Geotechnical Engineering Report

2nd Street Sink Hole

706 E 2nd Street

Greenville, North Carolina

May 5, 2016

Project No. 72165031

Prepared for:

The East Group PA
Greenville, North Carolina

Prepared by:

Terracon Consultants, Inc.
Winterville, North Carolina

terracon.com

Terracon

Environmental ■ Facilities ■ Geotechnical ■ Materials

May 5, 2016

The East Group, PA
324 Evans Street
Greenville, North Carolina 27858

Attn: Mr. Todd Tripp, PE

Re: Geotechnical Engineering Report
2nd Street Sink Hole Project
706 East 2nd Street
Greenville, North Carolina
Terracon Project No. 72165031

Dear Mr. Tripp:

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 P72165031, dated April 15, 2016.

This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning a corner of the building compromised by a sink hole.

We appreciate the opportunity to be of service to you on this project. Materials testing services are provided by Terracon. We would be pleased to discuss these services with you. If you have any questions concerning this report, or if we may be of further service, please contact us.

Sincerely,

Terracon Consultants, Inc.

NORTH CAROLINA PROFESSIONAL SEAL 042183 ENGINEER ANDREW J. GLINIAK

Carl F Bonner

Andrew J. Gliniak, P.E.
Geotechnical Project Engineer
Registered NC 042183

Carl F. Bonner, P.E.
Office Manager / Principal

Enclosures

Reviewed By: Barney C. Hale, PE

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The following items represent a brief summary of the findings of our subsurface exploration and recommendations for the corner of the residence compromised by a sink hole located at 706 East 2nd Street in Greenville, North Carolina. One boring was advanced 20 feet below the existing ground surface.

- The boring encountered a layer of very loose to loose sand underlain by soft to medium stiff clay. Groundwater was encountered at a depth of about 2 feet below the ground surface.
- The residence foundations at the corner and near the new pipe alignment should be supported by underpinning elements extending below the invert of the stormwater pipe.
- Helical piers should be installed prior to any excavations to avoid potential damage to the residence from undermining or soil loosening. The residence foundations should be supported with helical piers that extend along the building for 10 feet on the southern wall near the sinkhole, down the length of the eastern face, and up another 5 feet on the northern face.
- Helical piers with a triple lead section that has plates about 12 inches in diameter are recommended and would be expected to develop an axial capacity of about 8 kips per pier with a factor of safety of 2 when installed to depths of 20 to 30 feet.
- We understand a new pipe and alignment are proposed and that the existing pipe will be removed or abandoned. Care should be taken during these excavations to prevent damage to the installed helical piers.
- The groundwater was relatively shallow and any excavation to replace the stormwater pipe will likely encounter groundwater. Excavations should remain dewatered until they are properly backfilled. The soils below the groundwater table are expected to have excessive moisture content which wll make them unsuitable for use as engineered fill without additional dryign.
- We recommend Terracon be retained to observe helical pier installation and observe and test the 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
2^{ND} STREET SINK HOLE
706 EAST 2^{ND} STREET
GREENVILLE, NORTH CAROLINA

Terracon Project No. 72165031

May 5, 2016

1.0 INTRODUCTION

We have completed the geotechnical engineering report for the corner of the residence compromised by a sink sink hole located at 706 East 2^{nd} Street in Greenville, North Carolina. One boring was advanced 20 feet below the existing ground surface. A log of the boring 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
- Repair recommendations

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, Exhibits A-2 and A-3, Boring Location Plan
Site GPS	Latitude: 35.6120° Longitude: -77.3649°
Structure	Existing 2-story wood framed residence on shallow foundations.
Proposed Foundation Repair	Tim Hunt of Applied Science and Production proposed 3 helical piers at the corner and about 6 to 8 feet from the corner down each of the sides of the residence. The piers would support the foundation and be connected with angle iron.
Proposed Pipe Repair	Repair the failing couplings of the pipe with sealing bands or add new stormwater pipe in an alternate alignment with a centerline about 10 feet away from the existing residence and abandon the existing stormwater pipe.
Maximum loads	Walls: 1,250 pounds per linear foot (estimated)

2.2 Site Location and Description

ITEM	DESCRIPTION
Location	The southeast corner of the residence at 706 East 2nd Street in Greenville, North Carolina.
Existing improvements	A residence that is wood framed and supported by shallow foundations. There is a small storage building with a concrete slab-on-grade on the southern side of the property next to the existing and proposed alignment of the stormwater pipe. The existing stormwater pipe is a 36 inch diameter corrugated metal pipe with an invert elevation of 7 feet below existing grades. The pipe centerline is about 2.7 feet from the corner of the residence. A smaller diameter sewer pipe is also on this corner.
Sink Hole	The sinkhole encompassed an area about 6 feet by 6 feet on the southwest corner of the residence and was caused by soil loss into the stormwater pipe couplings that are failing. The sink hole appeared to be about 3 feet deep and was filled in with No. 57 stone. The corner of the residence has subsided next to the sinkhole.
Current ground cover	Grass and gravel.
Existing topography	Relatively level.

3.0 SUBSURFACE CONDITIONS

3.1 Typical Profile

Based on the results of the boring, 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
Stratum 1	0.5	Grass/Topsoil/Rootmat	NA
Stratum 2	8	Silty Sand (SM)	Very Loose to Loose
Stratum 3	18	Lean Clay (CL), Fat Clay (CH)	Soft
Stratum 4	Boring Terminated – 20	Lean Clay (CL)	Medium-Stiff

Laboratory tests for moisture content, Atterberg limits, and grain size, were conducted on selected soil samples. The test results are presented in the Appendix B of this report and in the borings log. For a comprehensive description of the conditions encountered in the boring, refer to the boring logs in Appendix A of this report.

3.2 Groundwater

Mud rotary drilling techniques were used to advance the borings which can obscure groundwater levels. A groundwater reading was taken 48 hours after completing the boring to allow groundwater levels to stabilize over time. Groundwater was observed at a depth of about feet below the ground surface. The moisture content of the soil samples support this groundwater depth.

The groundwater level can change due to the 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.

4.0 RECOMMENDATIONS FOR DESIGN AND CONSTRUCTION

4.1 Geotechnical Considerations

The borings encountered a layer of very loose to loose sand underlain by soft to medium stiff clay. A sink hole had developed and damaged the corner of the residence. A new stormwater pipe in an alignment about 10 feet away from the residence is proposed. The foundations at the corner and near the new pipe alignment should be supported by underpinning elements extending below the invert of the stormwater pipe. The underpinning should be completed prior to any excavations for the stormwater pipe to protect the residence from further damage.

Care should be taken during these excavations to prevent damage of the installed helical piers. After the new stormwater pipe is functional, we understand that the existing pipe will be removed or abandoned in place with flowable fill.

The residence foundations should be supported with helical piers that extend along the building for 10 feet on the southern wall near the sinkhole, down the length of the eastern face, and up another 5 feet on the northern face as shown in Appendix C, Exhibit C-3. The purpose of wrapping helical piers around the residence is to protect foundations from lateral movement toward the adjacent excavations proposed for the new and existing stormwater pipes. Potential damage from excavations to the small storage building on the southern portion of the property is not expected.

Helical piers with a triple lead section that has plates about 12 inches in diameter are recommended for foundation support of the residence. The helical piers would be expected to develop an axial capacity of about 8 kips per pier with a factor of safety of 2 when installed to depths of 20 to 30 feet. Piers should not be placed more than 5 feet apart to support the foundation.

The groundwater was relatively shallow and any excavation to replace the pipe will likely encounter groundwater. Excavations should remain dewatered until they are properly backfilled. The moisture content of the soils below the groundwater table have excessive moisture content which makes them unsuitable for use as engineered fill.

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

4.2 Earthwork

Engineered fill should be used for lateral support of the proposed pipe and as backfill for a minimum of 2 feet above the pipe. General soil fill can be placed 2 feet above the pipe if pavements are not proposed over the new fill. Only engineered fill should be used for backfill in excavations under pavements.

Backfill material for the excavations can consist of soil fill, flowable fill, or No. 57 Stone wrapped in filter cloth. Soil fill should meet the following material property requirements:

Fill Type [1,\]	USCS Classification	Acceptable Location for Placement
Imported Soil	Sand[2]: SC, SM with fines > 15%	All locations and elevations.
On-site Soils [3]	Sand: SM	All locations and elevations.

1. Controlled, compacted fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to the geotechnical engineer for evaluation.
2. Sand with less than 15 % fines should not be used as it may create perched water tables below pavements.
3. On site soils that meet the above soil classifications are generally suitable for fill if properly moisture conditioned.

4.2.1 Compaction Requirements

Engineered fill should be used for lateral support of the proposed pipe and as backfill for a minimum of 2 feet above the pipe. Only engineered fill should be used for backfill in excavations under pavements. We recommend that the engineered 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). [2]
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.

General fill has no placement specifications for lift thickness, compaction, or moisture content and is intended for areas inaccessible to conventional compaction equipment. General fill should still require hand compaction.

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.

4.2.3 Construction Considerations

Groundwater is expected in an excavation to replace the stormwater pipe. Excavations should remain dewatered until they are properly backfilled.

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 Helical Pier Recommendations

We recommend the residence be underpinned by triple lead helical piers installed to a depth of about 20 to 30 feet below existing grades, into the soft to medium stiff clay or denser sand likely to be encountered. Helical piers with a triple lead section that has plates about 12 inches in diameter would be expected to develop an axial capacity of about 8 kips per pier with a factor of safety of 2 when installed to depths of 20 to 30 feet. Piers should not be placed more than 5 feet apart to support the foundation.

We recommend that the piers have an on-center spacing of at least three times the maximum flight diameter. The minimum spacing should be maintained to prevent the pile group compression capacity from being significantly less than the summation of individual pier capacities. This spacing restriction also serves to reduce the possibility of damaging previously installed piers.

The helical pier installer should develop the final pier compressive, uplift and lateral design capacities, establish reasonable pier spacing and design loads and communicate pile capacities to the structural engineer for design.

The geotechnical engineer or their representative should observe installation of the first piers to confirm the torque and depth which can be used to check the capacity of the piers.

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.

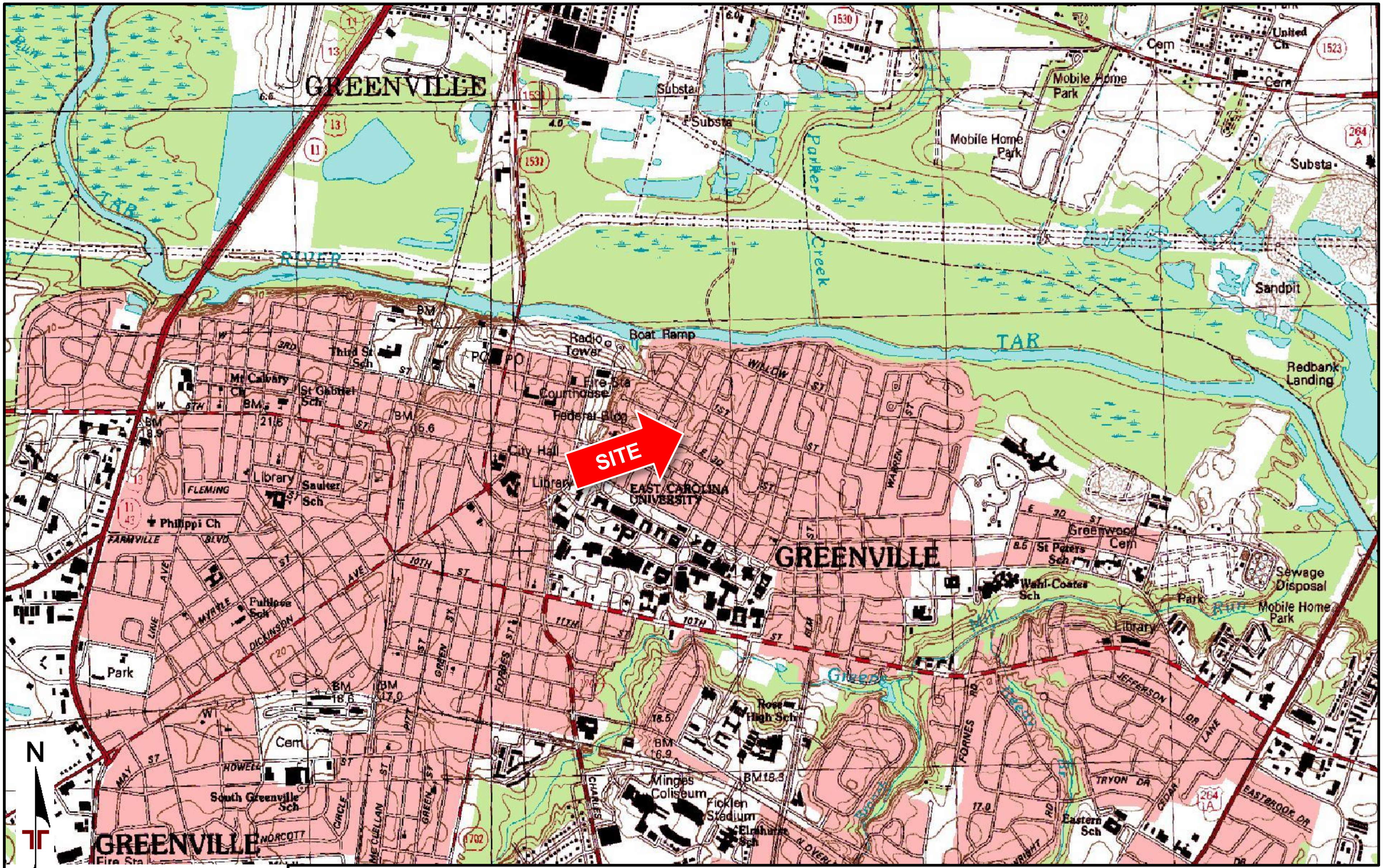
The analysis and recommendations presented in this report are based upon the data obtained from the borings performed at the indicated locations and from other information discussed in this report. This report does not reflect variations that may occur between borings, across the site, or due to the 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 express 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



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: GREENVILLE NW, NC (1/1/1998), GREENVILLE NE, NC (1/1/1998), GREENVILLE SW, NC (1/1/1998) and GREENVILLE SE, NC (1/1/1998).
DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: AJG	Project No. 72165031
Drawn by: AJG	Scale: 1"=2,000'
Checked by: BCH	File Name: 72165031 EXA
Approved by: BCH	Date: 5/3/2016

Terracon
314 Beacon Dr
Winterville, NC 28590-7956

SITE LOCATION PLAN

2nd Street Sink Hole
706 E 2nd St
Greenville, NC

Exhibit
A-1

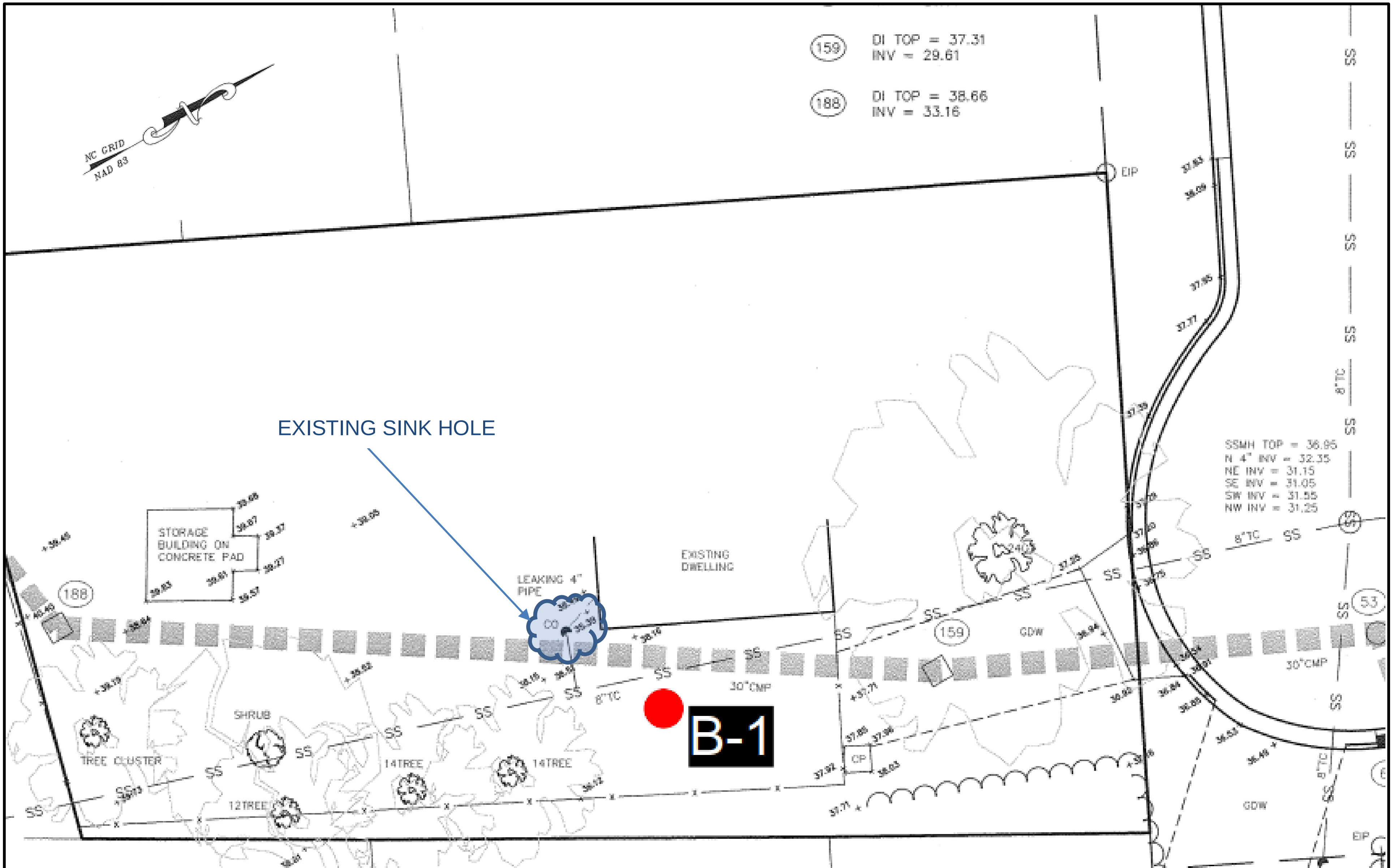


DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

Project Manager: AJG	Project No. 72165031
Drawn by: AJG	Scale: AS SHOWN
Checked by: BCH	File Name: 72165031 EXA
Approved by: BCH	Date: 5/3/2016

Terracon
314 Beacon Dr
Winterville, NC 28590-7956

BORING LOCATION PLAN

2nd Street Sink Hole
706 E 2nd St
Greenville, NC

Exhibit
A-2

Field Exploration Description

The GPS location of the borings was determined by referencing existing site features on aerial photography. The boring location was marked in the field by Terracon referencing existing site features. The location of the borings should be considered accurate only to the degree implied by the means and methods used to define it.

The soil test boring was performed by a track-mounted power drilling rig utilizing mud rotary drilling procedures to advance the boreholes. Representative soil samples were obtained at 2.5 foot intervals above a depth of 10 feet and at 5 foot intervals below 10 feet using split-barrel sampling procedures. In the split barrel sampling procedure, the number of blows required to advance a standard 2 inch O.D. split barrel sampler the last 12 inches of the typical total 18 inch penetration by means of a 140 pound automatic hammer with a free fall of 30 inches, is the standard penetration resistance value (SPT-N). This value is used to estimate the in-situ relative density of cohesionless soils and consistency of cohesive soils. Soil samples were taken.

An automatic SPT hammer was used to advance the split-barrel sampler in the boring performed on this site. A greater efficiency is typically achieved with the automatic hammer compared to the conventional safety hammer operated with a cathead and rope. Published correlations between the SPT values and soil properties are based on the lower efficiency cathead and rope method. This higher efficiency affects the standard penetration resistance blow count (N) value by increasing the penetration per hammer blow over what would be obtained using the cathead and rope method. The effect of the automatic hammer's efficiency has been considered in the interpretation and analysis of the subsurface information for this report.

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

BORING LOG NO. B-1

PROJECT: 2nd Street Sink Hole

CLIENT: East Group PA
Greenville, NC

SITE: 706 E 2nd Street
Greenville, NC

LOCATION See Exhibit A-2

Latitude: 35.612° Longitude: -77.3649°

DEPTH	Description
0.5	**Topsoil**
8.0	**SILTY SAND (SM)**, dark gray, light tan and dark brownish gray, very loose to loose
13.0	**LEAN CLAY (CL)**, light gray, soft
18.0	**FAT CLAY (CH)**, dark gray, soft
20.0	**LEAN CLAY WITH SAND (CL)**, dark gray, soft to medium-stiff
	Boring Terminated at 20 Feet

FIELD TEST RESULTS	SAMPLE	WATER CONTENT (%)	ATTERBERG LIMITS LL-PL-PI	PERCENT FINES
2-3-2 N=5	1	14		
1-1-1 N=2	2	28	NP	35
2-1-2 N=3	3	28		
1-1-1 N=2	4	54		
1-1-1 N=2	5	55		
1-2-2 N=4	6	52	43-14-29	71

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

Water Level on 4/24/16

Cave in Depth on 4/24/16

Terracon
314 Beacon Dr
Winterville, NC

Boring Started: 4/22/2016	Boring Completed: 4/22/2016
Drill Rig:	Driller: Carolina Drilling, Inc.
Project No.: 72165031	Exhibit: A-4

APPENDIX B

LABORATORY TESTING

Laboratory Test Description

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 testing as appropriate. The results of the laboratory testing are shown on the boring log and in Appendix B.

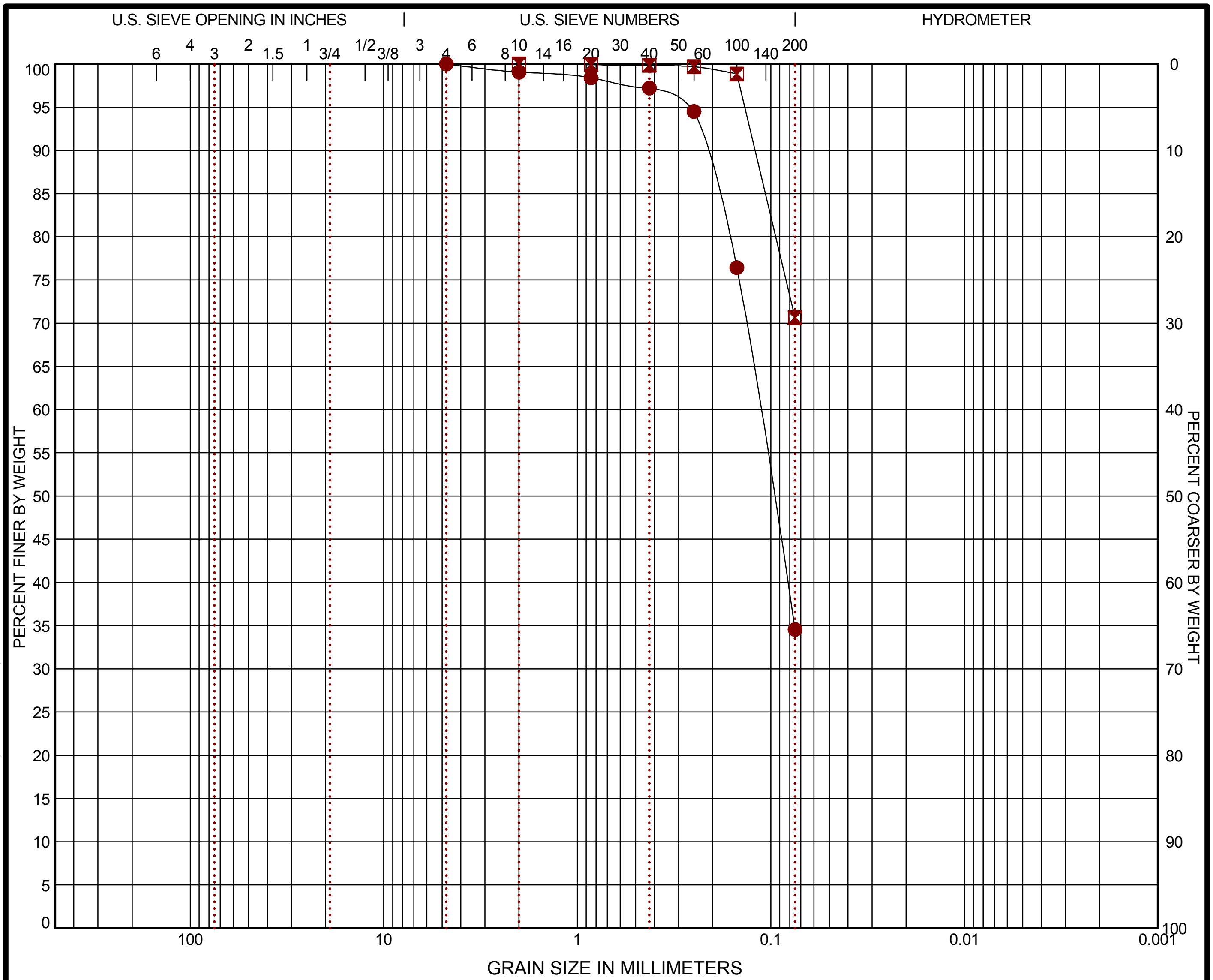
The laboratory test methods are described in the ASTM Standards listed below:

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 D1140 Standard Test Methods for Determining the Amount of Material Finer than No. 200 Sieve in Soils by Washing
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 / ASTM C136



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	BORING ID	DEPTH	% COBBLES	% GRAVEL	% SAND	% SILT	% FINES	% CLAY	USCS
●	**B-1**	**3.5 - 5**	**0.0**	**0.0**	**65.4**		**34.6**		**SM**
⊠	**B-1**	**18.5 - 20**	**0.0**	**0.0**	**29.4**		**70.6**		**CL**

	GRAIN SIZE		
	●	⊠	
D_{60}	**0.114**		
D_{30}			
D_{10}			
	COEFFICIENTS		
C_C			
C_U			

SIEVE (size)	PERCENT FINER		
	●	⊠	
1 1/2"			
1"			
3/4"			
1/2"			
3/8"			
#4	**100.0**		
#10	**99.05**	**100.0**	
#20	**98.4**	**99.91**	
#40	**97.21**	**99.83**	
#60	**94.5**	**99.68**	
#100	**76.43**	**98.83**	
#200	**34.56**	**70.64**	

SOIL DESCRIPTION

● DARK GRAY & LIGHT TAN SILTY SAND (SM)

⊠ DARK GRAY LEAN CLAY WITH SAND (CL)

REMARKS

●

⊠

PROJECT: 2nd Street Sink Hole

SITE: 706 E 2nd Street
Greenville, NC

Terracon
314 Beacon Dr
Winterville, NC

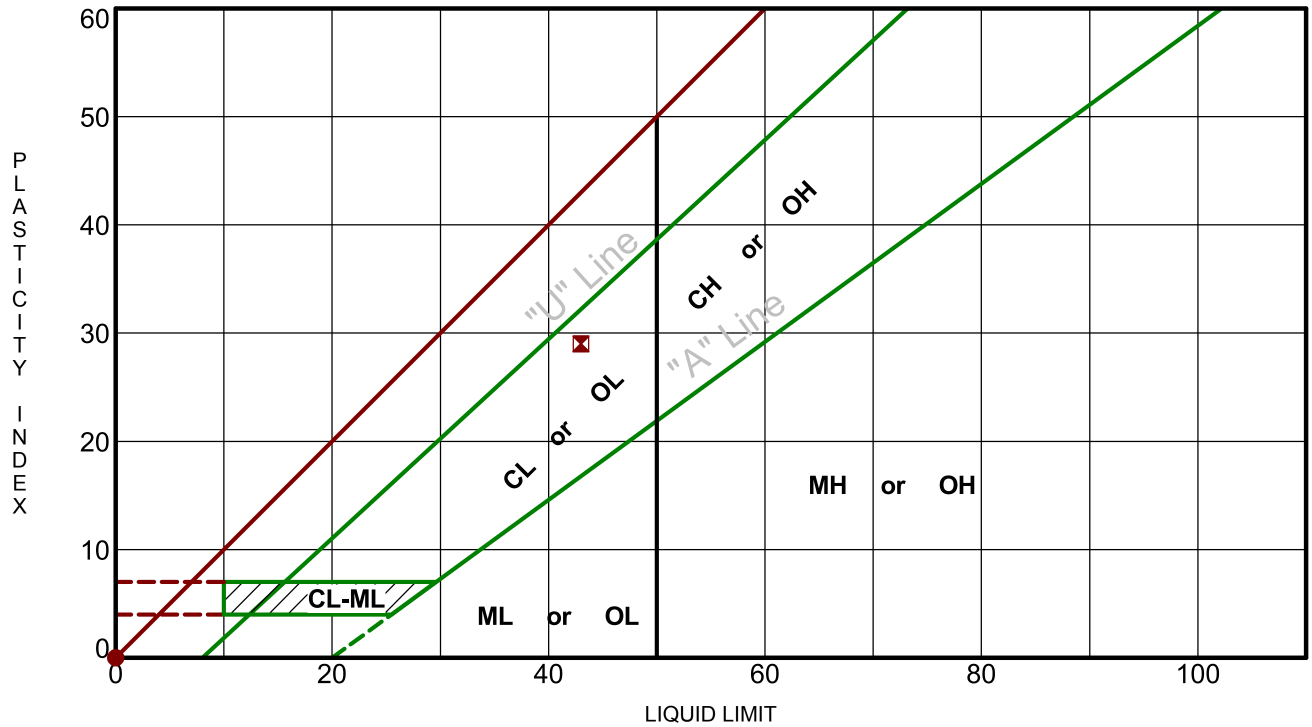
PROJECT NUMBER: 72165031

CLIENT: East Group PA
Greenville, NC

EXHIBIT: B-2

ATTERBERG LIMITS RESULTS

ASTM D4318



	Boring ID	Depth	LL	PL	PI	Fines	USCS	Description
●	B-1	3.5 - 5	NP	NP	NP	35	SM	DARK GRAY & LIGHT TAN SILTY SAND
⊠	B-1	18.5 - 20	43	14	29	71	CL	DARK GRAY LEAN CLAY WITH SAND

PROJECT: 2nd Street Sink Hole

SITE: 706 E 2nd Street
Greenville, NC

Terracon
314 Beacon Dr
Winterville, NC

PROJECT NUMBER: 72165031

CLIENT: East Group PA
Greenville, NC

EXHIBIT: B-3

APPENDIX C

SUPPORTING DOCUMENTS

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

Auger	**Split Spoon**
Shelby Tube	**Macro Core**
Ring Sampler	**Rock Core**
Grab Sample	**No Recovery**

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

[F] If soil contains $\geq$ 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 $\geq$ 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 $\geq$ 30% plus No. 200 predominantly sand, add "sandy" to group name.

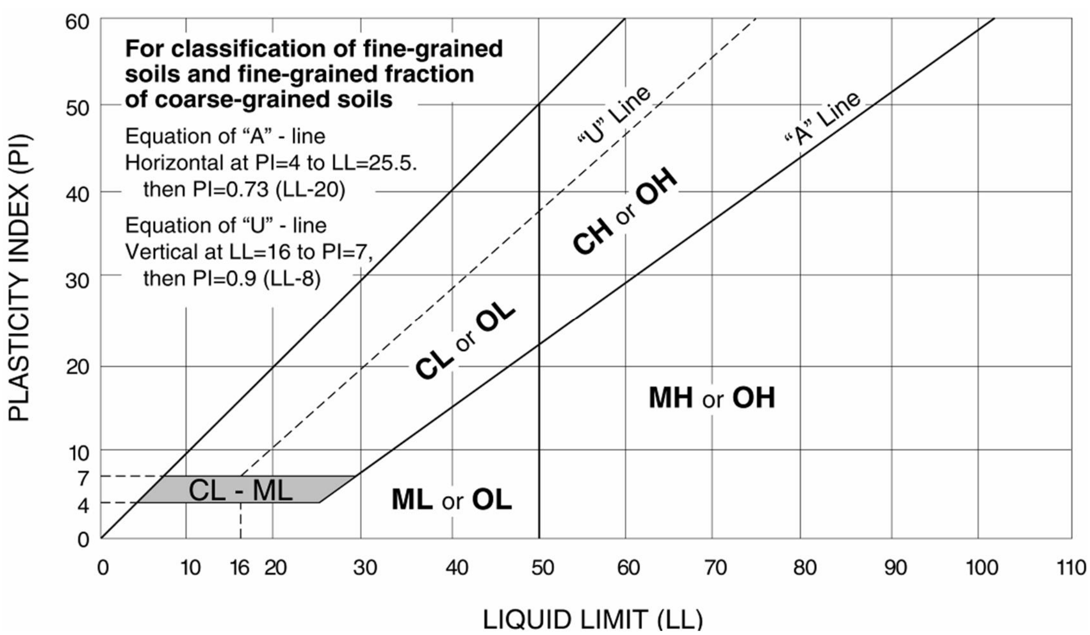
[M] If soil contains $\geq$ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

[N] $PI \geq 4$ and plots on or above "A" line.

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

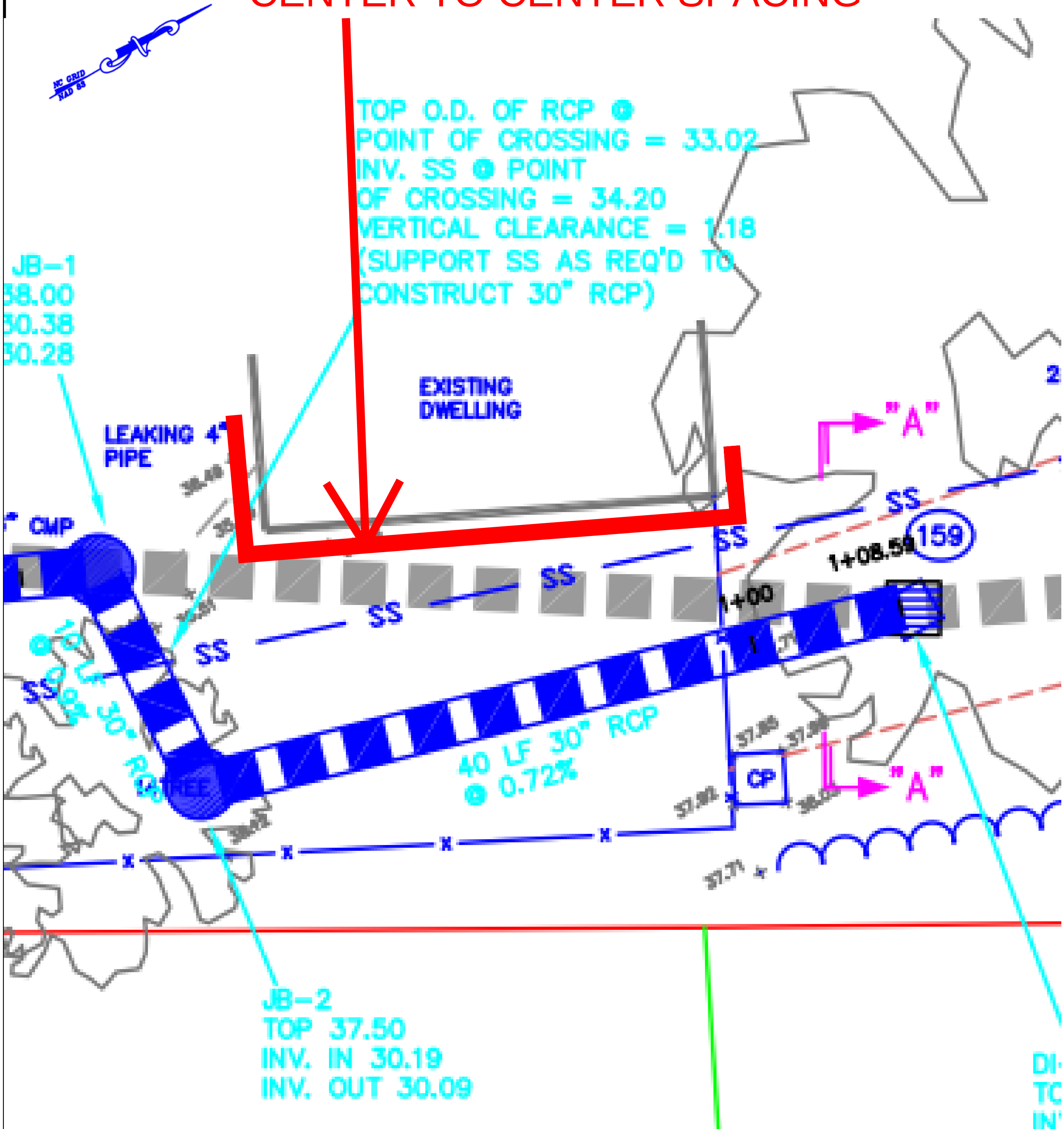
[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



Terracon

PROPOSED HELICAL PIER
REINFORCEMENT AT 5 FT MAXIMUM
CENTER TO CENTER SPACING



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: WOLF SUMMIT, WV (1/1/1976) and CLARKSBURG, WV (1/1/1996).

Project Manager: AJG	Project No. 72165031	Terracon	PROPOSED HELICAL PIER SUPPORT SKETCH	Exhibit
Drawn by: AJG	Scale: NTS	314 Beacon Drive	2ND STREET SINK HOLE	C-3
Checked by: CFB	File Name: 72165031 EC3	Winterville, NC	THE EAST GROUP PA	
Approved by: AJG	Date: 5/5/2016		GREENVILLE, NC	