COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION

DIVISION: MATERIALS

REPORT COVER SHEET

Final Soil Survey Report
December 13, 2013
Authored By: Jonathan Brown, P.E.

Jonathan J Brown
2013.12.12 15:45:04 -05'00'

VDOT Materials Division
Staunton District
Geotechnical Engineering

Charles B Weaver
2013.12.13 12:34:08 -05'00'

VDOT Materials Division
Staunton District
Geotechnical Engineering

Responsible for Pages: All

Responsible for Pages: All

Project Description	IMPROVE INTERSECTION WITH ROUTE 792 (BM)
From:	0.1 MILES WEST ROUTE 792
To:	0.1 MILES EAST ROUTE 792
Project UPC No.:	84645

Virginia Department of Transportation

Staunton District Materials Section

December 13, 2013

Internal Memorandum

To: Jason Hartman
Project Manager

Subject: **FINAL SOIL SURVEY AND MINOR STRUCTURES REPORT**

Project Number:	0612-007-773, M501
Project Name:	Improve Intersection with Route 792 (BM)
UPC Number:	84645
Project Limits:	
From:	0.1 miles West Route 792
To:	0.1 miles East Route 792
District:	Staunton
County:	Augusta
Adv. Date:	10/13/2015

1 INTRODUCTION

The purpose of this report is to present the results of the subsurface investigation performed by the Virginia Department of Transportation (VDOT) and the geotechnical recommendations based on the results of the subsurface investigation for the proposed project above located in Augusta County, Virginia. Subsurface investigations for this project were conducted based on the preliminary field inspection (PFI) plans.

2 PROJECT DESCRIPTION

The project is located just east of Verona, in Augusta County, Virginia, at the intersection of Route 612 (Laurel Hill Road) and Route 792 (Indian Mound Road and Riverside Avenue). The purpose of this project is to increase driver safety and better support the flow of traffic at the intersection of Route 612 and Route 792. This will be accomplished by reconstructing the existing intersection, widening the pavement, and improving the entrances to the parking lot and to the American Safety Razor (ASR) industrial site. Route 612 serves as a primary access route to Verona east of Interstate 81, resulting in a significant volume of traffic. Proposed improvements include:

- Widen both the eastbound and westbound lanes of Route 612 to twelve (12) feet each with eight (8) feet of shoulder and a twelve (12) foot middle turn lane;
- Widen both lanes of Route 792 to ten (10) feet each with five (5) feet of shoulder (two feet paved);

- Replace the existing grass island at the “Y” configuration with a smooth and widened curve while improving sight distance at the Route 792 south approach to Route 612;
- Remove the existing visitor entrance lane from Route 612 to ASR (current Razor Blade Lane) and provide access from Route 792;
- Relocate the existing access to the employee parking lot to the west.

At the time of this memorandum, the above listed improvements were proposed by widening Route 612 and Route 792 roadway along its current alignment and grade. Based on the existing topography and proposed alignment, earthwork consists of cut/fill slopes up to 4 feet for the construction of the proposed improvements.

3 SITE DESCRIPTION

Route 612 is an urban collector road which connects Route 11 to Interstate 81 (I-81) in Verona, VA and an interchange with I-81 is located approximately 0.5 miles west of the intersection of Route 792. Within project limits, Route 612 is an east/west facility with two lanes and is paved approximately 22 feet wide with 5 foot shoulders. Route 792 runs north/south and is paved approximately 16-20 feet wide with about 2 feet of shoulder on each side. The north approach serves a residential neighborhood as well as access to one of the employee parking lots of ASR. The south approach to the Route 612 intersection is configured as a “Y”. The “Y” contains a grass island which splits traffic in the north and south directions along each side of the island.

The site is surrounded by development, including residential units, an electrical substation, farmland, a gas station, and several business or industrial units. Curb and gutter configurations exist along business and industrial units on Route 612. Underground and aboveground utilities are prevalent throughout the site.

Partially clogged drainage pipes and drainage ditches with standing water were observed. Adequate staging areas are available during construction. Short detours are available within project limits.

4 GEOLOGIC MAPPING

This section summarizes the geology and surface soil types within the project vicinity.

4.1 Geology

Figure 1 illustrates the published geologic information for the project vicinity from the Geology of Fort Defiance Quadrangle (Gathright, et al, 1978). The mapped bedrock unit is the Martinsburg Formation (Omb). This bedrock formation generally consists of sandstone, over siltstone, over limestone and calcareous shale.

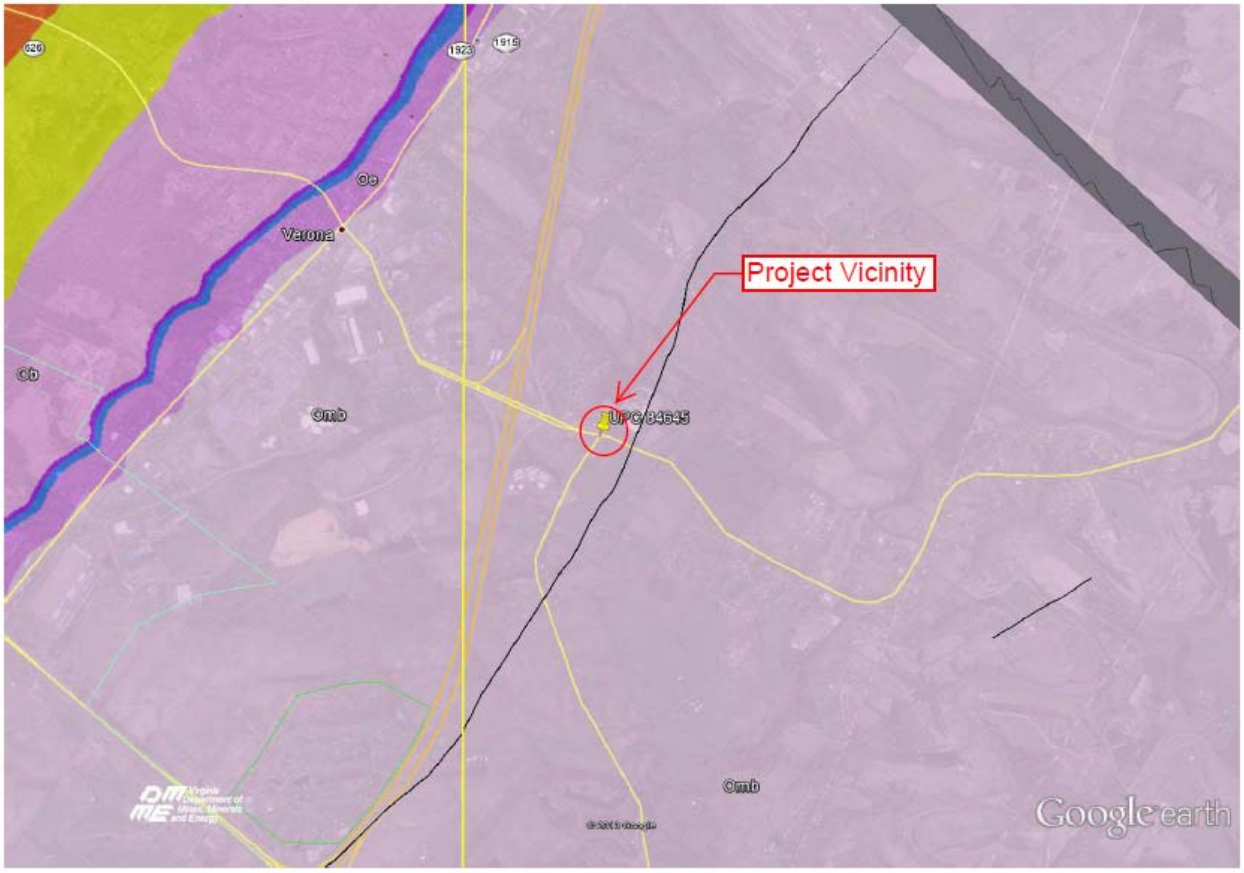


Figure 1 – Geology of the Project Vicinity (Gathright, et al, 1978)

A thinly bedded siltstone rock outcropping was observed during site reconnaissance, located just off the shoulder of the north approach of Route 792 to Route 612.

4.2 Wetlands

The US Fish & Wildlife Service (USFWS, 2013) wetlands mapper, available at http://www.fws.gov/wetlands/Wetlands-Mapper.html, included no wetlands within the project limits.

4.3 Karst Features

Published karst feature information for the project vicinity (Figure 2) includes the Virginia Division of Mineral Resources' map of Selected Karst Features of the Northern Valley and Ridge Province, Virginia (Hubbard, 1983). The project vicinity maps as a non-carbonate feature of the Martinsburg Formation. Since this site consists of a non-carbonate feature, as well as the fact that no karst features were noted during the site investigation and inspection, no special details or pay items are necessary.

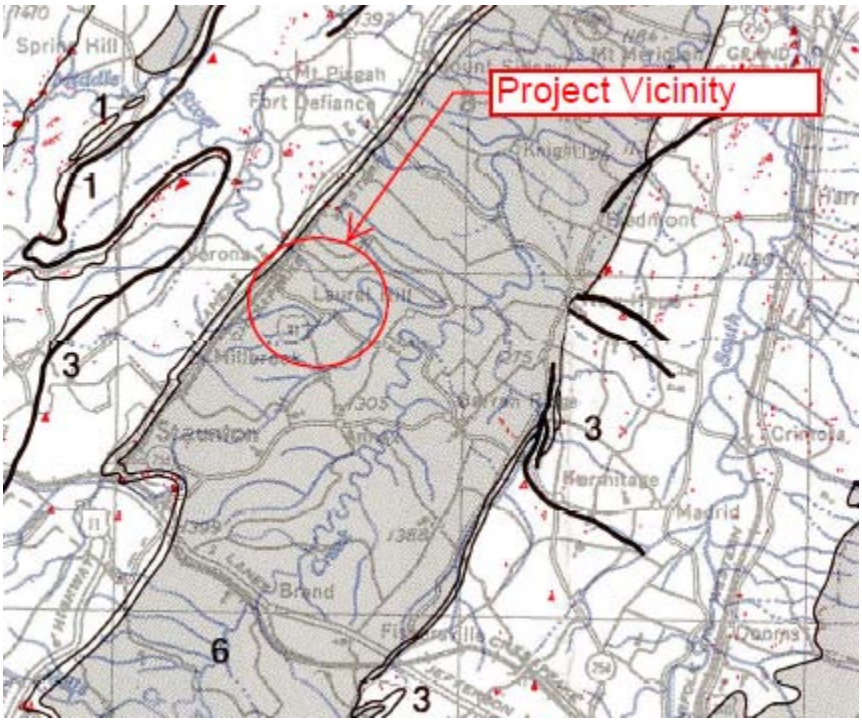


Figure 2 – Karst Features in the Project Vicinity

5 SUBSURFACE INVESTIGATION

The subsurface soil and groundwater conditions in the project area were evaluated by drilling eleven (11) explorations on October 9, 2013 to depths ranging from 5 to 6 feet below ground surface (BGS). The borings were drilled by Simon and Associates of Blacksburg, Virginia. The explorations were located with a handheld GPS device by Schnabel Engineering's staff.

Approximate locations of the explorations completed for this project are presented on the Boring Location Plan presented in Appendix A. Boring logs are presented in Appendix B.

6 LABORATORY TESTING

Laboratory testing was performed by Schnabel Engineering, at their AMRL (AASHTO Materials Reference Laboratory)-accredited laboratory in Blacksburg, Virginia. Laboratory tests conducted on the soil samples include water content, Atterberg Limits, percent passing the No. 200 sieve, sieve analysis, and California Bearing Ratio (CBR). The tests were conducted per relevant Virginia Test Methods (VTM), American Society of Testing Materials (ASTM), and/or AASHTO standards. The laboratory test results are presented in Appendix C and are also summarized on the respective boring logs.

7 SUBSURFACE CONDITIONS

This section presents the subsurface conditions based on the information provided above.

7.1 Subsurface Stratigraphy

Soils encountered in the subsurface investigation generally consisted of stiff to very stiff, low to high plasticity clays and silts with varying amounts of sands and gravels, of a residual origin.

Soils tended to consist of high plasticity soils in the western explorations (13BH-001, -002, -003, -007, and -011), and low plasticity soils in the eastern explorations (13BH-004, -005, -006, -008, -009, and -010).

7.2 Groundwater

Groundwater was not encountered in any of the soil survey explorations.

8 PAVEMENTS

8.1 Existing Pavement Structures

The existing pavement condition of Route 612 is fair within the project limits. A pavement joint was observed west of the intersection. The existing shoulders of both Route 612 and Route 792 are in poor condition primarily due to drainage. Full depth cracking was noted in the pavement core for 13BH-009, approximately 200 feet north of the Route 612/792 intersection. Additional surface cracking was observed, along with some pavement patching on Route 792. Surface cracks were also observed at the Route 612/792 intersection.

Upon researching this project site in the Pavement Management System (PMS) database, only an S-5 layer was shown in the database, without a thickness. Table 1 presents the pavement sections encountered during the investigation conducted in October 2013.

Table 1 – Existing Pavement Sections

Boring Number	Approximate Asphalt Thickness (in.)	Approximate Aggregate Thickness (in)
13BH-001	11	8
13BH-002	11	8
13BH-003	7	6
13BH-004	7	6
13BH-005	9	9
13BH-006	8.5	9
13BH-007	5.5	9
13BH-009	4.5	5
13BH-010	4	6

Photographs of the pavement cores are presented in Appendix D.

8.2 CBR Test Results and Subgrade Preparation

Four (4) CBR tests were conducted on bulk samples along the project alignment and Table 2 summarizes the test results.

Table 2 – Summary of California Bearing Ratio Tests

Boring Number	USCS Designation	LL/PI (%)	Optimum Moisture Content (%)	Maximum Dry Density (pcf)	CBR Value
13BH-002	CH	66/37	19.3	104.6	3.0
13BH-005	CL	40/16	17.4	107.0	2.5
13BH-007	CH	57/32	19.3	105.0	1.8
13BH-010	CL	37/20	16.9	112.1	5.1

8.3 Traffic Analysis Summary

Traffic data used for preliminary design is provided below. This information is based on information provided by the Project Manager.

Route 612, West of 792

Year	ADT	% Trucks
2012	6,737	2
2026	8,017	2

Route 612, East of 792

Year	ADT	% Trucks
2012	4,874	2
2026	5,800	2

Route 792

Year	ADT	% Trucks
2012	1,694	2
2026	2,016	2

8.4 Pavement Recommendations

The following recommended pavement designs are based on the 1993 AASHTO Pavement Design (AASHTO 1993) and the Virginia Department of Transportation Materials Division Manual of Instructions, Chapter 6 (VDOT 2011).

Table 3 – Pavement Design Data

Roadway Section	612 West of 792	612 East of 792	792
Highway Classification	High Volume Secondary Route	High Volume Secondary Route	High Volume Secondary Route
Design Years	20	20	20
ADT 2015	7,045	5,097	1,771
Growth Rate	1.25%	1.25%	1.25%
Estimated Average Resilient Modulus	11,000 psi		

Staunton Materials recommends salvaging the existing Route 612 pavement to the extent possible – regarding that no profile or cross-sections were available at the time of this report. Route 792, due to the extent of full depth cracking should be fully replaced.

New Pavement – Route 612

Material	Rate/Thickness
Asphalt Concrete Type SM-9.5A	165 lbs/yd^2
Asphalt Concrete Type BM-25.0A	3.0”
Aggregate Base Material, Type I, No. 21B	8.0”
Subgrade Separation Geotextile	

New Pavement – Route 792

Material	Rate/Thickness
Asphalt Concrete Type SM-9.5A	165 lbs/yd^2
Asphalt Concrete Type BM-25.0A	2.5”
Aggregate Base Material, Type I, No. 21B	6.0”
Subgrade Separation Geotextile	

Overlay – Route 612

Material	Rate/Thickness
Mill	1.5”
Asphalt Concrete Type SM-9.5A	165 lbs/yd^2

Combination CD-2 drains should be installed at all vertical sags of the project, located at approximately STA 305+50 (Route 792) and STA 109+75 (Route 612). The aggregate material layer above should be extended to daylight in all fill sections.

Pavement should be sawcut full depth at all tie-ins to existing VA Route 612 and 792. Sawcut depth estimates are provided in Table 1 as the “Approximate Asphalt Thickness”.

Additionally, please add the following note to the General Notes sheet in the plans:

Under Pavement:

> NOTE: Tie-in to existing pavements along mainline and connectors shall be milled to a depth matching the new surface asphalt course in accordance with Road and Bridge Standard ACOT-2. Widening shall conform to Road and Bridge Standard WP-2. Sawcut is expected to be approximately 10 inches in total depth along SR 612 mainline and approximately 5 inches in total depth along the SR 792 mainline.

Design calculations are provided in Appendix E.

9 GEOTECHNICAL RECOMMENDATIONS

9.1 Earthwork

Please add the following note to the plans:

> G-6: All regular excavation, borrow excavation and embankment material used to construct embankments for this project shall meet a minimum CBR value of 5 as determined by VTM-8, shall not include USCS CH or MH soils unless stabilized with lime (per VTM-11) or cement (per VTM-72), shall be in accordance with Section 303.04(h) of the 2007 Road and Bridge Specifications or as approved by the District Materials Engineer.
>
> Project soils are not expected to meet the above requirements.

Due to the presence of businesses and residences in the general area of construction, please add the Special Provision for Controlled Blasting to the contract. Special Provisions are included in Appendix F.

Additionally, please add the following note to the General Notes sheet in the plans:

> NOTE: In the event it becomes necessary to use blasting techniques to loosen, break and/or excavate bedrock, the Special Provision for Controlled Blasting shall apply.

Please add the Special Provision for Soil and Aggregate Density Requirements (October 09, 2012) to the contract. Special Provisions are included in Appendix F.

9.2 Slope Design

Materials recommends cut and fill slopes no steeper than 2:1 (H:V) throughout the project.

9.3 Unsuitable Materials

For the purposes of computing the estimated quantities of topsoil and rootmat materials requiring excavation, assume the average depth of topsoil removal from grass-covered areas to be eight (8) inches.

High plasticity soils were encountered in the southern and western portions of the site (13BH-001, -002, -003, -007, and -011). Also, the low plasticity soils have a CBR less than 5. Therefore, all of the soils on the site are not considered acceptable for use as embankment material.

9.4 Retaining Structures

No specific locations for retaining structures were provided at the time of this investigation.

9.5 Stormwater Management Basins

Stormwater management is expected to be handled off site, so, no explorations or analyses were done for any stormwater management basins.

9.6 Pipe and Culvert Foundations

No specific locations for pipes or culverts were provided at the time of this investigation.

10 PROJECT SCHEDULE

Please show this Materials activity (MT34F – Final Soil Survey and MT45 – Minor Structure Report) complete in iPM as of the date of this report.

11 LIMITATIONS

The boring logs included in this report depict the subsurface soil, ground water, rock and existing pavement conditions at the specific locations where the borings were performed. These conditions may vary at other locations beyond, or between, these specific locations. Accordingly, the Department does not warrant or guarantee that the information provided on the logs, or in this report, can be projected as indicative of conditions beyond the limits of the borings, and any such projection is purely interpretive. In addition, the ground water levels recorded on the boring logs indicate the ground water conditions that existed at the time of the investigation. Ground water levels may vary considerably, with time, according to prevailing climate, rainfall, surface run-off, evaporation, construction and other factors.

The boring logs are made available to bidders in order that they may have access to subsurface data identical to that which is possessed by the Department, and are not intended as a substitute for personal investigation, interpretation and judgment by others.

The pavement sections and discussion of geotechnical considerations as presented in this report are based on the information revealed by our exploration. We attempted to provide for normal contingencies, but the possibility remains that unexpected conditions may be encountered during subsequent site explorations and construction.

We have endeavored to complete the services identified herein in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality and under similar conditions as this project.

12 REFERENCES

AASHTO, 1993, AASHTO Guide for Design of Pavement Structures.

Hubbard, D, 1983, Selected Karst Features of the Northern Valley and Ridge Province, Virginia, Virginia Department of Mines, Minerals and Energy Publication 44, 1 sheet, 1:250,000.

Gathright, T. M., II, Henika, W. S., and Sullivan, J. L., III, 1978, Geology of the Fort Defiance Quadrangle , Virginia, Commonwealth of Virginia Department of Mines, Minerals and Energy, Division of Mineral Resources, Publication 12.

USFWS, 2013, US Fish and Wildlife Service, Wetlands Mapper: http://www.fws.gov/wetlands/Wetlands-Mapper.html (December 2013).

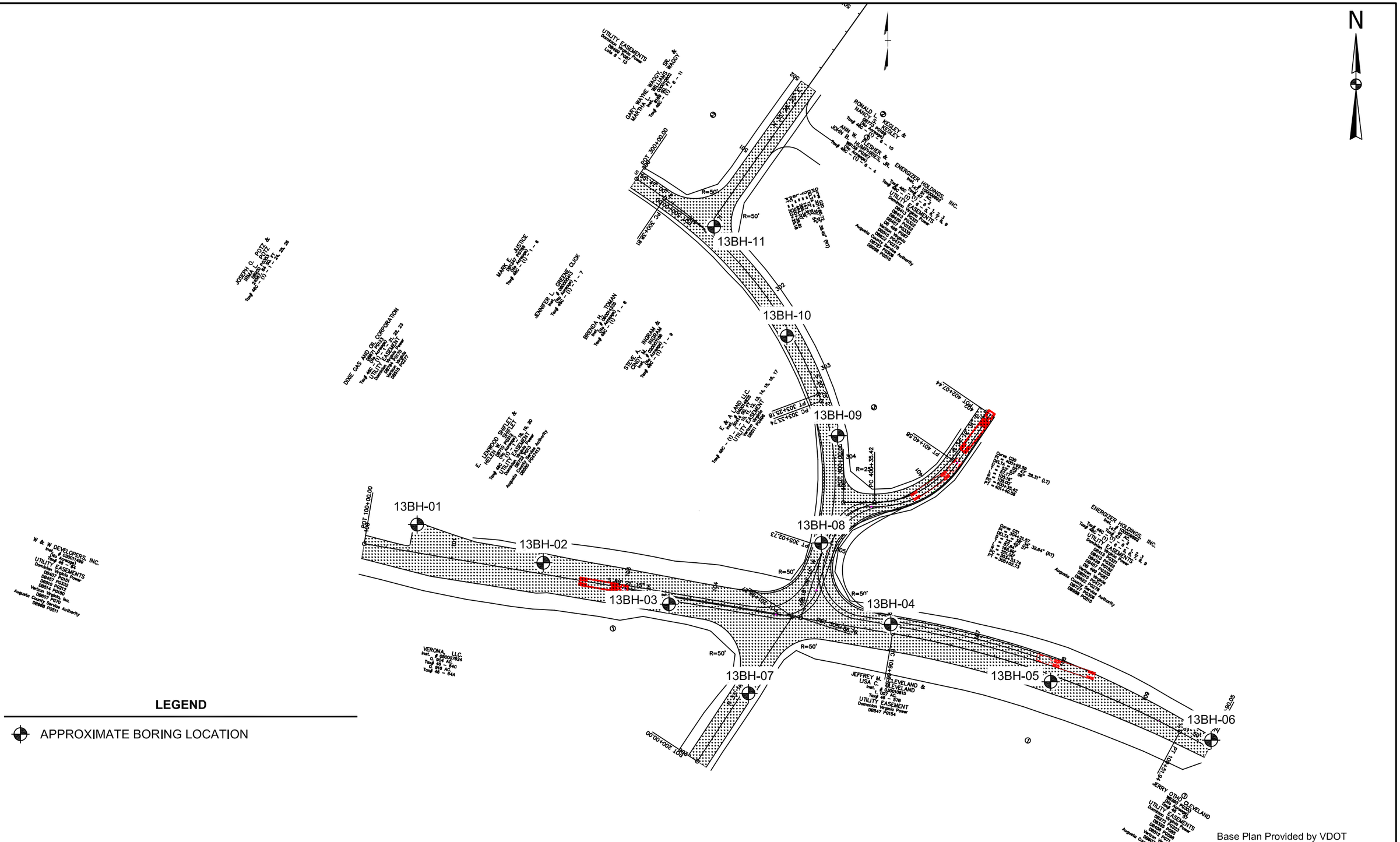
VDOT, 2011, Virginia Department of Transportation Materials Division Manual of Instructions, Section 6 – Fundamental Concepts of Pavement Design and Evaluation (Revised July, 2011).

If you have any questions regarding this memorandum, please feel free to contact me.

Prepared by:	*For:*
Jonathan Brown, P.E. Geotechnical Engineer	Chaz Weaver, P.E., MEM District Materials Engineer

Attachments:

Appendix A: Boring Layout



Schnabel ENGINEERING	RT 612 INTERSECTION IMPROVEMENTS AT RT 792 (UPC 84645, VDOT # 0612-007-773) AUGUSTA COUNTY, VIRGINIA	Figure Name: BORING LOCATION PLAN	Done: J. SPENCER	Figure Number: 1
		Project Number: 11610055.00	Reviewed: C. YEATTS	Date: NOV 2013

Appendix B: Boring Logs

SUBSURFACE EXPLORATION PROCEDURES

Test Borings – Hollow Stem Augers (HSA)

The borings are advanced by turning a continuous flight auger with a center opening of 2¼ or 3¼ inches. A plug device blocks off the center opening while augers are advanced. Cuttings are brought to the surface by the auger flights. Sampling is performed through the center opening in the hollow stem auger, by standard methods, after removal of the plug. Usually, no water is introduced into the boring using this procedure.

Standard Penetration Test Results

The numbers in the Sampling Data column of the boring logs represent Standard Penetration Test (SPT) results. Each number represents the blows needed to drive a 2-inch O.D., 1⅜-inch I.D. split-spoon sampler 6 inches, using a 140-pound hammer falling 30 inches. The sampler is typically driven a total of 18 or 24 inches. The first 6 inches are considered a seating interval. The total of the number of blows for the second and third 6-inch intervals is the SPT "N-value." The SPT is conducted according to ASTM D1586.

Many correlations with SPT N-values are used in the development of our geotechnical engineering recommendations. These correlations are usually based on SPT N-values obtained using a Safety Hammer. The SPTs for this project were performed using an Automatic Trip Hammer (ATH) rather than the Safety Hammer. The energy applied to the split-spoon sampler using the ATH is about 30 percent greater than that applied using the Safety Hammer. The hammer blows shown on the boring logs are uncorrected for the higher energy.

Soil Classification Criteria

The group symbols on the logs represent the Unified Soil Classification System Group Symbols (ASTM D2487) based on visual observation and limited laboratory testing of the samples. Criteria for visual identification of soil samples are included in this appendix. Some variation can be expected between samples visually classified and samples classified in the laboratory.

Residual soils are derived through the in-place physical and chemical weathering of the underlying rock. Intermediate geomaterials (IGM) describe residual material as it transitions between soil and rock, and vice-versa. VDOT classifies IGM as residual material with SPT N-values greater than 50 blows per 6 inches of penetration (*VDOT MOI Chapter III*, May 2012). For the purposes of classification, we have described rock as material encountering auger or SPT refusal. SPT refusal is defined as SPT N-values greater than 50 blows per 1 inch of penetration

Boring Locations and Elevations

Borings were located by Schnabel personnel approximately at the locations shown in the RFP utilizing a hand-held GPS unit. Boring locations are shown on Figure 1. Ground surface elevations at the boring locations were also obtained using the GPS unit, and are indicated on the logs. Locations and elevations should be considered no more accurate than the methods used to determine them.

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FIELD SOIL DESCRIPTIONS
VDOT MATERIALS BORING LOGS
(USCS, approx.)

DESCRIPTION FORMAT:
Color, primary grain size adjective, secondary component, PRIMARY COMPONENT, "with..." or "trace..." , "contains..." , relative density, moisture, expanded terms.

COLOR:
Keep it simple; first impressions are best. Don't use "ish" in your colors.

- *Mottled*, indicates splotches of various colors.
- *Variegated,* indicates thin layers of various colors.

SAND AND GRAVEL GRAIN SIZE ADJECTIVES

SIZE:	3"	¾"	¼"	No.10	No.40	No. 200	
SIZE DESCRIPTION:	GRAVEL		SAND			SILT TO CLAY	
RANGE:	**coarse**	**fine**	**coarse**	**medium**	**fine**		

- ***Cobbles*** are +3 inches to 12 inches.
- ***Boulders*** are +12 inches.

SECONDARY AND PRIMARY COMPONENTS

Primary Component (more than half the soil) is written in ALL CAPITAL LETTERS

Primary Component: SAND or GRAVEL		**Primary Component: SILT or CLAY**			
>12% fines	'**silty**' or '**clayey**' will be the secondary component	≥ 30% (one third) sand/gravel	more sand than gravel, '**sandy**' will be the secondary component	≥15% gravel	add 'with gravel'
				<15% gravel	add 'trace gravel'
5% to 12%	add '**with silt**' or '**with clay**' to description		more gravel than sand, '**gravelly**' will be the secondary component	≥15% sand	add 'with sand'
				<15% sand	add 'trace sand'
< 5% fines	add '**trace silt**' or '**trace clay**' to description	< 30% sand/gravel	15 % to 29% sand/gravel	'**with sand**' or '**with gravel**'	
			< 15% sand/gravel	'**trace sand**' or '**trace gravel**'	

NOTE: If a soil is predominately of one grain size, with traces of another size, it can be described as such. Example: Gray fat CLAY, trace fine sand (notice that there is no "y"-ending secondary component).

PLASTICITY OF CLAYS AND SILTS

- A **fat** *clay* can be consistently palm-rolled (and rerolled without additional wetting) to less than 1/16" to 1/32"diameter .
- A **lean** *clay* can be palm-rolled with ease (and partially rerolled without additional wetting) to less than 1/8" diameter.
- An **elastic** *silt* can be palm-rolled with ease (and partially rerolled without additional wetting) to less than 1/8" diameter.

GRAVEL/FRAGMENT DESCRIPTION:

Shape	**Description**
No sharp corners, no straight lines	Rounded
A few blunted corners with very few straight lines	Sub-rounded
A few sharp corners with some straight lines	Sub-angular
Many sharp corners with many straight lines	Angular

NOTE:
Fragments refers to broken pieces of rock from the parent source of the soil; fragments have the same mineralogy as the surrounding soil.

Gravel refers to gravel-sized pieces that were combined into the soil (such as sediments); the soil and gravel may not be from the same source.

CONTAINS: Unusual odors, organics, type/condition of organics (roots, branches, leaves, grass/decomposed, fresh, etc.), contamination by other items (construction material, concrete, asphalt pavement debris, wire, brick, etc.). For **mica content**, eliminate the word 'contains' and use one of the following: ***slightly micaceous*** (few shiny flakes), ***micaceous*** (common throughout soil), or ***highly micaceous*** (soil is almost all mica).

RELATIVE DENSITY **Primary Component**

SAND and **GRAVEL**

SPT(bpf)	**Density Description**
0 – 3	Very loose
4 – 9	Loose
10 – 29	Medium dense
30 – 50	Dense
> 50	Very dense

SILT and **CLAY**

SPT(bpf)	**Density Description**
0 – 1	Very soft
2 – 4	Soft
5 – 8	Firm
9 – 15	Stiff
16 – 30	Very stiff
31 – 50	Hard
> 50	Very hard

For samples which display ***Rock Structure and Parent Rock Mineralogy***, the material is described as a soil and followed by a reference to the parent rock type. The parent rock description follows the soil description (in parentheses).

SPT (bpf)	**Appearance of Soil**	**Density Description**
20 – 100	Relic rock structure/mineralogy present but can be molded or crumbled by hand; generally easy to penetrate with hollow stem augers; none to moderate grinding by augers.	(Decomposed [rock])
+100	Rock mass discolored; alteration of nearly all of the rock mineralogy. May contain pockets of slightly weathered rock; some minerals leached away. Difficult to penetrate with hollow stem augers; moderate to significant grinding by augers.	(Highly Weathered [rock])

EXAMPLE: Dark Grey f-c silty SAND, with fine angular rock fragments, micaceous and contains schistosity in all samples, very dense, dry (decomposed SCHIST)

MOISTURE:

Characteristic	**Description**
Dusty, dry to touch	Dry
Moisture can be felt, but none visible on sample	Moist
Moisture visible	Wet

EXPANDED TERMS:
The presence of FILL (can be "FILL" or "possible FILL") or unusual conditions in that layer which should be recorded on the log.

WOR – Weight of rods
WOH – Weight of hammer

EXAMPLE:
Red brown f-c clayey SAND, with fine rounded gravel, slightly micaceous , medium dense, moist , FILL

FIELD ROCK CORE DESCRIPTION
VDOT MATERIALS BORING LOGS

DESCRIPTION FORMAT

Weathering, hardness, thickness of bedding/foliation (if used), spacing of fractures/joints, color, ROCK TYPE, inclusions (minor rock types or minerals), other features

Note: the description should appear in narrative sentence structure with commas between the various section descriptions.

WEATHERING

Descriptor Characteristic	
Unweathered	No evidence of any chemical or mechanical alteration.
Slightly Weathered	Slight discoloration on surface, slight alteration along discontinuities, less than 10% of the rock volume altered.
Moderately Weathered	Discoloring evident, surface pitted and altered with alteration penetrating well below rock surfaces, weathering "halos" evident. 10% to 50% of the rock altered.
Highly Weathered	Entire mass discolored, alteration pervading nearly all of the rock, with some pockets of slightly weathered rock noticeable, some minerals leached away.
Decomposed	Rock reduced to a soil with relic rock structure (saprolite), generally can be molded and crumbled by hand.

HARDNESS[1,2]

Descriptor Characteristic		
Very Hard	Cannot be scratched with knife.	Hard
	Can be scratched with knife only with difficulty.	
Moderately Hard	Can be scratched with knife with relative ease.	
Soft	Can be scratched with a fingernail.	
Very Soft	Can be deformed by hand.	

[1]Engineering Description of Rock—NOT Moh's hardness scale
[2]Friabiltiy of rock should be noted; rock may not be decomposed but friable enough to represent an engineering hazard (such as piping or slaking).

THICKNESS of BEDDING or FOLIATION

Descriptor Characteristic	
Massive	Greater than 3.0 ft. thick.
Thick	Greater than 1.0 ft. up to 3.0 ft. thick.
Medium	Greater than 0.3 ft. up to 1.0 ft. thick.
Thin	0.3 ft. thick or less.

DEGREE OF FRACTURING and/or JOINTING[3]

Descriptor Characteristic	
Very Wide	Spacing of 5.0 ft. or greater.
Slight	Spacing from 2.0 ft. to less than 5.0 ft.
Moderate	Spacing from 0.7 ft. to less than 2.0 ft.
High	Spacing from 0.2 ft to less than 0.7 ft.
Intense	Spacing less than 0.2 ft.

[3] Parenthetical notation of the angle of the fractures/joints, relative to horizontal, should be made along with the spacing.

INCLUSIONS

Only the primary rock type should be shown in all capital letters. Ancillary or subordinate rock types and significant mineral inclusions should be shown in lower case except the first letter. Descriptive terms for subordinate rock types only need to be included where they differ substantially from those of the primary rock type.

OTHER FEATURES

Any descriptive terminology that will give the reader a more complete image of the rock core or note the presence of significant (geological, environmental, structural, etc.) issues encountered in the coring process or in the rock core specimen. Examples include: voids, slickensides, significant changes in the rate of coring, loss of circulation during coring, presence of contamination (petroleum or otherwise), presence of clay seams, etc.

ROCK QUALITY DESIGNATION (RQD)

$$\text{RQD (\%)} = \frac{\text{Total length of Columnar Pieces 4 in. and Longer}^{4}}{\text{Length of Attempted Core Run}} \times 100$$

RECOVERY

$$\text{REC. (\%)} = \frac{\text{Length of Rock Core Obtained}}{\text{Length of Attempted Core Run}} \times 100$$

[4]Breaks caused by drilling action or mishandling of the core should be disregarded. Unsound (i.e. "decomposed") pieces of rock should not be counted. Columnar pieces with (near) vertical partings are permissible for inclusion in the total length.

Virginia Department of Transportation

PROJECT #: 0612-007-773, UPC 84645
LOCATION: Verona, Augusta County, Virginia
STRUCTURE: RT. 612 INT. IMPROV. AT RT. 792

13BH-001

STATION: 100+55 OFFSET: 31L
LATITUDE: 38.191324° N LONGITUDE: 78.992222° W
SURFACE ELEVATION: 1,258.4 ft COORD. DATUM: NAD 83

FIELD DATA

Date(s) Drilled: 10/9/13 - 10/9/13
Drilling Method(s): 2.25 HSA
SPT Method: Automatic Hammer
Other Test(s):
Driller: R. Rice, Simon & Associates,
Logger: L. Joyce, Schnabel Engineering

GROUND WATER
NOT ENCOUNTERED DURING DRILLING
NO LONG TERM MEASUREMENTS TAKEN

LAB DATA

DEPTH (ft)	ELEVATION (ft)	SOIL: STANDARD PENETRATION TEST HAMMER BLOWS	SOIL: SOIL RECOVERY (%)	SAMPLE LEGEND	SAMPLE INTERVAL	ROCK: CORE RECOVERY (%)	ROCK: ROCK QUALITY DESIGNATION	ROCK: DIP ° STRATA	ROCK: DIP ° JOINTS	STRATA LEGEND	FIELD DESCRIPTION OF STRATA	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MOISTURE CONTENT (%)
0.5	1258										0.0 / 1,258.4 Asphalt Pavement (11 inches) **ASPH**			
1.0		10			1						0.9 / 1,257.5 Crushed Aggregate **CRA**			
1.5		5												
2.0		2	55											9.9
2.5	1256										1.6 / 1,256.8 *Fill,* Light brown and gray, SANDY LEAN CLAY FILL, contains rock fragments, stiff, moist **CL**			
3.0		2			3									
3.5		2												
4.0		3	100								3.0 / 1,255.4 *Residuum,* Orange-brown and gray, ELASTIC SILT, contains weathered rock fragments, firm, moist **MH**			27.9
4.5	1254	6												
5.0					5									

Boring Terminated at 5.0 ft.

REMARKS: Rig Type: Simco 2800.
Boring backfilled upon completion with grout and cold patch asphalt.

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PROJECT #: 0612-007-773, UPC 84645
LOCATION: Verona, Augusta County, Virginia
STRUCTURE: RT. 612 INT. IMPROV. AT RT. 792

13BH-002

STATION: 102+04 OFFSET: 13L
LATITUDE: 38.191207° N LONGITUDE: 78.991725° W
SURFACE ELEVATION: 1,257.5 ft COORD. DATUM: NAD 83

Date(s) Drilled: 10/9/13 - 10/9/13
Drilling Method(s): 2.25 HSA
SPT Method: Automatic Hammer
Other Test(s):
Driller: R. Rice, Simon & Associates,
Logger: L. Joyce, Schnabel Engineering

GROUND WATER
NOT ENCOUNTERED DURING DRILLING
NO LONG TERM MEASUREMENTS TAKEN

FIELD DATA / LAB DATA

DEPTH (ft)	ELEVATION (ft)	SOIL: STANDARD PENETRATION TEST HAMMER BLOWS	SOIL: SOIL RECOVERY (%)	SAMPLE LEGEND	SAMPLE INTERVAL	ROCK: CORE RECOVERY (%)	ROCK: ROCK QUALITY DESIGNATION	ROCK: DIP ° STRATA	ROCK: DIP ° JOINTS	STRATA LEGEND	FIELD DESCRIPTION OF STRATA	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MOISTURE CONTENT (%)
0.5											0.0 / 1,257.5 Asphalt Pavement (11 inches) **ASPH**			
1.0					1									
1.5	1256	8 3			1.6						0.9 / 1,256.6 Crushed Aggregate **CRA**			
2.0			63											34.6
2.5		1									1.6 / 1,255.9 *Residuum,* Gray and orange-brown, FAT CLAY WITH SAND, contains weathered rock fragments, firm, moist **CH**			
3.0		3			3									
3.5	1254	2 2												
4.0			90											28.1
4.5		4												
5.0		6			5									

Boring Terminated at 5.0 ft.

REMARKS: Rig Type: Simco 2800.
Boring backfilled upon completion with grout and cold patch asphalt.

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PROJECT #: 0612-007-773, UPC 84645
LOCATION: Verona, Augusta County, Virginia
STRUCTURE: RT. 612 INT. IMPROV. AT RT. 792

13BH-003
PAGE 1 OF 1

STATION: 103+52 OFFSET: 10R
LATITUDE: 38.191080° N LONGITUDE: 78.991229° W
SURFACE ELEVATION: 1,257.0 ft COORD. DATUM: NAD 83

Date(s) Drilled: 10/9/13 - 10/9/13
Drilling Method(s): 2.25 HSA
SPT Method: Automatic Hammer
Other Test(s):
Driller: R. Rice, Simon & Associates,
Logger: L. Joyce, Schnabel Engineering

GROUND WATER
NOT ENCOUNTERED DURING DRILLING
NO LONG TERM MEASUREMENTS TAKEN

FIELD DATA / **LAB DATA**

DEPTH (ft)	ELEVATION (ft)	SOIL: STANDARD PENETRATION TEST HAMMER BLOWS	SOIL: SOIL RECOVERY (%)	SAMPLE LEGEND	SAMPLE INTERVAL	ROCK: CORE RECOVERY (%)	ROCK: ROCK QUALITY DESIGNATION	ROCK: DIP ° STRATA	ROCK: DIP ° JOINTS	STRATA LEGEND	FIELD DESCRIPTION OF STRATA	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MOISTURE CONTENT (%)	FINES CONTENT -#200 (%)
0.5											0.0 / 1,257.0 Asphalt Pavement (7 inches) **ASPH**				
1.0	1256	9			1						0.6 / 1,256.4 Crushed Aggregate **CRA**				
1.5															
2.0		2	35									87	57	34.0	99.3
2.5		3									1.1 / 1,255.9 *Fill,* Orange-brown, FAT CLAY FILL, trace fine to coarse sand, firm, moist **CH**				
3.0	1254	4			3										
3.5		1													
4.0		2	70								3.0 / 1,254.0 *Fill,* Orange-brown and gray, FAT CLAY FILL, contains rock fragments, firm, moist **CH**			35.8	
4.5		2													
5.0	1252	4			5										

Boring Terminated at 5.0 ft.

REMARKS: Rig Type: Simco 2800.
Boring backfilled upon completion with grout and cold patch asphalt.

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13BH-003

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PROJECT #: 0612-007-773, UPC 84645
LOCATION: Verona, Augusta County, Virginia
STRUCTURE: RT. 612 INT. IMPROV. AT RT. 792

13BH-004

STATION: 106+03 OFFSET: 10L
LATITUDE: 38.191021° N LONGITUDE: 78.990355° W
SURFACE ELEVATION: 1,253.4 ft COORD. DATUM: NAD 83

FIELD DATA

Date(s) Drilled: 10/9/13 - 10/9/13
Drilling Method(s): 2.25 HSA
SPT Method: Automatic Hammer
Other Test(s):
Driller: R. Rice, Simon & Associates,
Logger: L. Joyce, Schnabel Engineering

GROUND WATER
NOT ENCOUNTERED DURING DRILLING
NO LONG TERM MEASUREMENTS TAKEN

LAB DATA

DEPTH (ft)	ELEVATION (ft)	SOIL: STANDARD PENETRATION TEST HAMMER BLOWS	SOIL: SOIL RECOVERY (%)	SAMPLE LEGEND	SAMPLE INTERVAL	ROCK: CORE RECOVERY (%)	ROCK: ROCK QUALITY DESIGNATION	ROCK: DIP ° STRATA	ROCK: DIP ° JOINTS	STRATA LEGEND	FIELD DESCRIPTION OF STRATA	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MOISTURE CONTENT (%)	FINES CONTENT -#200 (%)
0.5											0.0 / 1,253.4 Asphalt Pavement (7 inches) **ASPH**				
1.0					1										
1.5	1252	3									0.6 / 1,252.8 Crushed Aggregate **CRA**				
2.0		3	60									63	28	36.2	71.0
2.5		4									1.1 / 1,252.3 *Residuum,* Orange-brown, ELASTIC SILT WITH GRAVEL, stiff, moist **MH**				
3.0		7			3										
3.5	1250	3													
4.0		4	100											34.0	
4.5		7													
5.0		11			5										

Boring Terminated at 5.0 ft.

REMARKS: Rig Type: Simco 2800.
Boring backfilled upon completion with grout and cold patch asphalt.

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PROJECT #: 0612-007-773, UPC 84645
LOCATION: Verona, Augusta County, Virginia
STRUCTURE: RT. 612 INT. IMPROV. AT RT. 792

13BH-005

STATION: 107+95 OFFSET: 7R
LATITUDE: 38.190845° N LONGITUDE: 78.989724° W
SURFACE ELEVATION: 1,246.1 ft COORD. DATUM: NAD 83

FIELD DATA

Date(s) Drilled: 10/9/13 - 10/9/13
Drilling Method(s): 2.25 HSA
SPT Method: Automatic Hammer
Other Test(s):
Driller: R. Rice, Simon & Associates,
Logger: L. Joyce, Schnabel Engineering

GROUND WATER
NOT ENCOUNTERED DURING DRILLING
NO LONG TERM MEASUREMENTS TAKEN

LAB DATA

DEPTH (ft)	ELEVATION (ft)	SOIL: STANDARD PENETRATION TEST HAMMER BLOWS	SOIL: SOIL RECOVERY (%)	SAMPLE LEGEND	SAMPLE INTERVAL	ROCK: CORE RECOVERY (%)	ROCK: ROCK QUALITY DESIGNATION	ROCK: DIP ° STRATA	ROCK: DIP ° JOINTS	STRATA LEGEND	FIELD DESCRIPTION OF STRATA	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MOISTURE CONTENT (%)
0.5											0.0 / 1,246.1 Asphalt Pavement (9 inches) **ASPH**			
1.0		13			1									
1.5		5			1.5						0.75 / 1,245.35 Crushed Aggregate **CRA**			
2.0	1244	5	88											31.7
2.5		11									1.5 / 1,244.6 *Residuum,* Light brown, LEAN CLAY, contains weathered rock fragments, stiff, moist **CL**			
3.0		11			3									
3.5		9												
4.0	1242	9	100								3.0 / 1,243.1 *Residuum,* Light brown, LEAN CLAY, contains weathered rock fragments, very stiff, moist **CL**			28.6
4.5		15												
5.0					5									

Boring Terminated at 5.0 ft.

REMARKS: Rig Type: Simco 2800.
Boring backfilled upon completion with grout and cold patch asphalt.

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PROJECT #: 0612-007-773, UPC 84645
LOCATION: Verona, Augusta County, Virginia
STRUCTURE: RT. 612 INT. IMPROV. AT RT. 792

13BH-006
PAGE 1 OF 1

STATION: 109+88 OFFSET: 9L
LATITUDE: 38.190667° N LONGITUDE: 78.989090° W
SURFACE ELEVATION: 1,237.4 ft COORD. DATUM: NAD 83

FIELD DATA

Date(s) Drilled: 10/9/13 - 10/9/13
Drilling Method(s): 2.25 HSA
SPT Method: Automatic Hammer
Other Test(s):
Driller: R. Rice, Simon & Associates,
Logger: L. Joyce, Schnabel Engineering

GROUND WATER
NOT ENCOUNTERED DURING DRILLING
NO LONG TERM MEASUREMENTS TAKEN

LAB DATA

DEPTH (ft)	ELEVATION (ft)	SOIL: STANDARD PENETRATION TEST HAMMER BLOWS	SOIL: SOIL RECOVERY (%)	SAMPLE LEGEND	SAMPLE INTERVAL	ROCK: CORE RECOVERY (%)	ROCK: ROCK QUALITY DESIGNATION	ROCK: DIP ° STRATA	ROCK: DIP ° JOINTS	STRATA LEGEND	FIELD DESCRIPTION OF STRATA	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MOISTURE CONTENT (%)	FINES CONTENT -#200 (%)
0.5											0.0 / 1,237.4 Asphalt Pavement (8.5 inches) **ASPH**				
1.0					1										
1.5	1236	7									0.73 / 1,236.68 Crushed Aggregate **CRA**				
2.0		4	60									44	24	22.6	68.2
2.5		1									1.5 / 1,235.9 *Fill,* Brown, SANDY LEAN CLAY FILL, contains rock fragments, firm, moist **CL**				
3.0		1			3										
3.5	1234	11													
4.0		11	100								3.5 / 1,233.9 *Residuum,* Gray-brown, LEAN CLAY, contains weathered rock fragments, hard, moist **CL**			17.7	
4.5		27													
5.0		31			5										

Boring Terminated at 5.0 ft.

REMARKS: Rig Type: Simco 2800.
Boring backfilled upon completion with grout and cold patch asphalt.

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PROJECT #: 0612-007-773, UPC 84645
LOCATION: Verona, Augusta County, Virginia
STRUCTURE: RT. 612 INT. IMPROV. AT RT. 792

13BH-007

STATION: 200+96 OFFSET: 6R
LATITUDE: 38.190805° N LONGITUDE: 78.990914° W
SURFACE ELEVATION: 1,255.7 ft COORD. DATUM: NAD 83

FIELD DATA

Date(s) Drilled: 10/9/13 - 10/9/13
Drilling Method(s): 2.25 HSA
SPT Method: Automatic Hammer
Other Test(s):
Driller: R. Rice, Simon & Associates,
Logger: L. Joyce, Schnabel Engineering

GROUND WATER
NOT ENCOUNTERED DURING DRILLING
NO LONG TERM MEASUREMENTS TAKEN

LAB DATA

DEPTH (ft)	ELEVATION (ft)	SOIL: STANDARD PENETRATION TEST HAMMER BLOWS	SOIL: SOIL RECOVERY (%)	SAMPLE LEGEND	SAMPLE INTERVAL	ROCK: CORE RECOVERY (%)	ROCK: ROCK QUALITY DESIGNATION	ROCK: DIP ° STRATA	ROCK: DIP ° JOINTS	STRATA LEGEND	FIELD DESCRIPTION OF STRATA	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MOISTURE CONTENT (%)
0.5											0.0 / 1,255.7 Asphalt Pavement (5.5 inches) **ASPH**			
1.0		1			1									
1.5	1254	3			1.2						0.45 / 1,255.25 Crushed Aggregate **CRA**			
2.0		3	75											28.7
2.5											1.2 / 1,254.5 *Fill,* Orange-brown, FAT CLAY FILL, contains rock fragments, firm, moist **CH**			
3.0		5			3									
3.5		11												
4.0	1252	3	85								2.6 / 1,253.1 *Residuum,* Orange-brown to gray, LEAN CLAY, contains weathered rock fragments, stiff, moist **CL**			28.7
4.5		4												
5.0		8			5									

Boring Terminated at 5.0 ft.

REMARKS: Rig Type: Simco 2800.
Boring backfilled upon completion with grout and cold patch asphalt.

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PROJECT #: 0612-007-773, UPC 84645
LOCATION: Verona, Augusta County, Virginia
STRUCTURE: RT. 612 INT. IMPROV. AT RT. 792

13BH-008
PAGE 1 OF 1

STATION: 304+98 OFFSET: 4R
LATITUDE: 38.191273° N LONGITUDE: 78.990630° W
SURFACE ELEVATION: 1,257.7 ft COORD. DATUM: NAD 83

FIELD DATA

Date(s) Drilled: 10/9/13 - 10/9/13
Drilling Method(s): 2.25 HSA
SPT Method: Automatic Hammer
Other Test(s):
Driller: R. Rice, Simon & Associates,
Logger: L. Joyce, Schnabel Engineering

GROUND WATER
NOT ENCOUNTERED DURING DRILLING
NO LONG TERM MEASUREMENTS TAKEN

LAB DATA

DEPTH (ft)	ELEVATION (ft)	SOIL: STANDARD PENETRATION TEST HAMMER BLOWS	SOIL: SOIL RECOVERY (%)	SAMPLE LEGEND	SAMPLE INTERVAL	ROCK: CORE RECOVERY (%)	ROCK: ROCK QUALITY DESIGNATION	ROCK: DIP ° STRATA	ROCK: DIP ° JOINTS	STRATA LEGEND	FIELD DESCRIPTION OF STRATA	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MOISTURE CONTENT (%)	FINES CONTENT -#200 (%)
0.5		8									0.0 / 1,257.7 Topsoil and Rootmat (1 inch) - Road Shoulder **TOPS**				
1.0		8										28	12	14.1	54.5
1.5	1256	5	90								0.1 / 1,257.6 *Fill,* Light brown, GRAVELLY LEAN CLAY WITH SAND FILL, very stiff, moist **CL**				
2.0		6			2										
2.5		5													
3.0		8	100								2.0 / 1,255.7 *Fill,* Orange-brown, LEAN CLAY FILL, contains weathered rock fragments, very stiff, moist **CL**			28.4	
3.5	1254	8													
4.0		10			4										
4.5		3													
5.0		4	100								SAME			29.6	
5.5	1252	8													
6.0		8			6										

Boring Terminated at 6.0 ft.

REMARKS: Rig Type: Simco 2800.
Boring backfilled upon completion with grout and auger cuttings near surface.

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PROJECT #: 0612-007-773, UPC 84645
LOCATION: Verona, Augusta County, Virginia
STRUCTURE: RT. 612 INT. IMPROV. AT RT. 792

13BH-009
PAGE 1 OF 1

STATION: 303+76 OFFSET: 8L
LATITUDE: 38.191607° N LONGITUDE: 78.990568° W
SURFACE ELEVATION: 1,258.8 ft COORD. DATUM: NAD 83

FIELD DATA

Date(s) Drilled: 10/9/13 - 10/9/13
Drilling Method(s): 2.25 HSA
SPT Method: Automatic Hammer
Other Test(s):
Driller: R. Rice, Simon & Associates,
Logger: L. Joyce, Schnabel Engineering

GROUND WATER
NOT ENCOUNTERED DURING DRILLING
NO LONG TERM MEASUREMENTS TAKEN

LAB DATA

DEPTH (ft)	ELEVATION (ft)	SOIL: STANDARD PENETRATION TEST HAMMER BLOWS	SOIL: SOIL RECOVERY (%)	SAMPLE LEGEND	SAMPLE INTERVAL	ROCK: CORE RECOVERY (%)	ROCK: ROCK QUALITY DESIGNATION	ROCK: DIP ° STRATA	ROCK: DIP ° JOINTS	STRATA LEGEND	FIELD DESCRIPTION OF STRATA	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MOISTURE CONTENT (%)
0.5											0.0 / 1,258.8 Asphalt Pavement (4.5 inches) **ASPH**			
1.0	1258	1			1						0.35 / 1,258.45 Crushed Aggregate **CRA**			
1.5		2												
2.0		3	85											19.5
2.5											0.8 / 1,258.0 *Alluvium,* Light brown and red, LEAN CLAY, trace gravel, stiff, moist **CL**			
3.0	1256	5			3									
3.5		3												
4.0		6	75								3.0 / 1,255.8 *Alluvium,* Orange-brown, LEAN CLAY, trace gravel, stiff, moist **CL**			28.1
4.5		5												
5.0	1254	5			5									

Boring Terminated at 5.0 ft.

REMARKS: Rig Type: Simco 2800.
Cracked pavement across road at boring location. Cored with crack at center of boring.
Boring backfilled upon completion with grout and cold patch asphalt.

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PROJECT #: 0612-007-773, UPC 84645
LOCATION: Verona, Augusta County, Virginia
STRUCTURE: RT. 612 INT. IMPROV. AT RT. 792

13BH-010

STATION: 302+50 OFFSET: 5R
LATITUDE: 38.191916° N LONGITUDE: 78.990699° W
SURFACE ELEVATION: 1,260.5 ft COORD. DATUM: NAD 83

FIELD DATA

Date(s) Drilled: 10/9/13 - 10/9/13
Drilling Method(s): 2.25 HSA
SPT Method: Automatic Hammer
Other Test(s):
Driller: R. Rice, Simon & Associates,
Logger: L. Joyce, Schnabel Engineering

GROUND WATER
NOT ENCOUNTERED DURING DRILLING
NO LONG TERM MEASUREMENTS TAKEN

LAB DATA

DEPTH (ft)	ELEVATION (ft)	SOIL: STANDARD PENETRATION TEST HAMMER BLOWS	SOIL: SOIL RECOVERY (%)	SAMPLE LEGEND	SAMPLE INTERVAL	ROCK: CORE RECOVERY (%)	ROCK: ROCK QUALITY DESIGNATION	ROCK: DIP ° STRATA	ROCK: DIP ° JOINTS	STRATA LEGEND	FIELD DESCRIPTION OF STRATA	LIQUID LIMIT (LL)	PLASTICITY INDEX (PI)	MOISTURE CONTENT (%)
0.5	1260				0.8						0.0 / 1,260.5 Asphalt Pavement (4 inches) **ASPH**			
1.0		1			1						0.3 / 1,260.2 Crushed Aggregate **CRA**			
1.5		2												
2.0		5	75											17.8
2.5	1258	7									0.8 / 1,259.7 *Alluvium,* Light brown, LEAN CLAY WITH GRAVEL, firm, moist **CL**			
3.0					3									
3.5		3												
4.0		6	85								SAME: Orange-brown, very stiff			23.5
4.5	1256	7												
5.0		8			5									

Boring Terminated at 5.0 ft.

REMARKS: Rig Type: Simco 2800.
Boring backfilled upon completion with grout and cold patch asphalt.

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PROJECT #: 0612-007-773, UPC 84645
LOCATION: Verona, Augusta County, Virginia
STRUCTURE: RT. 612 INT. IMPROV. AT RT. 792

13BH-011

STATION: 301+04 OFFSET: 9L
LATITUDE: 38.192255° N LONGITUDE: 78.991059° W
SURFACE ELEVATION: 1,261.2 ft COORD. DATUM: NAD 83

FIELD DATA

Date(s) Drilled: 10/9/13 - 10/9/13
Drilling Method(s): 2.25 HSA
SPT Method: Automatic Hammer
Other Test(s):
Driller: R. Rice, Simon & Associates,
Logger: L. Joyce, Schnabel Engineering

GROUND WATER
NOT ENCOUNTERED DURING DRILLING
NO LONG TERM MEASUREMENTS TAKEN

LAB DATA

DEPTH (ft)	ELEVATION (ft)	STANDARD PENETRATION TEST HAMMER BLOWS (SOIL)	SOIL RECOVERY (%)	SAMPLE INTERVAL	CORE RECOVERY (%) (ROCK)	ROCK QUALITY DESIGNATION	DIP ° STRATA	DIP ° JOINTS	FIELD DESCRIPTION OF STRATA	LIQUID LIMIT LL	PLASTICITY INDEX PI	MOISTURE CONTENT (%)	FINES CONTENT -#200 (%)
0.5		5							0.0 / 1,261.2 Topsoil and Rootmat (1 inch) Road Shoulder **TOPS**				
1.0	1260	7 7 4	85	2					0.1 / 1,261.1 *Fill,* Gray and brown, SILTY GRAVEL FILL, medium dense, moist **GM**	21	6	14.6	74.7
1.5													
2.0		4											
2.5		7											
3.0	1258	5 4	85	4					0.5 / 1,260.7 *Alluvium,* Light brown, SILTY CLAY WITH SAND, trace rounded gravel, contains roots, very stiff, moist **CL-ML**			31.6	
3.5													
4.0		2							4.0 / 1,257.2 *Alluvium,* Orange-brown and gray, FAT CLAY, trace rounded gravel, firm, moist **CH**				
4.5		2											
5.0	1256	3	100	6								35.1	
5.5													
6.0		5											

Boring Terminated at 6.0 ft.

REMARKS: Rig Type: Simco 2800.
Boring backfilled upon completion with grout and auger cuttings near surface.

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Appendix C: Lab Testing

Summary Of Laboratory Tests

Project Number: 13616055

Boring No.	Sample Depth ft / Elevation ft	Sample Type	Description of Soil Specimen	Liquid Limit	Plasticity Index	% Passing No. 200 Sieve	Percent Sand	Percent Gravel	Maximum Dry Density (pcf)	Optimum Moisture Content (%)	Proctor Test Method	CBR Value	CBR Surcharge Pressure (psf)	CBR Percent Swell
13BH-002	1.6 - 5.0 / 1256.4 - 1253.0	Bulk	Light brown, FAT CLAY WITH SAND, contains rock fragments (CH)	66	37	70.4	21.0	8.6	104.6	19.3	VTM1	3.0	50	3.0
13BH-005	1.5 - 5.0 / 1244.5 - 1241.0	Bulk	Brown, fine to coarse, SANDY LEAN CLAY, contains rock fragments (CL)	40	16	61.0	30.2	8.8	107.0	17.4	VTM1	2.5	50	3.2
13BH-007	1.2 - 5.0 / 1254.8 - 1251.0	Bulk	Light brown, FAT CLAY, few sand, contains rock fragments (CH)	57	32	85.8	11.2	3.0	105.0	19.3	VTM1	1.8	50	5.2
13BH-010	0.8 - 5.0 / 1259.2 - 1255.0	Bulk	Brown, LEAN CLAY WITH SAND, contains rock fragments (CL)	37	20	71.9	25.0	3.1	112.1	16.9	VTM1	5.1	50	0.4

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

Project: 0612-007-773, UPC 84645
Rt. 612 Intersection Improvement at Rt. 792
Verona, Augusta County, VA

DYNAMIC LAB SUMMARY 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 11/19/13

Summary Of Laboratory Tests

Project Number: 13616055

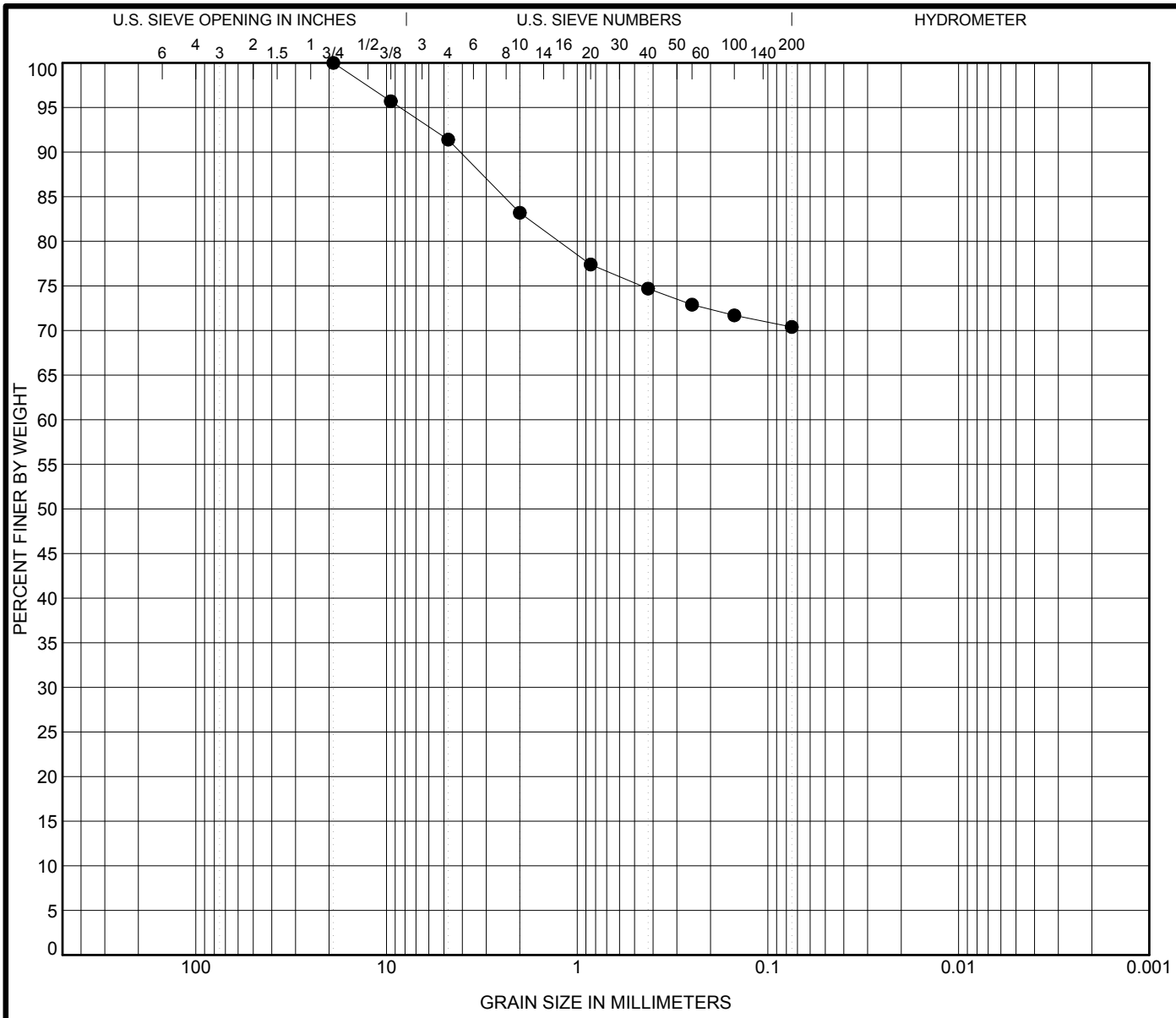
Boring No.	Sample Depth ft / Elevation ft	Sample Type	Description of Soil Specimen	Natural Moisture (%)	Liquid Limit	Plasticity Index	% Passing No. 200 Sieve	Percent Sand	Percent Gravel
13BH-003	1.0 - 3.0 / 1256.0 - 1254.0	Jar	Red brown, FAT CLAY, trace sand (CH)	34.0	87	57	99.3	0.7	0.0
13BH-004	1.0 - 3.0 / 1252.0 - 1250.0	Jar	Orange brown, ELASTIC SILT WITH GRAVEL, few sand (MH)	36.2	63	28	71.0	13.6	15.4
13BH-006	1.0 - 3.0 / 1236.0 - 1234.0	Jar	Brown, fine to coarse, SANDY LEAN CLAY, contains rock fragments (CL)	22.6	44	24	68.2	19.7	12.1
13BH-008	0.0 - 2.0 / 1258.0 - 1256.0	Jar	Brown, fine to coarse, GRAVELLY LEAN CLAY WITH SAND (CL)	14.1	28	12	54.5	20.9	24.6
13BH-011	0.0 - 2.0 / 1261.0 - 1259.0	Jar	Brown, SILTY CLAY WTH SAND, contains rock fragments (CL-ML)	14.6	21	6	74.7	21.8	3.5

Notes:
1. Soil tests in general accordance with ASTM standards.
2. Soil classifications are in general accordance with ASTM D2487(as applicable), based on testing indicated and visual classification.
3. Key to abbreviations: NP=Non-Plastic; -- indicates no test performed

Schnabel ENGINEERING

Project: 0612-007-773, UPC 84645
Rt. 612 Intersection Improvement at Rt. 792
Verona, Augusta County, VA

DYNAMIC LAB SUMMARY 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 11/19/13



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen		Sample Description	LL	PL	PI		
●	13BH-002	1.6 ft	**Light brown, FAT CLAY WITH SAND, contains rock fragments (CH)**	**66**	**29**	**37**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**19**				**8.6**	**21.0**	**70.4**	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4	3/8 in.	3/4 in.
% Finer	70.4	71.7	72.9	74.7	77.4	83.2	91.4	95.7	100.0

Tested By	Tested Date	Reviewed By	Calc By
MJF	10/30/13	TTM	DWC

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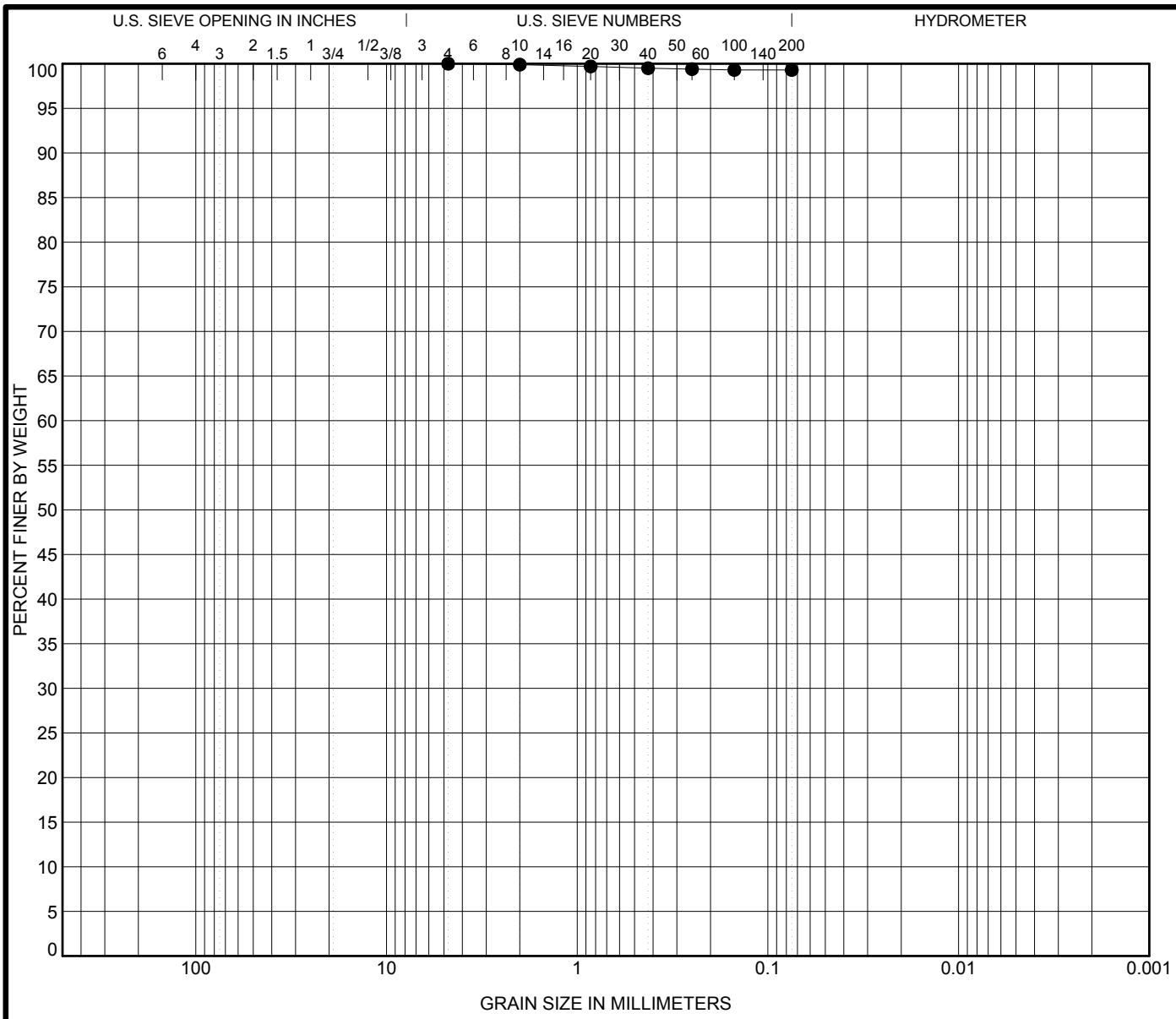
GRADATION CURVE

Project: 0612-007-773, UPC 84645
Rt. 612 Intersection Improvement at Rt. 792
Verona, Augusta County, VA

Contract: 13616055



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● 13BH-003	1.0 ft	**Red brown, FAT CLAY, trace sand (CH)**	**87**	**30**	**57**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**4.75**				**0.0**	**0.7**	**99.3**	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4
% Finer	99.3	99.3	99.4	99.5	99.7	99.9	100.0

Tested By	Tested Date	Reviewed By	Calc By
MJF	10/30/13	TTM	MJF

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GRADATION CURVE

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Verona, Augusta County, VA

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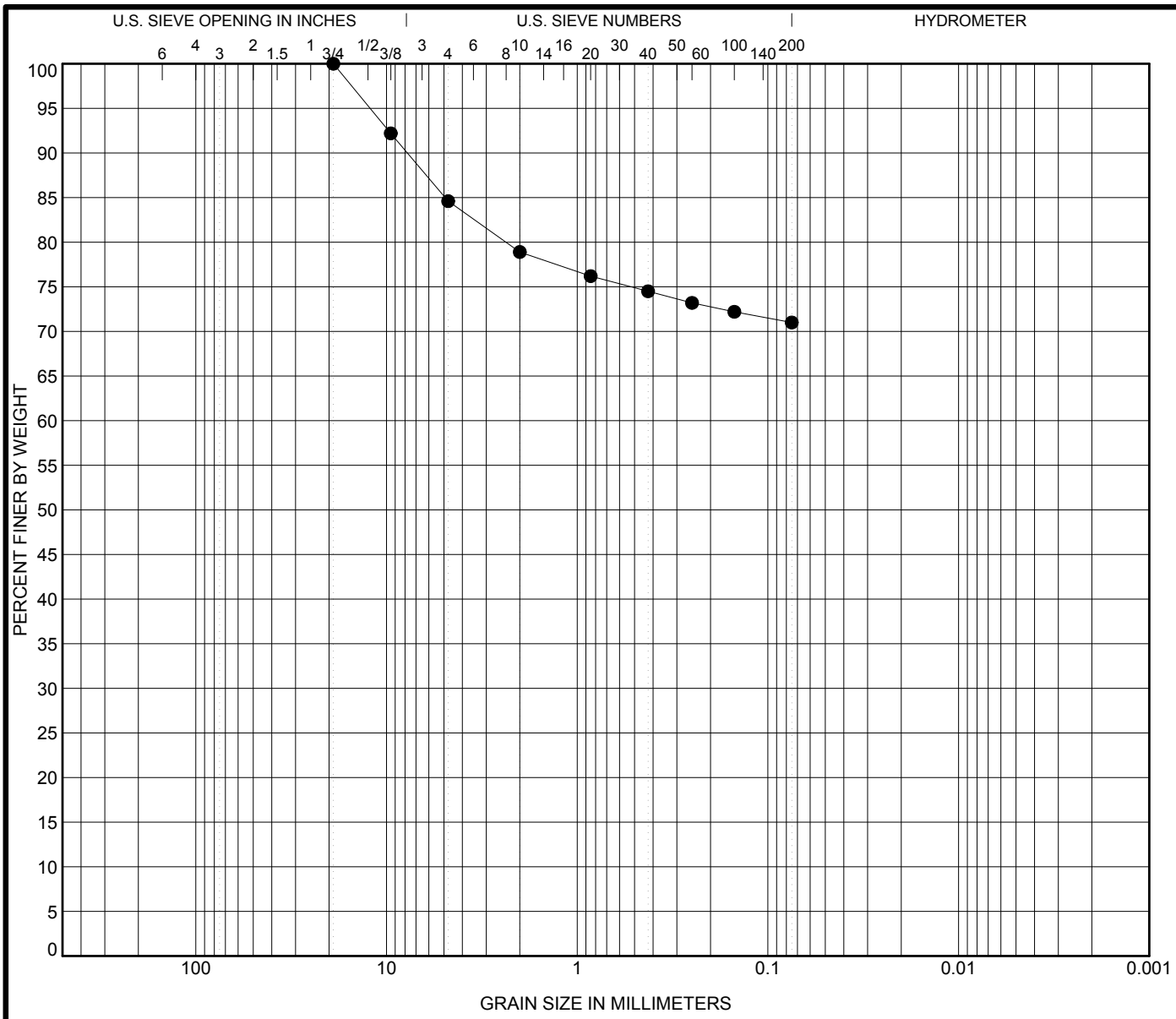
SIEVE 1/SHEET 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 11/19/13



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● 13BH-004	1.0 ft	**Orange brown, ELASTIC SILT WITH GRAVEL, few sand (MH)**	**63**	**35**	**28**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**19**				**15.4**	**13.6**	**71.0**	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4	3/8 in.	3/4 in.
% Finer	71.0	72.2	73.2	74.5	76.2	78.9	84.6	92.2	100.0

Tested By	Tested Date	Reviewed By	Calc By
MJF	10/30/13	TTM	DWC

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GRADATION CURVE

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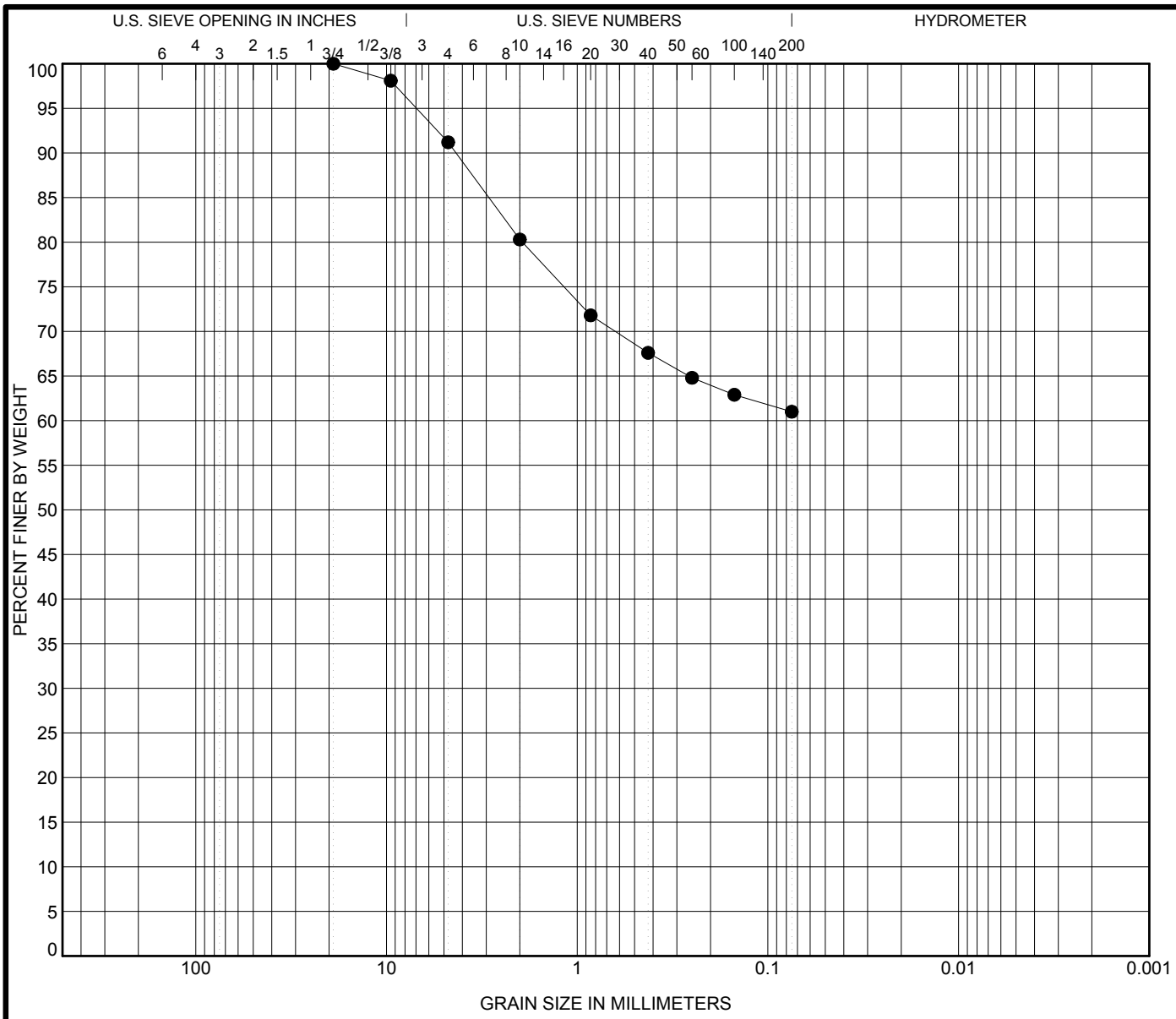
SIEVE 1/SHEET 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 11/19/13



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● 13BH-005	1.5 ft	**Brown, fine to coarse, SANDY LEAN CLAY, contains rock fragments (CL)**	**40**	**24**	**16**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**19**				**8.8**	**30.2**	**61.0**	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4	3/8 in.	3/4 in.
% Finer	61.0	62.9	64.8	67.6	71.8	80.3	91.2	98.1	100.0

Tested By	Tested Date	Reviewed By	Calc By
MJF	10/30/13	TTM	MJF

Schnabel ENGINEERING

GRADATION CURVE

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Verona, Augusta County, VA

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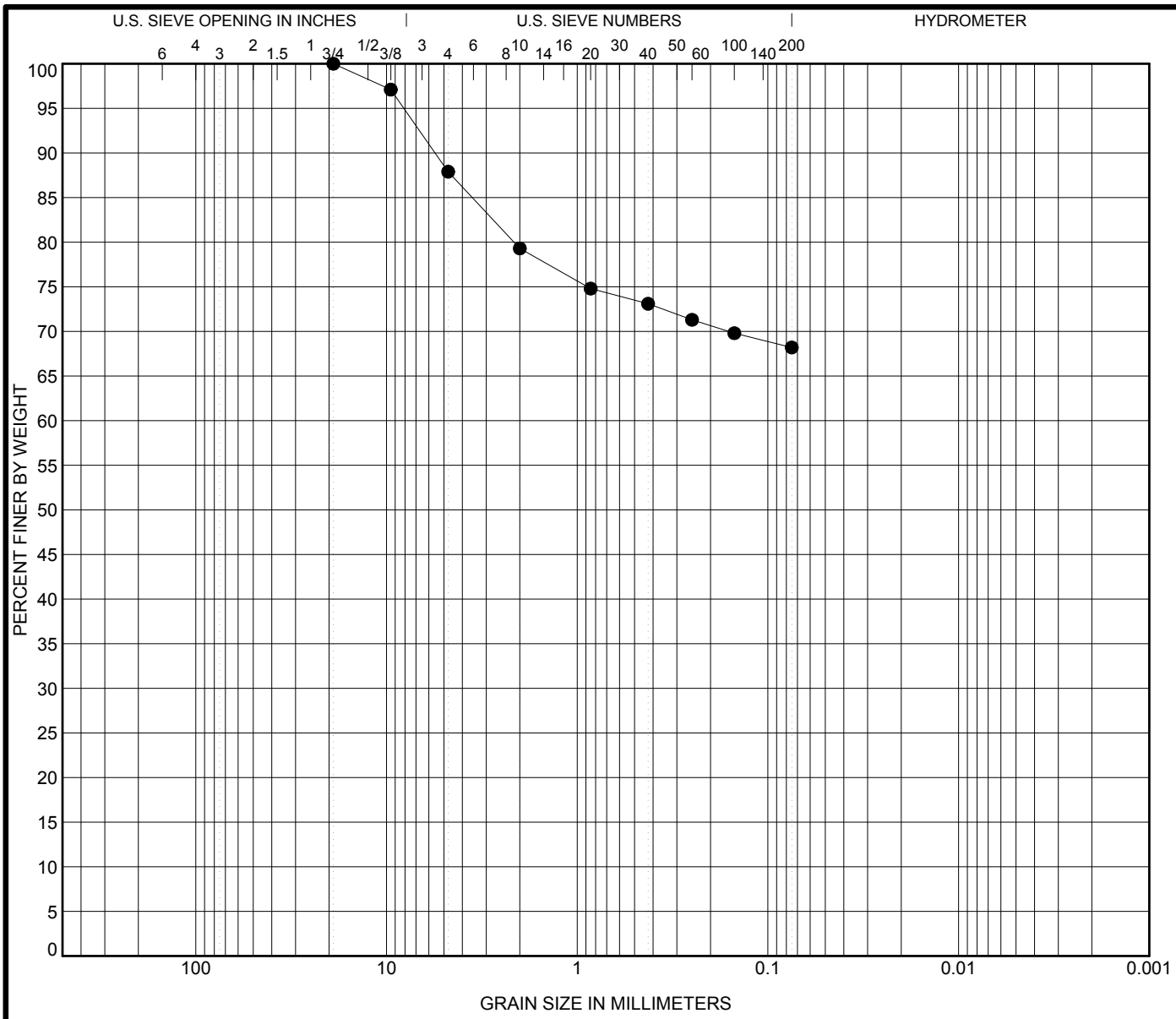
SIEVE 1/SHEET 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 11/19/13



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● 13BH-006	1.0 ft	**Brown, fine to coarse, SANDY LEAN CLAY, contains rock fragments (CL)**	**44**	**20**	**24**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**19**				**12.1**	**19.7**	**68.2**	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4	3/8 in.	3/4 in.
% Finer	68.2	69.8	71.3	73.1	74.8	79.3	87.9	97.1	100.0

Tested By	Tested Date	Reviewed By	Calc By
MJF	10/30/13	TTM	DWC

Schnabel ENGINEERING

GRADATION CURVE

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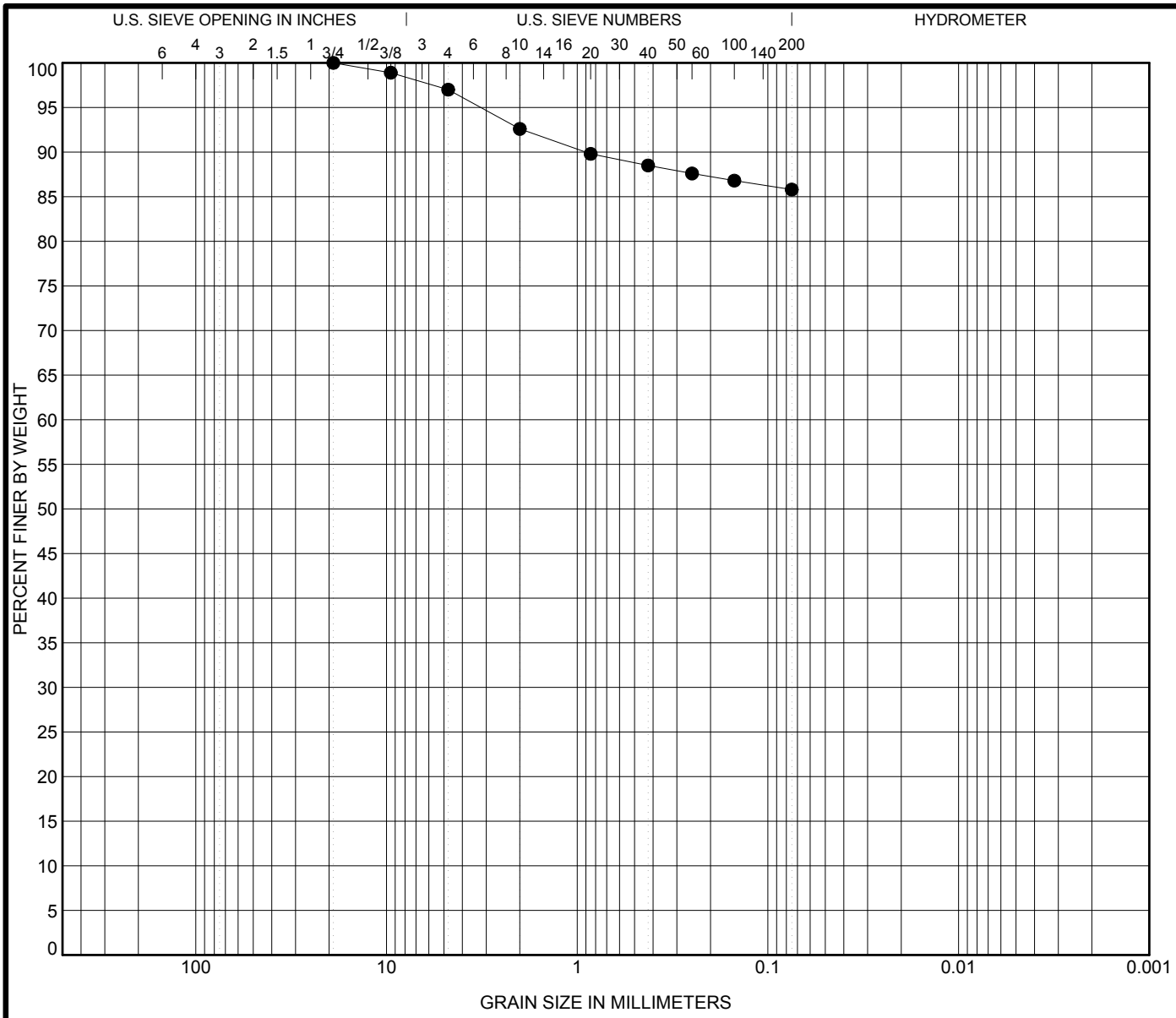
SIEVE 1/SHEET 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 11/19/13



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● 13BH-007	1.2 ft	**Light brown, FAT CLAY, few sand, contains rock fragments (CH)**	**57**	**25**	**32**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**19**				**3.0**	**11.2**	**85.8**	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4	3/8 in.	3/4 in.
% Finer	85.8	86.8	87.6	88.5	89.8	92.6	97.0	98.9	100.0

Tested By	Tested Date	Reviewed By	Calc By
MJF	10/30/13	TTM	MJF

Schnabel ENGINEERING

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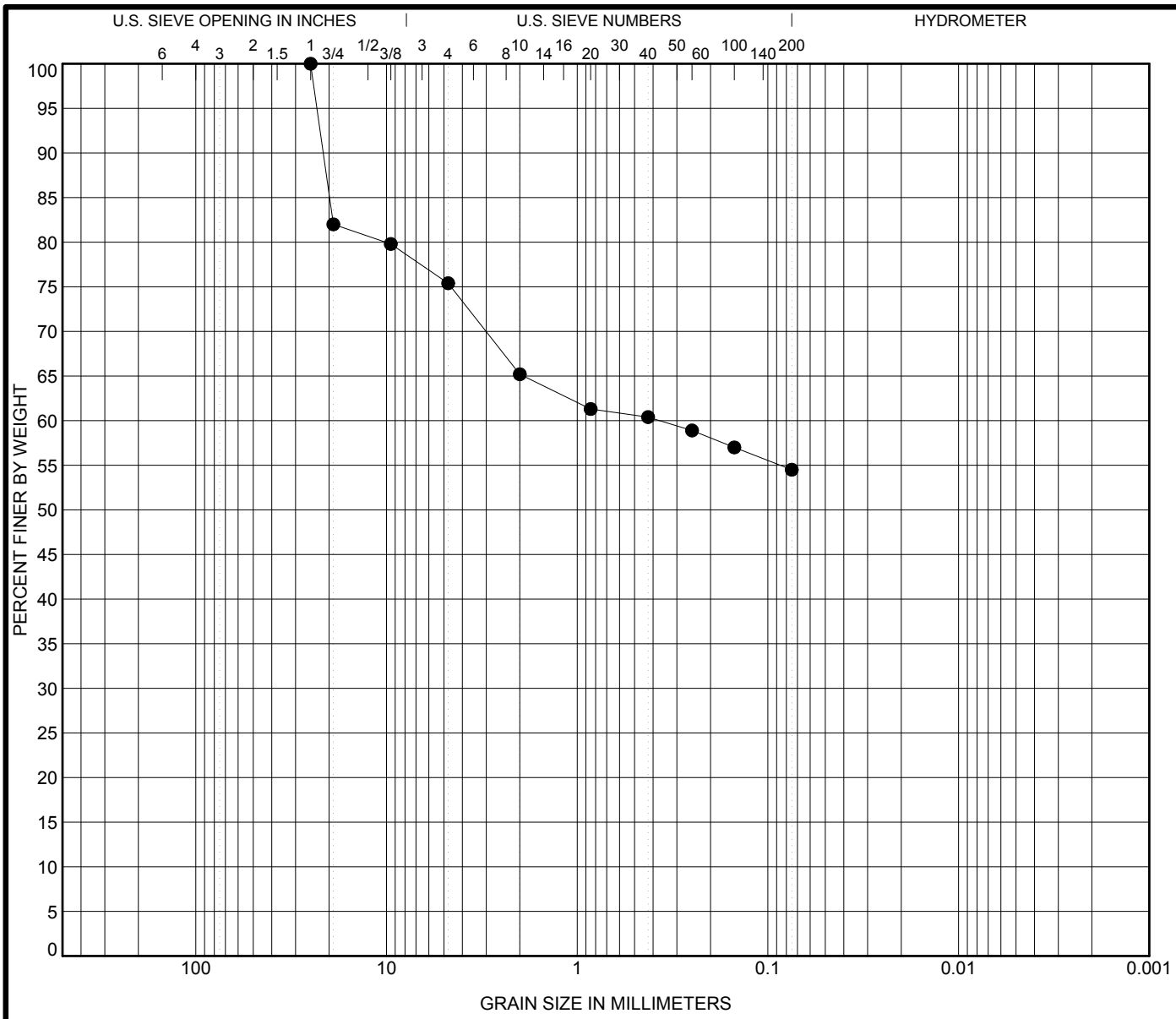
SIEVE 1/SHEET 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 11/19/13



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● 13BH-008	0.0 ft	**Brown, fine to coarse, GRAVELLY LEAN CLAY WITH SAND (CL)**	**28**	**16**	**12**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**25**	**0.369**			**24.6**	**20.9**	**54.5**	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4	3/8 in.	3/4 in.	1 in.
% Finer	54.5	57.0	58.9	60.4	61.3	65.2	75.4	79.8	82.0	100.0

Tested By	Tested Date	Reviewed By	Calc By
MJF	10/30/13	TTM	DWC

Schnabel ENGINEERING

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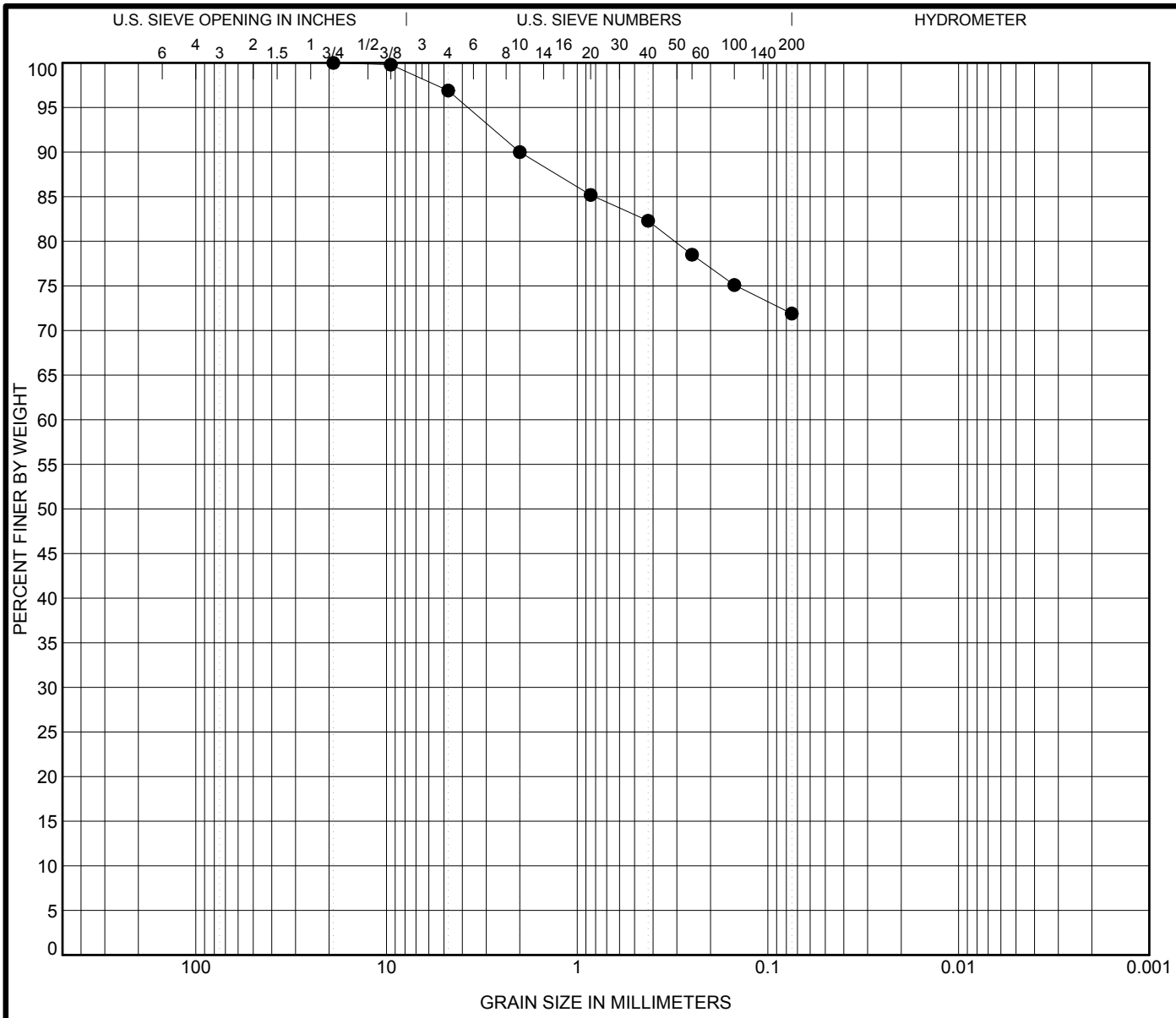
SIEVE 1/SHEET 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 11/19/13



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● 13BH-010	0.8 ft	**Brown, LEAN CLAY WITH SAND, contains rock fragments (CL)**	**37**	**17**	**20**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**19**				**3.1**	**25.0**	**71.9**	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4	3/8 in.	3/4 in.
% Finer	71.9	75.1	78.5	82.3	85.2	90.0	96.9	99.8	100.0

Tested By	Tested Date	Reviewed By	Calc By
MJF	10/30/13	TTM	MJF

Schnabel ENGINEERING

GRADATION CURVE

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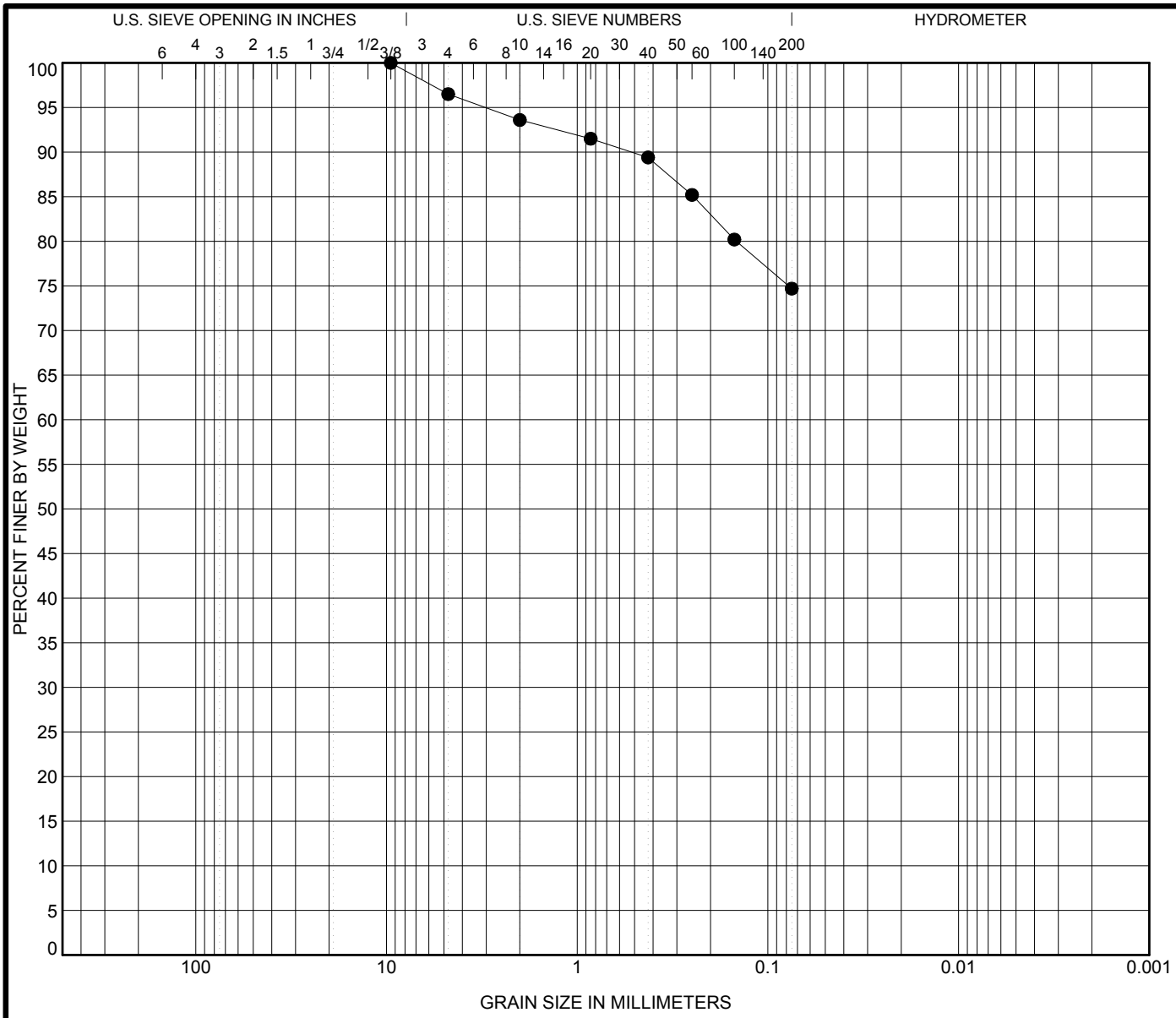
SIEVE 1/SHEET 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 11/19/13



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

Specimen		Sample Description	LL	PL	PI		
● 13BH-011	0.0 ft	**Brown, SILTY CLAY WTH SAND, contains rock fragments (CL-ML)**	**21**	**15**	**6**		

Test Method	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
ASTM D422	**9.5**				**3.5**	**21.8**	**74.7**	

Percent Finer

Sieve Size	No. 200	No. 100	No. 60	No. 40	No. 20	No. 10	No. 4	3/8 in.
% Finer	74.7	80.2	85.2	89.4	91.5	93.6	96.5	100.0

Tested By	Tested Date	Reviewed By	Calc By
MJF	10/30/13	TTM	DWC

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GRADATION CURVE

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Verona, Augusta County, VA

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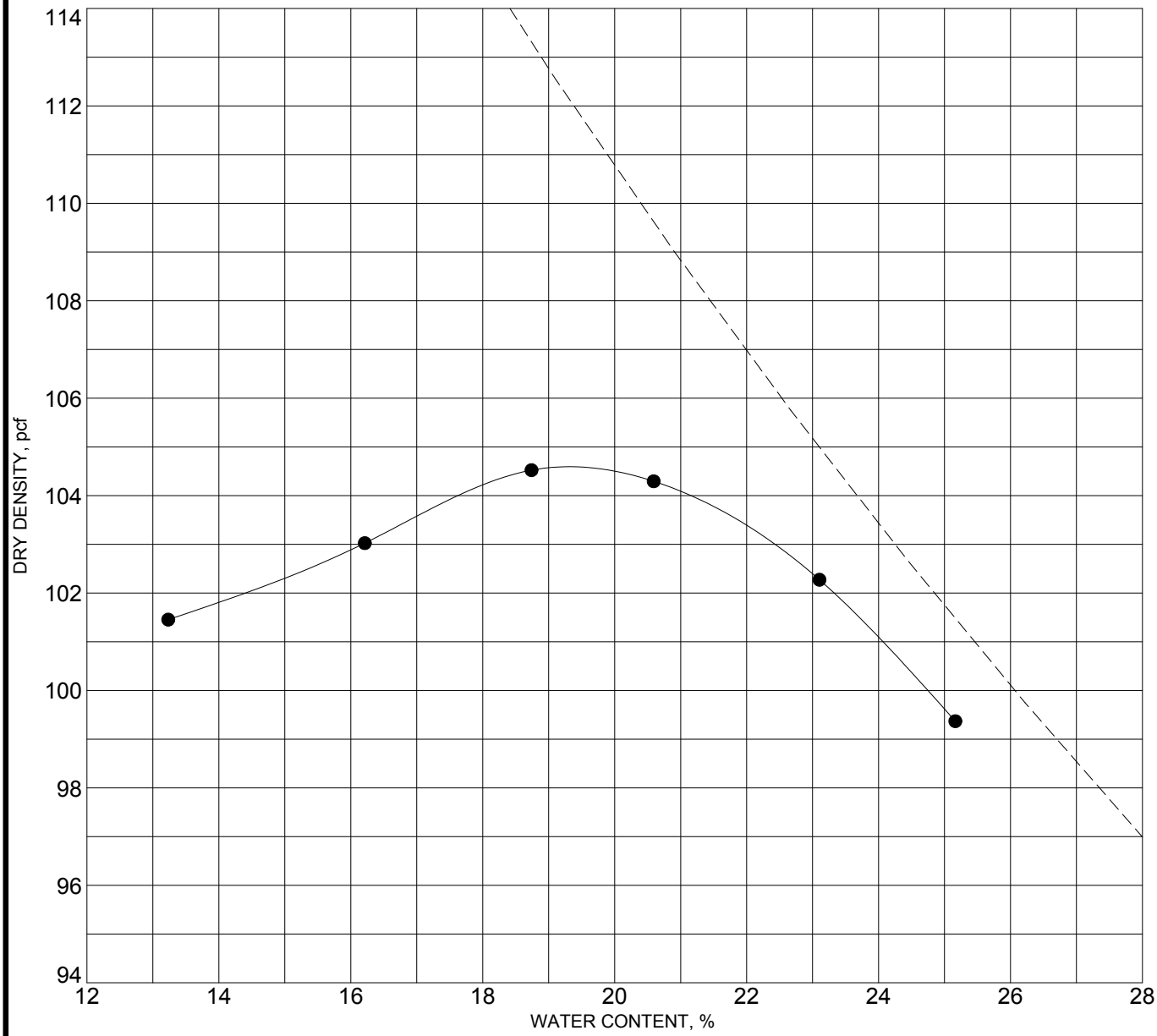
SIEVE 1/SHEET 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008 04 22.GDT 11/19/13



Sample Description:	Light brown, FAT CLAY WITH SAND, contains rock fragments (CH)	Assumed Specific Gravity:	2.75
		Max. Dry Density (pcf):	104.6
		Opt. Moisture (%):	19.3
Sample Source:	13BH-002, 1.6 ft		
Test Methods:	VTM1		

Liquid Limit (LL):	66	Comments:
Plasticity Index (PI):	37	
% Retained #4 Sieve:	8.6	
% Passing # 200 Sieve:	70.4	

Schnabel ENGINEERING

MOISTURE DENSITY RELATIONSHIP

Project: 0612-007-773, UPC 84645
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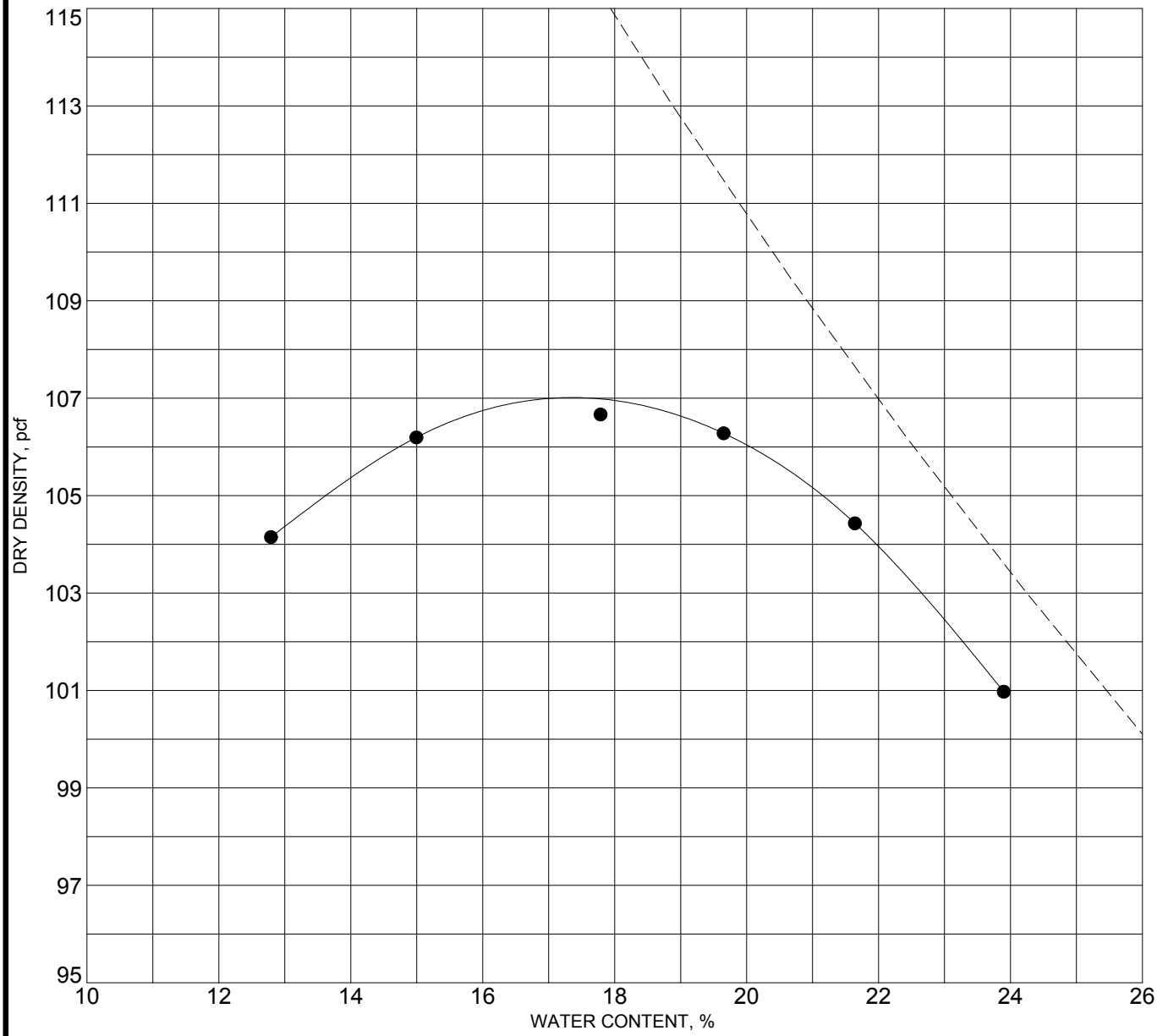

Sample Description:	Brown, fine to coarse, SANDY LEAN CLAY, contains rock fragments (CL)	Assumed Specific Gravity:	2.75
		Max. Dry Density (pcf):	107.0
		Opt. Moisture (%):	17.4
Sample Source:	13BH-005, 1.5 ft		
Test Methods:	VTM1		

Liquid Limit (LL):	40	Comments:
Plasticity Index (PI):	16	
% Retained #4 Sieve:	8.8	
% Passing # 200 Sieve:	61.0	

Schnabel ENGINEERING

MOISTURE DENSITY RELATIONSHIP

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Verona, Augusta County, VA

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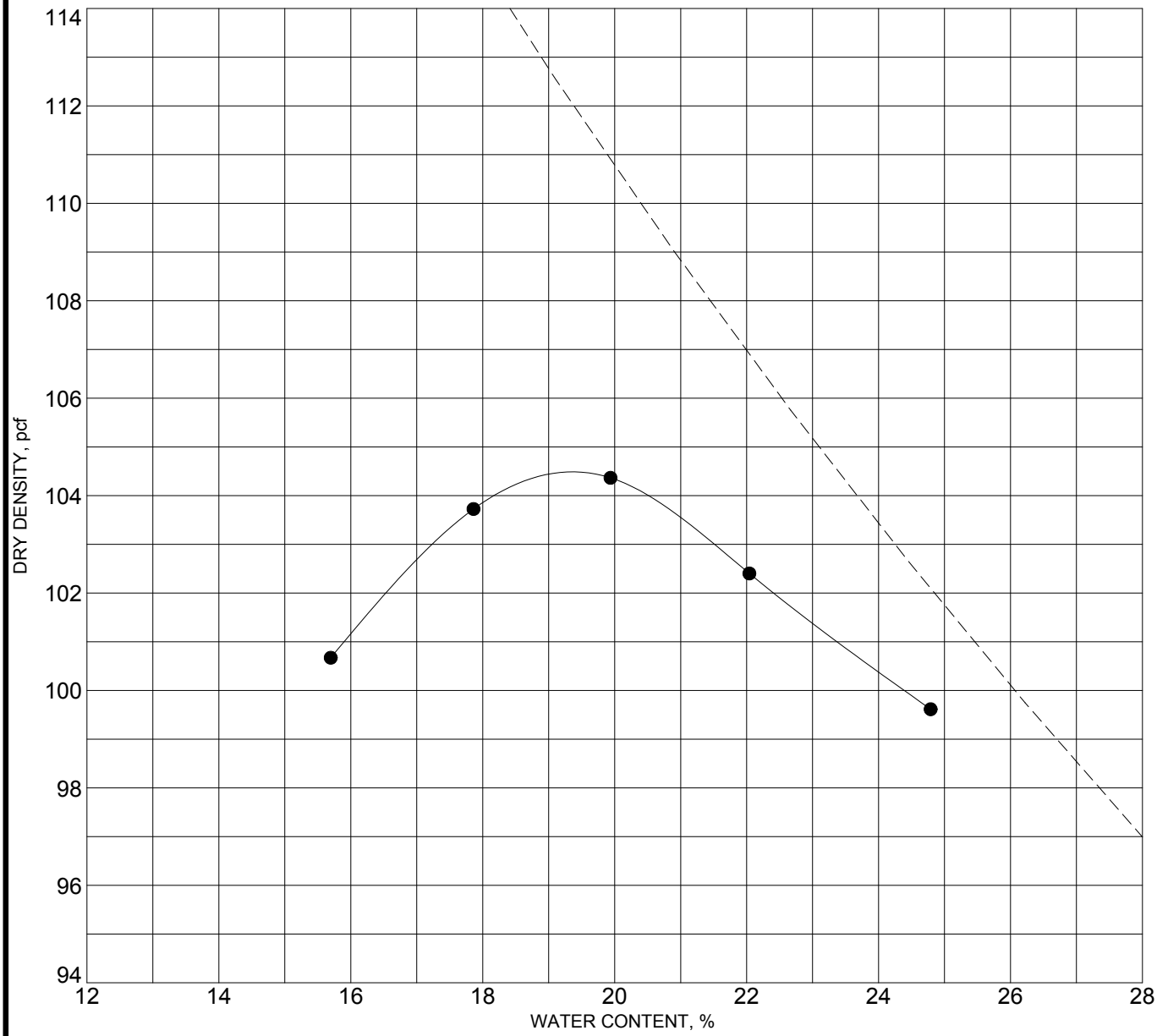
COMPACTION 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008_04_22.GDT 11/19/13



Sample Description:	Light brown, FAT CLAY, few sand, contains rock fragments (CH)	Assumed Specific Gravity:	2.75
		Max. Dry Density (pcf):	105.0
		Opt. Moisture (%):	19.3
Sample Source:	13BH-007, 1.2 ft		
Test Methods:	VTM1		

Liquid Limit (LL):	57	Comments:
Plasticity Index (PI):	32	
% Retained #4 Sieve:	3.0	
% Passing # 200 Sieve:	85.8	

Schnabel ENGINEERING

MOISTURE DENSITY RELATIONSHIP

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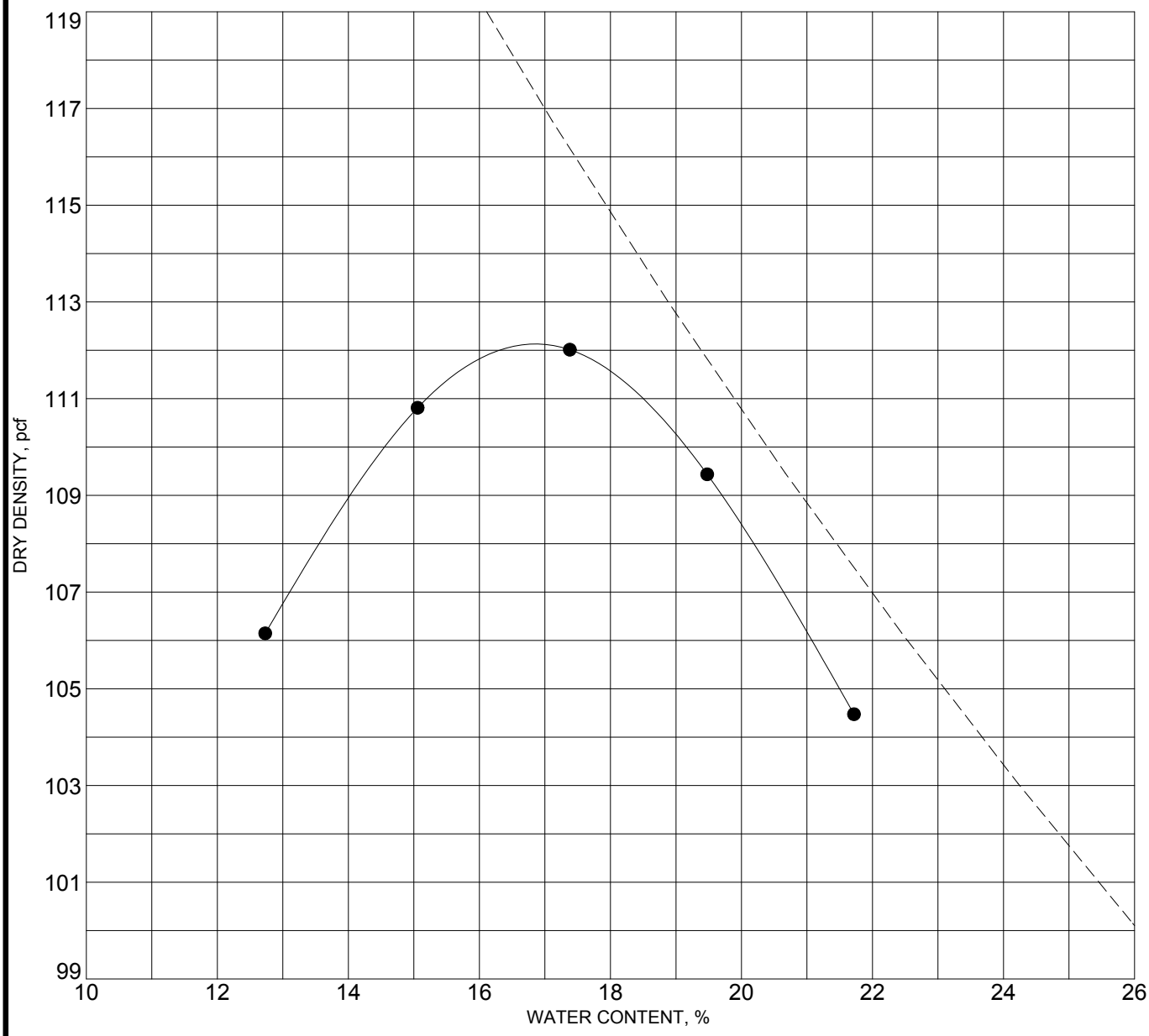
COMPACTION 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008_04_22.GDT 11/19/13



Sample Description:	Brown, LEAN CLAY WITH SAND, contains rock fragments (CL)	Assumed Specific Gravity:	2.75
		Max. Dry Density (pcf):	112.1
		Opt. Moisture (%):	16.9
Sample Source:	13BH-010, 0.8 ft		
Test Methods:	VTM1		

Liquid Limit (LL):	37	Comments:
Plasticity Index (PI):	20	
% Retained #4 Sieve:	3.1	
% Passing # 200 Sieve:	71.9	

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MOISTURE DENSITY RELATIONSHIP

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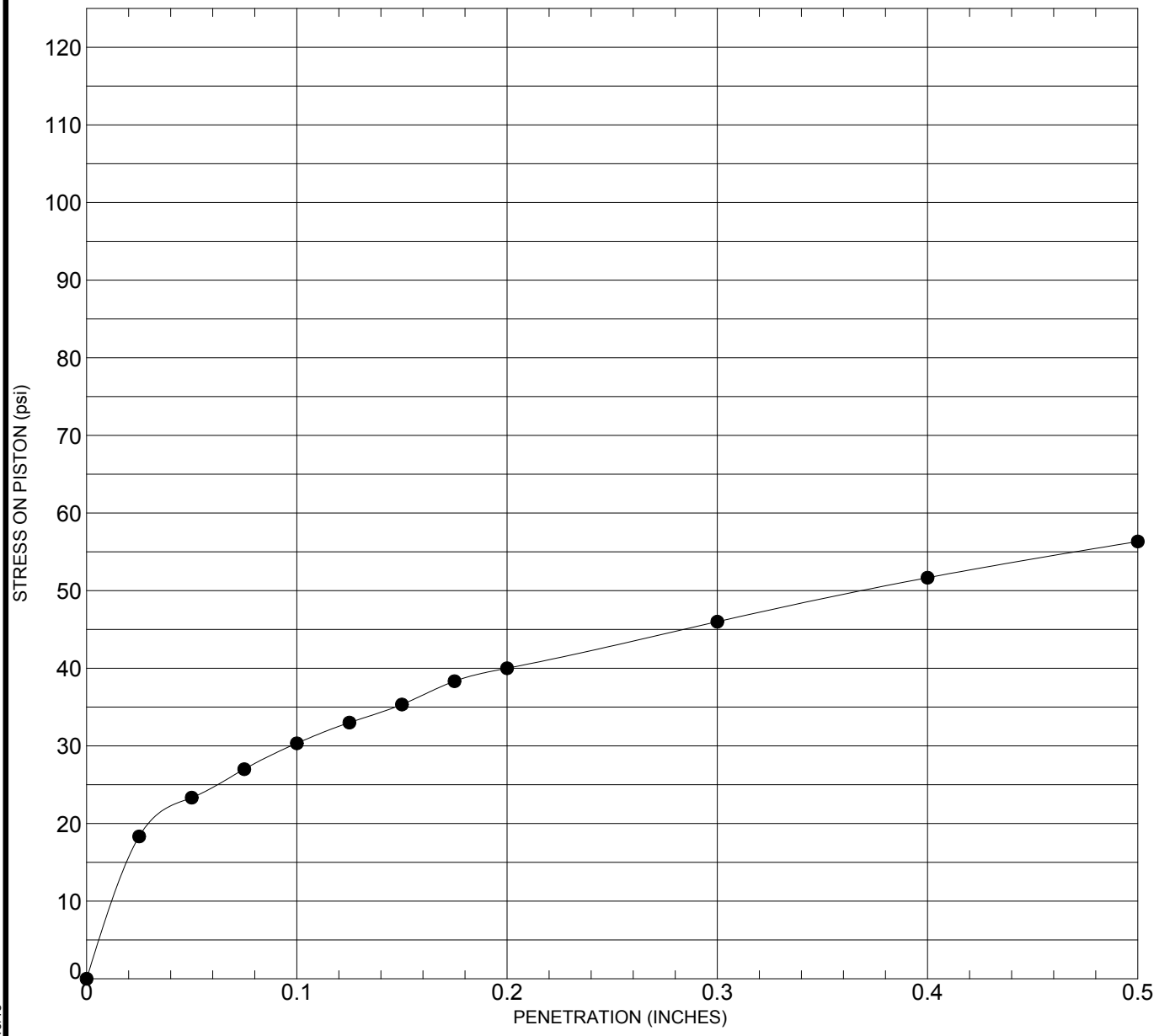
COMPACTION 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008_04_22.GDT 11/19/13



Sample Description:	Light brown, FAT CLAY WITH SAND, contains rock fragments (CH)
Sample Source:	13BH-002
Sample Depth:	1.6 ft
Test Method:	VTM-8

Dry Density Before Soaking (pcf):	105.1
Dry Density After Soaking (pcf):	102.0
Maximum Dry Density (pcf):	104.6
Moisture Content Before Soaking (%):	22.0
Moisture Content After Soaking (Avg) (%):	24.4
Moisture Content Top Inch After Soak (%):	29.4
Optimum Moisture Content (%):	19.3

Liquid Limit (LL):	66
Plasticity Index (PI):	37
% Retained #4 Sieve:	8.6
% Passing # 200 Sieve:	70.4

CBR:	3, Soaked
Surcharge (psf):	50
Swell (%):	3.0

Schnabel ENGINEERING

CALIFORNIA BEARING RATIO TEST

Project: 0612-007-773, UPC 84645
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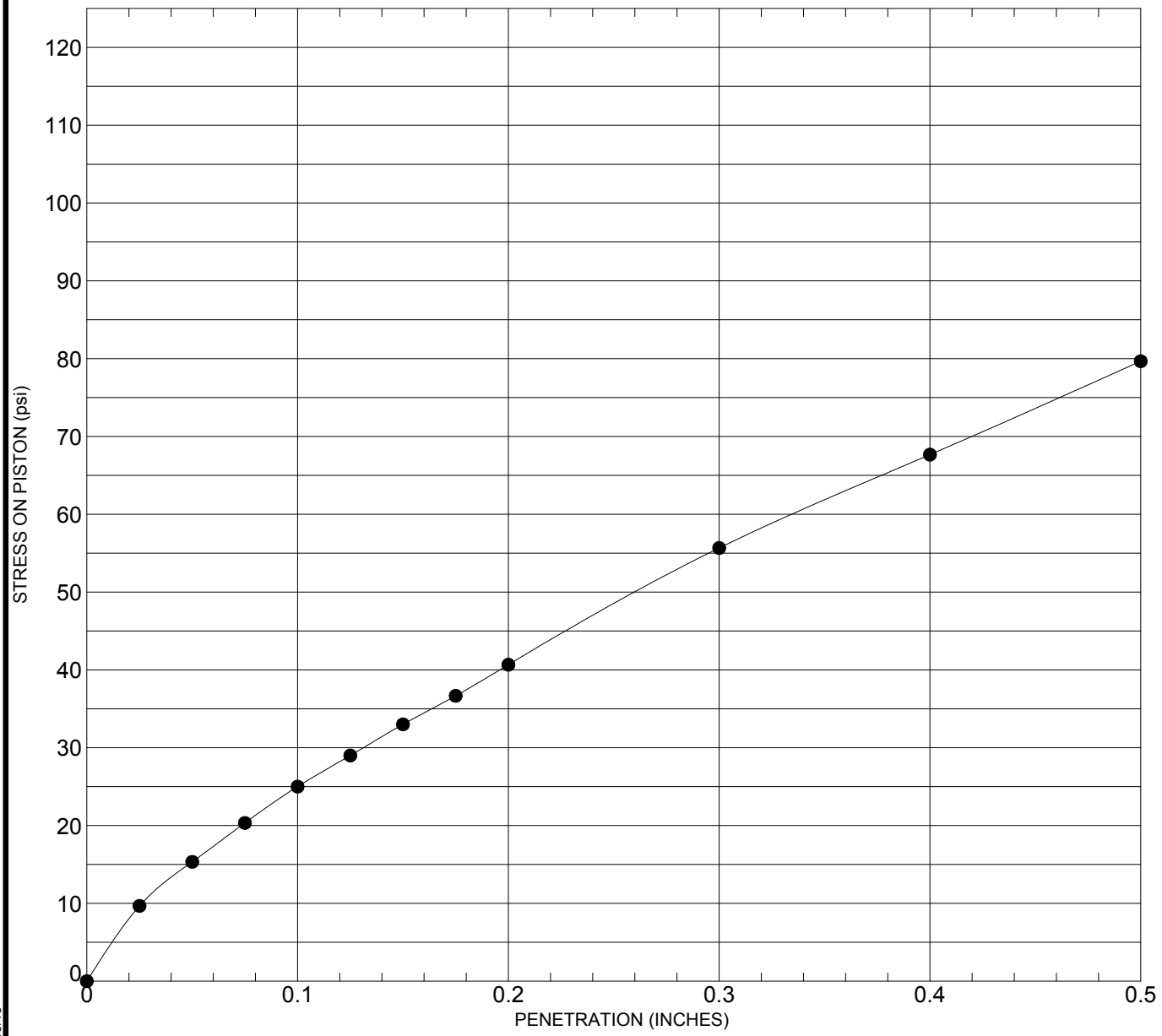

Sample Description:	Brown, fine to coarse, SANDY LEAN CLAY, contains rock fragments (CL)	Dry Density Before Soaking (pcf):	108.1
		Dry Density After Soaking (pcf):	104.7
		Maximum Dry Density (pcf):	107
		Moisture Content Before Soaking (%):	17.8
Sample Source:	13BH-005	Moisture Content After Soaking (Avg) (%):	22.7
Sample Depth:	1.5 ft	Moisture Content Top Inch After Soak (%):	25.3
Test Method:	VTM-8	Optimum Moisture Content (%):	17.4
Liquid Limit (LL):	40	CBR:	2.5, Soaked
Plasticity Index (PI):	16	Surcharge (psf):	50
% Retained #4 Sieve:	8.8	Swell (%):	3.2
% Passing # 200 Sieve:	61.0		

Schnabel ENGINEERING

CALIFORNIA BEARING RATIO TEST

Project: 0612-007-773, UPC 84645
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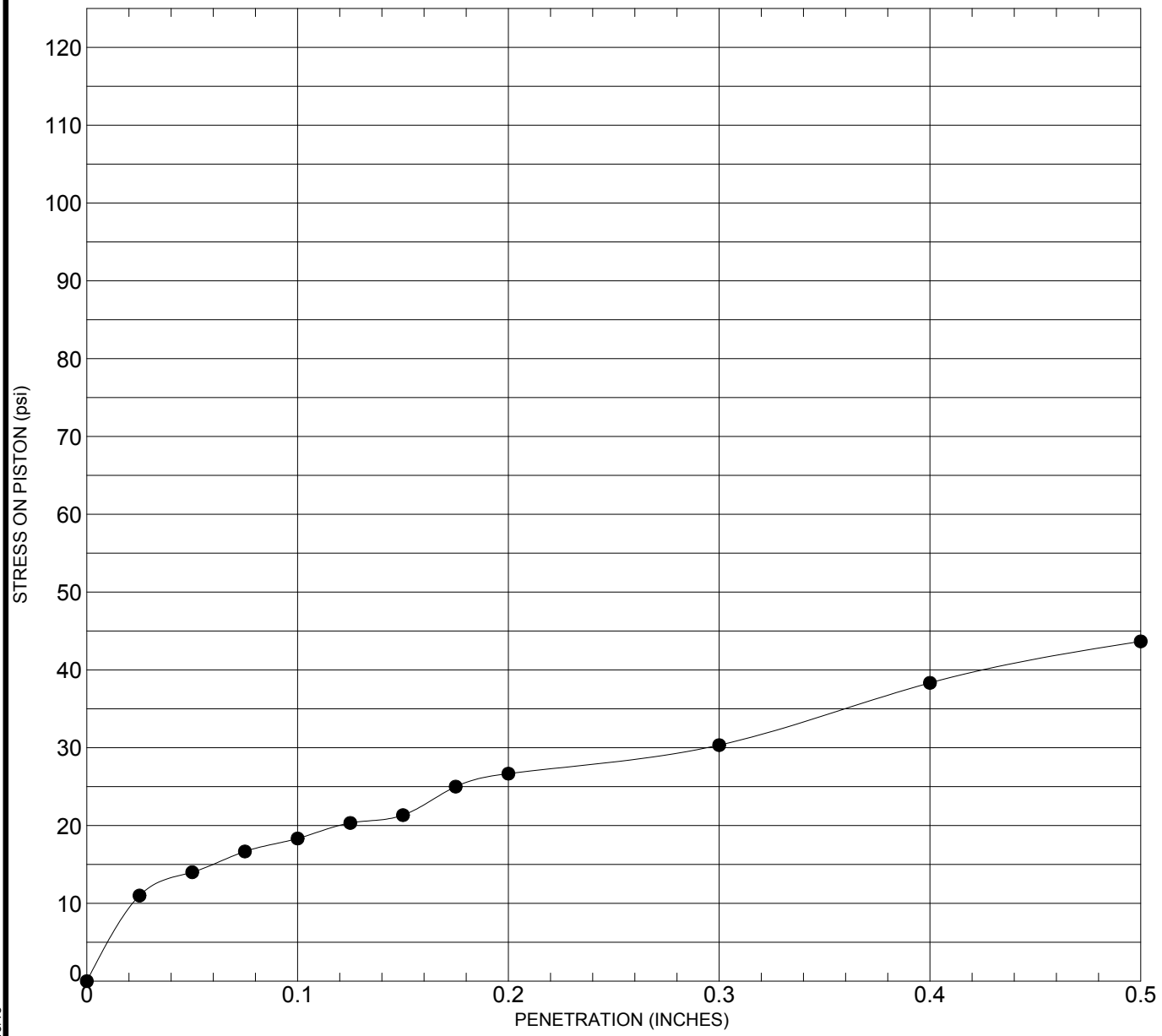
Verona, Augusta County, VA

Contract: 13616055

CBR SINGLE POINT 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008_04_22.GDT 11/19/13



Sample Description:	Light brown, FAT CLAY, few sand, contains rock fragments (CH)
Sample Source:	13BH-007
Sample Depth:	1.2 ft
Test Method:	VTM-8

Dry Density Before Soaking (pcf):	104.2
Dry Density After Soaking (pcf):	99.0
Maximum Dry Density (pcf):	105
Moisture Content Before Soaking (%):	19.1
Moisture Content After Soaking (Avg) (%):	25.7
Moisture Content Top Inch After Soak (%):	32.8
Optimum Moisture Content (%):	19.3

Liquid Limit (LL):	57
Plasticity Index (PI):	32
% Retained #4 Sieve:	3.0
% Passing # 200 Sieve:	85.8

CBR:	1.8, Soaked
Surcharge (psf):	50
Swell (%):	5.2

Schnabel ENGINEERING

CALIFORNIA BEARING RATIO TEST

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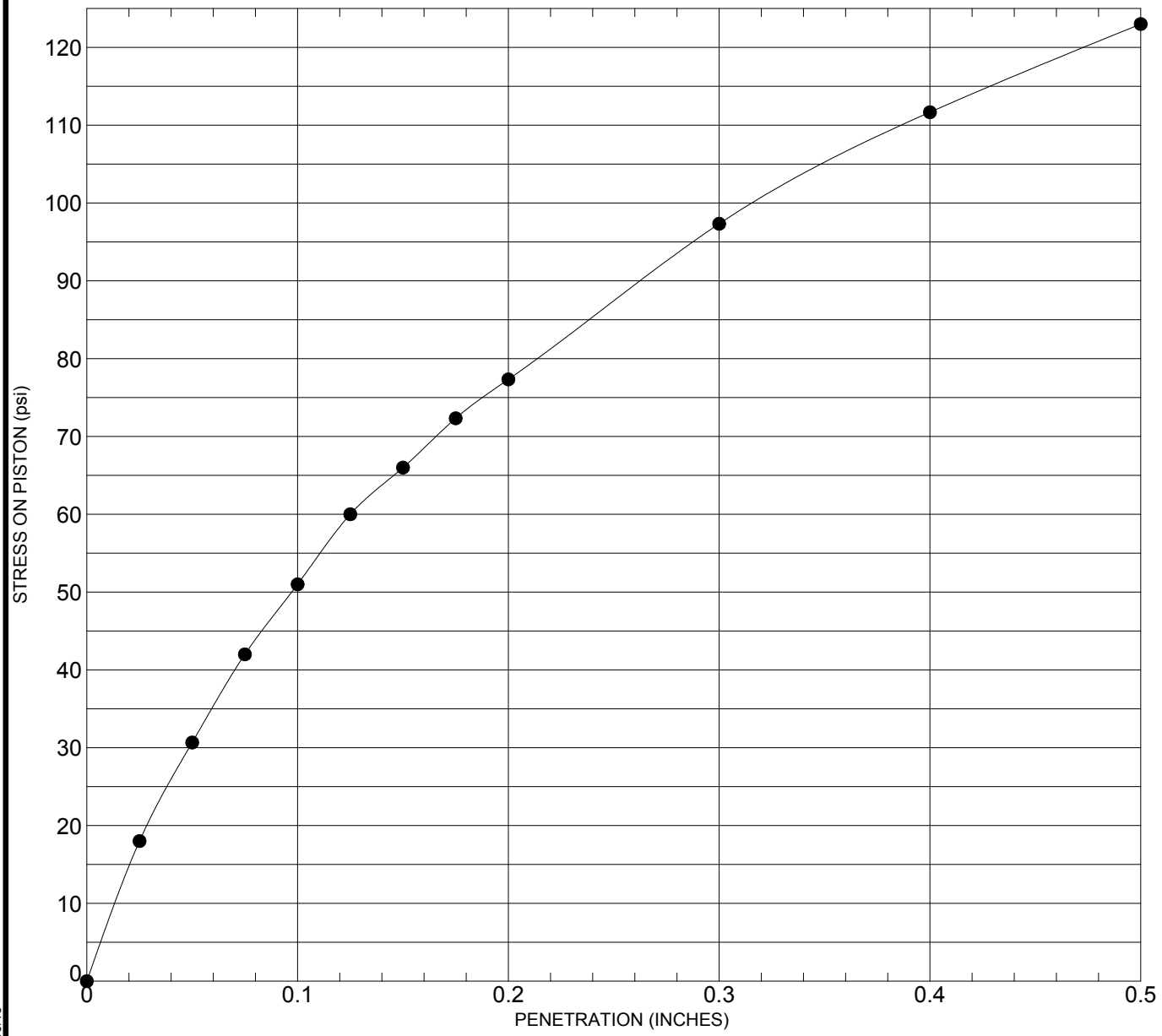


Sample Description:	Brown, LEAN CLAY WITH SAND, contains rock fragments (CL)	Dry Density Before Soaking (pcf):	112.5
		Dry Density After Soaking (pcf):	112.1
		Maximum Dry Density (pcf):	112.1
		Moisture Content Before Soaking (%):	18.3
Sample Source:	13BH-010	Moisture Content After Soaking (Avg) (%):	19.1
Sample Depth:	0.8 ft	Moisture Content Top Inch After Soak (%):	20.3
Test Method:	VTM-8	Optimum Moisture Content (%):	16.9
Liquid Limit (LL):	37	CBR:	5.1, Soaked
Plasticity Index (PI):	20	Surcharge (psf):	50
% Retained #4 Sieve:	3.1	Swell (%):	0.4
% Passing # 200 Sieve:	71.9		

Schnabel ENGINEERING

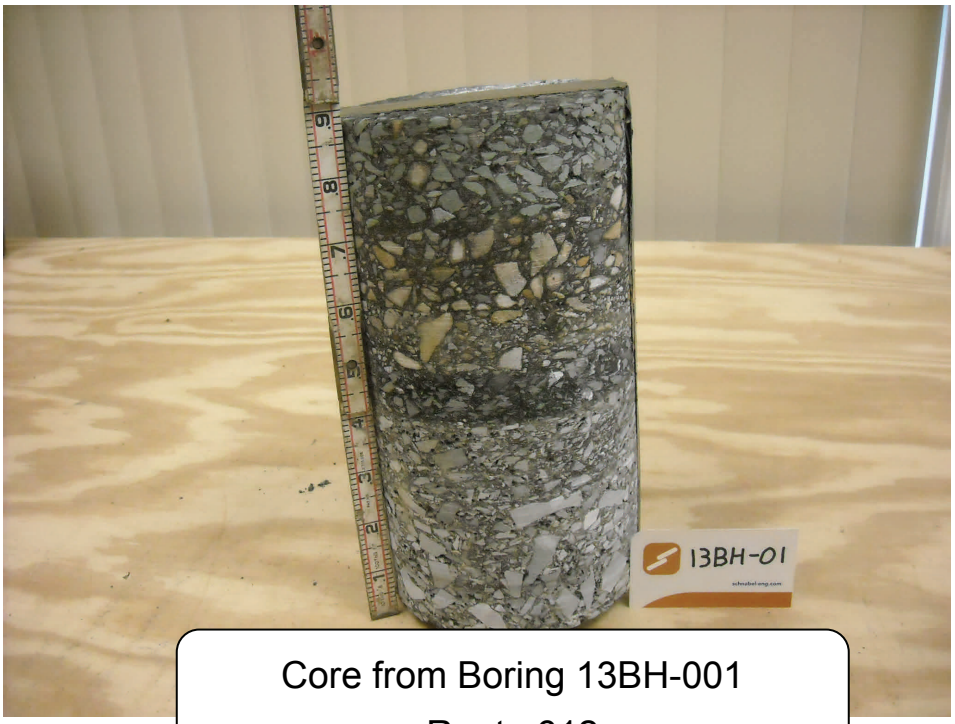
CALIFORNIA BEARING RATIO TEST

Project: 0612-007-773, UPC 84645
Rt. 612 Intersection Improvement at Rt. 792
Verona, Augusta County, VA

Contract: 13616055

CBR SINGLE POINT 13616055-LAB.GPJ SCHNABEL DATA TEMPLATE 2008_04_22.GDT 11/19/13

Appendix D: Pavement Cores



Core from Boring 13BH-001
Route 612

PHOTOGRAPH No.: 1

Core Taken: 10/9/13

LOCATION: Sta. 100+55

13BH-001

Rt. 612

West bound lane

COMMENTS:

Asphalt—11”
Base—8”

Core from Boring 13BH-002
Route 612

PHOTOGRAPH No.: 2

Core Taken: 10/9/13

LOCATION: Station 102+04

13BH-002

Rt. 612

West bound lane

COMMENTS:

Asphalt—11”
Base—8”

Schnabel ENGINEERING

RT. 612 at 792 INT. IMPROVEMENTS
UPC 84645 VDOT # 0612-007-773
Verona, VA

PROJECT NO. 13161055.00

DATE: 10/2013

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Core from Boring 13BH-003
Route 612

PHOTOGRAPH No.: 3

Core Taken: 10/9/13

LOCATION: Sta. 103+52

13BH-003

Rt. 612

East bound lane

COMMENTS:

Asphalt—7”
Base—6”

Core from Boring 13BH-006
Route 612

PHOTOGRAPH No.: 4

Core Taken: 10/9/13

LOCATION: Sta. 109+88

13BH-006

Rt. 612

West bound lane

COMMENTS:

Asphalt—8.5”
Base—9”

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Core from Boring 13BH-007
Route 792 (Indian Mound Road)

PHOTOGRAPH No.: 5

Core Taken: 10/9/13

LOCATION: Sta. 200+96

13BH-007

Rt. 792

North bound lane

COMMENTS:

Asphalt—5.5”
Base—9”

Core from Boring 13BH-009
Route 792 (Riverside Avenue)

PHOTOGRAPH No.: 6

Core Taken: 10/9/13

LOCATION: Sta. 303+76

13BH-009

Rt. 792

North bound lane

COMMENTS:

Asphalt—4.5”
Base—5”

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Core from Boring 13BH-010
Route 792 (Riverside Avenue)

PHOTOGRAPH No.: 7

Core Taken:

LOCATION: Sta. 302+50

13BH-010

Rt. 792

South bound lane

COMMENTS:

Asphalt—4”
Base—6”

Schnabel ENGINEERING

RT. 612 at 792 INT. IMPROVEMENTS
UPC 84645 VDOT # 0612-007-773
VERONA, VA

PROJECT NO. 13161055.00

DATE: 10/2013

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Appendix E: Pavement Design Calculations

1993 AASHTO Pavement Design

DARWin™ Pavement Design

Flexible Structural Design Module

UPC 84645
Route 612, Final Pavement Design
Wednesday, December 11, 2013

Rigorous ESAL Calculation

Performance Period	20
Growth Rate (Calculated)	1.25
Initial Year ADT	7045
% All Trucks in Design Lane	100
% All Trucks in Design Direction	50

Class	% of ADT	% Growth	ESALS/Truck	Accum. 18K ESALs over Perf. Period
Cars	98	1.25	0.0002	
Single unit	0	1.25	0.46	
T. Trailer	2	1.25	1.05	
	100			630,165

Flexible Structural Design Module Data

Accum 18K ESALs over Perf Per	630,165
Intial Serviceability	4.2
Terminal Serviceability	2.8
Reliability Level (%)	90
Overall Standard Deviation	0.49
Roadbed Soil Reilient Modulus	11000
Calculated Design Structural No	2.90

Specified Layer Design

Layer	Mat'l Description	Str. Coef.	Thick.	Width	Calc. SN
1	SM-9.5A	0.44	1.5	24	0.66
2	BM-25.0A	0.44	3	24	1.32
3	21B Aggregate	0.12	8	24	0.96
	Separation Geotextile				
Total			12.5		2.94

Drainage Coefficient = 1.0

1993 AASHTO Pavement Design

DARWin™ Pavement Design

Flexible Structural Design Module

UPC 84645

Route 792, Final Pavement Design

Thursday, December 12, 2013

Rigorous ESAL Calculation

Performance Period	20
Growth Rate (Calculated)	1.25
Initial Year ADT	1771
% All Trucks in Design Lane	100
% All Trucks in Design Direction	50

Class	% of ADT	% Growth	ESALS/Truck	Accum. 18K ESALs over Perf. Period
Cars	98	1.25	0.0002	
Single unit	0	1.25	0.46	
T. Trailer	2	1.25	1.05	
	100			158,447

Flexible Structural Design Module Data

Accum 18K ESALs over Perf Per	158,447
Intial Serviceability	4.2
Terminal Serviceability	2.8
Reliability Level (%)	90
Overall Standard Deviation	0.49
Roadbed Soil Reilient Modulus	11000
Calculated Design Structural No	2.28

Specified Layer Design

Layer	Mat'l Description	Str. Coef.	Thick.	Width	Calc. SN
1	SM-9.5A	0.44	1.5	20	0.66
2	BM-25.0A	0.44	2.5	20	1.10
3	21B Aggregate	0.12	6	20	0.72
4	Subgrade Geotextile				
Total			10		2.48

Drainage Coefficient = 1.0

1993 AASHTO Pavement Design

DARWin™ Pavement Design

Flexible Structural Design Module

UPC 84645
Route 612, Final Pavement Design
Wednesday, December 11, 2013

Rigorous ESAL Calculation

Performance Period	20
Growth Rate (Calculated)	1.25
Initial Year ADT	7045
% All Trucks in Design Lane	100
% All Trucks in Design Direction	50

Class	% of ADT	% Growth	ESALS/Truck	Accum. 18K ESALs over Perf. Period
Cars	98	1.25	0.0002	
Single unit	0	1.25	0.46	
T. Trailer	2	1.25	1.05	
	100			630,165

Flexible Structural Design Module Data

Accum 18K ESALs over Perf Per	630,165
Intial Serviceability	4.2
Terminal Serviceability	2.8
Reliability Level (%)	90
Overall Standard Deviation	0.49
Roadbed Soil Reilient Modulus	11000
Calculated Design Structural No	2.90

Specified Layer Design

Layer	Mat'l Description	Str. Coef.	Thick.	Width	Calc. SN
1	SM-9.5A	0.44	1.5	24	0.66
2	Existing HMA	0.35	5.5	24	1.93
3	21B Aggregate	0.12	8	24	0.96
	Mill 1.5"				
Total			15		3.545

Drainage Coefficient = 1.0

Appendix F: Special Provisions

VIRGINIA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
CONTROLLED BLASTING

August 31, 2012

I. DESCRIPTION

The Contractor is hereby advised of the close proximity of this project to private property, dwellings, water wells, springs, utilities, railroads and/or other structures. Therefore, to avoid property damages, the Contractor shall explore other means of loosening and/or reducing the size of the excavation without blasting, or if blasting becomes necessary, then controlled blasting techniques shall be employed during construction. Prior to prosecuting the work, the Contractor shall conduct an on-site review of the work involved and develop a plan of operations for performing the excavation work. Blasting plan shall be submitted to the Engineer at least two (2) weeks prior to scheduled blasting.

II. BLASTING PROCEDURES

No blasting shall be performed within fifty (50) feet of existing or new bridge foundations, railroad right-of-way, residential or commercial buildings, wells or other structures without the written approval of the Engineer. In the vicinity of proposed concrete construction, blasting shall be scheduled so that blasting operations are fully complete prior to the placement of concrete.

All blasting shall be performed in accordance with the current edition of the Virginia Statewide Fire Prevention Code. The Contractor shall utilize the services of an experienced powder man at all times. The drill hole diameter, hole spacing, and size of charge per hole shall be such as to afford satisfactory breakage with a minimum of vibration. A Construction Blasting Quantity and Distance Table shall be utilized to control the maximum quantity of explosives per shot for instantaneous firing or per delay for delay firing in pounds. At no time shall the total size of any charge cause the particle velocity of the ground motion to exceed 0.50 inches per second when measured at the nearest structure to a blast.

The Contractor shall maintain a daily log of the type, grade and quantity of explosives, type of detonating cap, hole locations, depths and minimum distances from the blasts to private property, dwellings, water wells, springs, utilities, and other structures. A copy of this log shall be submitted to the Engineer at the end of each workday on which blasting activity has occurred.

III. SEISMIC MONITORING

The Contractor shall also submit to the Department a comprehensive blasting plan detailing the blasting techniques to be used near private property, dwellings, water wells, springs, utilities, and other structures. Seismic monitoring shall be performed by a qualified firm in advance of performing construction operations near private property, dwellings, water wells, springs, utilities, and other structures. Some of the initial blasts shall be monitored close to the blasting while others shall be monitored at private properties, dwellings, water wells, springs, utilities, and other structures, and the blasting plan shall be revised if it is anticipated that the maximum particle velocity at those locations will exceed 0.50 inches per second.

The seismograph used should have the ability to store digital data for documentation and inspection by or submittal to the Department. Further, the seismograph used shall be capable of accurately measuring frequency and amplitude in three planes: vertically, longitudinally, and transversely. These instruments must be dynamically calibrated and of such sensitivity that displacements as little as 0.0005 inches and frequencies of from 1 to 100 cycles per

second may be read. The instruments must also be capable of adjustment so that the peak of maximum amplitude of vibration can be recorded on the tape or disk.

The Contractor shall cooperate and coordinate blasting activities with the owners of private property, dwellings, water wells, springs, utilities, and structures.

The cost for explosives and blasting operations, alternative methods, monitoring, and the recording and submission of daily blasting logs will be considered incidental to the cost of regular excavation, and will not be measured for separate payment. Contractor's failure to maintain and submit daily blasting logs as stipulated herein will result in withholding payment for regular excavation until such time that daily logs are provided.

IV. Rock Slopes

For use in this Special Provision, slopes shall be considered rock slopes when the following criteria are met:

1. Height of final slope is fifteen (15) feet or greater.
2. Fifty (50) percent of the face of the final slope is rock, based on visual inspection.

All rock slopes with a slope of 1H:1V or steeper shall be pre-split by blasting, controlled blasting or non-explosive techniques, in accordance with Section 303.04a of the Road & Bridge Specifications and the preceding sections.

VIRGINIA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
AGGREGATE DENSITY REQUIREMENTS

October 9, 2012

Section 305.03(e) Shoulders of the Specifications is amended to replace the last sentence of the first paragraph and subsequent chart with the following:

Except when aggregate material No. 18 is used, the density of the aggregate shoulder material, when compared to the theoretical maximum density as determined in accordance with the requirements of VTM-1 or VTM-12, shall conform to the following:

% Material Retained on No. 4 Sieve		Min. % Density
0-50		95
51-60		90
61-70		85

Section 308.03 Procedures of the Specifications is amended to replace the second sentence of the fourth paragraph and subsequent chart with the following:

The density of each layer of subbase aggregate material, when compared to the theoretical maximum density as determined in accordance with the requirements of VTM-1, shall conform to the following:

% Material Retained on No. 4 Sieve		Min. % Density
0-50		95
51-60		90
61-70		85

Section 309.05 Density Requirements of the Specifications is amended to replace the second sentence of the second paragraph and subsequent chart with the following:

The density of each layer of aggregate material, when compared to the theoretical maximum density as determined in accordance with the requirements of VTM-1, shall conform to the following:

% Material Retained on No. 4 Sieve		Min. % Density
0-50		95
51-60		90
61-70		85