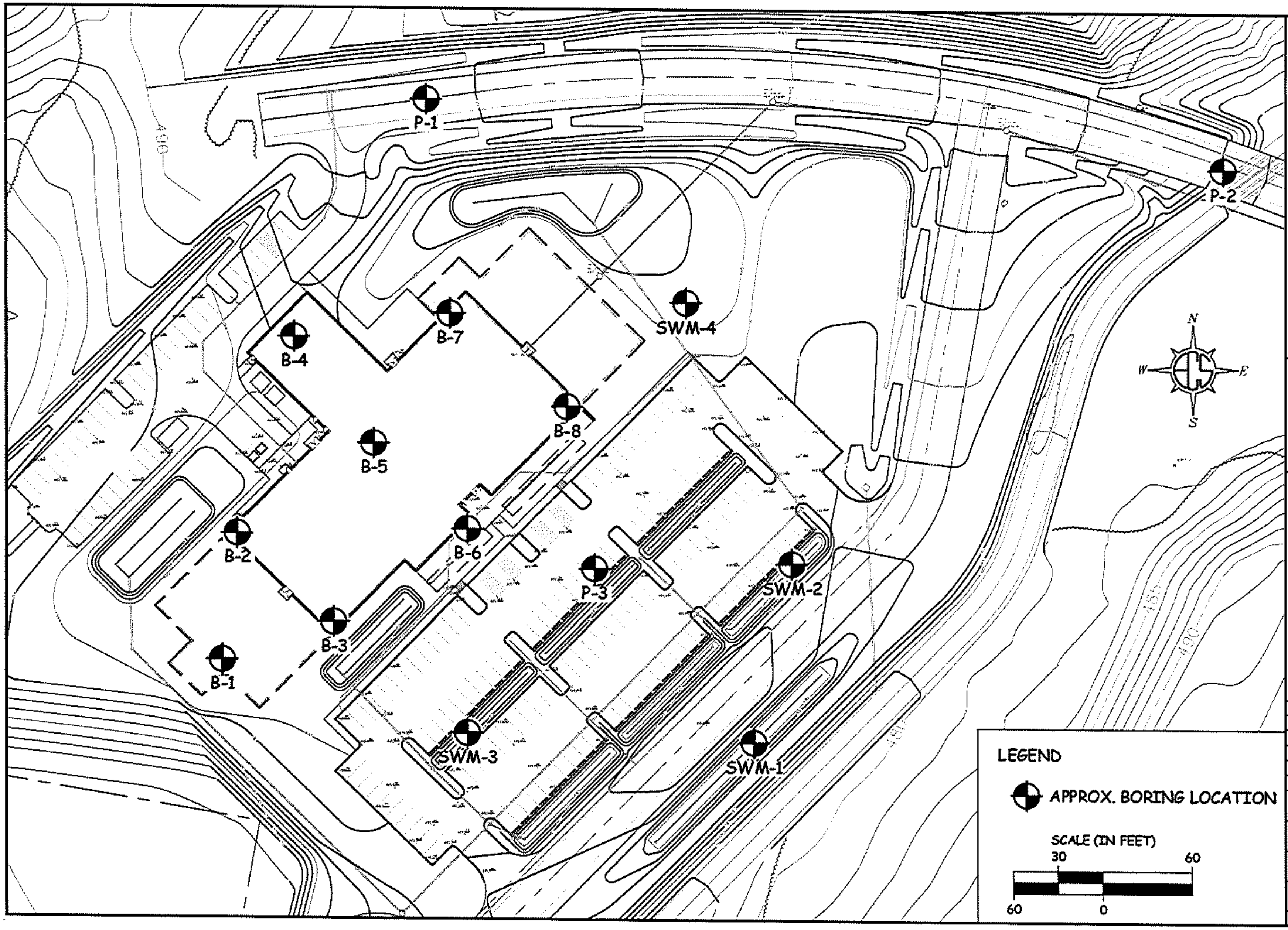
Site Location Diagram
Location Diagram
Geologic Map
Soil Survey Map

SITE LOCATION DIAGRAM
WASHINGTON COUNTY PUBLIC

9238 SHARPSBURG PIKE, HAGERSTOWN, MD

CRABTREE, ROHRBAUGH & ASSOCIATES

ENGINEER JM1
SCALE 1 " = 1000'
PROJECT NO. 8269
SHEET 1 OF 1
DATE 7/20/2018



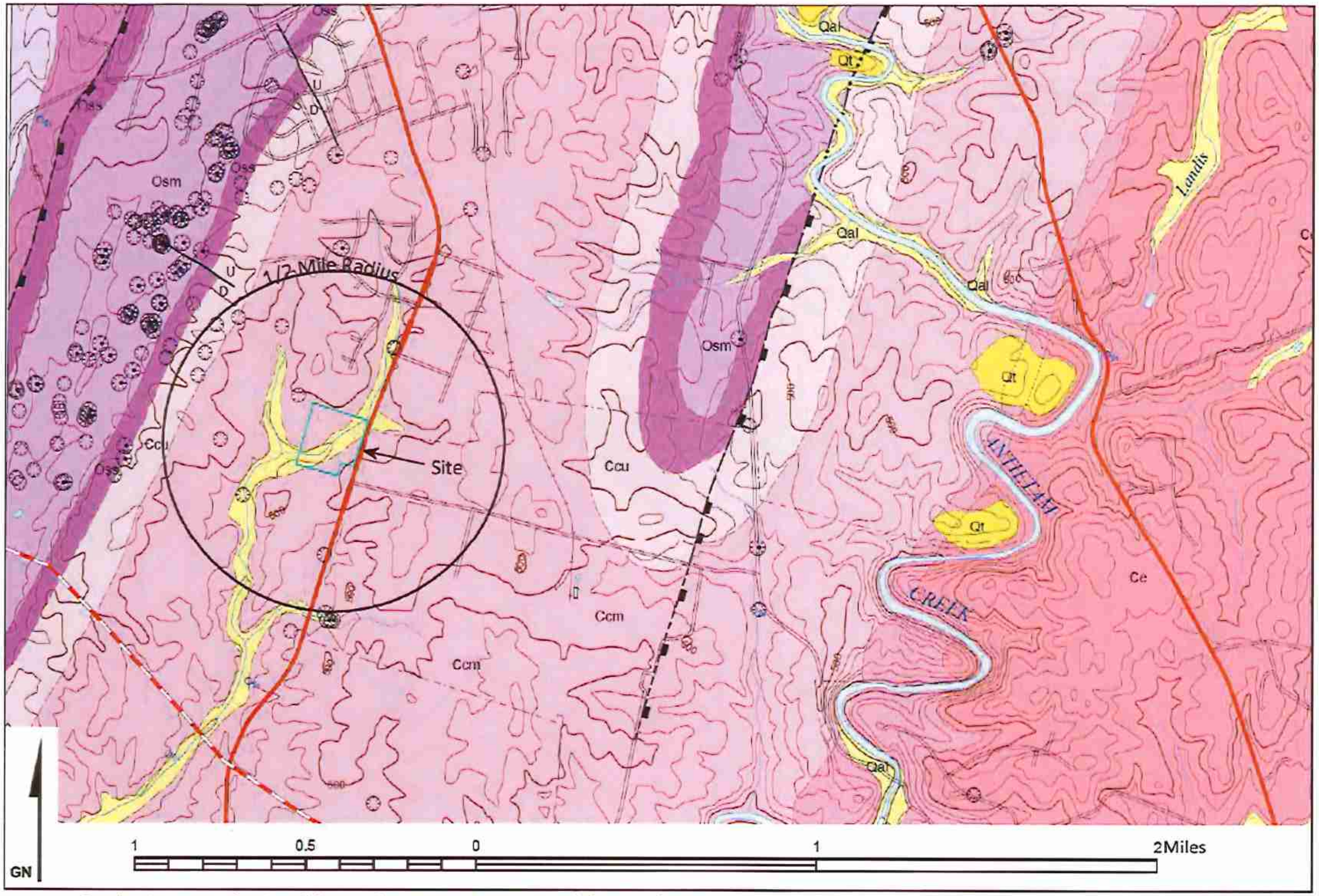
WASHINGTON COUNTY
PUBLIC SAFETY TRAINING CENTER
HAGERSTOWN, MD

ECS

BORING LOCATION
DIAGRAM

CRABTREE, ROHRBAUGH & ASSOCIATES ARCHITECTS

ECS REVISIONS	
ENGINEER GAR	DRAFTING AMH
SCALE 1" = 60'	
PROJECT NO. 13-8269	
SHEET 1 OF 1	
DATE 07/23/18	



Geologic map obtained from the Karst Features of the Funkstown Quadrangle, Washington County, Maryland (2009)

Appendix A – Drawings and Reports
Geologic Map
ECS Project No. 13:8269

Washington County Public Safety Training Center
9238 Sharpsburg Pike
Hagerstown, Washington County, Maryland

Soil Survey image obtained from USDA – Natural Resources Conservation Service; websoilsurvey.nrcs.usda.gov

Appendix A – Drawings and Reports
Soil Survey Map
ECS Project No. 13:8269

Washington County Public Safety Training Center
9238 Sharpsburg Pike
Hagerstown, Washington County, Maryland

APPENDIX B – Field Operations

Reference Notes for Boring Logs
Boring Logs (B-1 through B-8, P-1 through P-3, and SWM-1 through SWM-4)

REFERENCE NOTES FOR BORING LOGS

MATERIAL[1,2]

■		**ASPHALT**
▒		**CONCRETE**
○		**GRAVEL**
▧		**TOPSOIL**
□		**VOID**
▦		**BRICK**
○		**AGGREGATE BASE COURSE**
▒	**FILL[3]**	**MAN-PLACED SOILS**
▓	**GW**	**WELL-GRADED GRAVEL** gravel-sand mixtures, little or no fines
▓	**GP**	**POORLY-GRADED GRAVEL** gravel-sand mixtures, little or no fines
▓	**GM**	**SILTY GRAVEL** gravel-sand-silt mixtures
▓	**GC**	**CLAYEY GRAVEL** gravel-sand-clay mixtures
░	**SW**	**WELL-GRADED SAND** gravelly sand, little or no fines
░	**SP**	**POORLY-GRADED SAND** gravelly sand, little or no fines
▥	**SM**	**SILTY SAND** sand-silt mixtures
▨	**SC**	**CLAYEY SAND** sand-clay mixtures
▥	**ML**	**SILT** non-plastic to medium plasticity
▥	**MH**	**ELASTIC SILT** high plasticity
▨	**CL**	**LEAN CLAY** low to medium plasticity
▨	**CH**	**FAT CLAY** high plasticity
▧	**OL**	**ORGANIC SILT or CLAY** non-plastic to low plasticity
■	**OH**	**ORGANIC SILT or CLAY** high plasticity
▓	**PT**	**PEAT** highly organic soils

DRILLING SAMPLING SYMBOLS & ABBREVIATIONS

SS	Split Spoon Sampler	PM	Pressuremeter Test
ST	Shelby Tube Sampler	RD	Rock Bit Drilling
WS	Wash Sample	RC	Rock Core, NX, BX, AX
BS	Bulk Sample of Cuttings	REC	Rock Sample Recovery %
PA	Power Auger (no sample)	RQD	Rock Quality Designation %
HSA	Hollow Stem Auger		

PARTICLE SIZE IDENTIFICATION

DESIGNATION		PARTICLE SIZES
Boulders		12 inches (300 mm) or larger
Cobbles		3 inches to 12 inches (75 mm to 300 mm)
Gravel:	Coarse	¾ inch to 3 inches (19 mm to 75 mm)
	Fine	4.75 mm to 19 mm (No. 4 sieve to ¾ inch)
Sand:	Coarse	2.00 mm to 4.75 mm (No. 10 to No. 4 sieve)
	Medium	0.425 mm to 2.00 mm (No. 40 to No. 10 sieve)
	Fine	0.074 mm to 0.425 mm (No. 200 to No. 40 sieve)
Silt & Clay ("Fines")		<0.074 mm (smaller than a No. 200 sieve)

COHESIVE SILTS & CLAYS

UNCONFINED COMPRESSIVE STRENGTH, Q_P[4]	SPT[5] (BPF)	CONSISTENCY[7] (COHESIVE)
<0.25	<3	Very Soft
0.25 - <0.50	3 - 4	Soft
0.50 - <1.00	5 - 8	Medium Stiff
1.00 - <2.00	9 - 15	Stiff
2.00 - <4.00	16 - 30	Very Stiff
4.00 - 8.00	31 - 50	Hard
>8.00	>50	Very Hard

RELATIVE AMOUNT[7]	COARSE GRAINED (%)[8]	FINE GRAINED (%)[8]
Trace	≤5	≤5
Dual Symbol *(ex: SW-SM)*	10	10
With	15 - 20	15 - 25
Adjective *(ex: "Silty")*	≥25	≥30

GRAVELS, SANDS & NON-COHESIVE SILTS

SPT[5]	DENSITY
<5	Very Loose
5 - 10	Loose
11 - 30	Medium Dense
31 - 50	Dense
>50	Very Dense

WATER LEVELS[6]

▽	WL	Water Level (WS)(WD) (WS) While Sampling (WD) While Drilling
▽	SHW	Seasonal High WT
▼	ACR	After Casing Removal
▽	SWT	Stabilized Water Table
	DCI	Dry Cave-In
	WCI	Wet Cave-In

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[1] *Classifications and symbols per ASTM D 2488-09 (Visual-Manual Procedure) unless noted otherwise.*

[2] *To be consistent with general practice, "POORLY GRADED" has been removed from GP, GP-GM, GP-GC, SP, SP-SM, SP-SC soil types on the boring logs.*

[3] *Non-ASTM designations are included in soil descriptions and symbols along with ASTM symbol [Ex: (SM-FILL)].*

[4] *Typically estimated via pocket penetrometer or Torvane shear test and expressed in tons per square foot (tsf).*

[5] *Standard Penetration Test (SPT) refers to the number of hammer blows (blow count) of a 140 lb. hammer falling 30 inches on a 2 inch OD split spoon sampler required to drive the sampler 12 inches (ASTM D 1586). "N-value" is another term for "blow count" and is expressed in blows per foot (bpf).*

[6] *The water levels are those levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in granular soils. In clay and cohesive silts, the determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally employed.*

[7] *Minor deviation from ASTM D 2488-09 Note 16.*

[8] *Percentages are estimated to the nearest 5% per ASTM D 2488-09.*

CLIENT	Job #:	BORING #	SHEET
Crabtree, Rohrbaugh & Associates Architects	13:8269	B-1	1 OF 1
PROJECT NAME Washington County Public Safety Training Center	ARCHITECT-ENGINEER		

SITE LOCATION
9238 Sharpsburg Pike, Hagerstown, Washington County, MD

NORTHING	EASTING	STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

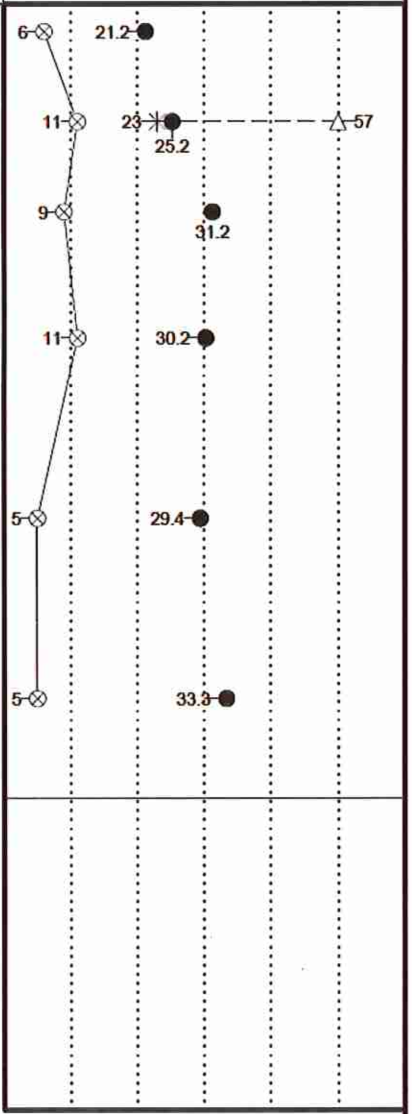
ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — –   REC% ———

PLASTIC LIMIT% ✕   WATER CONTENT% ●   LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS
BOTTOM OF CASING — LOSS OF CIRCULATION
SURFACE ELEVATION 485

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	14	Topsoil Depth [2.00"] (CL) LEAN CLAY, brownish orange, moist, firm		485	1 3 3
	S-2	SS	18	16	(CH) FAT CLAY, orangish brown, moist, stiff to firm			4 4 7
5	S-3	SS	18	16			480	3 4 5
10	S-4	SS	18	17			475	4 4 7
15	S-5	SS	18	18			470	2 2 3
20	S-6	SS	18	18			465	3 3 2
					AUGER REFUSAL @ 22.00'			
25							460	
30							455	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 07/27/18	CAVE IN DEPTH @ 12.6'
WL(SHW) WL(ACR) Dry	BORING COMPLETED 07/27/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

CLIENT	Job #:	BORING #	SHEET
Crabtree, Rohrbaugh & Associates Architects	13:8269	B-2	1 OF 1

PROJECT NAME
Washington County Public Safety Training Center

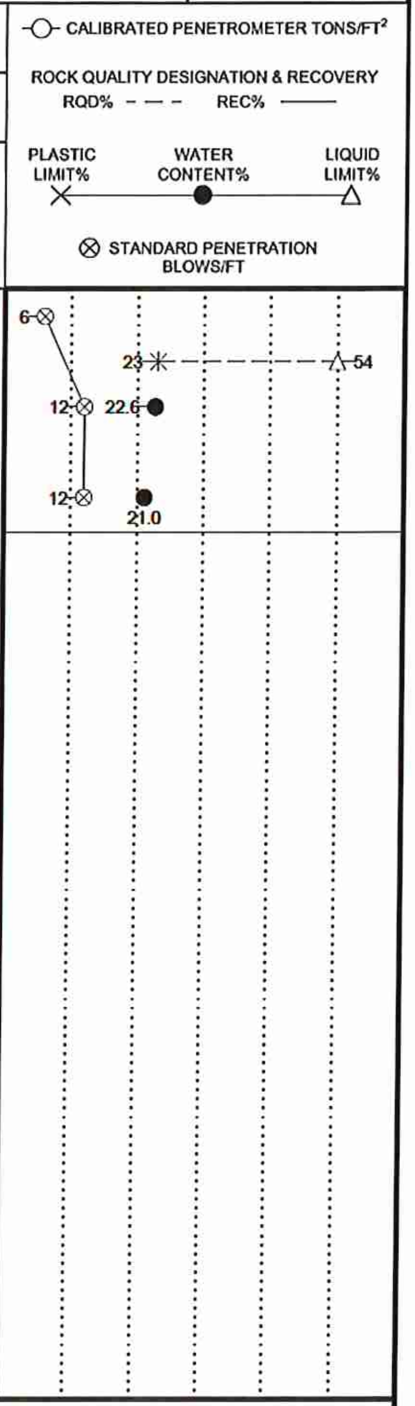
ARCHITECT-ENGINEER

SITE LOCATION
9238 Sharpsburg Pike, Hagerstown, Washington County, MD

NORTHING
EASTING
STATION

DESCRIPTION OF MATERIAL — ENGLISH UNITS
BOTTOM OF CASING ➡ LOSS OF CIRCULATION
SURFACE ELEVATION 486

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18	Topsoil Depth [1.00"] (ML/CL) CLAYEY SILT, contains significant roots, brown, moist, firm		485	1 2 4
	Bag 2-5 S-2	SS	18	18	(CH) FAT CLAY, orangish brown, moist, stiff			4 5 7
5	S-3	SS	18	18			480	3 5 7
					AUGER REFUSAL @ 6.70'			
10							475	
15							470	
20							465	
25							460	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 07/27/18	CAVE IN DEPTH @ 4.8'
WL(SHW) WL(ACR) Dry	BORING COMPLETED 07/27/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

CLIENT	Job #:	BORING #	SHEET
Crabtree, Rohrbaugh & Associates Architects	13:8269	B-3	1 OF 1

PROJECT NAME
Washington County Public Safety Training Center

ARCHITECT-ENGINEER

SITE LOCATION
9238 Sharpsburg Pike, Hagerstown, Washington County, MD

NORTHING
EASTING
STATION

-○- CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% — — — REC% ———

PLASTIC LIMIT% × WATER CONTENT% ● LIQUID LIMIT% △

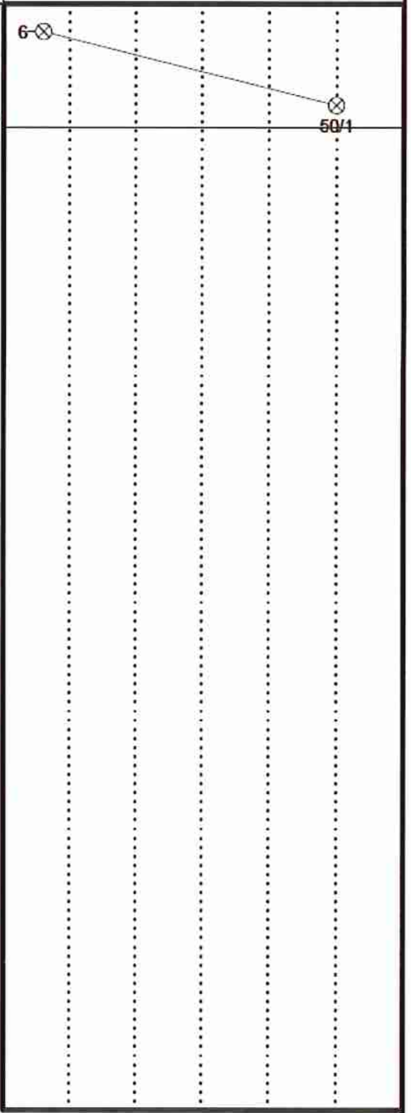
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION

SURFACE ELEVATION 485

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18	Topsoil Depth [2.00"] (CL) LEAN CLAY, orangish brown, moist, firm		485	1 2 4
	S-2	SS	7	6	(WR) WEATHERED ROCK SAMPLED AS GRAVEL, gray, moist, very dense [Weathered ROCK] AUGER REFUSAL @ 3.4'			3 50/1
5							480	
10							475	
15							470	
20							465	
25							460	
30							455	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS☐ WD☒	BORING STARTED	07/27/18	CAVE IN DEPTH @ 1.3'
WL(SHW) WL(ACR) Dry	BORING COMPLETED	07/27/18	HAMMER TYPE Auto
WL	RIG Track	FOREMAN Roberts	DRILLING METHOD HSA

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269

BORING #: B-4

SHEET: 1 OF 1

PROJECT NAME: Washington County Public Safety Training Center

ARCHITECT-ENGINEER:

SITE LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

NORTHING:

EASTING:

STATION:

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY

RQD% - — -   REC% ———

PLASTIC LIMIT% ×   WATER CONTENT% ●   LIQUID LIMIT% △

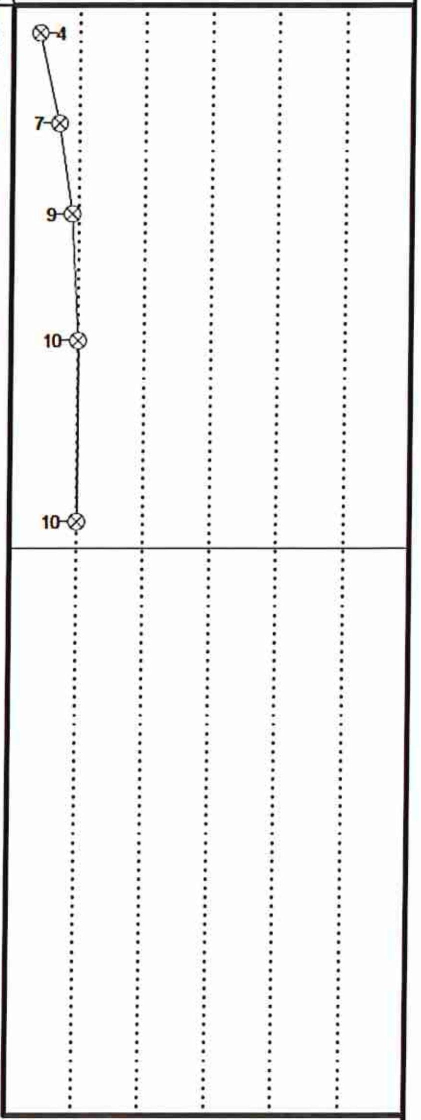
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL   ENGLISH UNITS

BOTTOM OF CASING   LOSS OF CIRCULATION

SURFACE ELEVATION 485.5

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18	Topsoil Depth [3.00"] (CL/ML) SILTY CLAY, orangish brown, moist, soft		485	1 2 2
	S-2	SS	18	18	(CL) LEAN CLAY, contains slight roots, orange to brownish orange, moist, firm to stiff			3 3 4
5	S-3	SS	18	18			480	2 3 6
	S-4	SS	18	18				3 4 6
10							475	
	S-5	SS	18	18	(SP-SM) SAND WITH SILT, orange, moist, loose			2 4 6
15					END OF BORING @ 15.00'		470	
20							465	
25							460	
30							455	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry   WS ☐   WD ☒

BORING STARTED 07/27/18

CAVE IN DEPTH @ 8.7'

WL(SHW)   WL(ACR)

BORING COMPLETED 07/27/18

HAMMER TYPE Auto

WL

RIG Track   FOREMAN Roberts

DRILLING METHOD HSA

CLIENT Crabtree, Rohrbaugh & Associates Architects	Job #: 13:8269	BORING # B-5	SHEET 1 OF 1
PROJECT NAME Washington County Public Safety Training Center	ARCHITECT-ENGINEER		
SITE LOCATION 9238 Sharpsburg Pike, Hagerstown, Washington County, MD			
NORTHING	EASTING	STATION	

-○- CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

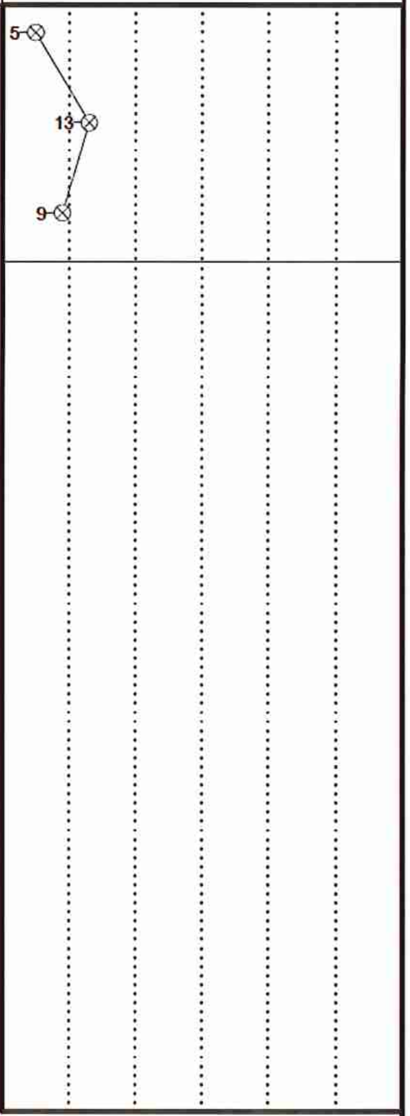
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION

SURFACE ELEVATION 487

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	8	Topsoil Depth [2.00"] (ML) GRAVELLY SILT, trace sand, contains slight roots, dark brown, moist, loose		485	3 2 3
	S-2	SS	18	10	(GC/CH) CLAYEY GRAVEL/ GRAVELLY FAT CLAY, brown and gray, moist, medium dense			8 6 7
5	S-3	SS	18	14	(CL) LEAN CLAY WITH SAND, brownish orange, moist, stiff		480	3 4 5
					AUGER REFUSAL @ 7.10'			
10							475	
15							470	
20							465	
25							460	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 07/27/18	CAVE IN DEPTH @ 4.0'
WL(SHW) WL(ACR) Dry	BORING COMPLETED 07/27/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

CLIENT	Job #:	BORING #	SHEET
Crabtree, Rohrbaugh & Associates Architects	13:8269	B-6	1 OF 2

PROJECT NAME
Washington County Public Safety Training Center

ARCHITECT-ENGINEER

SITE LOCATION
9238 Sharpsburg Pike, Hagerstown, Washington County, MD

NORTHING | EASTING | STATION

-O- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – – – REC% ———

PLASTIC LIMIT% × WATER CONTENT% ● LIQUID LIMIT% △

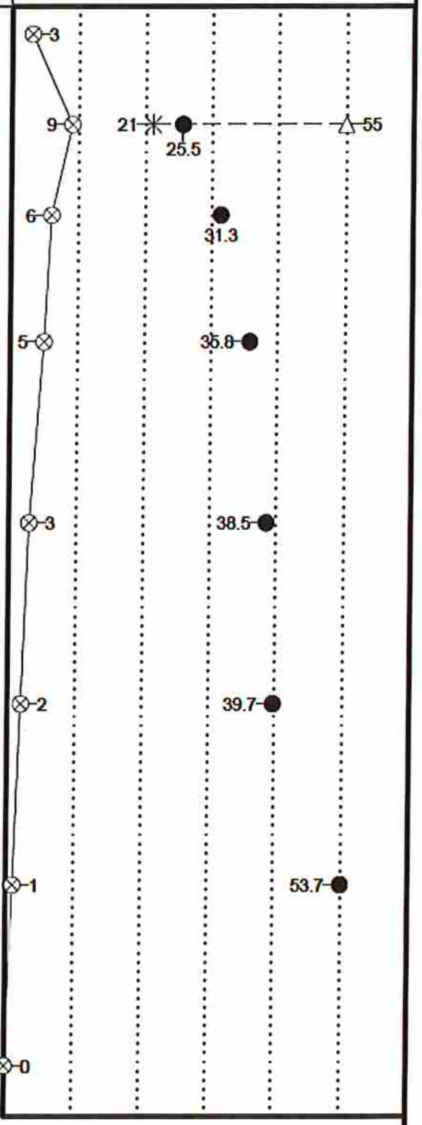
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING LOSS OF CIRCULATION

SURFACE ELEVATION 482

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [6.00"]			
	S-1	SS	18	18	(CL) LEAN CLAY, orangish brown, moist, soft			2 2 1
							480	
	S-2	SS	18	18	(CH) FAT CLAY, yellowish brown, moist, stiff to firm			2 4 5
5	S-3	SS	18	18				2 2 4
							475	
	S-4	SS	18	18				1 2 3
10								
							470	
	S-5	SS	18	18	(CH) FAT CLAY, orangish brown to brownish orange, moist, soft to very soft			1 1 2
15								
							465	
	S-6	SS	18	18				1 1 1
20								
							460	
	S-7	SS	18	18				woh woh 1
25								
							455	
						▽		
	S-8	SS	18	18				woh woh woh
30								



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THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 28.0 WS ☐ WD ☒	BORING STARTED 07/26/18	CAVE IN DEPTH @ 4.2'
▼ WL(SHW) ▼ WL(ACR) Dry	BORING COMPLETED 07/26/18	HAMMER TYPE Auto
▽ WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

CLIENT Crabtree, Rohrbaugh & Associates Architects	Job #: 13:8269	BORING # B-6	SHEET 2 OF 2
PROJECT NAME Washington County Public Safety Training Center	ARCHITECT-ENGINEER		
SITE LOCATION 9238 Sharpsburg Pike, Hagerstown, Washington County, MD			
NORTHING	EASTING	STATION	

-○- CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% - — - REC% ———

PLASTIC LIMIT% × WATER CONTENT% ● LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL ENGLISH UNITS BOTTOM OF CASING ➡ LOSS OF CIRCULATION ⟩⟩⟩ SURFACE ELEVATION 482	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
					(CH) FAT CLAY, orangish brown to brownish orange, moist, soft to very soft			
					AUGER REFUSAL @ 31.50'		450	
35								
							445	
40								
							440	
45								
							435	
50								
							430	
55								
							425	
60								

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 28.0 WS☐ WD☒	BORING STARTED 07/26/18	CAVE IN DEPTH @ 4.2'
▼ WL(SHW) ▼ WL(ACR) Dry	BORING COMPLETED 07/26/18	HAMMER TYPE Auto
▽ WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

CLIENT	Job #:	BORING #	SHEET
Crabtree, Rohrbaugh & Associates Architects	13:8269	B-7	1 OF 1
PROJECT NAME Washington County Public Safety Training Center	ARCHITECT-ENGINEER		

SITE LOCATION
9238 Sharpsburg Pike, Hagerstown, Washington County, MD

NORTHING
EASTING
STATION

-○- CALIBRATED PENETROMETER TONS/FT²

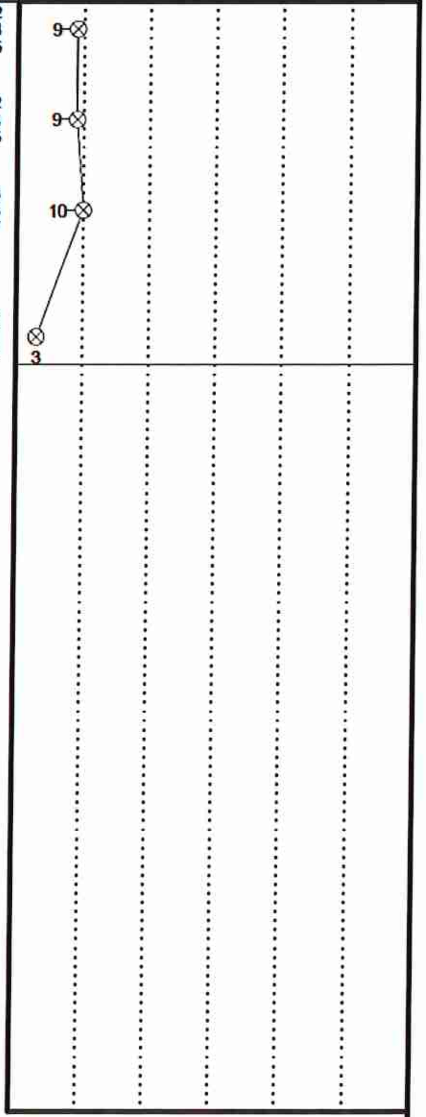
ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% × WATER CONTENT% ● LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS
BOTTOM OF CASING — LOSS OF CIRCULATION
SURFACE ELEVATION 489

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [3.00"]			
	S-1	SS	18	18	(CL) LEAN CLAY, orange to brownish orange, moist, stiff			2 4 5
	S-2	SS	18	18			485	2 4 5
5								
	S-3	SS	18	18				3 3 7
	S-4	SS	18	18	(CL) LEAN CLAY, brownish orange, moist, soft		480	2 1 2
10					AUGER REFUSAL @ 10.00'			
							475	
15								
							470	
20								
							465	
25								
							460	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS☐ WD☒	BORING STARTED 07/27/18	CAVE IN DEPTH @ 5.7'
WL(SHW) WL(ACR) Dry	BORING COMPLETED 07/27/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

CLIENT Crabtree, Rohrbaugh & Associates Architects	Job #: 13:8269	BORING # B-8	SHEET 1 OF 1
PROJECT NAME Washington County Public Safety Training Center	ARCHITECT-ENGINEER		
SITE LOCATION 9238 Sharpsburg Pike, Hagerstown, Washington County, MD			
NORTHING	EASTING	STATION	

-○- CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ——

PLASTIC LIMIT% × WATER CONTENT% ● LIQUID LIMIT% △

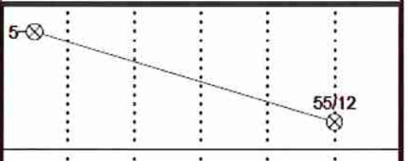
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ➡ LOSS OF CIRCULATION ⟹

SURFACE ELEVATION 487

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [2.00"]			
	S-1	SS	18	14	(CL) LEAN CLAY, brownish orange, moist, firm		485	2 2 3
	S-2	SS	18	10	(CH) FAT CLAY, orange, moist, firm			3 5 50/6
					(WR) WEATHERED ROCK SAMPLED AS GRAVEL, gray, moist, very dense [Weathered ROCK]			
5					AUGER REFUSAL @ 4.00'			
							480	
10								
							475	
15								
							470	
20								
							465	
25								
							460	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL Dry WS ☐ WD ☒	BORING STARTED 07/27/18	CAVE IN DEPTH @ 1.4'
▼ WL(SHW) ▼ WL(ACR)	BORING COMPLETED 07/27/18	HAMMER TYPE Auto
▽ WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

CLIENT	Job #:	BORING #	SHEET
Crabtree, Rohrbaugh & Associates Architects	13:8269	P-1	1 OF 1

PROJECT NAME
Washington County Public Safety Training Center

ARCHITECT-ENGINEER

SITE LOCATION
9238 Sharpsburg Pike, Hagerstown, Washington County, MD

NORTHING

EASTING

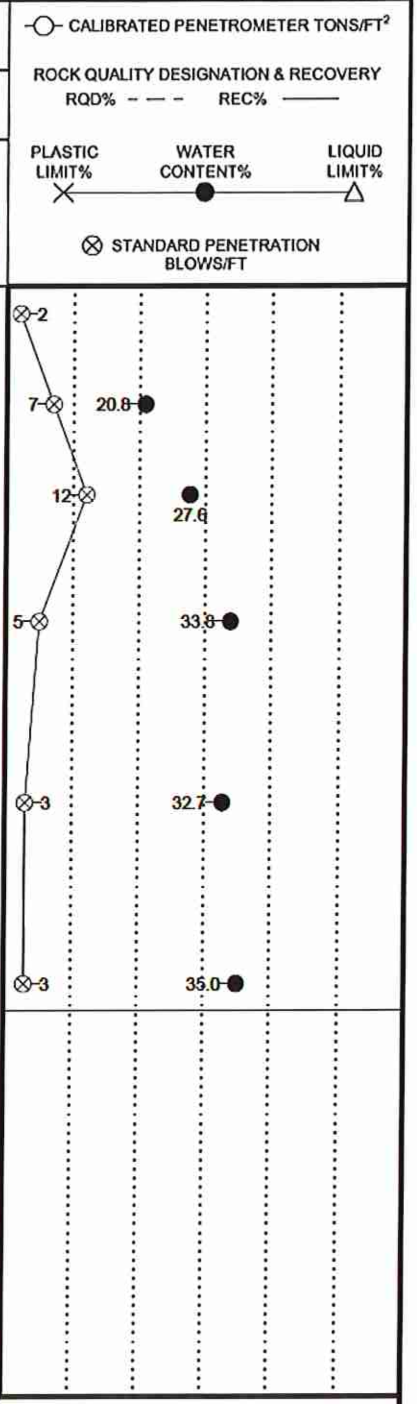
STATION

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 494

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18	Topsoil Depth [2.00"] (ML/CL) CLAYEY SILT, contains slight roots, brown, moist, very soft			1 1 1
	S-2	SS	18	18	(CL/ML) SILTY CLAY, brownish orange, moist, firm		490	2 3 4
5	S-3	SS	18	18	(CL) LEAN CLAY, orange, moist, stiff			3 5 7
	S-4	SS	18	18	(CH) FAT CLAY, orangish brown, moist, soft		485	2 2 3
10								
	S-5	SS	18	18			480	2 2 1
15								
	S-6	SS	18	18			475	2 1 2
20					END OF BORING @ 20.00'			
							470	
25								
							465	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 07/27/18	CAVE IN DEPTH @ 10.1'
WL(SHW) WL(ACR)	BORING COMPLETED 07/27/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

CLIENT Crabtree, Rohrbaugh & Associates Architects	Job #: 13:8269	BORING # P-2	SHEET 1 OF 1	
PROJECT NAME Washington County Public Safety Training Center	ARCHITECT-ENGINEER			
SITE LOCATION 9238 Sharpsburg Pike, Hagerstown, Washington County, MD				
NORTHING	EASTING	STATION		

-◯- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% - — - REC% ———

PLASTIC LIMIT% ✕ — WATER CONTENT% ● — LIQUID LIMIT% △

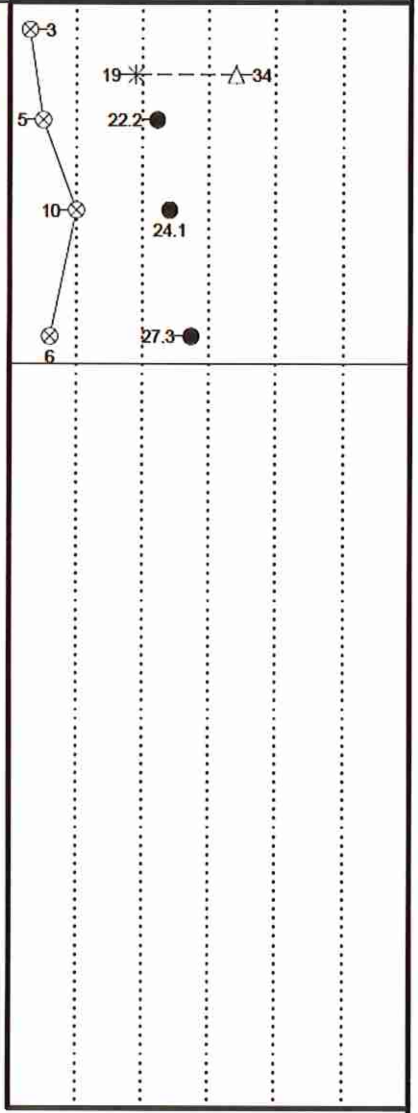
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION

SURFACE ELEVATION 480

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [8.00"]		480	
	S-1	SS	18	18	(ML/CL) CLAYEY SILT, brown, moist, soft			1 2 1
	Bag 2-5							
	S-2	SS	18	18	(CL) LEAN CLAY WITH SAND, brown, moist, firm			1 2 3
5							475	
	S-3	SS	18	18	(CL) LEAN CLAY, orange to brown, moist, stiff to firm			5 5 5
	S-4	SS	18	18				2 3 3
10					END OF BORING @ 10.00'		470	
15							465	
20							460	
25							455	
30							450	



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 07/26/18	CAVE IN DEPTH @ 5.4'
WL(SHW) WL(ACR) Dry	BORING COMPLETED 07/26/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

CLIENT Crabtree, Rohrbaugh & Associates Architects	Job #: 13:8269	BORING # P-3	SHEET 1 OF 1	
PROJECT NAME Washington County Public Safety Training Center	ARCHITECT-ENGINEER			
SITE LOCATION 9238 Sharpsburg Pike, Hagerstown, Washington County, MD				
NORTHING	EASTING	STATION		

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY

RQD% – – – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

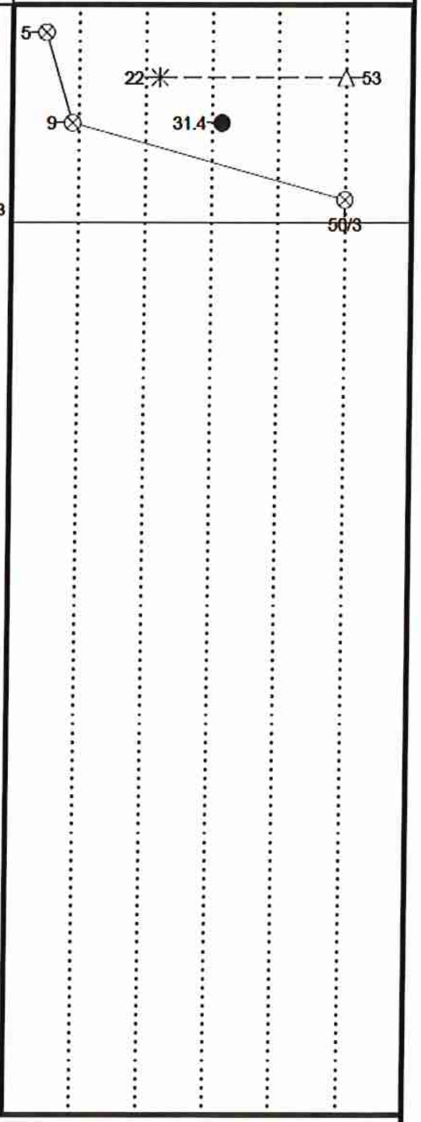
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 481

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	13	Topsoil Depth [5.00"] (CL/ML) SILTY CLAY, orange to brown, moist, firm		480	2 2 3
	Bag 2-5							
	S-2	SS	18	17	(CH) FAT CLAY, orangish brown, moist, stiff			2 4 5
5	S-3	SS	9	7	(WR) WEATHERED ROCK SAMPLED AS GRAVEL, gray, moist, very dense [Weathered ROCK] AUGER REFUSAL @ 6.00'		475	2 50/3
10							470	
15							465	
20							460	
25							455	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 07/27/18	CAVE IN DEPTH @ 3.1'
WL(SHW) WL(ACR) Dry	BORING COMPLETED 07/27/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

CLIENT Crabtree, Rohrbaugh & Associates Architects	Job #: 13:8269	BORING # SWM-1	SHEET 1 OF 1	ECS
PROJECT NAME Washington County Public Safety Training Center	ARCHITECT-ENGINEER			
SITE LOCATION 9238 Sharpsburg Pike, Hagerstown, Washington County, MD				
NORTHING	EASTING	STATION		

-○- CALIBRATED PENETROMETER TONS/FT²

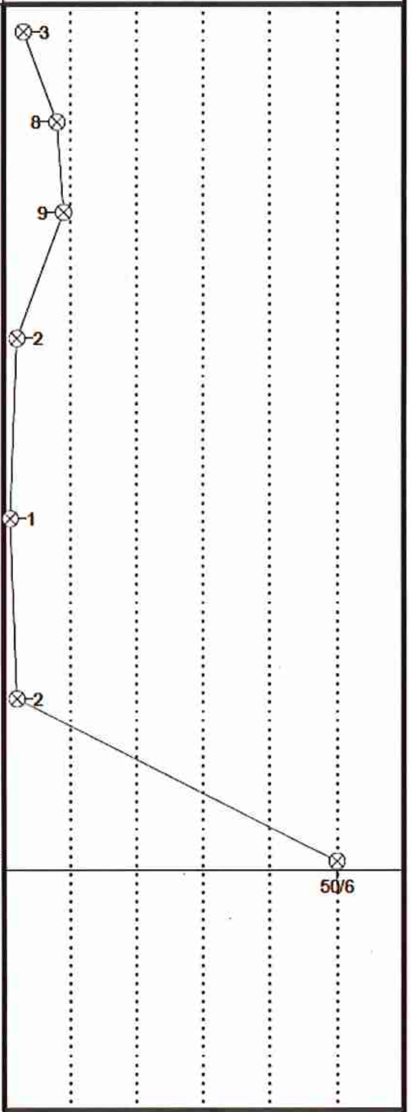
ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ——

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS
BOTTOM OF CASING — LOSS OF CIRCULATION
SURFACE ELEVATION 482

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [8.00"]			
	S-1	SS	18	18	(ML) SILT WITH SAND, trace clay, brown to light brown, moist, very loose		480	2 1 2
	S-2	SS	18	18	(CL/ML) SILTY CLAY WITH SAND, light brown, moist, firm			2 3 5
5	S-3	SS	18	18	(SC) CLAYEY SAND WITH GRAVEL, brown, moist, loose		475	2 4 5
10	S-4	SS	18	18	(CL/ML) SILTY CLAY, trace sand, orange, moist, very soft		470	woh 1 1
15	S-5	SS	18	16	(SC-SM) SILTY CLAYEY SAND, brown, moist, very loose		465	2 1 woh
20	S-6	SS	18	18	(CL) LEAN CLAY, orangish brown, moist, very soft	∇	460	1 1 1
25	S-7	SS	6	0	(WR) WEATHERED ROCK SAMPLED AS GRAVEL, gray, moist, very dense [Weathered ROCK] AUGER REFUSAL @ 24.00'		455	50/6
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

∇ WL 23.0 WS☐ WD☒	BORING STARTED 07/26/18	CAVE IN DEPTH @ 17.7'
∇ WL(SHW) ∇ WL(ACR) Dry	BORING COMPLETED 07/26/18	HAMMER TYPE Auto
∇ WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

CLIENT
Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269

BORING #: SWM-2

SHEET: 1 OF 1

PROJECT NAME
Washington County Public Safety Training Center

ARCHITECT-ENGINEER

SITE LOCATION
9238 Sharpsburg Pike, Hagerstown, Washington County, MD

NORTHING

EASTING

STATION

-○- CALIBRATED PENETROMETER TONS/FT^2

ROCK QUALITY DESIGNATION & RECOVERY
RQD% – — – REC% ———

PLASTIC LIMIT% ✕ WATER CONTENT% ● LIQUID LIMIT% △

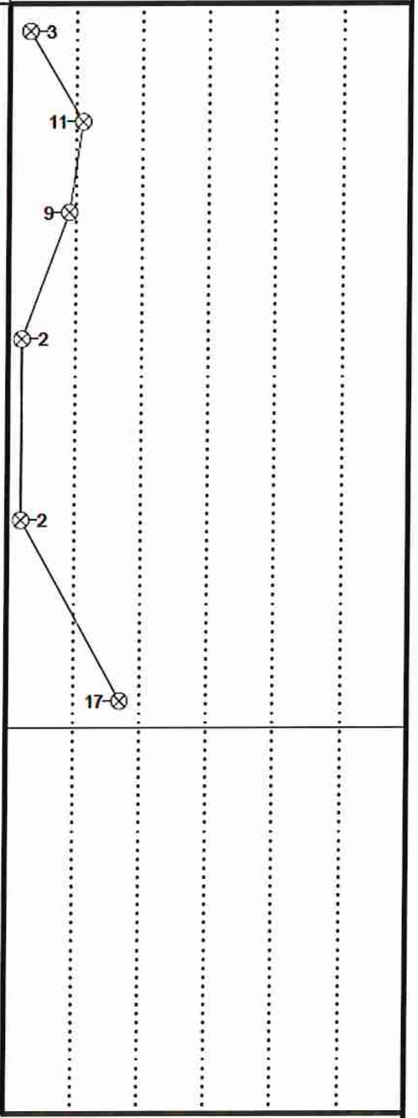
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL — ENGLISH UNITS

BOTTOM OF CASING — LOSS OF CIRCULATION

SURFACE ELEVATION 478

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [11.00"]			
	S-1	SS	18	18	(ML/CL) CLAYEY SILT WITH SAND, brown, moist, soft			1 1 2
	S-2	SS	18	18	(SC) CLAYEY SAND, orangish brown, moist, medium dense		475	3 5 6
5	S-3	SS	18	18	(CL) LEAN CLAY, brown, moist, stiff			10 6 3
							470	
10	S-4	SS	18	13	(ML/CL) CLAYEY SILT, trace sand, brown, moist, very soft			1 1 1
							465	
15	S-5	SS	18	18	(ML/CL) SANDY CLAYEY SILT, orangish brown, moist, very soft			1 1 1
						▽	460	
20	S-6	SS	18	18	(ML) SILT WITH SAND, trace gravel, trace clay, brown to gray, moist, medium dense			18 12 5
					END OF BORING @ 20.00'			
							455	
25								
							450	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

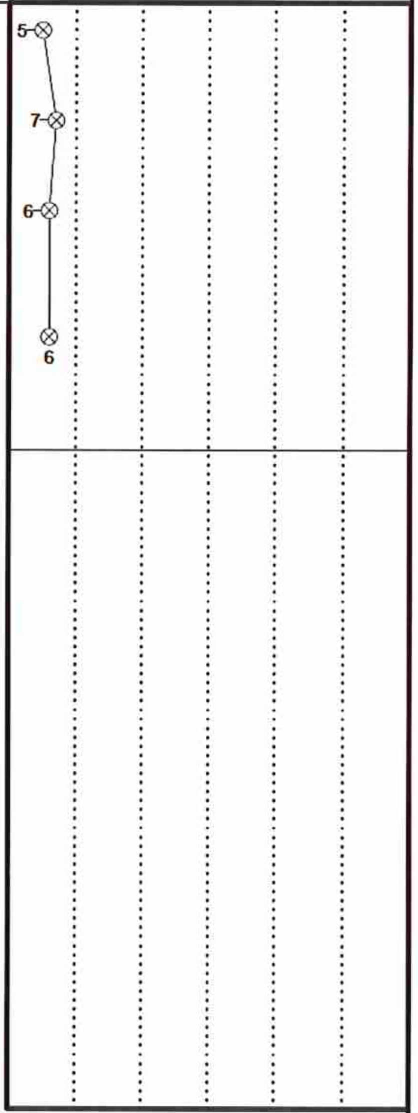
▽ WL 18.5 WS ☐ WD ☒	BORING STARTED 07/26/18	CAVE IN DEPTH @ 6.6'
▼ WL(SHW) ▼ WL(ACR) Dry	BORING COMPLETED 07/26/18	HAMMER TYPE Auto
▽ WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

CLIENT: Crabtree, Rohrbaugh & Associates Architects
Job #: 13:8269
BORING #: SWM-3
SHEET: 1 OF 1
ECS
PROJECT NAME: Washington County Public Safety Training Center
ARCHITECT-ENGINEER:
SITE LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD
NORTHING:
EASTING:
STATION:

-○- CALIBRATED PENETROMETER TONS/FT^2
ROCK QUALITY DESIGNATION & RECOVERY
RQD% - — -   REC% ———
PLASTIC LIMIT% ×   WATER CONTENT% ●   LIQUID LIMIT% △
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL   ENGLISH UNITS
BOTTOM OF CASING   LOSS OF CIRCULATION
SURFACE ELEVATION 478

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0	S-1	SS	18	18	Topsoil Depth [4.00"] (CL) LEAN CLAY, trace gravel, contains slight roots, orangish brown, moist, firm			1 2 3
	S-2	SS	18	18	(CL/CH) LEAN TO FAT CLAY, brownish orange, moist, firm		475	2 3 4
5	S-3	SS	18	18	(CL) LEAN CLAY, orange to orangish brown, moist, firm			3 3 3
							470	
	S-4	SS	18	18				3 3 3
10								
					AUGER REFUSAL @ 12.40'		465	
15								
							460	
20								
							455	
25								
							450	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

WL Dry WS ☐ WD ☒	BORING STARTED 07/26/18	CAVE IN DEPTH @ 3.0'
WL(SHW) WL(ACR) Dry	BORING COMPLETED 07/26/18	HAMMER TYPE Auto
WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

CLIENT	Job #:	BORING #	SHEET
Crabtree, Rohrbaugh & Associates Architects	13:8269	SWM-4	1 OF 1

PROJECT NAME: Washington County Public Safety Training Center

ARCHITECT-ENGINEER:

SITE LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

NORTHING EASTING STATION

-○- CALIBRATED PENETROMETER TONS/FT²

ROCK QUALITY DESIGNATION & RECOVERY

RQD% – — – REC% ———

PLASTIC LIMIT% × WATER CONTENT% ● LIQUID LIMIT% △

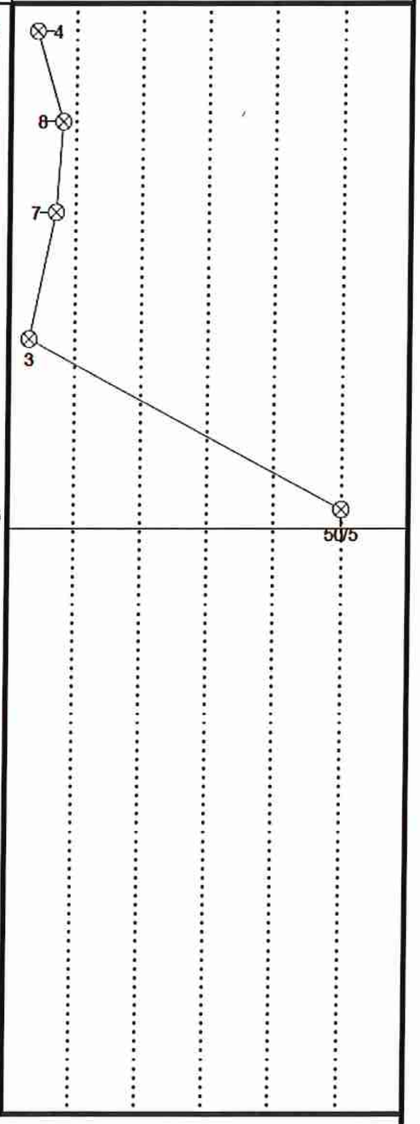
⊗ STANDARD PENETRATION BLOWS/FT

DESCRIPTION OF MATERIAL ENGLISH UNITS

BOTTOM OF CASING ➤ LOSS OF CIRCULATION

SURFACE ELEVATION 482

DEPTH (FT)	SAMPLE NO.	SAMPLE TYPE	SAMPLE DIST. (IN)	RECOVERY (IN)	DESCRIPTION OF MATERIAL	WATER LEVELS	ELEVATION (FT)	BLOWS/6"
0					Topsoil Depth [10.00"]			
	S-1	SS	18	18	(CL/ML) SILTY CLAY, contains slight roots, brown, moist, soft			1 2 2
							480	
	S-2	SS	18	18	(CL) LEAN CLAY, orangish brown, moist, firm			2 3 5
5								
	S-3	SS	18	18				1 4 3
							475	
	S-4	SS	18	18	(CL/ML) SILTY CLAY WITH SAND, brown, moist, very soft			2 2 1
10								
							470	
						▽		
	S-5	SS	11	7				9 50/5
					(WR) WEATHERED ROCK SAMPLED AS GRAVEL, gray, moist, very dense [Weathered ROCK]			
15								
					AUGER REFUSAL @ 14.50'			
							465	
20								
							460	
25								
							455	
30								



THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

▽ WL 13.5 WS☐ WD☒	BORING STARTED 07/26/18	CAVE IN DEPTH @ 9.2'
▽ WL(SHW) ▼ WL(ACR) Dry	BORING COMPLETED 07/26/18	HAMMER TYPE Auto
▽ WL	RIG Track FOREMAN Roberts	DRILLING METHOD HSA

APPENDIX C – Laboratory Testing

Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Other
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
B-1												
	S-1	0.00 - 1.50	21.2									
	S-2	2.50 - 4.00	25.2	CH	57	23	34	88.1				
	S-3	5.00 - 6.50	31.2									
	S-4	8.50 - 10.00	30.2									
	S-5	13.50 - 15.00	29.4									
	S-6	18.50 - 20.00	33.3									
B-2												
	Bag 2-5	2.00 - 2.00		CH	54	23	31	89.9	102.6	21.1		
	S-2	2.50 - 4.00	22.6									
	S-3	5.00 - 6.50	21.0									
B-6												
	S-2	2.50 - 4.00	25.5	CH	55	21	34	92.9				
	S-3	5.00 - 6.50	31.3									
	S-4	8.50 - 10.00	35.8									
	S-5	13.50 - 15.00	38.5									
	S-6	18.50 - 20.00	39.7									
	S-7	23.50 - 25.00	53.7									
P-1												
	S-2	2.50 - 4.00	20.8									
	S-3	5.00 - 6.50	27.6									
	S-4	8.50 - 10.00	33.8									
	S-5	13.50 - 15.00	32.7									
	S-6	18.50 - 20.00	35.0									
P-2												
	Bag 2-5	2.00 - 2.00		CL	34	19	15	82.6	112.4	14.9	7.3	
											10.4	
											11.7	

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content (ASTM D 2974)

Project No.	13:8269
Project Name:	Washington County Public Safety Training Center
PM:	Greg Ratkowski
PE:	Jeff McGregor
Printed On:	Wednesday, September 12, 2018

ECS MID-ATLANTIC, LLC
5112 Pegasus Court, Suite S
Frederick, MD 21704
Phone: (301) 668-4303
Fax: (301) 668-3519

Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Other
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
	S-2	2.50 - 4.00	22.2									
	S-3	5.00 - 6.50	24.1									
	S-4	8.50 - 10.00	27.3									
P-3												
	Bag 2-5	2.00 - 2.00		CH	53	22	31	89.8	104.5	21.3	2.4	
											6	
											10.6	
	S-2	2.50 - 4.00	31.4									

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content (ASTM D 2974)

Project No.	13:8269
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Printed On:	Wednesday, September 12, 2018

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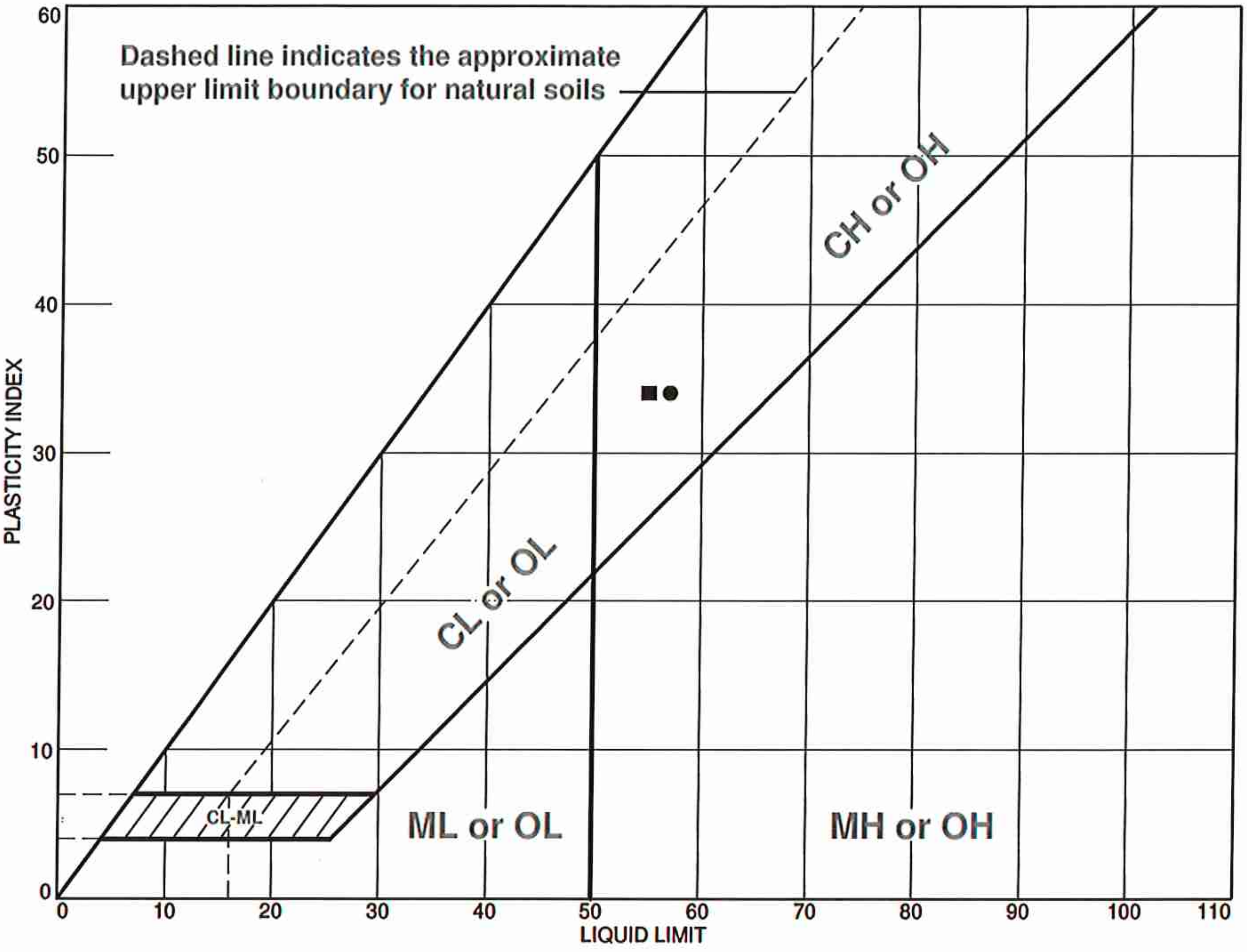
5112 Pegasus Court, Suite S
Frederick, MD 21704
Phone: (301) 668-4303
Fax: (301) 668-3519

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Orangish Brown Fat CLAY	57	23	34	99.3	88.1	CH
■	Yellowish Brown Fat CLAY	55	21	34	99.6	92.9	CH

Project No. 8269 **Client:** Crabtree, Rohrbaugh & Associates Architects

Project: Washington County Public Safety Training Center

● **Source of Sample:** B-1 **Depth:** 2.50-4.00 **Sample Number:** S-2

■ **Source of Sample:** B-6 **Depth:** 2.50-4.00 **Sample Number:** S-2

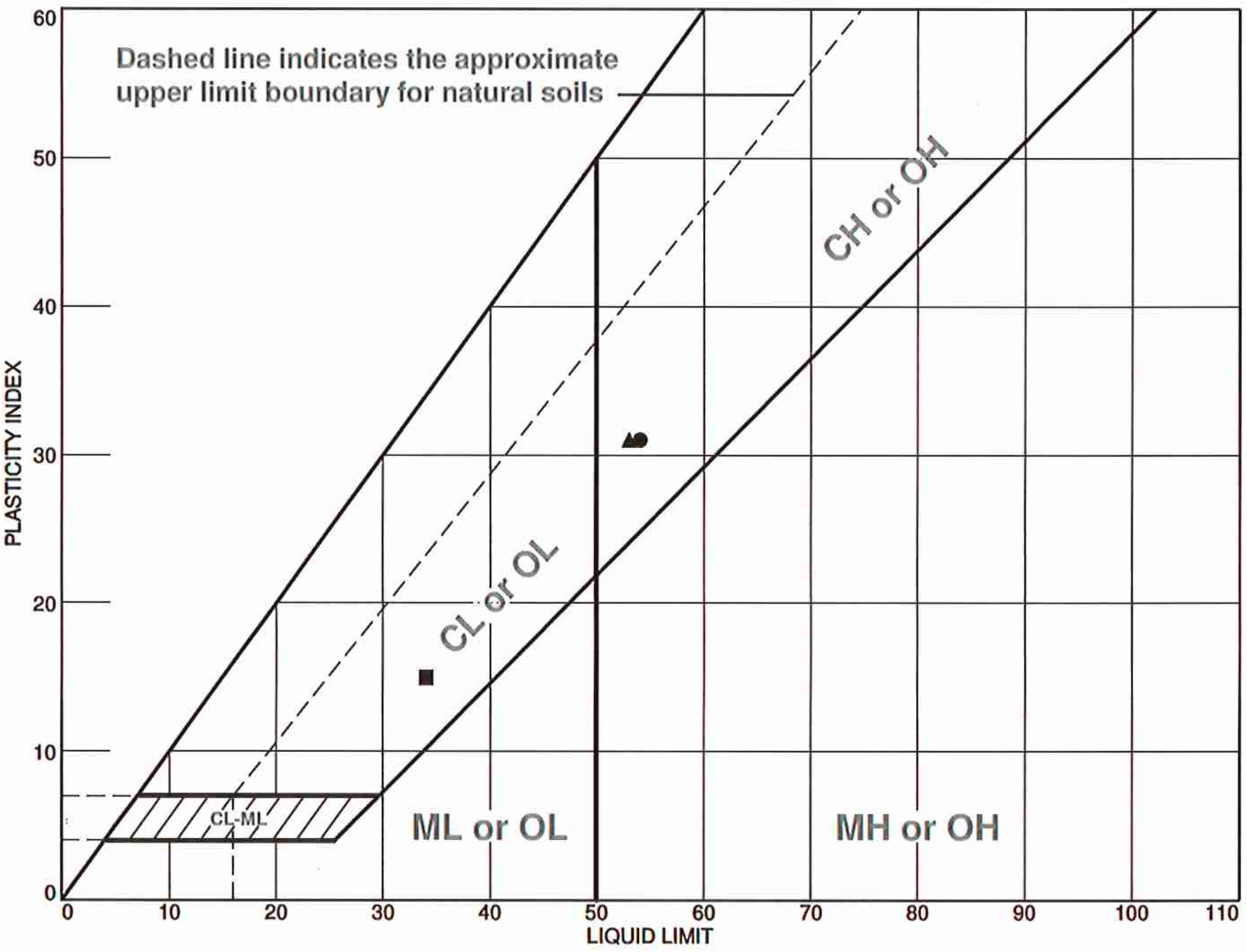
Remarks:

ECS MID-ATLANTIC, LLC
5112 Pegasus Court, Suite S
Frederick, MD 21704
Phone: (301) 668-4303
Fax: (301) 668-3519

Figure

Tested By: PK **Checked By:** PK

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Orangish Brown Fat CLAY	54	23	31	99.0	89.9	CH
■	Brown Lean CLAY w/Sand	34	19	15	94.4	82.6	CL
▲	Orangish Brown Fat CLAY	53	22	31	99.0	89.8	CH

Project No. 8269 **Client:** Crabtree, Rohrbaugh & Associates Architects

Project: Washington County Public Safety Training Center

● **Source of Sample:** B-2 **Depth:** 2.00-5.00 **Sample Number:** Bag 2-5
■ **Source of Sample:** P-2 **Depth:** 2.00-5.00 **Sample Number:** Bag 2-5
▲ **Source of Sample:** P-3 **Depth:** 2.00-5.00 **Sample Number:** Bag 2-5

Remarks:

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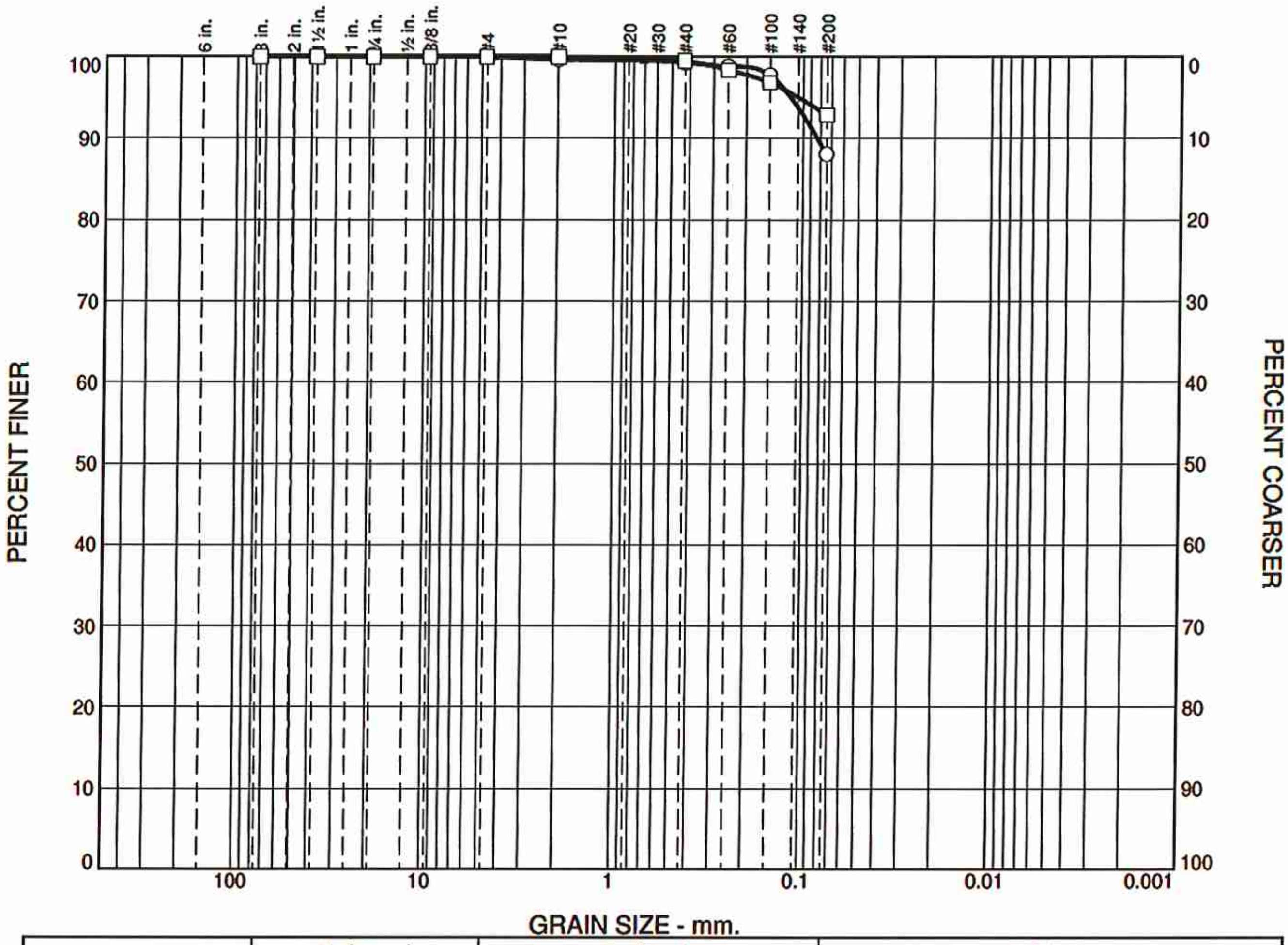
5112 Pegasus Court, Suite S
Frederick, MD 21704
Phone: (301) 668-4303
Fax: (301) 668-3519

Figure

Tested By: PK **Checked By:** PK

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.3	0.4	11.2	88.1	
□	0.0	0.0	0.0	0.0	0.4	6.7	92.9	

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	B-1	S-2	2.50-4.00	Orangish Brown Fat CLAY	CH
□	B-6	S-2	2.50-4.00	Yellowish Brown Fat CLAY	CH

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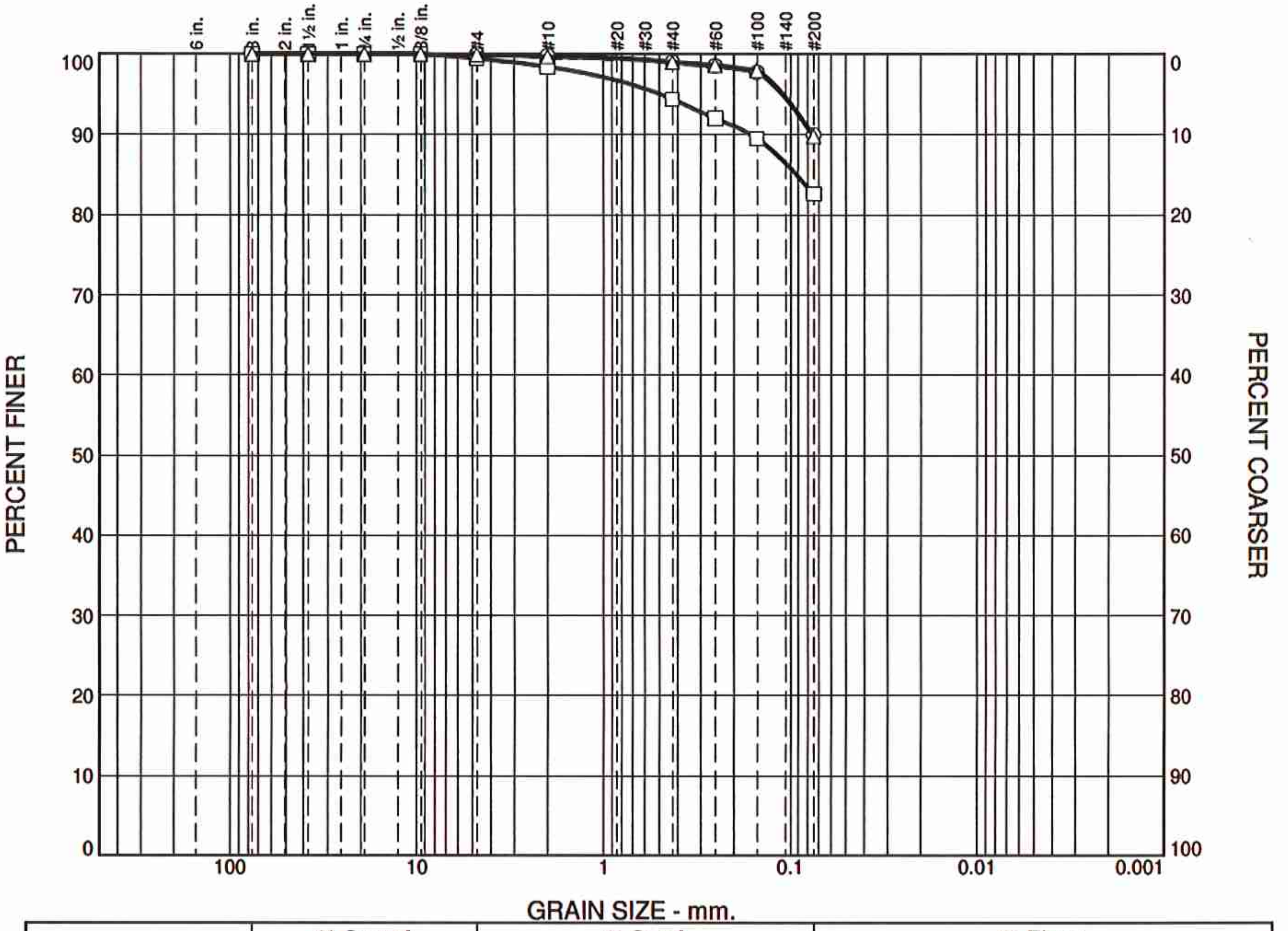
Frederick, MD 21704
Phone: (301) 668-4303
Fax: (301) 668-3519

Client: Crabtree, Rohrbaugh & Associates Architects
Project: Washington County Public Safety Training Center

Project No.: 8269 **Figure**

Tested By: PK **Checked By:** PK

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.0	0.2	0.8	9.1	89.9	
□	0.0	0.0	0.5	1.1	4.0	11.8	82.6	
△	0.0	0.0	0.0	0.3	0.7	9.2	89.8	

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	B-2	Bag 2-5	2.00-5.00	Orangish Brown Fat CLAY	CH
□	P-2	Bag 2-5	2.00-5.00	Brown Lean CLAY w/Sand	CL
△	P-3	Bag 2-5	2.00-5.00	Orangish Brown Fat CLAY	CH

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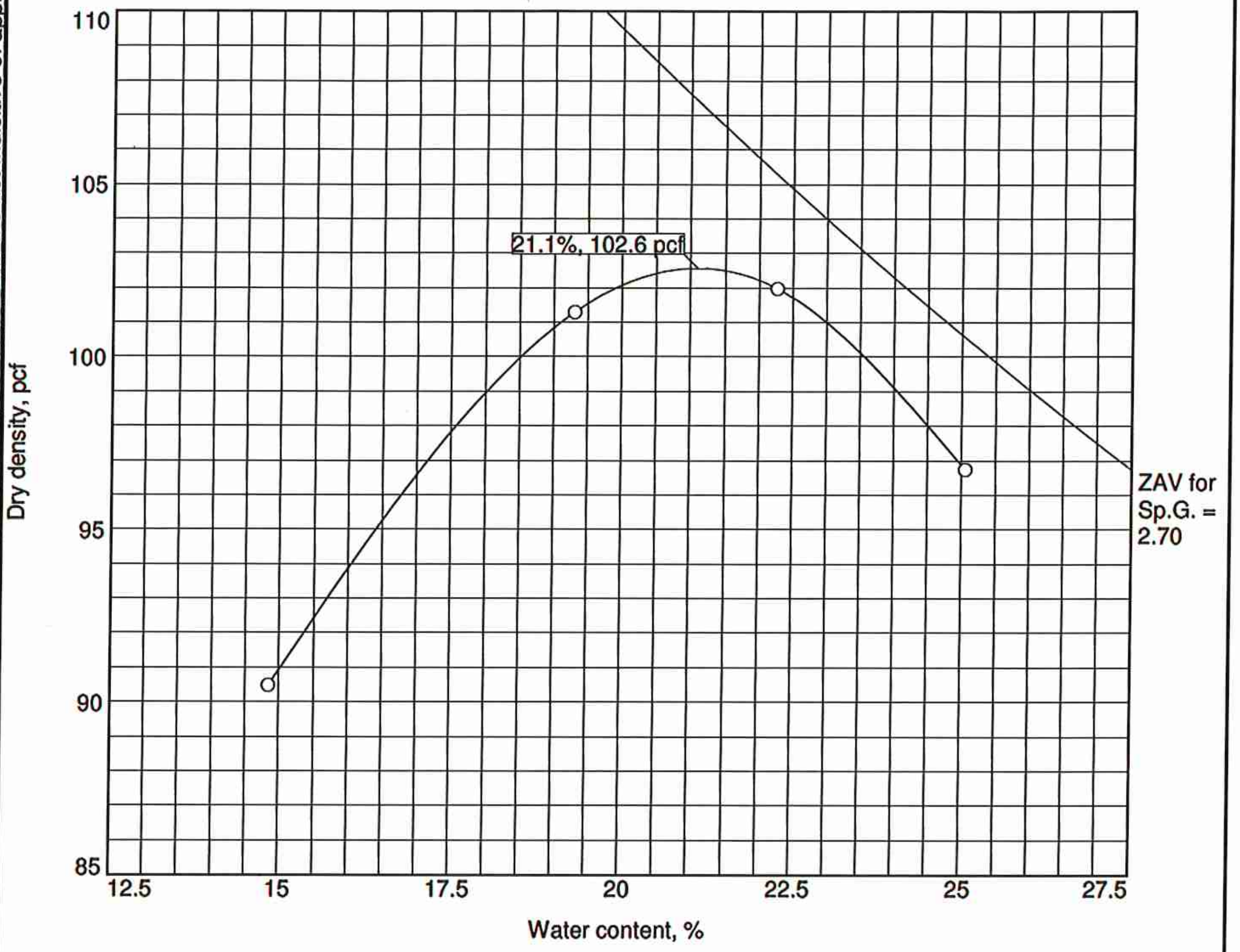
Frederick, MD 21704
Phone: (301) 668-4303
Fax: (301) 668-3519

Client: Crabtree, Rohrbaugh & Associates Architects
Project: Washington County Public Safety Training Center

Project No.: 8269 **Figure**

Tested By: PK **Checked By:** PK

COMPACTION TEST REPORT For Curve No. B-2 Bag 2-5



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
2.00-5.00	CH	A-7-6(31)		2.7	54	31	0.0	89.9

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 102.6 pcf Optimum moisture = 21.1 %	Orangish Brown Fat CLAY

Project No. 8269 **Client:** Crabtree, Rohrbaugh & Associates Architects

Project: Washington County Public Safety Training Center

Date: 08/15/

○ **Source of Sample:** B-2 **Sample Number:** Bag 2-5

Remarks:

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Frederick, MD 21704
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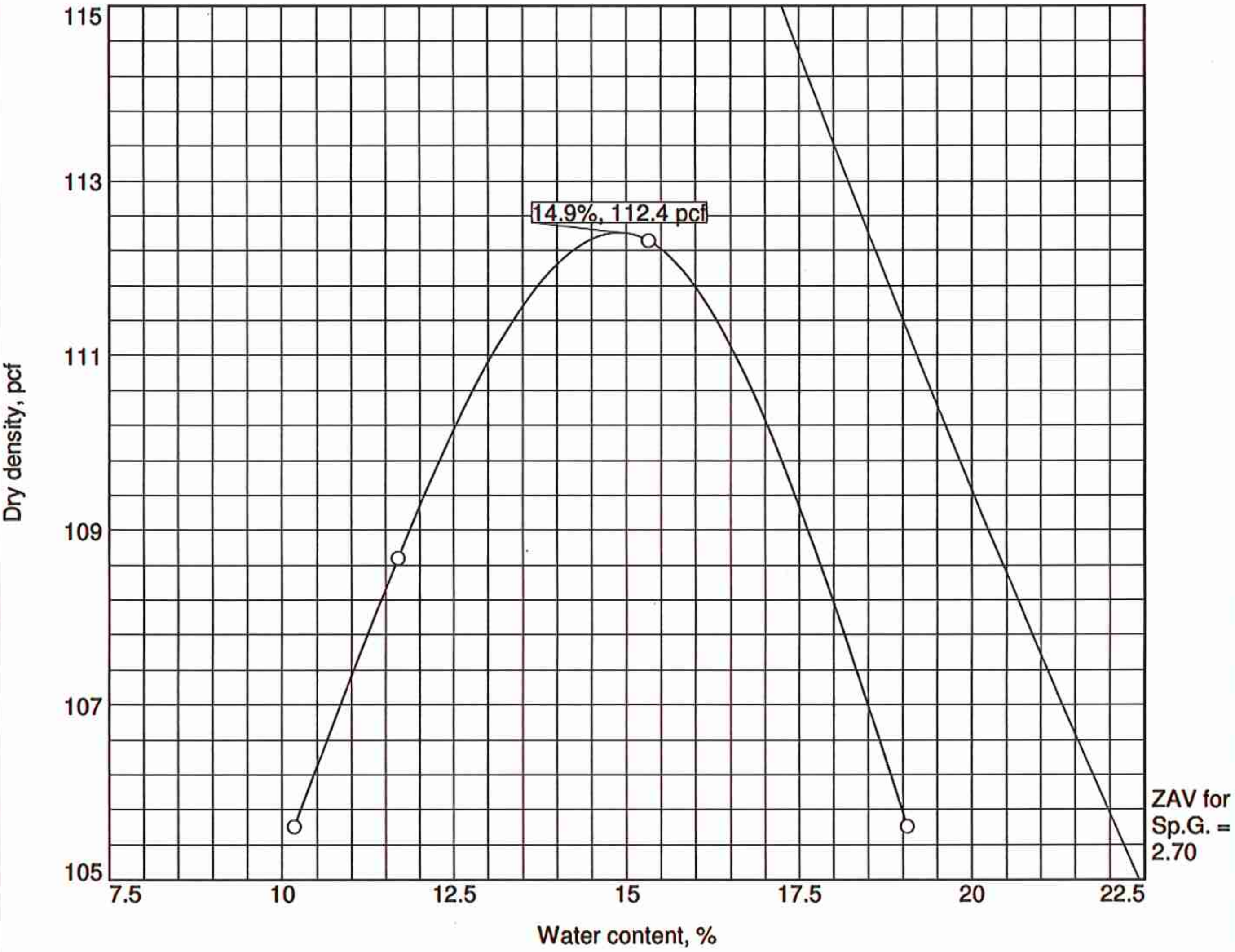
Fax: (301) 668-3519

Figure

Tested By: PK **Checked By:** PK

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identic

COMPACTION TEST REPORT For Curve No. P-2 Bag 2-5



Test specification: AASHTO T 99-15 Method C Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
2.00-5.00	CL	A-6(12)		2.7	34	15	0.0	82.6

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 112.4 pcf Optimum moisture = 14.9 %	Brown Lean CLAY w/Sand

Project No. 8269 **Client:** Crabtree, Rohrbaugh & Associates Architects

Project: Washington County Public Safety Training Center

Date: 08/15/

○ **Source of Sample:** P-2 **Sample Number:** Bag 2-5

Remarks:

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Frederick, MD 21704
Phone: (301) 668-4303
Fax: (301) 668-3519

Figure

Tested By: PK **Checked By:** PK

COMPACTION TEST REPORT For Curve No. P-3 Bag 2-5

Test specification: AASHTO T 99-15 Method C Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > 3/4 in.	% < No.200
	USCS	AASHTO						
2.00-5.00	CH	A-7-6(30)		2.7	53	31	0.0	89.8

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 104.5 pcf Optimum moisture = 21.3 %	Orangish Brown Fat CLAY

Project No. 8269 **Client:** Crabtree, Rohrbaugh & Associates Architects

Project: Washington County Public Safety Training Center

Date: 08/15/

○ **Source of Sample:** P-3 **Sample Number:** Bag 2-5

Remarks:

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Frederick, MD 21704
Phone: (301) 668-4303
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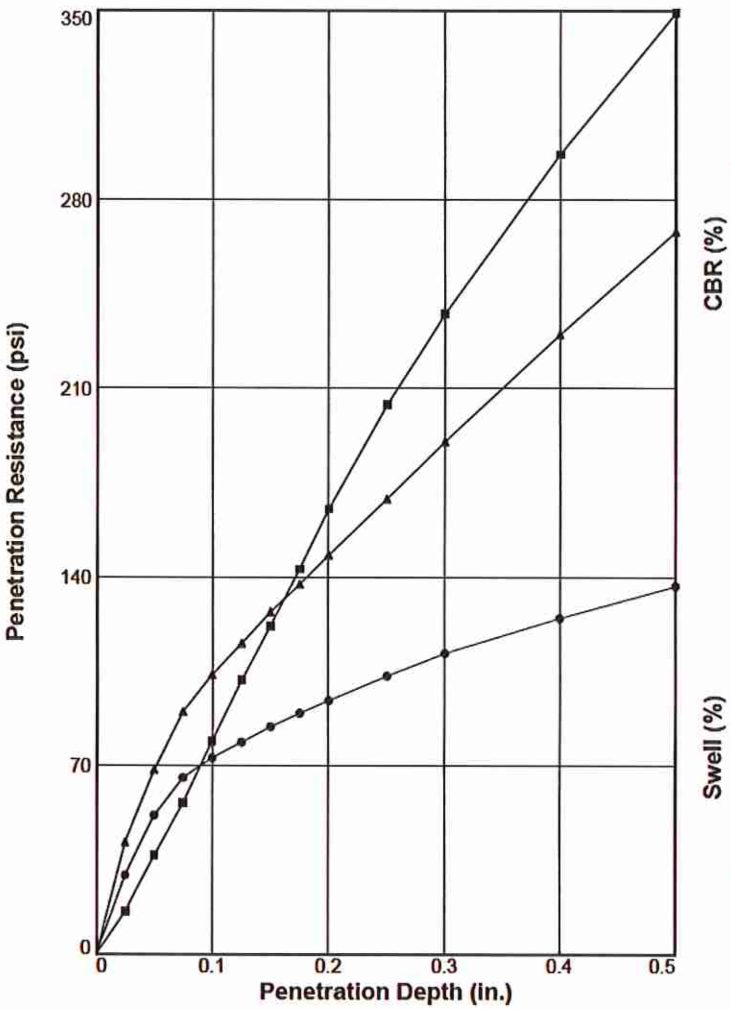
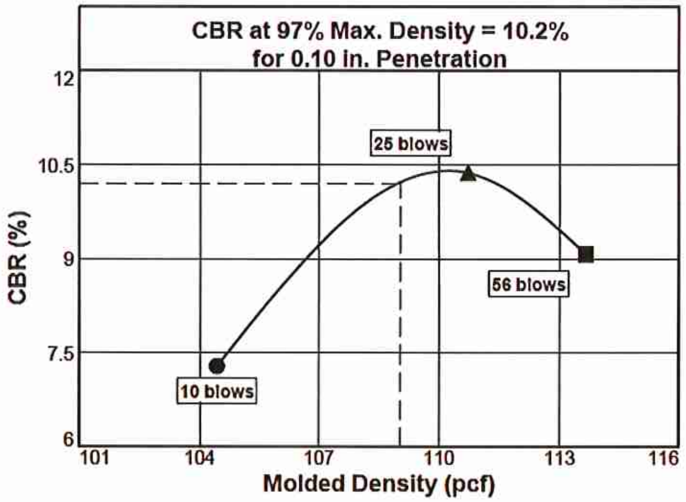
Figure

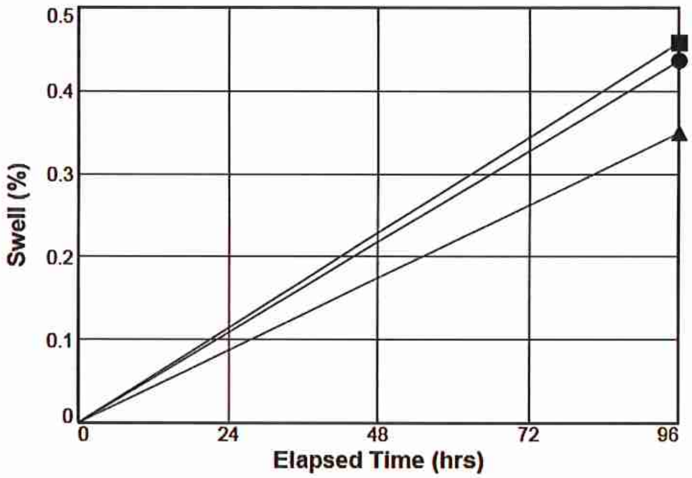
Tested By: PK **Checked By:** PK

These results are for the exclusive use of the client for whom they were obtained. They apply only to the samples tested and are not indicitive of apparently identical sam

BEARING RATIO TEST REPORT
ASTM D1883-14




CBR at 97% Max. Density = 10.2%
for 0.10 In. Penetration



	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	104.4	92.9	15.2	104.0	92.5	21.9	7.3	6.3	0.000	10	0.4
2 △	110.7	98.5	15.2	110.3	98.2	20.1	10.4	9.9	0.000	10	0.3
3 ☐	113.7	101.2	15.2	113.1	100.7	19.0	9.1	11.7	0.013	10	0.5

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Brown Lean CLAY w/Sand	CL	112.4	14.9	34	15

Project No: 8269

Project: Washington County Public Safety Training Center

Source of Sample: P-2 **Depth:** 2.00-5.00

Sample Number: Bag 2-5

Date:

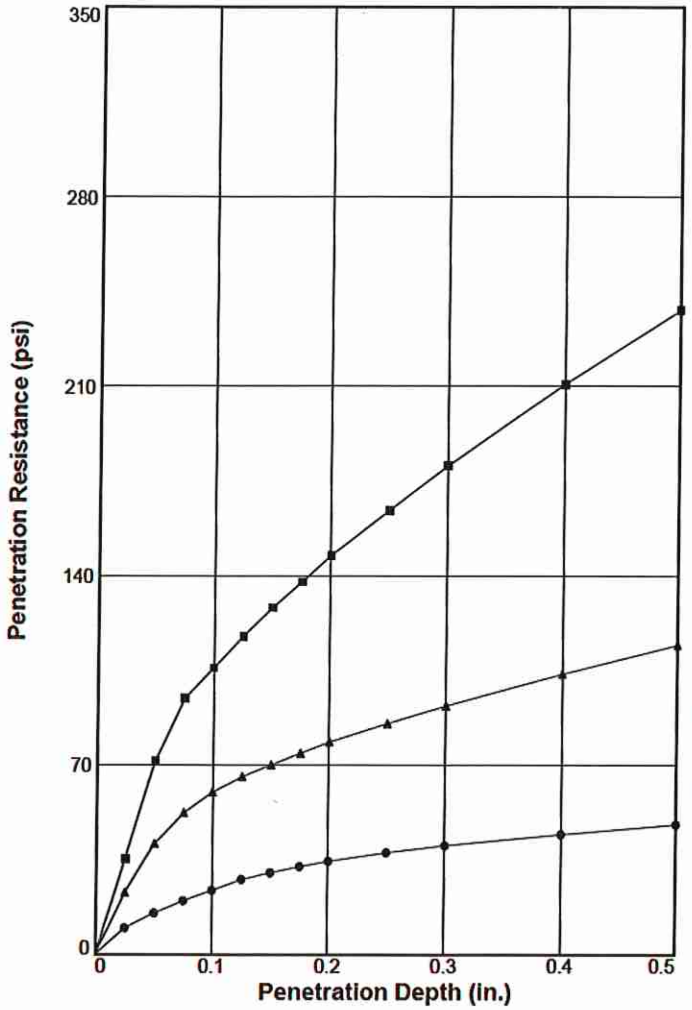
ECS MID-ATLANTIC, LLC
5112 Pegasus Court, Suite S
Frederick, MD 21704
Phone: (301) 668-4303
Fax: (301) 668-3519

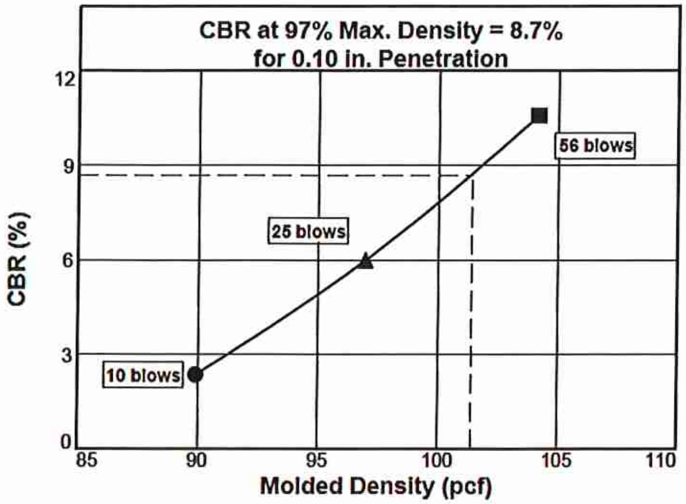
Test Description/Remarks:

Figure ______

Tested By: PK **Checked By:** PK

BEARING RATIO TEST REPORT
ASTM D1883-14





	Molded			Soaked			CBR (%)		Linearity Correction (in.)	Surcharge (lbs.)	Max. Swell (%)
	Density (pcf)	Percent of Max. Dens.	Moisture (%)	Density (pcf)	Percent of Max. Dens.	Moisture (%)	0.10 in.	0.20 in.			
1 ○	89.9	86	18.3	88.5	84.7	29.6	2.4	2.3	0.000	10	1.6
2 △	96.9	92.7	18.3	95.7	91.6	26.6	6.0	5.2	0.000	10	1.3
3 □	104.2	99.7	18.3	103.3	98.8	24.6	10.6	9.8	0.000	10	0.9

Material Description	USCS	Max. Dens. (pcf)	Optimum Moisture (%)	LL	PI
Orangish Brown Fat CLAY	CH	104.5	21.3	53	31

Project No: 8269

Project: Washington County Public Safety Training Center

Source of Sample: P-3 **Depth:** 2.00-5.00

Sample Number: Bag 2-5

Date:

Test Description/Remarks:

ECS MID-ATLANTIC, LLC
5112 Pegasus Court, Suite S
Frederick, MD 21704
Phone: (301) 668-4303
Fax: (301) 668-3519

Figure ________

Tested By: PK **Checked By:** PK

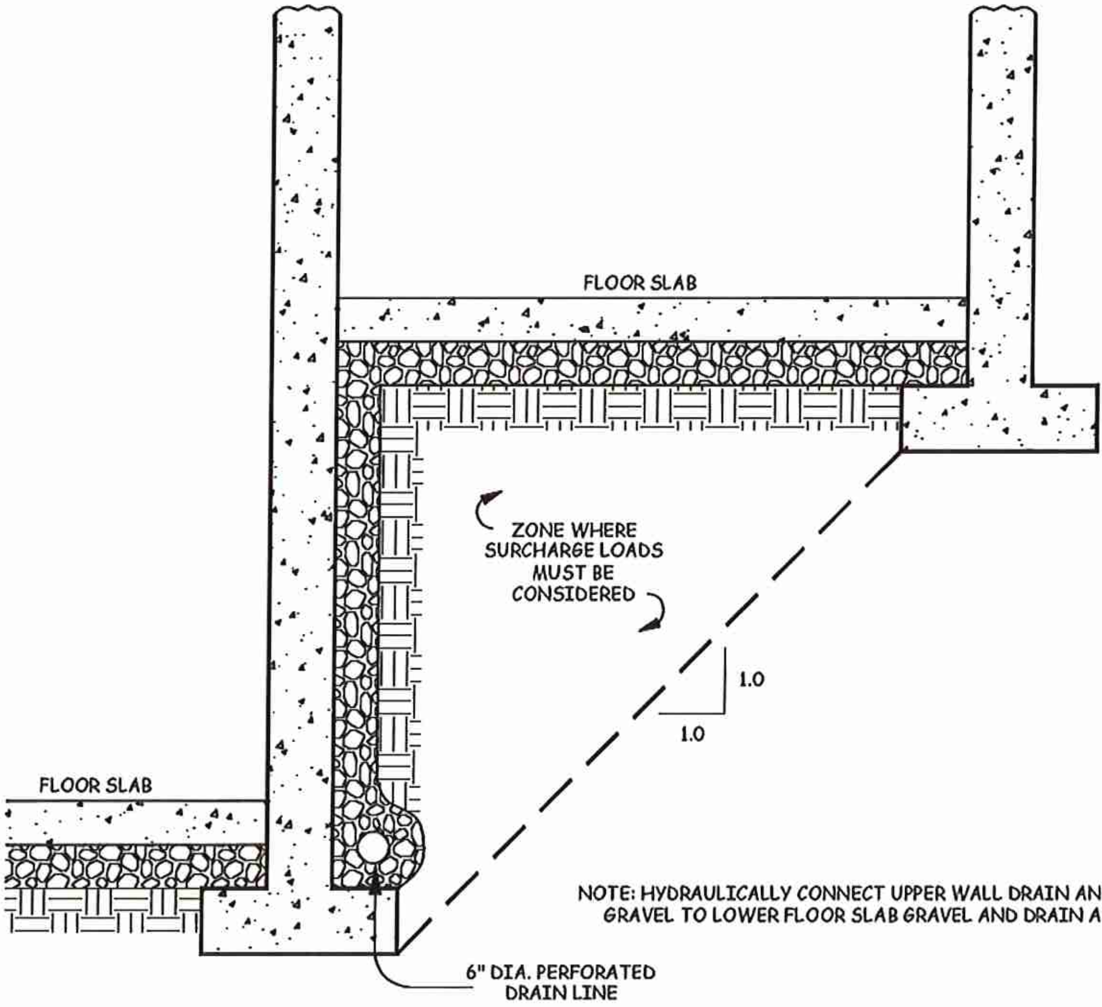
APPENDIX D – Supplemental Report Documents

Zone of Influence Diagram
French Drain Installation Procedure

ZONE OF INFLUENCE DIAGRAM

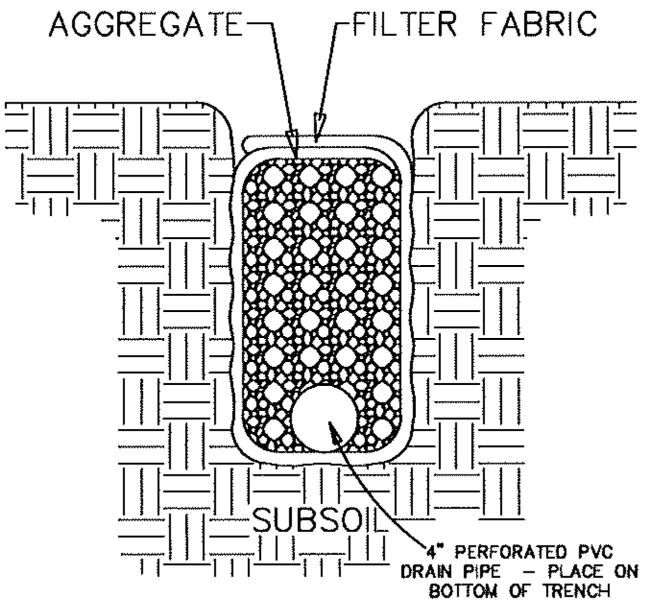
(INTERIOR WALLS)

NOT TO SCALE



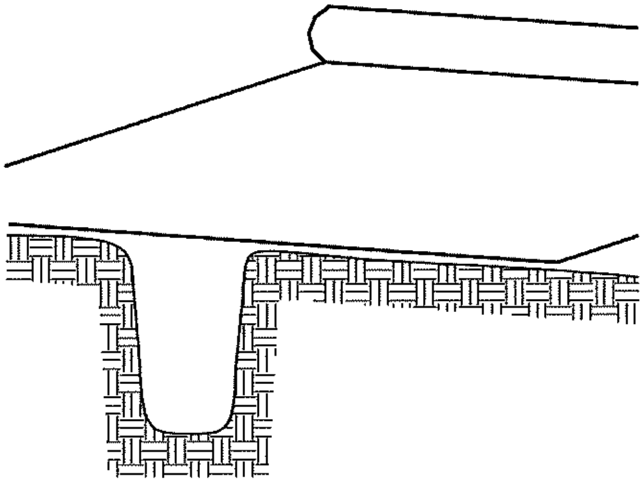
NOTE: HYDRAULICALLY CONNECT UPPER WALL DRAIN AND UNDERSLAB GRAVEL TO LOWER FLOOR SLAB GRAVEL AND DRAIN AS SHOWN.

FINAL CONFIGURATION



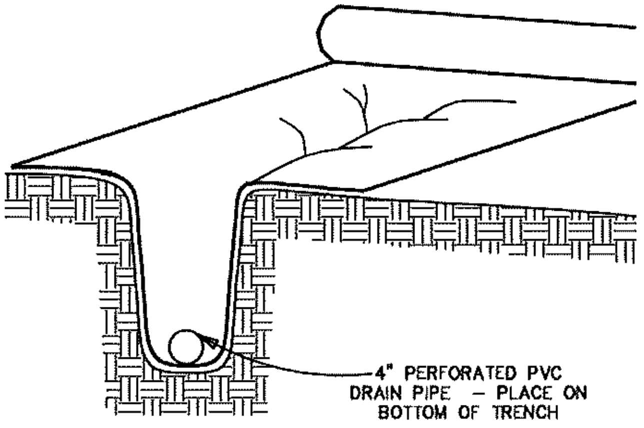
SUBDRAIN USING FILTER FABRIC

STEP 1



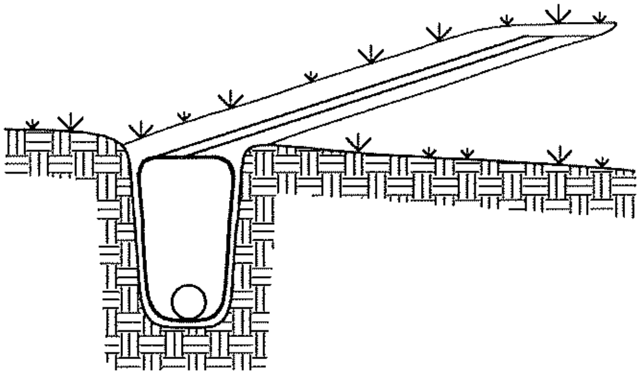
FABRIC IS UNROLLED DIRECTLY OVER TRENCH

STEP 2



THE TRENCH IS FILLED WITH AGGREGATE

STEP 3



THE FABRIC IS LAPPED CLOSED AND COVERED WITH SOIL

ECS LLC
MID-ATLANTIC

FRENCH DRAIN INSTALLATION PROCEDURE

ECS MID-ATLANTIC, LLC
"Setting the Standard for Service"
Geotechnical • Construction Materials • Environmental • Facilities

November 16, 2018
Revised December 3, 2018

Mr. John Pryor
Crabtree Rohrbaugh & Associates Architects
401 East Winding Hill Road
Mechanicsburg, Pennsylvania 17055

ECS Project No.: 13-8269-A

Reference: Revised Addendum #1 to Geotechnical Engineering Report
Washington County Public Safety Training Center
9238 Sharpsburg Pike
Hagerstown, Washington County, Maryland

Dear Mr. Pryor:

As requested, ECS has prepared this letter to accompany our original "Geotechnical Engineering Report", prepared for Crabtree Rohrbaugh & Associates Architects, dated September 19, 2018. Potentially unsuitable soil materials were encountered within several of the borings completed for this study. In order to further define the extent of the potentially unsuitable materials, and provide additional recommendations regarding remediation of unsuitable materials, a series of test pits and laboratory testing has been completed. The results of the test pits and our subsequent recommendations are contained in this letter.

3.1.2 Test Pits

A total of 15 test pits were excavated across the site. The test pits were excavated by a representative from Washington County with a John Deere 310 SL hydraulic backhoe with a maximum reach of about 12 feet. The test pits were completed under the direct supervision of an ECS geologist.

Test pit locations were survey located in the field by Washington County personnel. The approximate test pit locations are included on the Test Pit Location Diagram. Ground surface elevations noted on our test pit logs were interpolated from the topographic plan provided, as prepared by KCI.

The test pits generally encountered 5 to 14 inches of topsoil at the ground surface, underlain by natural medium to high-plasticity CLAY (CL, CH) soils. The soil conditions encountered in the test pits are consistent with the conditions encountered in the original borings. For subsurface information at a specific location, refer to the Test Pit Logs included with this letter.

5.2.1 Pavement Design

The current phase of the project is to include a paved road on the north side of the proposed training center building and paved roads and parking lots on the northwest and southeast sides of the training center. Portions of the on-site soils anticipated to be present at pavement subgrades consist of high-plasticity CLAY (CH) materials. These soils are unsuitable for direct pavement support and should be undercut and replaced. In lieu of undercutting and replacement of unsuitable soils, we feel that treatment of the subgrade materials with soil cement would be an economical solution. In areas where suitable subgrade materials are present, the pavement section provided in the original report (dated September 19, 2018) will apply.

Soil cement pills, blended at 3%, 5%, and 7% by weight, were tested from samples obtained from TP-1 and TP-9. Based on the results of the laboratory testing, the anticipated amount of cement to stabilize the base material and provide a structural number of 0.2 is approximately 5% by weight. We recommend a minimum depth of 12 inches of soil cement treatment below pavements. All soil cement stabilization, including curing, should be performed in accordance with MSHA specifications. The soil cement materials should be compacted to at least 100 percent per ASTM D698 (Standard Proctor).

For asphalt pavements constructed over soil cement treated subgrade soils, the following pavement section can be utilized. Please note that the aggregate subbase (GAB) is eliminated in areas where soil cement stabilization is implemented.

Table 5.2.1.1 Asphalt Pavement Section

Recommended Pavement Section (CBR=5)	**Pavement Thickness (inches) (275,000 ESALs)**
Bituminous concrete surface course (Typ. 12.5mm Superpave)	2.0
Bituminous base course (Typ. 25.0mm Superpave)	3.5
Soil Cement (5% by weight)	12.0
Total Pavement Thickness	**17.5**

Unless otherwise stated herein, no other revisions to our original report are required. We appreciate the opportunity to provide geotechnical engineering services on this project. Should you have questions regarding the information and recommendations contained in this letter, please do not hesitate to contact our office.

Respectfully,

ECS MID-ATLANTIC, LLC

JEFFREY A. McGREGOR
No. 30901

Gregory A. Ratkowski, P.E.
Geotechnical Department Manager
gratkowski@ecslimited.com

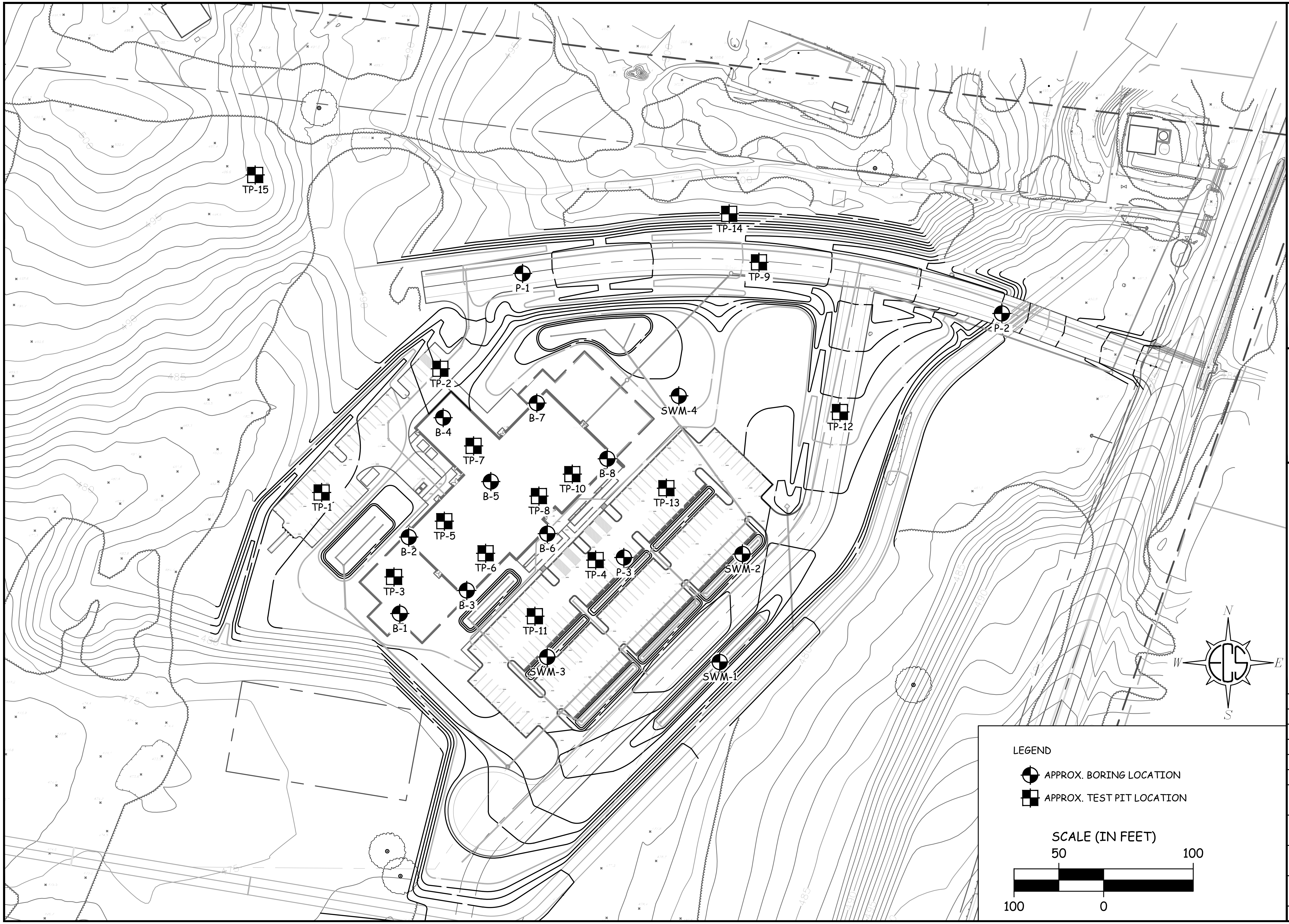
Jeffrey A. McGregor, P.E.
Vice President
jmcgregor@ecslimited.com

Professional Certification. I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Maryland.

License No.: 30901 Expiration Date: 08/15/2020

Enclosures: Test Pit Location Diagram (1 page)
Test Pit Logs (15 pages)
Laboratory Test Results (13 pages)

I:\Department 3 Geotechnical\GEOTECHNICAL\PROJECTS\8200's\13-8269-A Wash Co PSTC\13-8269-A Revised 12-03-18 Addendum #1 Washington County PSTC.doc



WASHINGTON COUNTY
PUBLIC SAFETY TRAINING CENTER
HAGERSTOWN, MD

ECS

BORING AND TEST PIT
LOCATION DIAGRAM

CRABTREE, ROHRBAUGH & ASSOCIATES ARCHITECTS

ECS REVISIONS

ENGINEER	DRAFTING
GAR	AMH

SCALE 1" = 100'

PROJECT NO. 13-8269-A

SHEET 1 OF 1

DATE 11/16/2018

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-1

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 483.5

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Thickness [10.00"]					
2	482	(ML/CL) CLAYEY SILT, trace sand, brown, moist	E				
4	480	(CL) LEAN CLAY WITH SAND, brownish orange, moist				TP-1 3-5	20.0
6	478	(CH) FAT CLAY, orange, moist	M				
8	476	END OF TEST PIT @ 7'					
10	474						
12	472						
14	470						

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR: Client Provided

OPERATOR: Washington County

MAKE/MODEL: John Deere/310 SL

REACH: 12

ECS REP.: NB

DATE: 10/19/18

UNITS: Feet

Cave-in Depth:

Groundwater Encountered:

Groundwater Prior to Backfill:

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-2

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 486

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0	486	Topsoil Thickness [9.50"]					
		(CH) FAT CLAY, brownish red, moist	E				
2	484					TP-2 2-4	
4	482						
		BUCKET REFUSAL @ 5'					
6	480						
8	478						
10	476						
12	474						
14	472						

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR: Client Provided

OPERATOR: Washington County

MAKE/MODEL: John Deere/310 SL

REACH: 12

ECS REP.: NB

DATE: 10/19/18

UNITS: Feet

Cave-in Depth:

Groundwater Encountered:

Groundwater Prior to Backfill:

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-3

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 485.5

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Thickness [9.00"]	E				
	484	(CL/ML) SILTY CLAY, brown, moist					
2		(CL) LEAN CLAY, orange, moist					
	482						
4							
	480						
6		END OF TEST PIT @ 6'					
	478						
8							
	476						
10							
	474						
12							
	472						
14							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR: Client Provided

OPERATOR: Washington County

MAKE/MODEL: John Deere/310 SL

REACH: 12

ECS REP.: NB

DATE: 10/19/18

UNITS: Feet

Cave-in Depth:

Groundwater Encountered:

Groundwater Prior to Backfill:

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-4

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 483.3

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Thickness [10.00"]					
		(CL) LEAN CLAY, brown, moist					
	482		E				
2							
		(CH) FAT CLAY, orange, moist					
	480						
			M				
4							
		END OF TEST PIT @ 4.5'					
	478						
6							
	476						
8							
	474						
10							
	472						
12							
	470						
14							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR: Client Provided

OPERATOR: Washington County

MAKE/MODEL: John Deere/310 SL

REACH: 12

ECS REP.: NB

DATE: 10/19/18

UNITS: Feet

Cave-in Depth:

Groundwater Encountered:

Groundwater Prior to Backfill:

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-5

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 486.5

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL		EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Thickness [9.00"]	▨					
	486	(CL/CH) LEAN TO FAT CLAY, orange, moist	▨	E				
2	484							
		BUCKET REFUSAL @ 3.5'						
4	482							
6	480							
8	478							
10	476							
12	474							
14								

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR: Client Provided

OPERATOR: Washington County

MAKE/MODEL: John Deere/310 SL

REACH: 12

ECS REP.: NB

DATE: 10/19/18

UNITS: Feet

Cave-in Depth:

Groundwater Encountered:

Groundwater Prior to Backfill:

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-6

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 485

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Thickness [8.00"]					
		(CH) FAT CLAY, contains slight roots, orange, moist					
	484						
2							
	482						
4			E				
		(CL) LEAN CLAY, contains slight roots, orange, moist					
	480						
6							
	478						
8		END OF TEST PIT @ 8'					
	476						
10							
	474						
12							
	472						
14							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR:	OPERATOR:	MAKE/MODEL:	REACH:
Client Provided	Washington County	John Deere/310 SL	12

ECS REP.:	DATE:	UNITS:	Cave-in Depth:	Groundwater Encountered:	Groundwater Prior to Backfill:
NB	10/19/18	Feet			

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-7

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 486.8

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Thickness [14.00"]					
	486						
		(CL) LEAN CLAY, orange, moist	D				
2							
	484						
		BUCKET REFUSAL @ 3'					
4							
	482						
6							
	480						
8							
	478						
10							
	476						
12							
	474						
14							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR: Client Provided

OPERATOR: Washington County

MAKE/MODEL: John Deere/310 SL

REACH: 12

ECS REP.: NB

DATE: 10/19/18

UNITS: Feet

Cave-in Depth:

Groundwater Encountered:

Groundwater Prior to Backfill:

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-8

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 486.5

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Thickness [14.00"]					
	486						
		(CL/ML) SILTY CLAY, contains slight roots, orange, moist					
2							
	484						
4		(CL) LEAN CLAY, orange, moist	E				
	482						
6							
	480						
8		END OF TEST PIT @ 8'					
	478						
10							
	476						
12							
	474						
14							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR: Client Provided

OPERATOR: Washington County

MAKE/MODEL: John Deere/310 SL

REACH: 12

ECS REP.: NB

DATE: 10/19/18

UNITS: Feet

Cave-in Depth:

Groundwater Encountered:

Groundwater Prior to Backfill:

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-9

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 489

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Thickness [5.00"]					
		(CL) LEAN CLAY WITH SAND, contains slight roots, brown, moist					
	488						
2			E			TP-9 2-4	
	486						
4		(CL) LEAN CLAY, orange, moist					
	484					TP-9 5-7	20.2
6			M				
	482						
		END OF TEST PIT @ 7.5'					
8							
	480						
10							
	478						
12							
	476						
14							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR:	OPERATOR:	MAKE/MODEL:	REACH:
Client Provided	Washington County	JOhn Deere/310 SL	12

ECS REP.:	DATE:	UNITS:	Cave-in Depth:	Groundwater Encountered:	Groundwater Prior to Backfill:
NB	10/19/18	Feet			

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-10

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 487

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Thickness [12.00"]					
	486	(CL/ML) SILTY CLAY, contains slight roots, orange, moist					
2							
	484						
		(CH) FAT CLAY, orange, moist					
4							
	482		E				
6		(ML/MH) SILT/ELASTIC SILT, orange / yellowish, moist					
	480						
8							
	478						
10		END OF TEST PIT @ 10'					
	476						
12							
	474						
14							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR: Client Provided

OPERATOR: Washington County

MAKE/MODEL: John Deere/310 SL

REACH: 12

ECS REP.: NB

DATE: 10/19/18

UNITS: Feet

Cave-in Depth:

Groundwater Encountered:

Groundwater Prior to Backfill:

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-11

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 479

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Thickness [10.00"]	E				
	478	(CH) FAT CLAY, orange, moist					
2							
	476		M				
4							
	474						
6		BUCKET REFUSAL @ 6'					
	472						
8							
	470						
10							
	468						
12							
	466						
14							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR: Client Provided

OPERATOR: Washington County

MAKE/MODEL: John Deere/310 SL

REACH: 12

ECS REP.: NB

DATE: 10/19/18

UNITS: Feet

Cave-in Depth:

Groundwater Encountered:

Groundwater Prior to Backfill:

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-12

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 478.6

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Thickness [12.00"]					
	478						
		(CL) LEAN CLAY WITH SAND, brown, moist					
2			E				
	476	(CL) GRAVELLY LEAN CLAY, trace sand, brown, moist					
4		(SP) SAND WITH GRAVEL, brown, moist					
	474						
			M				
6		END OF TEST PIT @ 6'					
	472						
8							
	470						
10							
	468						
12							
	466						
14							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR: Client Provided

OPERATOR: Washington County

MAKE/MODEL: John Deere/310 SL

REACH: 12

ECS REP.: NB

DATE: 10/19/18

UNITS: Feet

Cave-in Depth:

Groundwater Encountered:

Groundwater Prior to Backfill:

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-13

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 483

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0		Topsoil Thickness [10.00"]					
	482	(CL) LEAN CLAY, orange, moist					
2							
	480		E				
4							
	478						
6		END OF TEST PIT @ 6'					
	476						
8							
	474						
10							
	472						
12							
	470						
14							

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR: Client Provided

OPERATOR: Washington County

MAKE/MODEL: John Deere/310 SL

REACH: 12

ECS REP.: NB

DATE: 10/19/18

UNITS: Feet

Cave-in Depth:

Groundwater Encountered:

Groundwater Prior to Backfill:

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-14

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 492

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0	492	Topsoil Thickness [6.00"]					
		(ML) SILT, trace clay, trace gravel, brown, moist					
2	490						
		(CL) LEAN CLAY, orange, moist					
4	488		E				
						TP-14 5-7	
6	486						
		END OF TEST PIT @ 7.5'					
8	484						
10	482						
12	480						
14	478						

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR: Client Provided

OPERATOR: Washington County

MAKE/MODEL: John Deere/310 SL

REACH: 12

ECS REP.: NB

DATE: 10/19/18

UNITS: Feet

Cave-in Depth:

Groundwater Encountered:

Groundwater Prior to Backfill:

PROJECT NAME: Washington County PSTC - Change Order #1

TEST PIT #: TP-15

CLIENT: Crabtree, Rohrbaugh & Associates Architects

Job #: 13:8269-A

SURFACE ELEVATION (FT): 496

LOCATION: 9238 Sharpsburg Pike, Hagerstown, Washington County, MD

ARCH/ENG:

DEPTH (FT.)	ELEV. (FT.)	DESCRIPTION OF MATERIAL	EXCAV. EFFORT	DCP	QP (TSF)	SAMPLE NO.	MOIST. CONT. (%)
0	496	Topsoil Thickness [10.00"]					
		(CH) FAT CLAY, orange, moist				TP-15 1-3	
2	494						
			E				
4	492						
		(CL/ML) SILTY CLAY, orangish brown, moist					
6	490						
		(CL) LEAN CLAY, contains slight rock fragments, orange, moist					
			M				
8	488	BUCKET REFUSAL @ 8'					
10	486						
12	484						
14	482						

REMARKS:

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES. IN-SITU THE TRANSITION MAY BE GRADUAL.

GROUND WATER: ENCOUNTERED ▽ PRIOR TO BACKFILL ▼

EXCAVATION EFFORT: E - EASY M - MEDIUM D - DIFFICULT VD - VERY DIFFICULT

CONTRACTOR: Client Provided

OPERATOR: Washington County

MAKE/MODEL: John Deere/310 SL

REACH: 12

ECS REP.: NB

DATE: 10/19/18

UNITS: Feet

Cave-in Depth:

Groundwater Encountered:

Groundwater Prior to Backfill:

Laboratory Testing Summary

Sample Source	Sample Number	Depth (feet)	MC[1] (%)	Soil Type[2]	Atterberg Limits[3]			Percent Passing No. 200 Sieve[4]	Moisture - Density (Corr.)[5]		CBR Value[6]	Other
					LL	PL	PI		Maximum Density (pcf)	Optimum Moisture (%)		
TP-1												
	TP-1 3-5	3.00 - 3.00	20.0	CL	46	19	27	83.2	106.6	18.4		
TP-2												
	TP-2 2-4	2.00 - 2.00		CH	55	24	31	88.9	87.6	30.7		
TP-7												
TP-9												
	TP-9 2-4	2.00 - 2.00		CL	35	18	17	85.3	106.5	17.7		
	TP-9 5-7	5.00 - 5.00	20.2	CL	30	21	9	90.1	108.8	16.4		
TP-14												
	TP-14 5-7	5.00 - 5.00		CL	44	22	22	86.0	100.4	21.7		
TP-15												
	TP-15 1-3	1.00 - 1.00		CH	52	21	31	88.9	96.7	24.5		

Notes: 1. ASTM D 2216, 2. ASTM D 2487, 3. ASTM D 4318, 4. ASTM D 1140, 5. See test reports for test method, 6. See test reports for test method

Definitions: MC: Moisture Content, Soil Type: USCS (Unified Soil Classification System), LL: Liquid Limit, PL: Plastic Limit, PI: Plasticity Index, CBR: California Bearing Ratio, OC: Organic Content (ASTM D 2974)

Project No. 13:8269-A
Project Name: Washington County PSTC - Change Order #1
PM: Greg Ratkowski
PE: Jeff McGregor
Printed On: Monday, November 12, 2018

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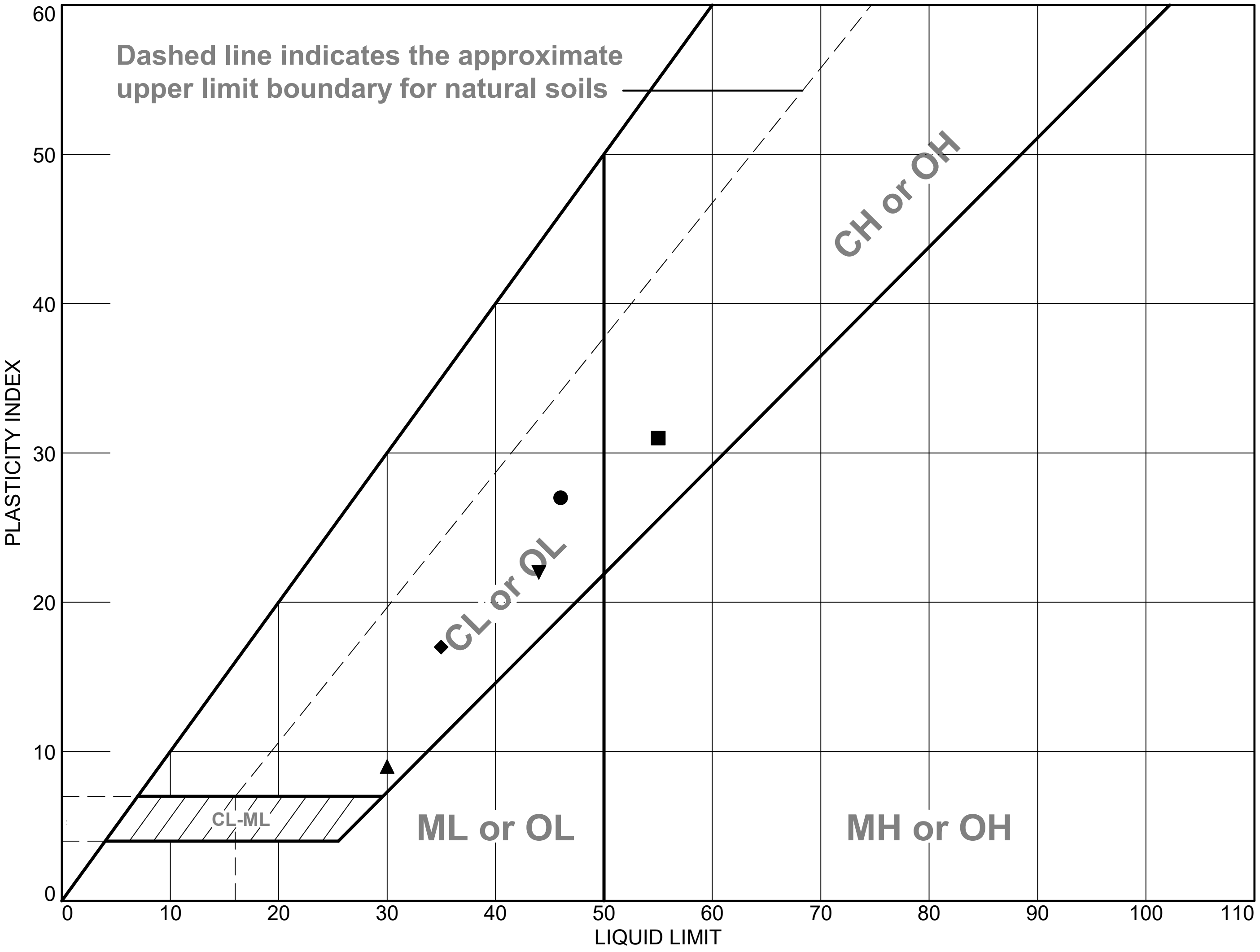
LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Orange Lean CLAY w/Sand	46	19	27	98.1	83.2	CL
■	Orange FAT CLAY	55	24	31	99.4	88.9	CH
▲	Brown LEAN CLAY	30	21	9	97.5	90.1	CL
◆	Brown LEAN CLAY w/Sand	35	18	17	95.0	85.3	CL
▼	Orangish LEAN CLAY	44	22	22	95.3	86.0	CL

Project No. 8269-A **Client:** Crabtree, Rohrbaugh & Associates Architects

Project: Washington County PSTC - Change Order #1

● **Source:** TP-1 **Depth:** 3.00-5.00 **Sample No.:** TP-1 3-5
■ **Source:** TP-2 **Depth:** 2.00-4.00 **Sample No.:** TP-2 2-4
▲ **Source:** TP-9 **Depth:** 5.00-7.00 **Sample No.:** TP-9 5-7
◆ **Source:** TP-9 **Depth:** 2.00-4.00 **Sample No.:** TP-9 2-4
▼ **Source:** TP-14 **Depth:** 5.00-7.00 **Sample No.:** TP-14 5-7

Remarks:

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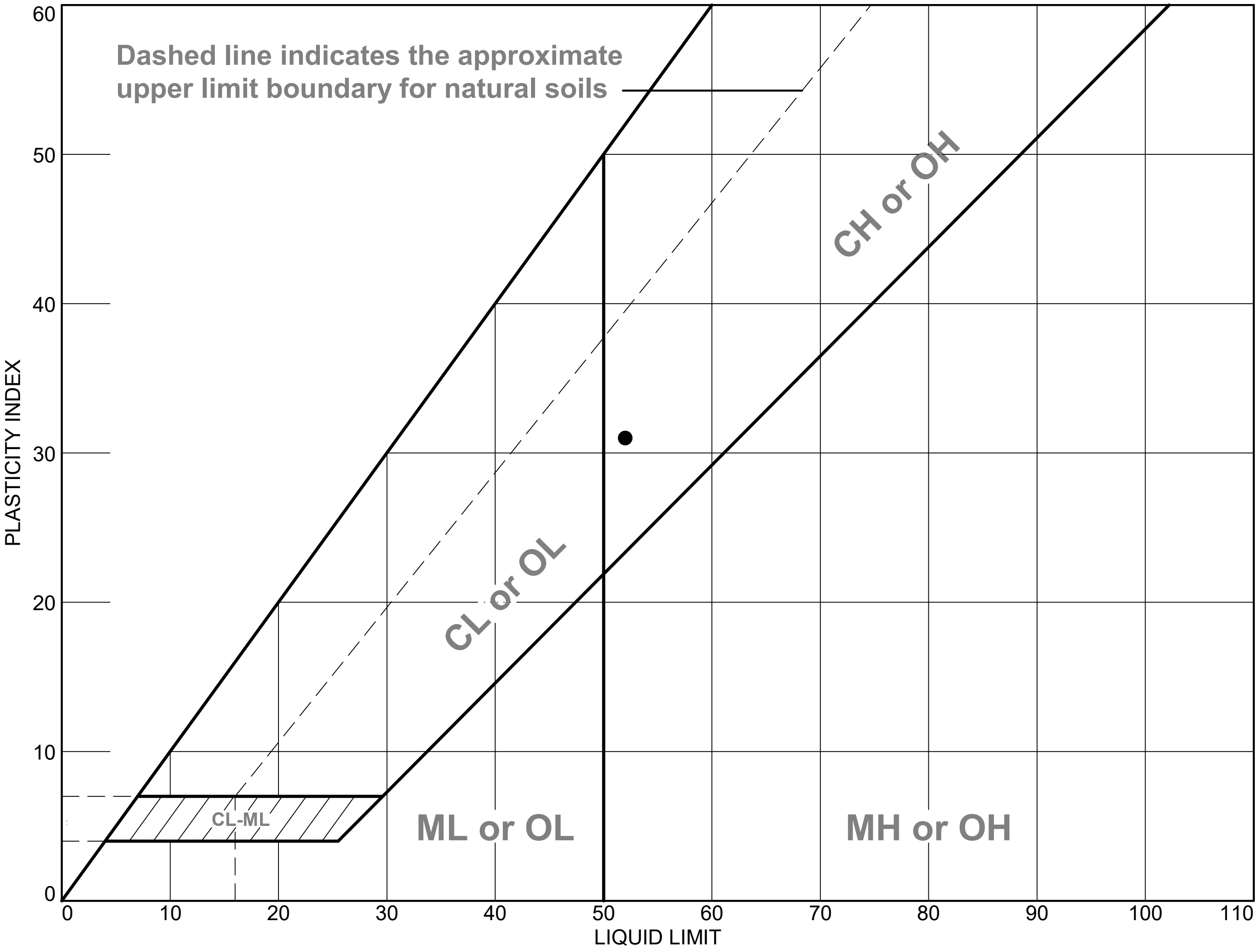
Figure

Tested By: PK **Checked By:** PK

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Orangish Brown FAT CLAY	52	21	31	98.8	88.9	CH

Project No. 8269-A **Client:** Crabtree, Rohrbaugh & Associates Architects

Project: Washington County PSTC - Change Order #1

● **Source:** TP-15 **Depth:** 1.00-3.00 **Sample No.:** TP-15 1-3

Remarks:

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Figure

Tested By: PK **Checked By:** PK

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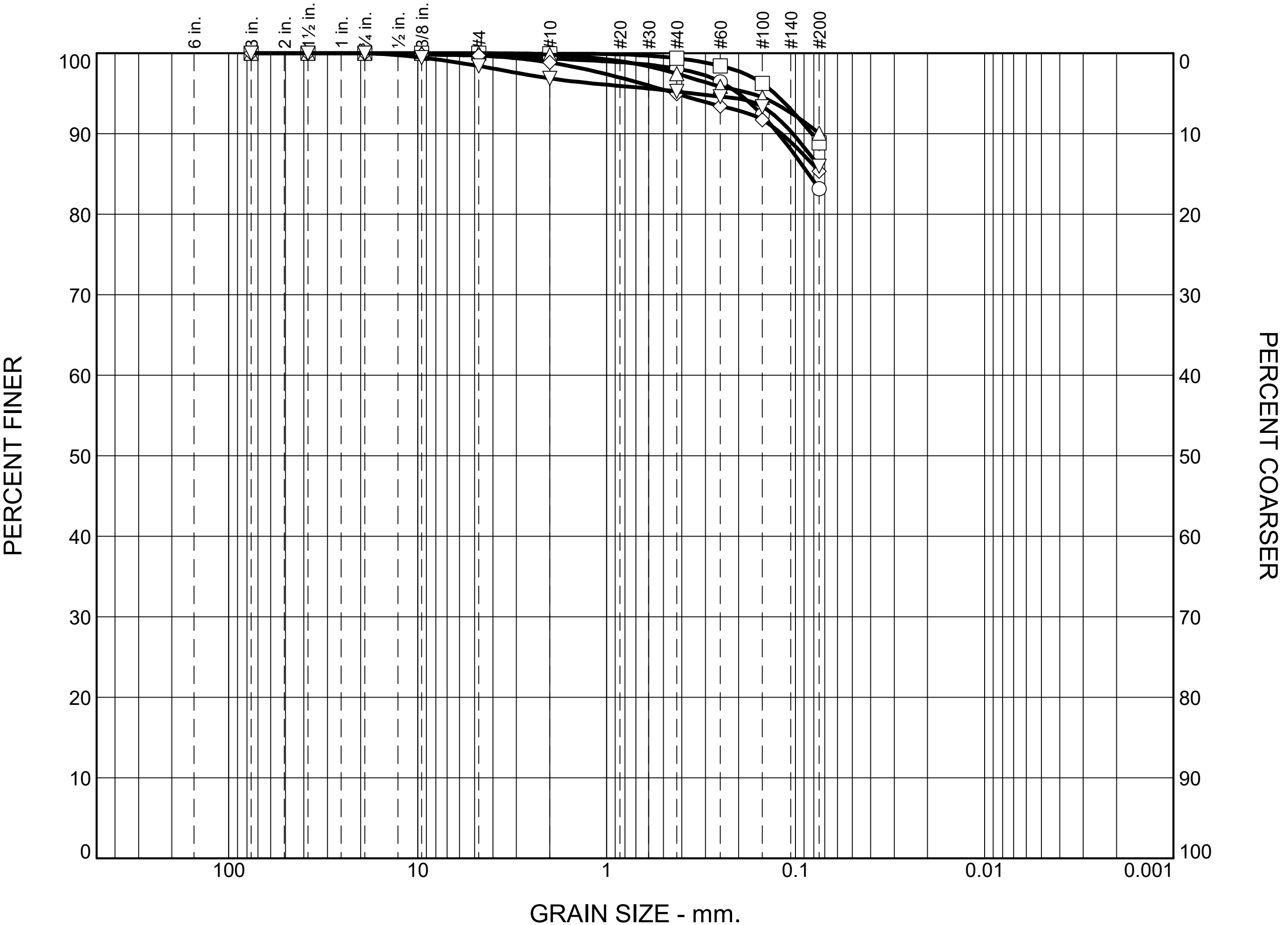
Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.1	0.5	1.3	14.9	83.2	
□	0.0	0.0	0.0	0.1	0.5	10.5	88.9	
△	0.0	0.0	0.0	0.2	2.3	7.4	90.1	
◇	0.0	0.0	0.3	0.8	3.9	9.7	85.3	
▽	0.0	0.0	1.6	1.5	1.6	9.3	86.0	

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	TP-1	TP-1 3-5	3.00-5.00	Orange Lean CLAY w/Sand	CL
□	TP-2	TP-2 2-4	2.00-4.00	Orange FAT CLAY	CH
△	TP-9	TP-9 5-7	5.00-7.00	Brown LEAN CLAY	CL
◇	TP-9	TP-9 2-4	2.00-4.00	Brown LEAN CLAY w/Sand	CL
▽	TP-14	TP-14 5-7	5.00-7.00	Orangish LEAN CLAY	CL

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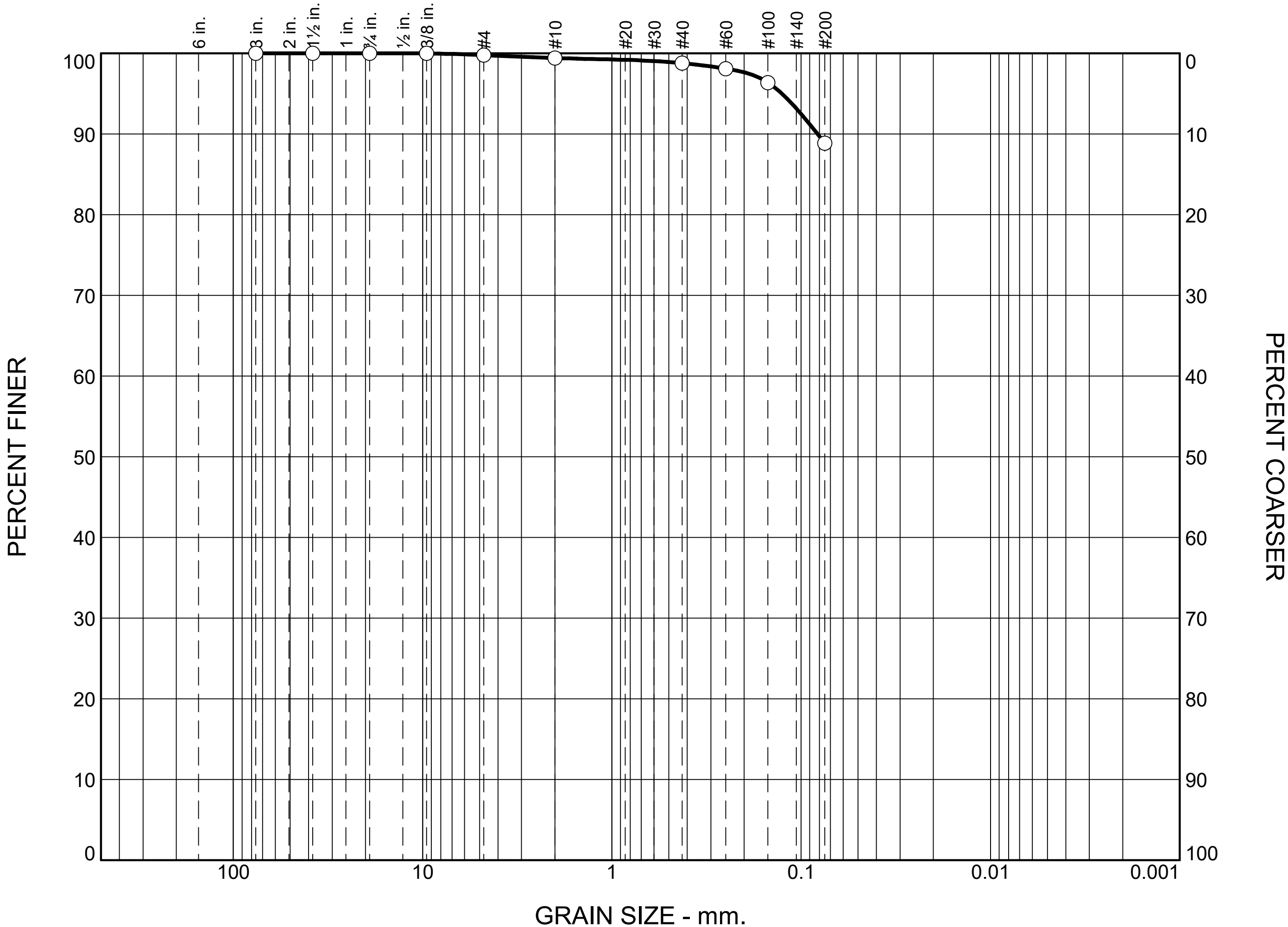
Client: Crabtree, Rohrbaugh & Associates Architects

Project: Washington County PSTC - Change Order #1

Project No.: 8269-A **Figure**

Tested By: PK **Checked By:** PK

Particle Size Distribution Report



	% +3"	% Gravel		% Sand			% Fines	
		Coarse	Fine	Coarse	Medium	Fine	Silt	Clay
○	0.0	0.0	0.2	0.4	0.6	9.9	88.9	

SOIL DATA

SYMBOL	SOURCE	SAMPLE NO.	DEPTH (ft.)	Material Description	USCS
○	TP-15	TP-15 1-3	1.00-3.00	Orangish Brown FAT CLAY	CH

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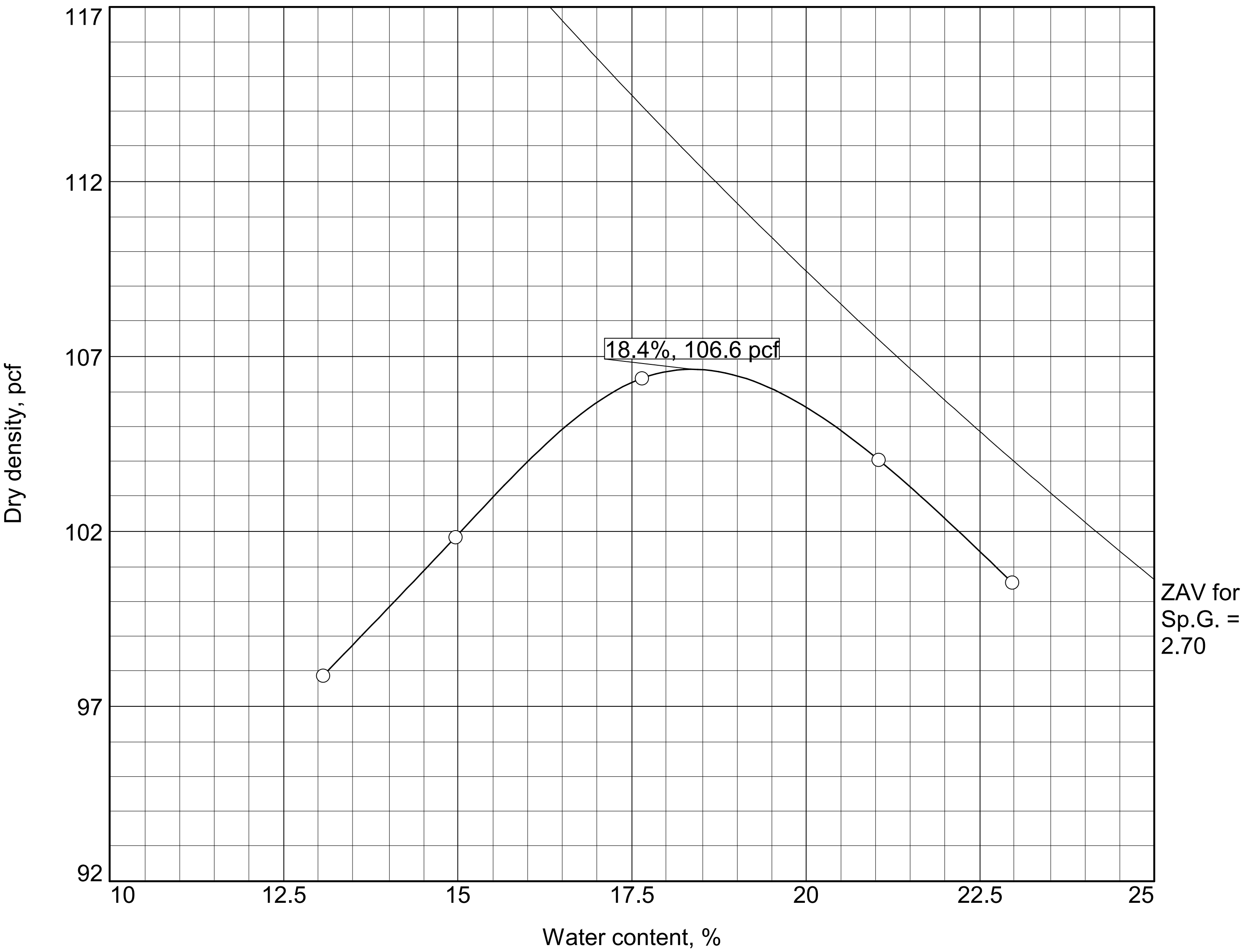
Client: Crabtree, Rohrbaugh & Associates Architects
Project: Washington County PSTC - Change Order #1

Project No.: 8269-A **Figure**

Tested By: PK **Checked By:** PK



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
3.00-5.00	CL	A-7-6(23)	20.0	2.7	46	27		83.2

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 106.6 pcf Optimum moisture = 18.4 %	Orange Lean CLAY w/Sand

Project No. 8269-A **Client:** Crabtree, Rohrbaugh & Associates Architects

Project: Washington County PSTC - Change Order #1

Date: 10/30/

○ **Source of Sample:** TP-1 **Sample Number:** TP-1 3-5

Remarks:

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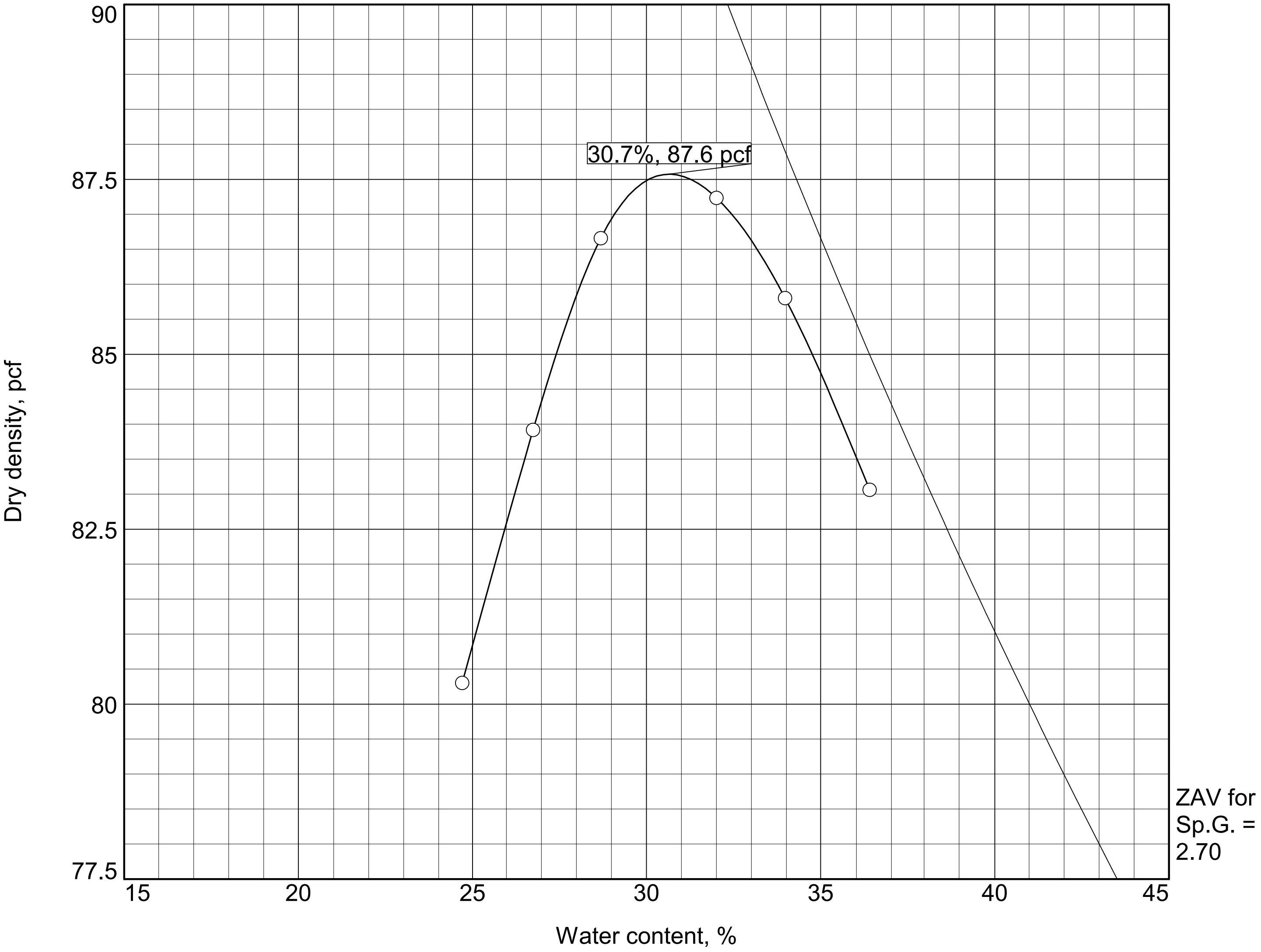
Figure

Tested By: PK **Checked By:** PK

COMPACTION TEST REPORT For Curve No. TP-2 2-4



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
2.00-4.00	CH	A-7-6(30)		2.7	55	31		88.9

TEST RESULTS

Maximum dry density = 87.6 pcf

Optimum moisture = 30.7 %

MATERIAL DESCRIPTION

Orange FAT CLAY

Project No. 8269-A **Client:** Crabtree, Rohrbaugh & Associates Architects

Project: Washington County PSTC - Change Order #1

Date: 11/02/

○ **Source of Sample:** TP-2 **Sample Number:** TP-2 2-4

Remarks:

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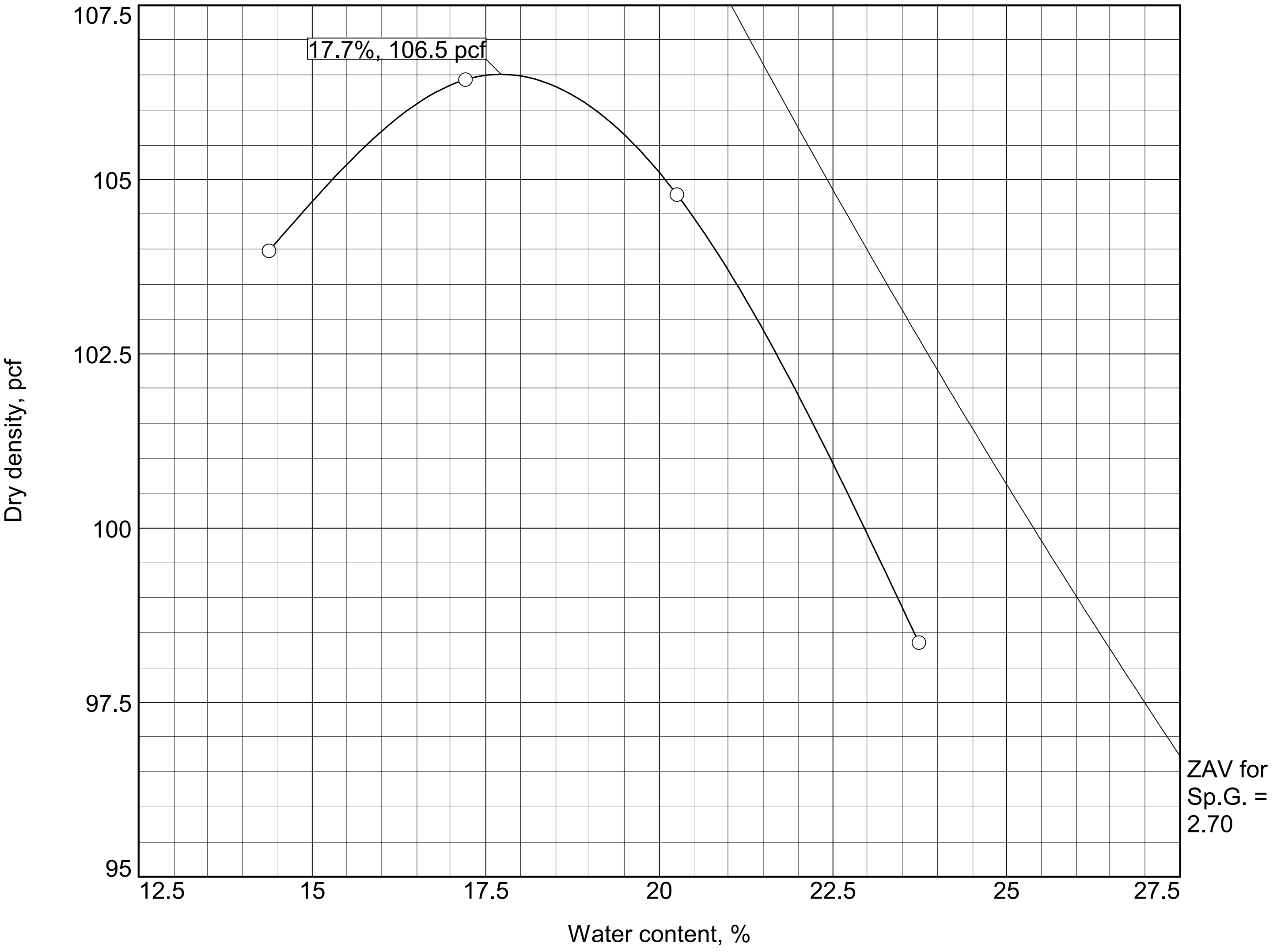
Figure

Tested By: PK **Checked By:** PK

COMPACTION TEST REPORT For Curve No. TP-9 2-4



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
2.00-4.00	CL	A-6(14)		2.7	35	17		85.3

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 106.5 pcf Optimum moisture = 17.7 %	Brown LEAN CLAY w/Sand

Project No. 8269-A **Client:** Crabtree, Rohrbaugh & Associates Architects

Project: Washington County PSTC - Change Order #1

Date: 11/02/

○ **Source of Sample:** TP-9 **Sample Number:** TP-9 2-4

Remarks:

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Figure

Tested By: PK **Checked By:** PK

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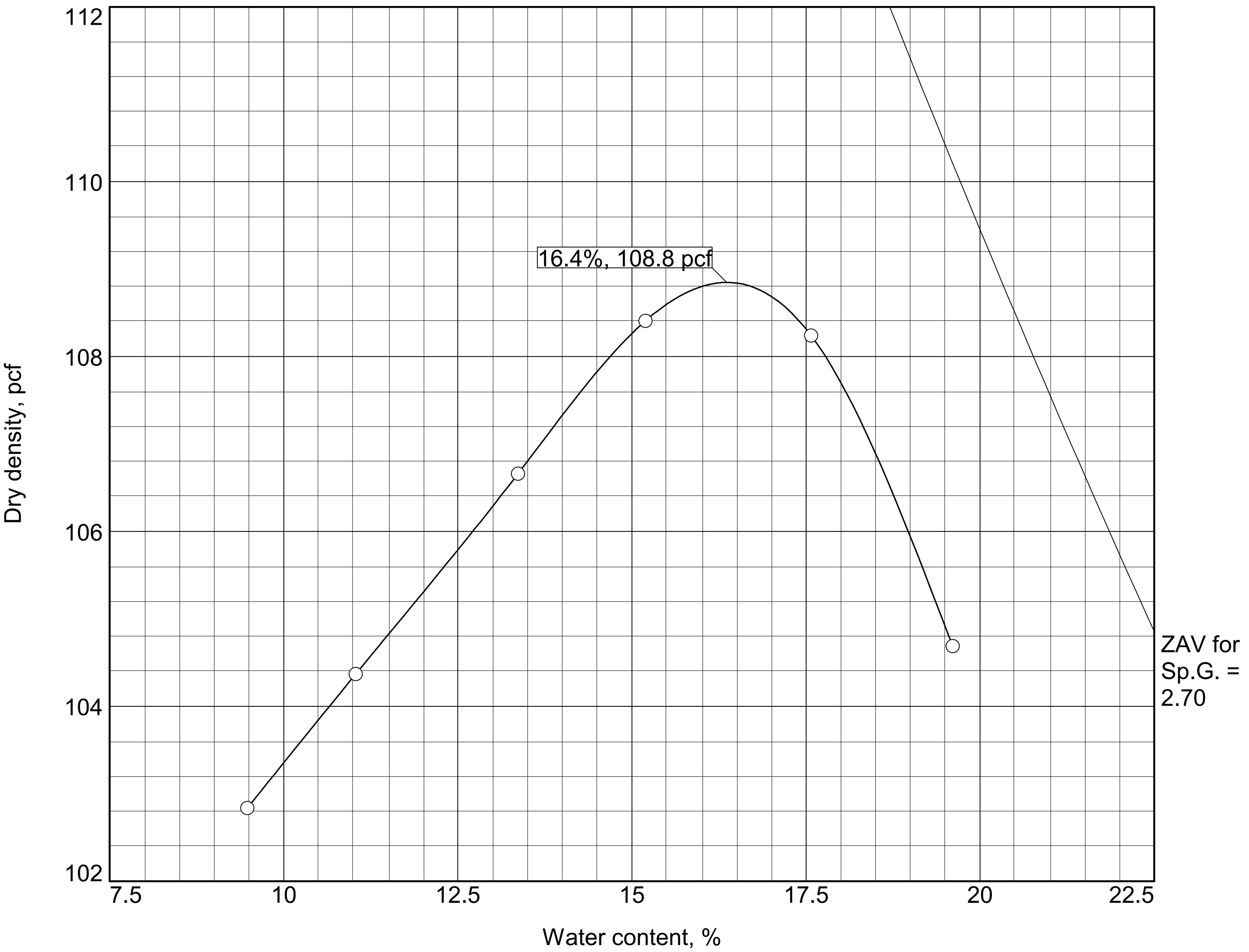
COMPACTION TEST REPORT For Curve No. TP-9/TP-9 5-7



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
5.00-7.00	CL	A-4(8)	20.2	2.7	30	9		90.1

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 108.8 pcf Optimum moisture = 16.4 %	Brown LEAN CLAY

Project No. 8269-A **Client:** Crabtree, Rohrbaugh & Associates Architects

Project: Washington County PSTC - Change Order #1

Date: 10/30/

○ **Source of Sample:** TP-9 **Sample Number:** TP-9 5-7

Remarks:

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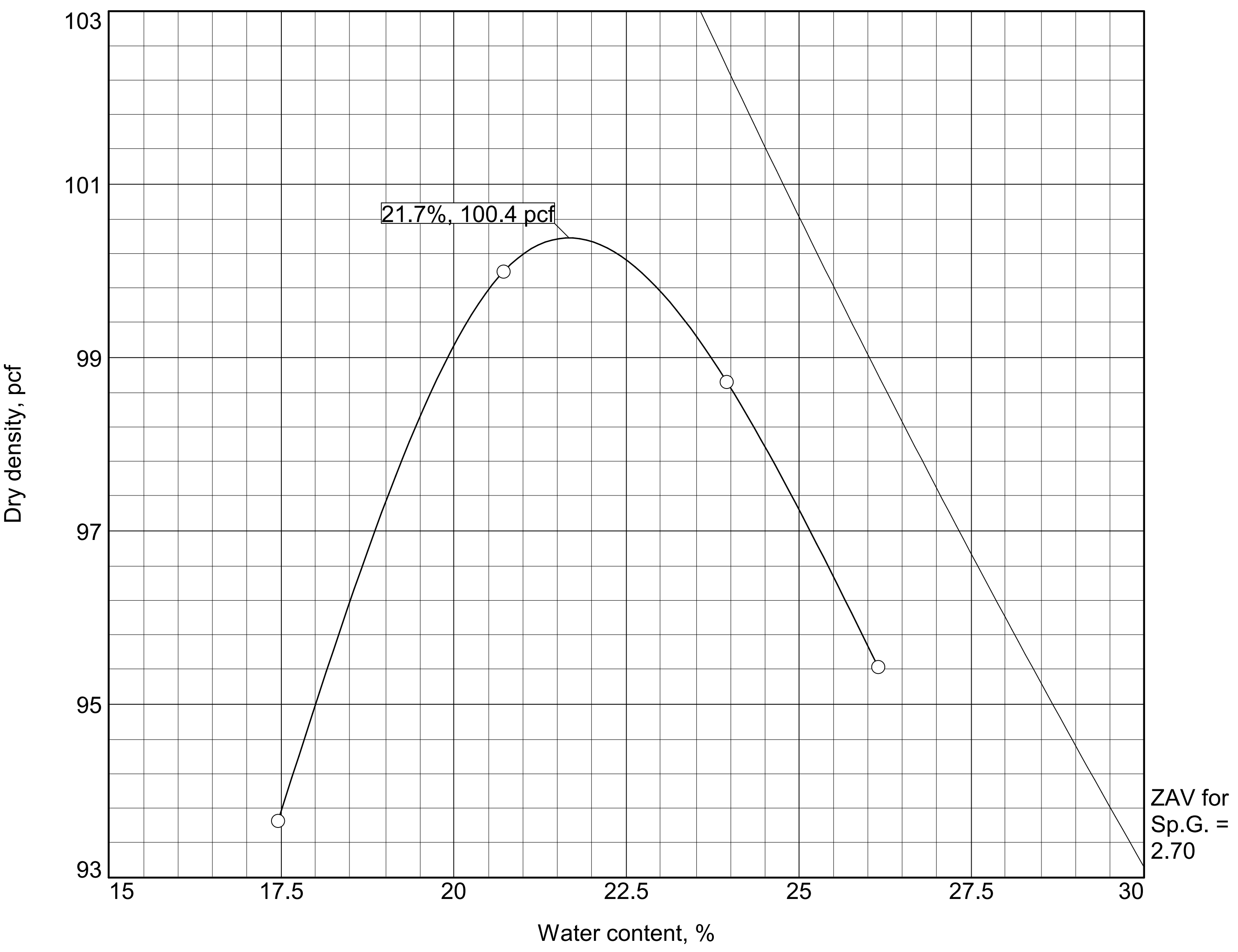
Fax: (301) 668-3519

Figure

Tested By: PK **Checked By:** PK

COMPACTION TEST REPORT For Curve No. TP-14 5-7



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
5.00-7.00	CL	A-7-6(20)		2.7	44	22		86.0

TEST RESULTS	MATERIAL DESCRIPTION
Maximum dry density = 100.4 pcf Optimum moisture = 21.7 %	Orangish LEAN CLAY

Project No. 8269-A **Client:** Crabtree, Rohrbaugh & Associates Architects

Project: Washington County PSTC - Change Order #1

Date: 11/02/

○ **Source of Sample:** TP-14 **Sample Number:** TP-14 5-7

Remarks:

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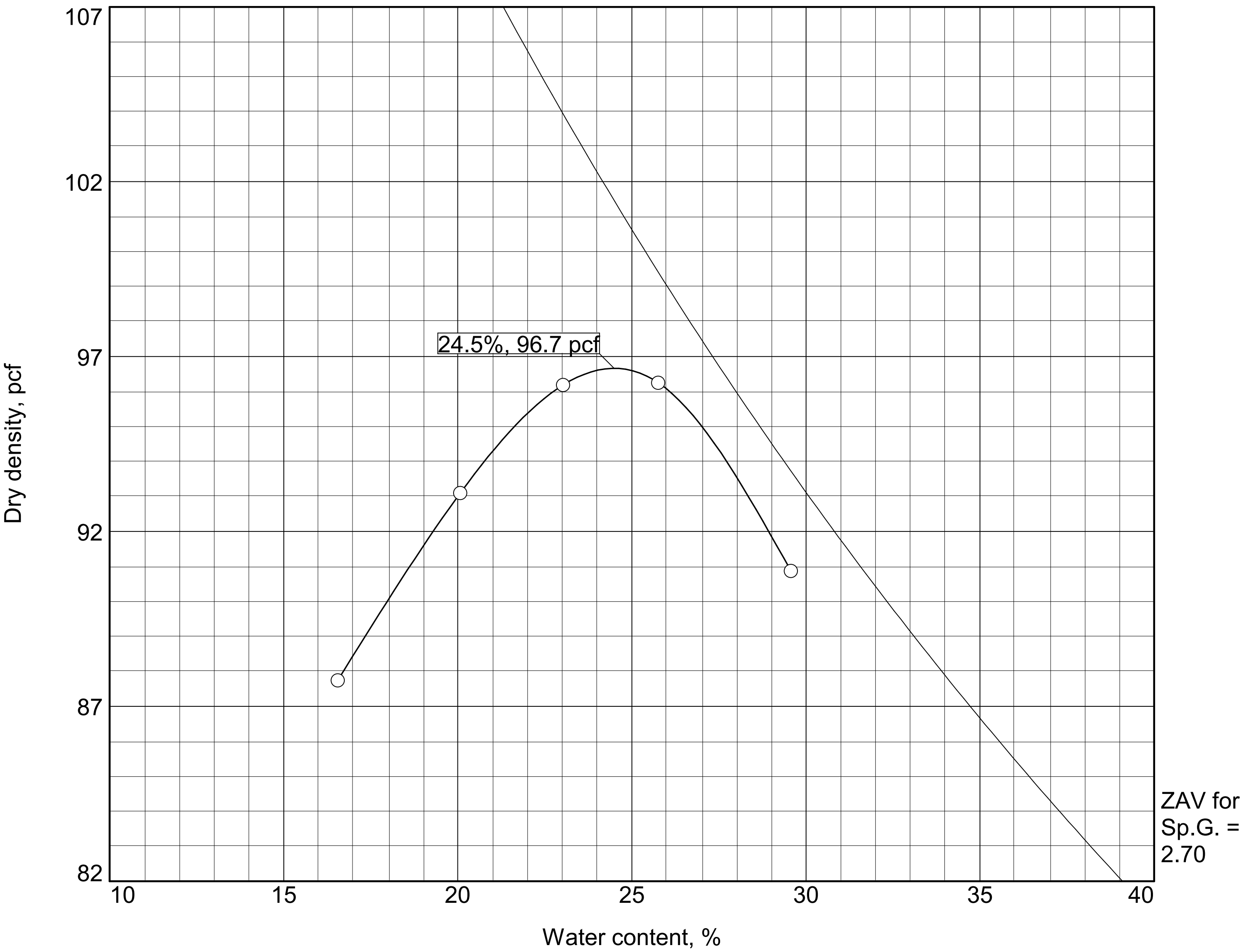
Figure

Tested By: PK **Checked By:** PK

COMPACTION TEST REPORT For Curve No. TP-15 1-3



Test specification: ASTM D 698-12 Method A Standard

Elev/ Depth	Classification		Nat. Moist.	Sp.G.	LL	PI	% > #4	% < No.200
	USCS	AASHTO						
1.00-3.00	CH	A-7-6(30)		2.7	52	31		88.9

TEST RESULTS

Maximum dry density = 96.7 pcf

Optimum moisture = 24.5 %

MATERIAL DESCRIPTION

Orangish Brown FAT CLAY

Project No. 8269-A **Client:** Crabtree, Rohrbaugh & Associates Architects

Project: Washington County PSTC - Change Order #1

Date: 11/02/

○ **Source of Sample:** TP-15 **Sample Number:** TP-15 1-3

Remarks:

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Figure

Tested By: PK **Checked By:** PK

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Phone: 301/668-4303
FAX: 301/668-3519

COMPRESSIVE STRENGTH TEST RESULTS FOR SOIL-CEMENT PILLS

Project: Washington County PSTC - Change
Project #: 8269-A
Sample: TP-1 3-5
Date: 11/5/2018

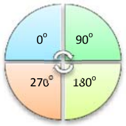
Rezeroed Caliper? Yes ☒ No ☐
Zero Reading Changed By < 0.01" ? Yes ☒ No ☐

PILL ID	DATE MOLDED	TEST DATE	AGE OF PILL (days)	DIAMETER (in)*		LENGTH UNCAPPED (in)*					AVERAGE LENGTH (in)**	AREA (sq in)	LOAD (lbs)	COMPRESSIVE STRENGTH (psi)	LENGTH TO DIAMETER RATIO	CORRECTION FACTOR *	CORRECTED COMPRESSIVE STRENGTH (psi)	OPTIMUM MOISTURE (%)	MAX DRY DENSITY OF PILL (pcf)
				D1	D2	At 0^o	At 90^o	At 180^o	At 270^o	CENTER ALONG AXIS									
PILL 1 @ 3%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	3227	254	1.14	0.90	229	18.4	104.6
PILL 2 @ 3%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	3102	245	1.14	0.90	220	18.4	106.0
PILL 3 @ 3%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	3217	254	1.14	0.90	228	18.4	105.2
PILL 4 @ 5%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	5915	466	1.14	0.90	420	18.9	106.9
PILL 5 @ 5%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	5736	452	1.14	0.90	407	18.9	106.2
PILL 6 @ 5%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	5724	451	1.14	0.90	406	18.9	105.8
PILL 7 @ 7%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	7224	569	1.14	0.90	513	19.3	105.0
PILL 8 @ 7%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	7093	559	1.14	0.90	503	19.3	105.6
PILL 9 @ 7%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	6426	507	1.14	0.90	456	19.3	106.2

* CORRECTION FACTOR

Ratio of Length to Diameter	Strength Correction Factor*
1.000	0.870
1.125	0.900
1.250	0.930
1.375	0.945
1.500	0.960
1.625	0.970
1.750	0.980
1.760	1.000

REMARKS: Samples (conform / do not conform) to project specifications.



A. TYPE OF CURING ____________ Location: ____________
B. MOISTURE CONDITION ____________ ____________
C. NOMINAL MAX. SIZE AGGREGATE ____________ ____________
D. DIRECTION OF LOAD APPLICATION ____________ ____________
TO THE HORIZONTAL PLANE OF
CONCRETE AS PLACED.

Caliper Spec:
Range: 0" - 12"
Accuracy: 0.001"

* Measure & record length to the nearest 0.01"
** Record value to the nearest 0.05"

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Phone: 301/668-4303
FAX: 301/668-3519

COMPRESSIVE STRENGTH TEST RESULTS FOR SOIL-CEMENT PILLS

Project: Washington County PSTC - Change
Project #: 8269-A
Sample: TP-9 5-7
Date: 11/5/2018

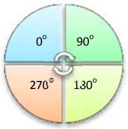
Rezeroed Caliper? Yes ☒ No ☐ Zero Reading Changed By < 0.01" ? Yes ☒ No ☐

PILL ID	DATE MOLDED	TEST DATE	AGE OF PILL (days)	DIAMETER (in)*		LENGTH UNCAPPED (in)*					AVERAGE LENGTH (in)**	AREA (sq in)	LOAD (lbs)	COMPRESSIVE STRENGTH (psi)	LENGTH TO DIAMETER RATIO	CORRECTION FACTOR *	CORRECTED COMPRESSIVE STRENGTH (psi)	OPTIMUM MOISTURE (%)	MAX DRY DENSITY OF PILL (pcf)
				D1	D2	At 0°	At 90°	At 180°	At 270°	CENTER ALONG AXIS									
PILL 1 @ 3%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	2099	165	1.14	0.90	149	18.0	107.4
PILL 2 @ 3%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	2069	163	1.14	0.90	147	18.0	107.1
PILL 3 @ 3%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	2023	159	1.14	0.90	144	18.0	107.2
PILL 4 @ 5%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	3474	274	1.14	0.90	246	17.6	107.8
PILL 5 @ 5%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	3470	274	1.14	0.90	246	17.6	108.2
PILL 6 @ 5%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	3203	252	1.14	0.90	227	17.6	108.2
PILL 7 @ 7%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	4119	325	1.14	0.90	292	17.6	107.9
PILL 8 @ 7%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	4357	343	1.14	0.90	309	17.6	108.1
PILL 9 @ 7%	10/28/18	11/5/18	8	4.02	4.02	4.57	4.57	4.57	4.57	4.57	4.57	12.69	4491	354	1.14	0.90	319	17.6	107.5

* CORRECTION FACTOR

Ratio of Length to Diameter	Strength Correction Factor*
1.000	0.870
1.125	0.900
1.250	0.930
1.375	0.945
1.500	0.960
1.625	0.970
1.750	0.980
1.760	1.000

REMARKS: Samples (conform / do not conform) to project specifications.



A. TYPE OF CURING: Mist Room
Location:
B. MOISTURE CONDITION: As Molded
C. NOMINAL MAX. SIZE AGGREGATE
D. DIRECTION OF LOAD APPLICATION TO THE HORIZONTAL PLANE OF CONCRETE AS PLACED.

Caliper Spec:
Range: 0" - 12"
Accuracy: 0.001"

* Measure & record length to the nearest 0.01"
** Record value to the nearest 0.05"