Geotechnical Engineering Report

Proposed Hobucken USCG Station Boat Maintenance Building

Highway 33

Hobucken, North Carolina

November 21, 2014

Project No. 72145057

Prepared for:

The Johnson – McAdams Firm
Collierville, Tennessee

Prepared by:

Terracon Consultants, Inc.
Winterville, North Carolina

November 21, 2014

The Johnson – McAdams Firm
340 Poplar View Lane East; Suite 4
Collierville, Tennessee 38017

Attention: Mr. Chip Johnson, PE

Re: Geotechnical Engineering Report
Proposed Hobucken USCG Station Boat Maintenance Building
Highway 33
Hobucken, NC
Terracon Project No. 72145057

Dear Mr. Johnson:

Terracon Consultants, Inc. (Terracon) has completed the geotechnical engineering services for the above referenced project. This study was performed in general accordance with our proposal P72140218, dated October 6, 2014. We received written authorization to proceed on the project on October 6, 2014. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design of foundations for the proposed boat maintenance building.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.

Andrew J. Gliniak
Geotechnical Project Engineer

NORTH CAROLINA PROFESSIONAL SEAL 034749 ENGINEER RAYMOND L. DENTON II

R.L. "Levi" Denton, II PE
Principal / Geotechnical Manager
Registered NC 034749

Enclosures

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EXECUTIVE SUMMARY

The following items represent a brief summary of the findings of our subsurface exploration and recommendations for the proposed boat maintenance building to be located at the Hobucken USCG Station in Hobucken, North Carolina. Two borings were performed to a depth of approximately 20 feet below the existing ground surface

- The proposed single story boat maintenance building will be approximately 48 feet deep by 24 to 36 feet wide by 15 feet tall. It will consist of a pre-engineered metal building.

- At the time of our site exploration, the site was undeveloped and covered with grass.

- Based on the results of the borings, subsurface conditions on the project site can be generalized as very loose to loose sands to a depth of about 6 to 8 feet underlain by loose to medium dense sands to a depth of about 18 feet that are underlain by very loose to loose sands.

- The primary geotechnical considerations are the presence of very loose to loose sands to a depth of about 6 to 8 feet below the ground surface and the shallow groundwater table at the site. Shallow foundations consisting of a monolithic slab with thickened edges and column areas are recommended after preparing the subgrade and placing engineered fill. We understand site grades will be raised by 2 to 4 feet. Prior to placing fill, the exposed subgrade soils in the building footprint should be compacted using a heavy vibratory roller. The high ground water table will require intermittent rolling operations to allow surface/pore water pressure to subside. After vibratory rolling, a thorough proofrolling should be performed to detect areas of unstable soil that may need to be overexcavated and replaced. Foundations bearing on the newly placed fill materials could be designed using a maximum net allowable soil bearing pressure of 1,500 psf.

- Performing earthwork operations during warmer periods of the year (May through October) will reduce the potential for problems associated with unstable subgrades. Site drying conditions are typically enhanced when it is warm.

- We recommend Terracon be retained to observe and test the foundation bearing materials and as well as other construction materials at the site.

This summary should be used in conjunction with the entire report for design purposes. Details were not included or fully developed in this section, and the report must be read in its entirety for a comprehensive understanding of the items contained herein. The section titled **GENERAL COMMENTS** should be read for an understanding of report limitations.

GEOTECHNICAL ENGINEERING REPORT
PROPOSED HOBUCKEN USCG STATION BOAT MAINTENANCE BUILDING
HOBUCKEN, NORTH CAROLINA

Terracon Project No. 72145057
November 21, 2014

1.0 INTRODUCTION

We have completed the geotechnical engineering report for the proposed boat maintenance building to be located at the Hobucken USCG Station in Hobucken, North Carolina. Two borings were performed to a depth of approximately 20 feet below the existing ground surface. Logs of the borings along with a site location plan and a boring location plan are included in Appendix A of this report.

The purpose of these services is to provide information and geotechnical engineering recommendations relative to:

- subsurface soil conditions
- groundwater conditions
- earthwork
- foundation design and construction
- seismic considerations
- floor slab design and construction

2.0 PROJECT INFORMATION

2.1 Project Description

ITEM	DESCRIPTION
Site Location	See Appendix A, Exhibit A-1, Site Location Plan
Site layout	See Appendix A, Exhibit A-2, Boring Location Plan
Site GPS	Latitude: 35.247435° Longitude: -76.592947°
Structure	A single story boat maintenance building 48 feet deep by 24 to 36 feet wide by 15 feet tall.
Building Construction	The building will be a pre-engineered metal building with a concrete slab on grade.
Maximum loads	Columns: 40 kips (assumed) Walls: 2 kips lf (assumed) Floor: 100 psf (assumed)
Maximum Allowable Settlement	Up to 1-inch Total and up to 3/4-inch differential along 40 feet of wall (assumed).

ITEM	DESCRIPTION
Finished floor elevation	Not provided.
Grading	Fill heights of 3 feet or more are anticipated.

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	The Hobucken USCG Station is located on Highway 33 in Hobucken, Pamlico County, NC.
Existing improvements	The site for the proposed boat maintenance building is currently undeveloped and adjacent to the boat ramp.
Current ground cover	Grassed.
Existing topography	Relatively level.

3.0 SUBSURFACE CONDITIONS

3.1 Typical Profile

Based on the results of the borings, subsurface conditions on the project site can be generalized as shown on the following table:

Description	Approximate Depth to Bottom of Stratum (feet)	Material Encountered	Consistency/Density
Surface	0.7	Topsoil	N/A
Stratum 1	6.0 to 8.0	Poorly Graded Sand with Silt (SP-SM), Clayey Sand (SC), and Silty Sand (SM)	Very Loose to Loose
Stratum 2	18.0	Poorly Graded Sand with Silt (SP-SM) and Silty Sand (SM)	Loose to Medium Dense
Stratum 3	20.0	Clayey Sand (SC) and Silty Sand (SM)	Very Loose to Loose

Laboratory tests for water content, Atterberg limits, and grain size were conducted on selected soil samples and the test results are presented in Appendix B of this report and in the following table:

Boring Number	Sample Depth (feet)	Liquid Limit (%)	Plasticity Index (%)	#200 Wash (%)	Natural Moisture (%)
B-1	6.0 – 7.5	NP	NP	12	27
B-2	3.5 – 5.0	39	4	41	70

Conditions encountered at the boring locations are indicated on the boring logs. Stratification boundaries on the boring logs represent the approximate location of changes in soil types; in-situ, the transition between materials may be gradual. For a comprehensive description of the conditions encountered in the borings, refer to the boring logs in Appendix A of this report.

3.2 Groundwater

Mud rotary drilling techniques were used to advance the borings. The boreholes were observed while drilling and after completion for the presence and level of groundwater. Groundwater was observed at a depth of approximately 2 feet below the ground surface in all of the borings while drilling. The moisture condition of the soil samples supports this groundwater level.

The groundwater level can change due to seasonal variations in the amount of rainfall, runoff and other factors not evident at the time the borings were performed. The possibility of groundwater level fluctuations should be considered when developing the design and construction plans for the project.

3.3 Site Geology

The subject site is located in the Coastal Plain Physiographic Province. The Coastal Plain soils consist mainly of marine sediments that were deposited during successive periods of fluctuating sea level and moving shoreline. The soils include sands, silts, and clays with irregular deposits of shells, which are typical of those lain down in a shallow sloping sea bottom. Recent alluvial sands, silts, and clays are typically present near rivers and creeks. According to the *1985 Geologic Map of North Carolina*, the site is mapped within Surficial Deposits, Undivided.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The primary geotechnical considerations are the presence of very loose to loose sands to a depth of about 6 to 8 feet below the ground surface and a shallow groundwater table. Shallow foundations consisting of a monolithic slab with thickened edges and column areas are

recommended after preparing the subgrade and placing engineered fill. Site grades are anticipated to be raised 3 to 4 feet with engineered fill to raise the building above the flood plain.

After site clearing and stripping and prior to placing fill, the exposed subgrade soils in the building footprint should be densified in-place using a heavy weight vibratory roller. The high ground water table will require intermittent rolling operations to allow surface/pore water pressure to subside. The purpose of the vibratory rolling is to improve the exposed subgrade soils for floor slab and pavement support and to potentially improve the foundation bearing soils. The exposed subgrade soils should then be proofrolled to evaluate their stability and suitability relative to supporting new fill, or floor slabs.

After the vibratory rolling and proofrolling, the site grades should be raised to the required subgrade elevation and sloped to promote drainage. Foundation construction should not commence until two weeks has passed since the last of the engineered fill is placed to allow for any additional settlement due to the new fill.

Foundations are expected to bear on the new engineered fill compacted to the recommendations given herein. Foundations bearing on these suitable materials could be designed using a maximum net allowable soil bearing pressure of 1,500 psf.

Performing earthwork operations during warmer periods of the year (May through October) will reduce the potential for problems associated with unstable subgrades. Site drying conditions are typically enhanced when it is warm. The moisture sensitivity of the on-site soils does not preclude performing earthwork at other times of the year, but does lead to an increased potential for having to perform overexcavation and replacement or some other form of remedial work. Protecting the exposed subgrade soils from infiltration of surface water by keeping the site grades sloped to promote runoff in advance of rain events will also reduce the potential for needing to perform remedial work on wet subgrades. Should unstable subgrade conditions develop, stabilization measures should be employed.

A more complete discussion of these points and additional information is included in the following sections.

4.2 Earthwork

Site preparation should begin with the removal of surface vegetation and root systems. Based on site observations during the drilling process, topsoil should be stripped to a depth of approximately 8 inches after clearing. However, surface stripping depths may vary between borings and a Terracon representative should field verify the stripping depth during construction. Topsoil may be reused in areas of the site to be landscaped. Topsoil should not be used as structural fill or backfill.

After clearing and stripping, the exposed subgrade soils in the building and parking lot footprints should be densified in place using a heavy weight vibratory roller. The high ground water table will require intermittent frolling operations to allow surface/pore water pressure to subside. The purpose of the vibratory rolling is to improve the exposed subgrade soils for floor slab and pavement support and to potentially improve the foundation bearing soils. The roller should make at least six passes across the site, with the second set of three passes perpendicular to the first set of three passes. If water is brought to the surface by the vibratory rolling, the operation should be discontinued until the water subsides. Vibratory rolling should be completed during dry weather.

Proofrolling should then be performed on the exposed subgrade soils with a fully loaded, tandem-axle, dump truck or similar rubber-tired construction equipment. Proofrolling is recommended as a means of detecting areas of soft or unstable subgrade soils. The proofrolling should be performed during a period of dry weather to avoid degrading an otherwise suitable subgrade. The proofrolling operations should be observed by a representative of the geotechnical engineer. Subgrade soils that exhibit excessive rutting or deflection during proofrolling should be overexcavated as directed by the representative and replaced with properly compacted fill.

After the vibratory rolling and proofrolling, the site grades should be raised to a suitable subgrade elevation to promote drainage. We understand 2 to 4 feet of new engineered fill will be placed and our recommendations are contingent upon placement of this fill. Slopes of the fill should not be steeper than three horizontal to one vertical (3H:1V). Building construction should not commence until 2 weeks after the last of the engineered fill has been placed.

Engineered fill should meet the following material property requirements:

Fill Type [1,]	USCS Classification	Acceptable Location for Placement
Imported Soil With < 15% silt or clay	SC, SM, SP	All locations and elevations

1. Controlled, compacted fill should consist of approved materials that are free of deleterious material such as organic matter and debris. A sample of each material type should be submitted to the geotechnical engineer for evaluation.

4.2.1 Compaction Requirements

We recommend that the fill be placed as recommended in the following table.

ITEM	DESCRIPTION
Fill Lift Thickness	9-inches or less in loose thickness (4" to 6" lifts when hand-operated equipment is used).
Compaction Requirements [1]	Compact to a minimum of 95% of the materials standard Proctor maximum dry density (ASTM D 698).
Moisture Content – Structural Fill	Within the range of -2% to +2% of optimum moisture content as determined by the standard Proctor test at the time of placement and compaction.

1. Engineered fill should be tested for moisture content and compaction during placement. If in-place density tests indicate the specified moisture or compaction limits have not been met, the area represented by the tests should be reworked and retested as required until the specified moisture and compaction requirements are achieved.

4.2.2 Grading and Drainage

During construction, grades should be sloped to promote runoff away from the construction area. Final surrounding grades should be sloped away from the structures on all sides to prevent ponding of water. Gutters/downspouts should not discharge directly adjacent to the building. This can be accomplished through the use of splash-blocks, downspout extensions, and flexible pipes that are designed to attach to the end of the downspout. Flexible pipe should only be used if it is daylighted in such a manner that it gravity-drains collected water. Splash-blocks should also be considered below hose bibs and water spigots.

4.2.3 Construction Considerations

The site should be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed or these materials should be scarified, moisture conditioned, and recompacted.

As a minimum, all temporary excavations should be sloped or braced as required by Occupational Safety and Health Administration (OSHA) regulations to provide stability and safe working conditions. Temporary excavations will most likely be required during grading operations. The grading contractor, by his contract, is usually responsible for designing and constructing stable, temporary excavations and should shore, slope or bench the sides of the excavations as required, to maintain stability of both the excavation sides and bottom. All excavations should comply with applicable local, state and federal safety regulations, including the current OSHA Excavation and Trench Safety Standards.

The geotechnical engineer should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation; vibratory rolling, proofrolling; placement and compaction of controlled compacted fills; and backfilling of excavations.

4.3 Foundation Recommendations

4.3.1 Shallow Foundations

In our opinion, the proposed structure can be supported by a shallow foundation system after vibratory rolling and placement of engineered fill. The shallow foundations should consist of a monolithic slab with thickened edges and column areas. The new engineered fill and prepared vibratory rolled subgrade are expected to carry the majority of the foundation stresses, thereby reducing the effect of the original very loose/loose underlying soils on building settlement.

Design recommendations for a shallow foundation system are presented in the following table and paragraphs.

DESCRIPTION	VALUE
Maximum Net allowable bearing pressure [1]	1,500 psf
Minimum embedment below lowest adjacent finished grade for frost protection and protective embedment [2]	12 inches
Minimum width for continuous wall footings	16 inches
Minimum width for isolated column footings	24 inches
Approximate total settlement [3]	Up to 1 inch
Estimated differential settlement [3]	Up to 1/2 inch along 40 feet of wall
Ultimate coefficient of sliding friction	0.35

1. The recommended net allowable bearing pressure is the pressure in excess of the minimum surrounding overburden pressure at the footing base elevation.
2. For perimeter footings and footings beneath unheated areas.
3. The actual magnitude of settlement that will occur beneath the foundations will depend upon the variations within the subsurface soil profile, the structural loading conditions and the quality of the foundation excavation. The estimated total and differential settlements listed assume that the foundation-related earthwork and the foundation design are completed in accordance with our recommendations.

4.3.2 Construction Considerations

The foundation bearing materials should be evaluated at the time of the foundation excavation after a minimum of 2 weeks has passed after placing the last of the engineered fill. This is an essential part of the construction process. A representative of the geotechnical engineer should use a combination of hand auger borings and dynamic cone penetrometer (DCP) testing to determine the suitability of the bearing materials for the design bearing pressure. DCP testing

should be performed to a depth of 3 to 5 feet below the bottom of footing excavation. Excessively soft, loose or wet bearing soils should be overexcavated to a depth recommended by the geotechnical engineer. The footings could then bear directly on these soils at the lower level or the excavated soils could be replaced with compacted soil fill or washed, crushed stone (NCDOT No. 57) wrapped in a geotextile fabric (Mirafi 140 N or equivalent).

Raising site grades and remedial work such as the vibratory rolling during initial site preparation are expected to reduce, but not necesarily eliminate, the need for over excavation.

The base of all foundation excavations should be free of water and loose soil prior to placing concrete. Concrete should be placed soon after excavating to reduce bearing soil disturbance. Should the soils at bearing level become excessively disturbed or saturated, the affected soil should be removed prior to placing concrete.

4.4 Seismic Considerations

Code Used	Seismic Parameters
2012 North Carolina Building Code	Seismic Site Class E Ss = 0.107 S_1 = 0.056 S_{ms} = 0.267 S_{m1} = 0.195 S_{DS} = 0.178 S_{D1} = 0.130

Based on our experience with the geology of the area, it is our opinion that the subsurface characteristics reflect those of Site Class E as described in the 2012 North Carolina State Building Code. Liquefaction of sand is not expected based on the relatively low level of ground motions projected for a seismic event and the amount of fines content in the subsurface materials.

4.5 Floor Slabs

4.5.1 Design Recommendations

ITEM	DESCRIPTION
Floor slab support	Approved new engineered fill.
Modulus of subgrade reaction	100 pounds per square inch per inch (psi/in) for point loading conditions.
Capillary Break layer	4 inches of washed crushed stone (No. 57).

Saw-cut control joints should be placed in the slab to help control the location and extent of cracking. For additional recommendations, refer to the ACI Design Manual.

The use of a vapor retarder should be considered beneath concrete slabs on grade that will be covered with wood, tile, carpet or other moisture sensitive or impervious coverings. The slab designer should refer to ACI 302 and/or ACI 360 for procedures and cautions regarding the use and placement of a vapor retarder.

4.5.2 Construction Considerations

On most project sites, the site grading is generally accomplished early in the construction phase. However as construction proceeds, the subgrade may be disturbed due to utility excavations, construction traffic, desiccation, rainfall, etc. If such disturbance occurs, the floor slab subgrade may not be suitable for placement of the stone sub base and concrete and corrective action will be required. Areas where unsuitable conditions are located should be repaired by removing and replacing the affected material with properly compacted fill. Floor slab subgrade areas should be moisture conditioned and properly compacted to the recommendations in this report immediately prior to placement of the aggregate base course and concrete.

5.0 GENERAL COMMENTS

Terracon should be retained to review the final design plans and specifications so comments can be made regarding interpretation and implementation of our geotechnical recommendations in the design and specifications. Terracon also should be retained to provide observation and testing services during grading, excavation, foundation construction and other earth-related construction phases of the project.

The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. If variations appear, we should be immediately notified so that further evaluation and supplemental recommendations can be provided.

The scope of services for this project does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

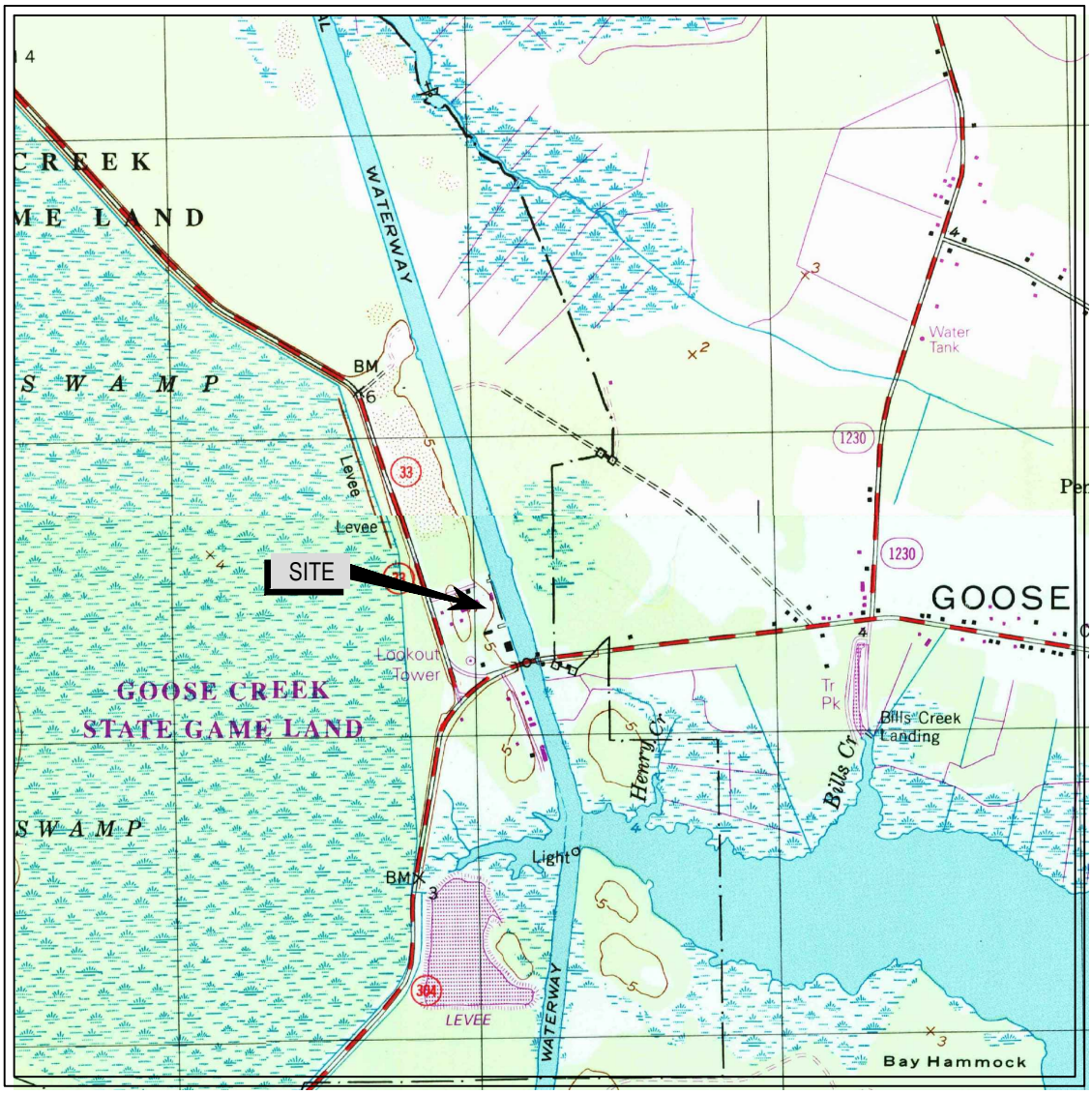
This report has been prepared for the exclusive use of our client for specific application to the project discussed and has been prepared in accordance with generally accepted geotechnical engineering practices. No warranties, either expressed or implied, are intended or made. Site safety, excavation support, and dewatering requirements are the responsibility of others. In the event that changes in the nature, design, or location of the project as outlined in this report are

planned, the conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing.

APPENDIX A

FIELD EXPLORATION

UNITED STATES – DEPARTMENT OF THE INTERIOR – GEOLOGICAL SURVEY



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1000 0 METERS 1000 2000

1 .5 0 1

MILES

1000 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10 000

FEET

CONTOUR INTERVAL 5 FEET

NATIONAL GEODETIC VERTICAL DATUM OF 1929

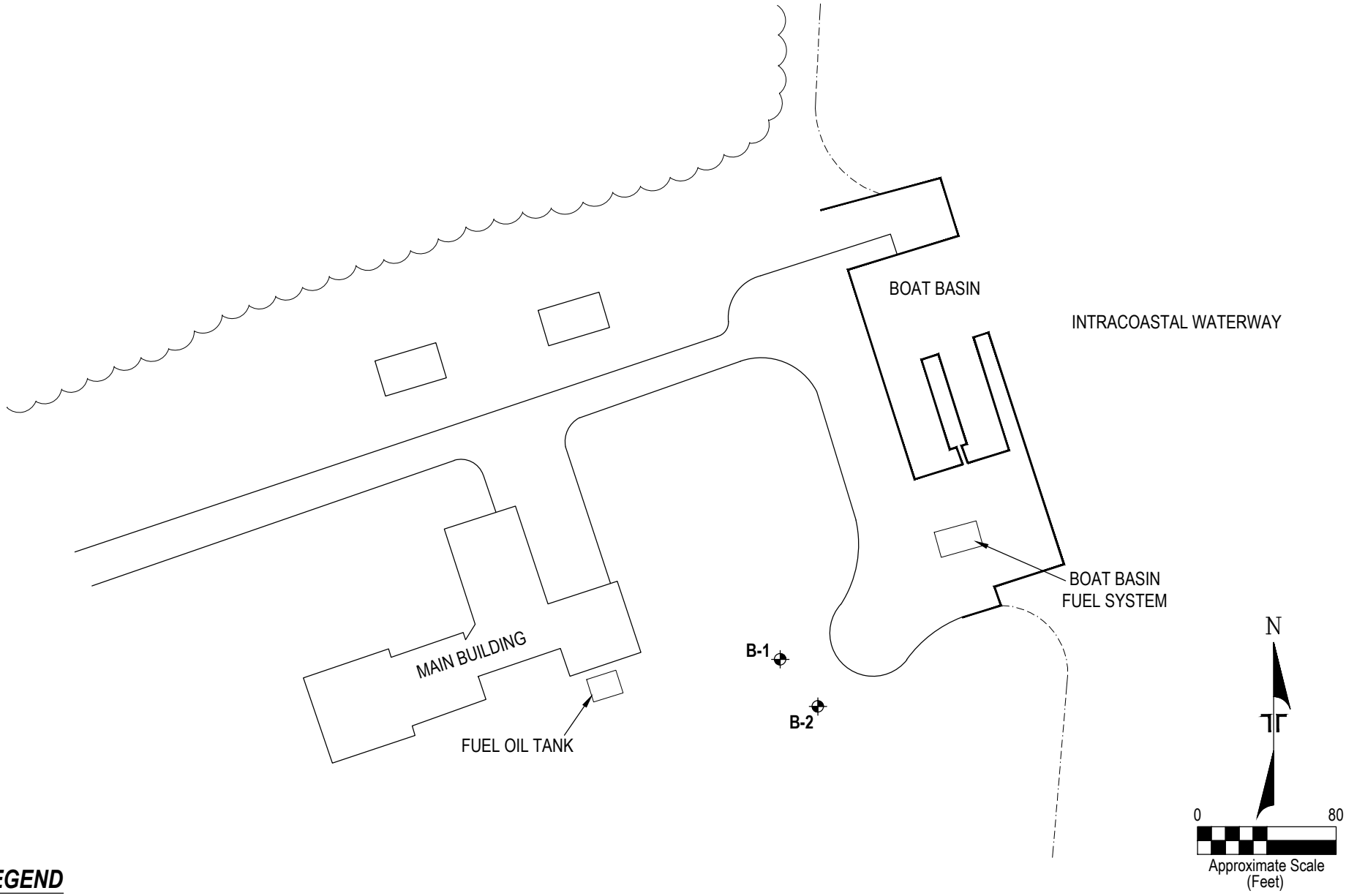
N

LOWLAND, NC
JONES BAY, NC*
2000
7.5 MINUTE SERIES (TOPOGRAPHIC)

Project Mngr: AJG	Project No. 72145057	Terracon Consulting Engineers and Scientists	SITE LOCATION PLAN
Drawn By: TLY	Scale: AS SHOWN	314 Beacon Drive Winterville, NC 28590	GEOTECHNICAL ENGINEERING REPORT
Checked By: AJG/MRF	File No. GEO72145057-1	(252) 353-1600 (252) 353-0002	PROPOSED HOBUCKEN USCG BOAT MAINTENANCE BUILDING
Approved By: CB	Date: OCTOBER 2014		HIGHWAY 33 WEST
			HOBUCKEN, NC

EXHIBIT

A-1



LEGEND

SITE

BORING LOCATION

THIS DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Mngr: AJG	Project No. 72145057
Drawn By: TLY	Scale: AS SHOWN
Checked By: AJG/MRF	File No. GEO72145057-2
Approved By: AJG	Date: OCTOBER 2014

Terracon
Consulting Engineers and Scientists
314 Beacon Drive Winterville, NC 28590
(252) 353-1600 (252) 353-0002

BORING LOCATION DIAGRAM

GEOTECHNICAL ENGINEERING REPORT
PROPOSED HOBUCKEN USCG BOAT MAINTENANCE BUILDING
HIGHWAY 33 WEST
HOBUCKEN, NC

EXHIBIT

A-2

Field Exploration Description

The boring locations were marked by a representative of Terracon using a measuring wheel and referencing existing site features shown on the site plan provided to us. Boring elevation information was not provided. The locations of the borings should be considered accurate only to the degree implied by the means and methods used to define them.

The soil test borings were performed by a trailer-mounted CME 45 power drilling rig utilizing mud rotary drilling procedures to advance the boreholes. The drilling tools were removed from the borehole and representative soil samples were obtained at 2.5 to 5 foot intervals using split-barrel sampling procedures. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon is driven into the ground with a 140-pound automatic hammer falling a distance of 30 inches. After seating the sampler six inches at the bottom of the borehole to penetrate any loose cuttings, the sampler is driven an additional 12 inches. The number of blows required to advance the sampling spoon the last 12 inches is recorded as the standard penetration resistance value (N-value). These N-values are indicated on the boring logs at the depths of occurrence.

The samples were tagged for identification, sealed to reduce moisture loss, and taken to our laboratory for further examination, testing, and classification. Information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions.

A field log of each boring was prepared by the drill crew. These logs included visual classifications of the materials encountered during drilling as well as the driller's interpretation of the subsurface conditions between samples. Final boring logs included with this report represent the engineer's interpretation of the field logs and include modifications based on laboratory observation and tests of the samples. Additional information provided on the boring logs attached to this report includes soil descriptions, consistency evaluations, boring depths, sampling intervals, and groundwater conditions

BORING LOG NO. B-1

PROJECT: Hobucken USCG Station Boat Maintenance Bldg

CLIENT: The Johnson - McAdams Firm
Collierville, TN

SITE: Hwy 33
Hobucken, NC

GRAPHIC LOG	LOCATION See Exhibit A-2 / DEPTH	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
	0.7 **Grass/Topsoil/Rootmat**						
	POORLY GRADED SAND WITH SILT (SP-SM), dark brown and dark gray to light gray, very loose to loose		▽		5-5-4 N=9		
					0-0-0 N=0		
		5			2-3-3 N=6	27	NP
	8.5 **SILTY SAND (SM)**, dark brown and dark gray to light gray, loose to medium dense				3-4-6 N=10		
		10					
					2-3-4 N=7		
		15					
	18.0 **CLAYEY SAND (SC)**, dark gray, loose				2-2-2 N=4		
	20.0 ***Boring Terminated at 20 Feet***	20					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While Drilling*

Terracon
314 Beacon Drive
Winterville, North Carolina

Boring Started: 10/20/2014 | Boring Completed: 10/20/2014

Drill Rig: 45D-14 | Driller: Carolina Drilling, Inc.

Project No.: 72145057 | Exhibit: A-4

BORING LOG NO. B-2

PROJECT: Hobucken USCG Station Boat Maintenance Bldg

CLIENT: The Johnson - McAdams Firm
Collierville, TN

SITE: Hwy 33
Hobucken, NC

LOCATION See Exhibit A-2

DEPTH	GRAPHIC LOG		DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD TEST RESULTS	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI
0.7		**Grass/Topsoil/Rootmat**						
		CLAYEY SAND (SC), with organics, dark gray brown to dark brown, very loose to loose		▽		1-2-2 N=4	29	
3.0		**SILTY SAND (SM)**, dark brown, light gray to dark gray, very loose to medium dense				0-0-0 N=0	70	39-35-4
			5			1-1-1 N=2	65	
						7-7-8 N=15	27	
			10					
						2-3-2 N=5	34	
			15					
						2-1-2 N=3	30	
20.0		***Boring Terminated at 20 Feet***	20					

Stratification lines are approximate. In-situ, the transition may be gradual.

Hammer Type: Automatic

Advancement Method:
Mud Rotary

Abandonment Method:
Borings backfilled with soil cuttings upon completion.

See Exhibit A-3 for description of field procedures.
See Appendix B for description of laboratory procedures and additional data (if any).
See Appendix C for explanation of symbols and abbreviations.

Notes:

WATER LEVEL OBSERVATIONS

▽ *While Drilling*

Terracon
314 Beacon Drive
Winterville, North Carolina

Boring Started: 10/20/2014 | Boring Completed: 10/20/2014

Drill Rig: 45D-14 | Driller: Carolina Drilling, Inc.

Project No.: 72145057 | Exhibit: A-5

APPENDIX B
LABORATORY TESTING

Laboratory Testing

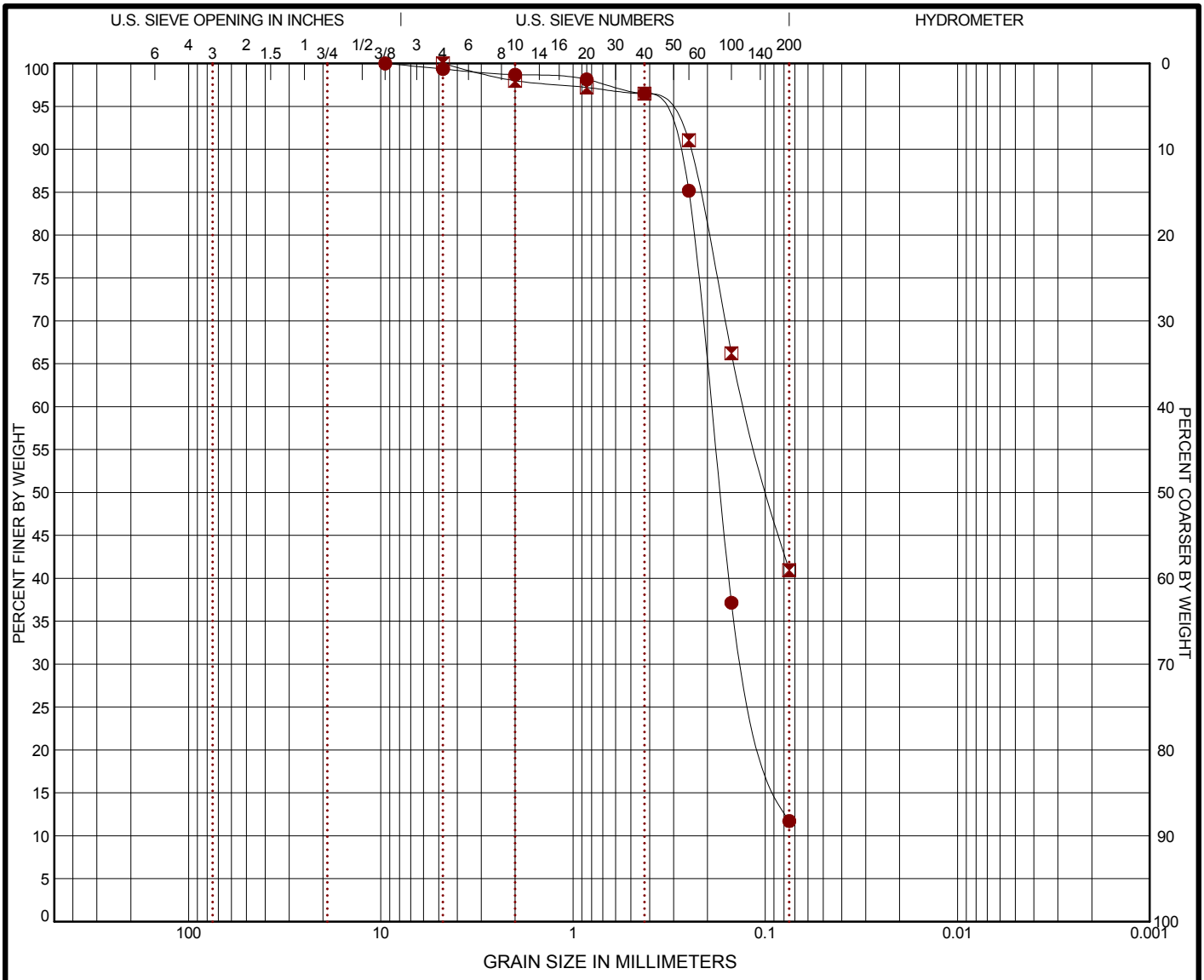
Descriptive classifications of the soils indicated on the boring logs are in accordance with the enclosed General Notes and the Unified Soil Classification System. Also shown are estimated Unified Soil Classification Symbols. A brief description of this classification system is attached to this report. Soils laboratory testing was performed under the direction of a geotechnical engineer and included visual classification, moisture content, grain size analysis and Atterberg limits, as appropriate. The results of the laboratory testing are shown on the borings logs and in Appendix B.

- ASTM D2216 Standard Test Method of Determination of Water Content of Soil and Rock by Mass
- ASTM D2487 Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
- ASTM D2488 Standard Practice of Description and Identification of Soils (Visual Manual Method)
- ASTM D422 Standard Test Method for Particle Size Analysis of Soils
- ASTM D4318 Standard Test Method for Liquid Limit, Plastic Limit and Plasticity Index of Soils

Procedural standards noted above are for reference to methodology in general. In some cases variations to methods are applied as a result of local practice or professional judgment.

GRAIN SIZE DISTRIBUTION

ASTM D422



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**B-1**	**6 - 7.5**	**0.0**	**0.7**	**87.6**		**11.7**		**SP-SM**
⊠	**B-2**	**3.5 - 5**	**0.0**	**0.0**	**59.0**		**41.0**		**SM**

	GRAIN SIZE		
	●	⊠	
D_{60}	**0.191**	**0.126**	
D_{30}	**0.123**		
D_{10}			
	COEFFICIENTS		
C_C	**1.11**		
C_U	**2.67**		

SIEVE (size)	PERCENT FINER ●	PERCENT FINER ⊠	
1 1/2"			
1"			
3/4"			
1/2"			
3/8"	100.0		
#4	99.35	100.0	
#10	98.69	97.98	
#20	98.13	97.2	
#40	96.5	96.49	
#60	85.17	91.04	
#100	37.16	66.22	
#200	11.72	40.96	

SOIL DESCRIPTION

● DARK BROWN & DARK GRAY POORLY GRADED SAND WITH SILT

⊠ DARK BROWN & LIGHT GRAY SILTY SAND

REMARKS

●

⊠

PROJECT: Hobucken USCG Station Boat Maintenance Bldg

SITE: Hwy 33
Hobucken, NC

Terracon
314 Beacon Drive
Winterville, North Carolina

PROJECT NUMBER: 72145057

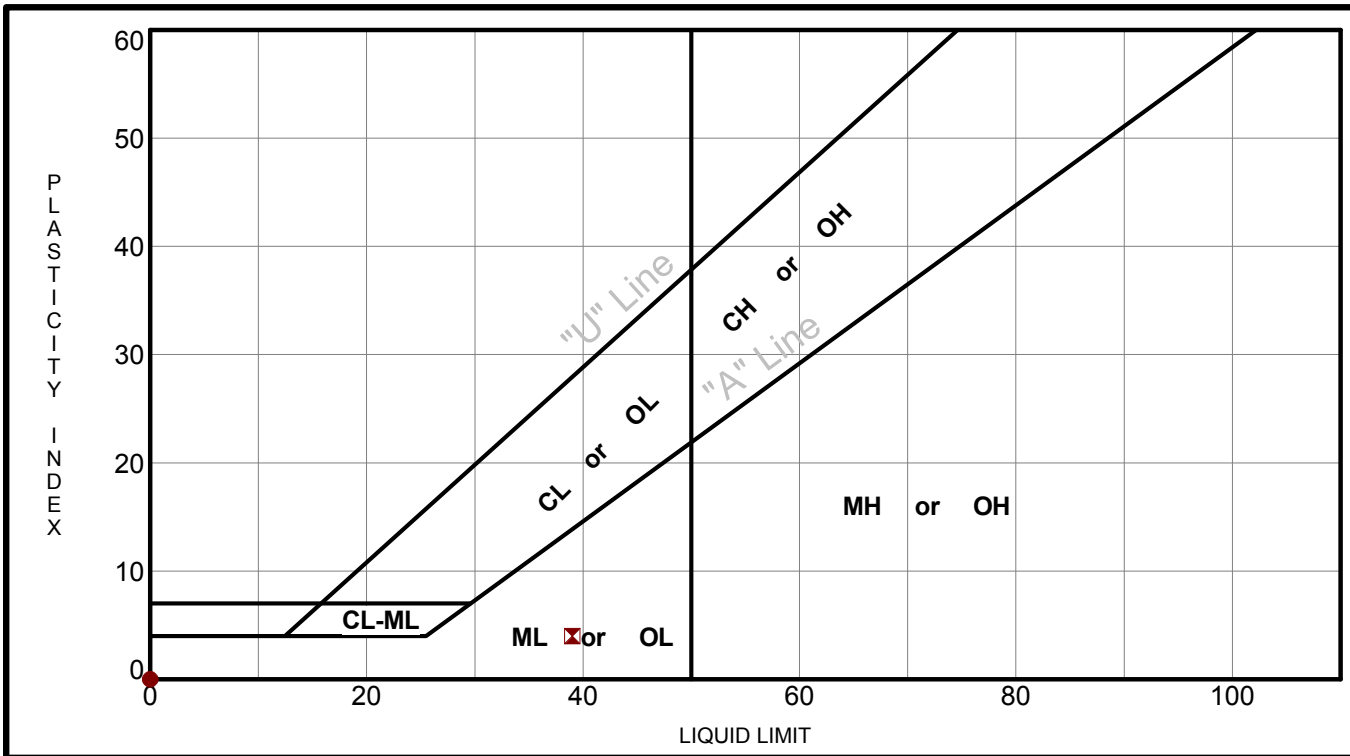
CLIENT: The Johnson - McAdams Firm
Collierville, TN

EXHIBIT: B-2

LABORATORY TESTS ARE NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GRAIN SIZE: USCS 1 72145057 PROPOSED HOBUCKEN USCG STATION BOAT MAINTENANCE BLDG; HOBUCKEN, NC.GPJ TERRACON2012.GDT 11/17/14

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth (ft)	LL	PL	PI	Fines	USCS	Description
●	**B-1**	**6.0 - 7.5**	**NP**	**NP**	**NP**	**11.7**	**SP-SM**	**DRK BRWN & DRK GRY POORLY GRADED SAND WITH SILT**
⊠	**B-2**	**3.5 - 5.0**	**39**	**35**	**4**	**41.0**	**SM**	**DARK BROWN & LIGHT GRAY SILTY SAND**

PROJECT: Hobucken USCG Station Boat Maintenance Bldg

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Collierville, TN

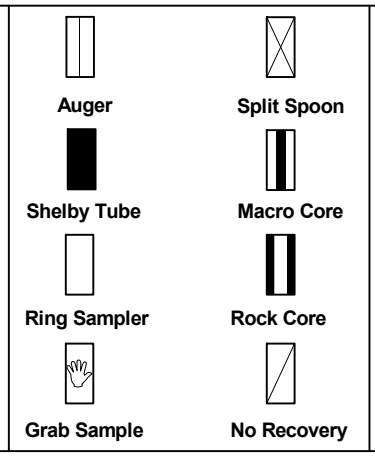
EXHIBIT: B-3

APPENDIX C
SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING



WATER LEVEL

Water Initially Encountered

Water Level After a Specified Period of Time

Water Level After a Specified Period of Time

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	Hand Penetrometer
(T)	Torvane
(b/f)	Standard Penetration Test (blows per foot)
(PID)	Photo-Ionization Detector
(OVA)	Organic Vapor Analyzer

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			CONSISTENCY OF FINE-GRAINED SOILS (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	4 - 8	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 15	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests [A]					Soil Classification	
					Group Symbol	Group Name [B]
Coarse Grained Soils: More than 50% retained on No. 200 sieve	**Gravels:** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravels:** Less than 5% fines [C]	$Cu \geq 4$ and $1 \leq Cc \leq 3$ [E]		GW	Well-graded gravel [F]
			$Cu < 4$ and/or $1 > Cc > 3$ [E]		GP	Poorly graded gravel [F]
		Gravels with Fines: More than 12% fines [C]	Fines classify as ML or MH		GM	Silty gravel [F,G,H]
			Fines classify as CL or CH		GC	Clayey gravel [F,G,H]
	Sands: 50% or more of coarse fraction passes No. 4 sieve	**Clean Sands:** Less than 5% fines [D]	$Cu \geq 6$ and $1 \leq Cc \leq 3$ [E]		SW	Well-graded sand [I]
			$Cu < 6$ and/or $1 > Cc > 3$ [E]		SP	Poorly graded sand [I]
		Sands with Fines: More than 12% fines [D]	Fines classify as ML or MH		SM	Silty sand [G,H,I]
			Fines classify as CL or CH		SC	Clayey sand [G,H,I]
Fine-Grained Soils: 50% or more passes the No. 200 sieve	**Silts and Clays:** Liquid limit less than 50	**Inorganic:**	PI > 7 and plots on or above "A" line [J]		CL	Lean clay [K,L,M]
			PI < 4 or plots below "A" line [J]		ML	Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OL	Organic clay [K,L,M,N]
			Liquid limit - not dried			Organic silt [K,L,M,O]
	Silts and Clays: Liquid limit 50 or more	**Inorganic:**	PI plots on or above "A" line		CH	Fat clay [K,L,M]
			PI plots below "A" line		MH	Elastic Silt [K,L,M]
		Organic:	Liquid limit - oven dried	< 0.75	OH	Organic clay [K,L,M,P]
			Liquid limit - not dried			Organic silt [K,L,M,Q]
Highly organic soils:	Primarily organic matter, dark in color, and organic odor				PT	Peat

[A] Based on the material passing the 3-inch (75-mm) sieve

[B] If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

[C] Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

[D] Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay

[E] $Cu = D_{60}/D_{10}$ $\quad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

[G] If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

[H] If fines are organic, add "with organic fines" to group name.

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

[J] If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

[K] If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] PI ≥ 4 and plots on or above "A" line.

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.