PRELIMINARY GEOTECHNICAL EXPLORATION REPORT
SHEARIN PROPERTY
U.S. HIGHWAY 301
HALIFAX COUNTY, NORTH CAROLINA

S&ME PROJECT NO. 1051-11-271

Prepared For:
Green Engineering, PLLC
303 Goldsboro Street E
Wilson, North Carolina 27893

Prepared By:

S&ME, Inc.
3201 Spring Forest Road
Raleigh, North Carolina 27616

September 29, 2011

S&ME

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Green Engineering, PLLC
303 Goldsboro Street E
Wilson, North Carolina 27893

Attention: Mr. E. Leo Green, III, P.E., P.L.S.

Reference: Preliminary Geotechnical Exploration Report
Shearin Property
U.S. Highway 301
Halifax County, North Carolina
S&ME Project Number 1051-11-271

Dear Mr. Green:

S&ME, Inc. is pleased to submit this preliminary geotechnical exploration report for the above referenced site. Due to time and cost restraints, the scope of work included in our Proposal No. P149-11E dated September 12, 2011was reduced, as presented below. Deep soft subsurface conditions were encountered that required the borings that were drilled to be extended to depths as great as 80 feet. The exploration was performed to evaluate general subsurface conditions with respect to site grading and preliminary foundation support of the proposed industrial facility.

This report presents a brief discussion of our understanding of the project, results of the exploration, and our preliminary geotechnical conclusions and recommendations regarding site development. A Boring Location Plan, Generalized Subsurface Conditions Profile, and Test Boring Records are included in the Appendix.

S&ME, Inc. appreciates the opportunity to be of service to you on this project. If there are questions or comments concerning this report, or if we can provide additional information relative to this project, please contact us at your convenience.

Sincerely,

S&ME, Inc.

NORTH CAROLINA PROFESSIONAL SEAL 034984 9/30/11 ENGINEER J. ADAM BROWNING, P.E.

J. Adam Browning, P.E.
Engineering Department Manager
N.C. Registration No. 034984

John R. Browning, P.E.
Senior Engineer

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S&ME, INC. / 3201 Spring Forest Road / Raleigh, NC 27616 / p 919.872.2660 f 919.876.3958 / www.smeinc.com

PROJECT AND SITE INFORMATION

We understand that the Shearin Property located in Halifax County, North Carolina is being considered for industrial development. The site consists of three parcels (330 acres, 50 acres, and 55 acres) located west of U.S. Highway 301 just east of Enfield, North Carolina. We understand that potential industrial development will consist of a wood processing facility, access roadway, and spur train tracks connecting to the CSX railroad mainline on the western portion of the property. We assume the access roadway will service car and industrial type truck traffic. We understand the geotechnical design recommendations must accommodate the following:

- Graded areas must be able to support 250 kN/m^2 or approximately 5,200 psf loading. We assume this loading is associated with the stacked round timber lot.
- Foundation soil conditions for the Ev2-module structure must be able to support bearing conditions ranging from 120 kN/m^2 (~2,500 psf) to 45 MN/m^2 (~940 psf).

In our preliminary foundation analyses we have assumed that the structural frame loadings will be on the order of 100 to 300 kips and floor loadings within the building may range from 100 psf to as much as 500 psf. In our foundation analyses we have assumed only static loading conditions, no dynamic loading.

The site currently consists of an unpaved landing strip in the middle of agricultural fields. A site grading plan showing existing ground surface elevations and proposed site grades was unavailable at the time of this report; however, based on Google Earth, existing site elevations range from approximately 85 feet in the wetlands area on the north portion of the property to 125 feet on the eastern portion of the property. We assume site grading may involve fill depths of as much as 10 feet and minimal depth of cut.

EXPLORATION PROGRAM

The exploration program included a visual site reconnaissance by a representative of S&ME and performance of five (5) soil test borings (B-1, B-2, B-3, B-5, and B-9). Proposed boring locations B-4, B-6, B-7, B-8, and B-10 were not performed due to time constraints to provide geotechnical findings and because the proposed drilling footage was consumed by having to drill three of the borings to much deeper depths than proposed. These deeper boring depths were required to penetrate the soft subsurface conditions. The borings were performed to depths ranging from 20 to 80 feet below the existing ground surface.

The soil test borings were advanced using hollow stem auger and mud rotary procedures with a CME-550x drill rig mounted on an all-terrain vehicle (ATV) carrier. Within the borings, samples of subsurface soils were taken at 2.5-foot intervals above a depth of 10 feet and at 5-foot intervals below 10 feet using a split-spoon sampler. Standard penetration testing (SPT) was performed in conjunction with split-spoon sampling in general accordance with ASTM D 1586-99. The CME-550x drill rig used to drill the borings is equipped with a hydraulic automatic hammer for Standard Penetration tests rather than the traditional rope, cathead and safety hammer. The N-values reported on the attached Boring Logs are the actual field measured blow counts and are not corrected for the hammer energy.

The water level was measured in the open borehole of boring B-2 after completion, since this boring was performed with hollow stem augers. Since the other boreholes were advanced with mud rotary procedures, the water levels were not measured after the completion of drilling. After completion the boreholes were backfilled up to the original ground surface with auger cuttings and a borehole closure device. Representative portions of spilt spoon samples were returned to our laboratory for visual classification.

A Generalized Subsurface Conditions Profile and Test Boring Records are included in the Appendix. Stratification lines shown on the Test Boring Records are intended to represent approximate depths of changes in soil types. Naturally, transitional changes in soil types are often gradual and cannot be defined at a particular depth.

AREA GEOLOGY

The site is located within the Yorktown basal formation of the Coastal Plain Physiographic Province of North Carolina. The Coastal Plain is typically characterized by marine and eolian sediments that were deposited during periods of fluctuating sea levels and moving shore lines. Upper soils (upper 18 to 28 feet at this site) often consist of more recent undifferentiated deposits of inter-bedded sands, silts, and clays. Deeper deposits also consist of sands, silts, or clays but can be defined as particular formations with distinguishable characteristics and engineering properties.

The geology in the area of the subject site primarily consists of Undifferentiated Surface Deposits of Quaternary Age and recent alluvial sediments. Typically, the Undifferentiated Deposits consist of silty and sandy clays, clayey sands and silty sands. The deposits are underlain by the Yorktown Formation of the Middle Tertiary Age which was encountered at depths of 18 to 28 feet in the test borings. The Yorktown Formation at this site consists of blue gray silty clays with sand and shell hash and silty sands with shell pieces.

SUBSURFACE CONDITIONS

Topsoil was encountered at the ground surface of each boring location. Topsoil thicknesses typically ranged from approximately 3 to 5 inches; however, approximately 12 inches of topsoil was encountered at boring location B-2. Below the topsoil approximately 18 to 28 feet of undifferentiated Coastal Plain deposits were encountered underlain by Yorktown Formation soils to boring termination. The undifferentiated soils consist of silty and sandy clays, clayey sands and silty sands. The upper 3 to 5 feet of soils consisted of silty sands (USCS classification of SM) and sandy clays (CL, CH). These soils were typically moist. At B-5 and B-9 the near surface sandy clays were visually classified as being highly plastic. The Yorktown Formation at this site consists of blue gray silty clays (CH) with sand and shell hash and silty sands (SM) with shell pieces. The Yorktown clay is generally very plastic (CH) and can be overconsolidated. These soils were generally wet.

Standard Penetration Test (SPT) N-values within the upper Coastal Plain soils ranged from weight of hammer (W.O.H.) to 40 blows per foot (bpf). SPT N-values in the upper 2 to 3 feet ranged from 3 to 6 blows per foot in borings B-1, B-2, B-3 and B-5. In the upper 10 to 15 feet SPT N-values ranged from 1 to 20 blows per foot. A very soft weight of hammer (W.O.H.) clay was encountered at B-3 from about 17 to 22 feet.

Within the Yorktown formation (CH and SM soils) the SPT N-values ranged from 2 to 40 blows per foot. Typically these soils had SPT N-values of 3 to 5 blows per foot. Our experience has been that these SPT N-values may not truly represent the strength of these soils since they can be overconsolidated. To determine the actual strength of these clays and whether they are overconsolidated, intact samples will need to be obtained and laboratory consolidation and triaxial compression tests performed during a final geotechnical exploration (to be performed once more detailed development plans are available).

In borings B-5 stiff clay (N-values of 12 to 14 blows per foot) was encountered from 68 to 80 feet. In B-9 dense to very dense silty sand (N-Values of 28 and 40 blows per foot) was encountered from 68 to 75 feet.

Groundwater was observed in boring B-2 at an approximate depth of 5.5 feet below the existing ground surface at termination of drilling. Groundwater was not measured at the remaining borings at the termination of drilling since they were advanced with mud rotary procedures. Based on the above groundwater level and visual observation of the soils' moisture content, groundwater is likely present at approximate depths ranging from 5.5 to 10 feet below the existing ground surface. Perched groundwater conditions may exist during the typically wetter winter months above less permeable fine-grained soils. Groundwater elevations can be expected to fluctuate due to seasonal variations in rainfall, evaporation, and other factors.

CONCLUSIONS AND RECOMMENDATIONS

Geotechnical conclusions and recommendations presented herein should be considered preliminary and not sufficiently detailed for final project design. Site grading plans, building locations and makeup, anticipated structural and floor loadings and traffic loading will be required prior to performing a further subsurface exploration and providing geotechnical recommendations that can be used for final project design.

Based on our site reconnaissance and field exploration findings, the site is acceptable for development of the proposed industrial facility; however, there are several geotechnical issues that will impact development. These issues include:

- Near surface soils in the upper 2 to 3 feet have SPT N-values ranging from 3 to 6 blows per foot in borings B-1, B-2, B-3 and B-5. It should be anticipated that the more clayey soils, having N-values of 3 to 5 blows per foot (B-3 and B-5), will require undercut and replacement. The more sandy soils (B-1 and B-2) will likely require repair involving in-place densification under favorable weather conditions. Undercut soils should be replaced with select offsite borrow or the undercut soils if they are not highly plastic and have suitable moisture conditions. These repairs will be required prior to fill placement and construction of the spur tracks, access roadway, and buildings.
- Structures having column loads less than 100 kips can likely be supported on shallow spread footings designed for a preliminary net soil bearing pressure of 2,000 psf, however overexcavation of soft soils (to anticipated depths of 2 to 3 feet) and replacement with NCDOT #57 stone should be expected at many footing locations. Also, this loading will cause settlement of the column foundations on the order of 1 to 1 ½ inches. This column settlement does not include any adjacent heavy floor loading or settlement due to fill loading.
- Foundation support for column loads greater than 100 kips will likely require in place soil improvement (i.e. use of Geopiers) to use shallow foundations or installation of a deep foundation system in order to keep settlements within tolerable limits.
- Due to the deep soft soil conditions, preloading of heavily loaded floor slab areas or log storage areas may be required in order to keep settlements within tolerable limits. In building areas where heavy floor loads exist, in place soil improvement may be an alternative to preloading.
- If actual aerial loads are 5,200 psf in the log storage areas, settlements on the order 12 to 18 inches could occur beneath these loads. Over 40 feet of surcharging would be needed to equate to this loading, which obviously is impractical. Some height of surcharging of these areas would help reduce the overall settlement. Additional understanding of this loading condition is necessary to provide geotechnical recommendations.

Site Preparation - General

Site grading will be difficult during periods of extended rainfall that generally occurs during the spring and winter months, especially for the clayey subgrade soils present at this site. During these wetter periods soil moistures will be elevated and groundwater tables will be at their higher levels. To reduce potential earthwork problems, site preparation and grading should be scheduled during the typically drier months of May through November. If spring or winter grading is attempted, significant repair of near surface soils and use of select off-site borrow will likely be necessary to adequately prepare subgrades for new construction. Heavy rubber-tired construction equipment should not be allowed to operate on marginal soils or exposed subgrades. Because of the low consistency of the near surface soils at this site, we recommend that heavy rubber-tire construction equipment be limited unless subgrade conditions are stable under this traffic. Grading of this site during dry summer and fall weather, will aid in providing more stable subgrade conditions. Even during drier periods of the year, we recommend that exposed subgrades be sloped and sealed at the end of each day to promote runoff and reduce infiltration from rainfall.

Initial site preparation should include stripping of grass, weeds and topsoil, and removing any other deleterious materials. The soil test borings indicate that topsoil thicknesses vary from about 3 to 12 inches. Typical topsoil thicknesses of about 4 to 6 inches should be anticipated. However, deeper stripping will be required to remove rootmat associated with mature trees. Logging operations often disturb the upper soils mixing topsoil with undisturbed soils below, thus increasing stripping depths. This is especially true if logging occurs during wet conditions. Topsoil stripping should only be performed during drier weather when rubber tired equipment will not rut the subgrade soils. Topsoil may be stockpiled on site and reused in landscaped areas.

Site Preparation – Site Drainage

As previously discussed, groundwater was observed in boring B-3 at an approximate depth of 5.5 feet at termination of boring. Visual evaluation of the moisture contents of the split-spoon samples indicates groundwater levels ranging from 5.5 to 10 feet below the existing ground surface. Grading plans should limit the depth of excavation to allow at least 3 feet of separation between final grades and the groundwater table. Additional soil test borings and piezometers will be required to obtain more accurate groundwater table information. If deeper excavations are required, open ditches or ditches converted to French drains may be needed to lower groundwater tables.

Site Preparation – Subgrade Evaluation

After stripping of topsoil, the exposed subgrade in areas to receive fill and areas near final grades should be evaluated by the geotechnical engineer or his representative. This evaluation should include proofrolling with a fully loaded, tandem-axle dump truck or equivalent piece of construction equipment. Areas that are unstable and are unsuitable for placement of fill, in the judgment of the geotechnical engineer, should be repaired. Subgrade repair may involve undercutting and replacement, scarifying and in place compaction if soils are at suitable moisture and unstable soils are shallow, use of geotextiles and select fill or a combination of these measures. The measure(s) to repair unstable subgrade areas will be a field decision at time of grading.

Near surface soils in the upper 2 to 3 feet have SPT N-values ranging from 3 to 6 blows per foot in borings B-1, B-2, B-3 and B-5. It should be anticipated that the more clayey soils, having N-values of 3 to 5 blows per foot (B-3 and B-5), will require undercut and replacement. The more sandy soils (B-1 and B-2) will likely require repair involving in-place densification under favorable weather conditions. Undercut soils should be replaced with select offsite borrow (having the characteristics presented below) or the undercut soils if they are not highly plastic (should have plasticity indices less than 30%) and have suitable moisture conditions. These repairs will be required prior to fill placement and construction of the spur tracks, access roadway and buildings.

The near surface clays at B-5 and B-9 were visually classified as highly plastic. During the final geotechnical exploration, Atterberg limits testing and swell tests will need to be performed to determine if these soils have objectional swell characteristics, requiring them to be undercut beneath pavements and buildings. Typically if clays have plasticity indices greater than 30% we recommend that they not exist within 2 feet of design subgrade in pavement areas and 3 feet in building areas.

Excavations

Design grades were not established at time of report preparation. Assuming shallow excavations, low to moderate consistency soils will be excavated. These type soils can be excavated with conventional grading equipment. General excavations will need to take into consideration the low consistency soils and groundwater conditions. We recommend that heavy, rubber-tired equipment not be used to make these excavations. Such equipment can cause rutting and disturbance of the lower consistency soils, resulting in excessive undercutting. Local excavations for shallow utility trenches and foundations can be accomplished by a conventional backhoe.

Groundwater will likely be encountered within excavations that extend more than 5 feet below existing grades, if water tables are not lowered. Groundwater will affect the stability of excavation sidewalls. We expect that groundwater infiltration into excavations will be relatively high in sands. As such, if excavations extend below the water table, dewatering measures consisting of well points or sump and pump systems may be required to control groundwater in sands. Well points will not be effective in dewatering clays and silts. The contractor should determine actual groundwater control measures. All excavations should be performed in accordance with OSHA guidelines.

Washed stone may be needed as a bedding material below portions of the utility lines if soft or very loose subgrade soils are encountered. The need for washed stone will depend on the extent of groundwater infiltration and subgrade conditions.

Use of On-Site and Off Site Borrow as Structural Fill

On-site sands and clays with USCS classifications of SM and CL should be suitable for reuse as structural fill provided that the moisture content is properly controlled during placement and compaction. Without further laboratory testing the CH soils are considered to be unsuitable for structural fill, with exception these soils can be placed in deeper fill sections (below 2 feet of design grade in pavement areas and 3 feet in building areas). During our exploration, near-surface soils typically appeared slightly above to wet of their optimum moisture content. It should be expected that the on-site soils will require some drying to achieve the recommended compaction and moisture levels. The moisture condition of on-site soils will be influenced by prevailing weather conditions. On-site clayey soils will be more difficult to dry than the more sandy soils.

We recommend that any off-site borrow consist of soils having USCS classifications of SP, SW, SM, SC, or CL. These soils should have plasticity indices less than 20%, be organic free, have a maximum particle size of 2 inches and have a standard Proctor maximum dry density of at least 100 pounds per cubic foot.

Fill Placement and Compaction

Structural fill should be compacted beneath buildings and pavements to at least 95% of its standard Proctor maximum dry density with exception in the top 12 inches where compaction should be increased to 98%. Compaction moisture should be controlled with plus or minus 2 percent of optimum moisture.

Fill placement should be observed by a qualified soils technician working under the direction of the geotechnical engineer. In addition to visual observation, the technician should perform a sufficient amount of in-place soil density tests to confirm that the required degree of compaction is achieved.

Where fill depths will be greater than 5 feet we recommend that settlement due to the fill loading be monitored by use of settlement plates. Fill settlements should be completed before building construction.

Foundation Support

Shallow Foundations

Based on the test boring data and foundation analysis, structures having columns loads less than 100 kips can likely be supported on shallow spread footings designed for a preliminary net soil bearing pressure of 2,000 psf, however overexcavation of soft soils (to anticipated depths of 2 to 3 feet) and replacement with NCDOT #57 stone should be expected at many footing locations. This assumes the total and differential settlements presented below are acceptable for the structure. Footings should bear at least 18 inches below exterior finished grades to provide adequate frost protection and for bearing capacity considerations. Column footings should also have minimum dimensions of 24 inches.

The geotechnical engineer or his representative should observe the foundation bearing conditions prior to placement of reinforcing steel and concrete at each footing. This evaluation should include the performance of shallow hand auger borings with dynamic cone penetrometer testing to confirm the suitability of near surface bearing soils for foundation support. Exposure to the environment will cause the bearing soils to rapidly deteriorate. Excessively loose/soft soils, water and other unsuitable materials should be removed. Over-excavated soils can be replaced by NCDOT #57 stone or lean concrete. To further reduce the potential for deterioration of bearing soils, we recommend that foundation excavation and placement of concrete be conducted on the same day if practical. If placement of the foundation concrete is to be delayed, a lean concrete mud mat should be placed on exposed bearing soils. As stated above it should be expected that many footings will require overexcavation and replacement with NCDOT #57 stone.

Settlement

Based on our settlement analysis, past experience and assuming that all unsuitable materials are adequately removed at the footing bearing elevation, settlement of column footings that support loads of 100 kips or less should be 1 to 1 ½ inches. This column settlement does not include any adjacent heavy floor loading or settlement due to fill loading. Detailed load information is required for differential settlement analysis. However, we expect differential settlements between adjacent spread footings will be on the order of 1/2 to ¾ inch. The structural engineer should determine if these magnitudes of differential settlement are tolerable.

In-Place Soil Improvement

Foundation support for structures having column loads greater than 100 kips will likely require in-place soil improvement (i.e. Geopiers) in order to use shallow foundations or installation of a deep foundation system in order to keep settlements within tolerable limits. This section discusses in-place soil improvement and the following section presents our recommendations for deep foundations.

Structures having column loads greater than 100 kips could likely be supported on shallow foundations underlain with a Geopier Rammed Aggregate Pier™ (RAP) Intermediate Foundation System. Geopiers can be designed to increase the allowable design bearing pressure while reducing the total and differential settlements to acceptable levels, generally less than 1 and ½ inches, respectively. These settlements assume that fill settlements have occurred prior to foundation construction and do not account for large floor loads. Where significant floor loads exist, Geopiers could be installed below the floor to reduce floor settlements.

The Geopier support elements are constructed by drilling a hole to create a cavity, removing a volume of subsoil materials, then building a bottom bulb of clean, open-graded stone while vertically pre-stressing and pre-straining subsoils underlying the bottom bulb. The Geopier shaft is built on top of the bottom bulb, using well-graded highway base course stone placed in thin lifts (12 inches compacted thickness) above groundwater levels. For shaft portions that may exist within water, clean open-graded aggregate is used. Densification of the bottom bulb and of the overlying shaft lifts is accomplished by using the impact ramming action of a modified hydraulic hammer. The tamper consists of a special steel alloy shaft and a round, beveled tamper head. The beveled tamper head assists in transferring force laterally during impact densification, resulting in pushing of aggregate against the confined walls of the cavity. The nature of the soil is to "push back", creating significant lateral pressure buildup in the matrix soil resulting in lateral confinement to the Geopier elements. In addition to increasing shear resistance at the Geopier element perimeter, the increased horizontal stress in the matrix soil improves the matrix soil and makes it stiffer.

The Geopier foundation system could likely be designed to provide an allowable bearing pressure of 4,000 to 5,000 pounds per square foot. The actual spacing, diameter, and length of the Geopiers should be determined by a specialty contractor experienced with this method. A specialty contractor we have worked with and has experience with Geopiers is GeoStructures (919-859-5535). The specialty contractor should submit a proposed ground modification program with associated cost.

Deep Foundations

Another alternative for foundation support for structures having column loads greater than 100 kips would be to use a deep foundation system consisting of either driven steel H-piles or precast concrete piles. Our preliminary recommendations for allowable axial and uplift capacities are presented in the table below. Final recommendations for allowable axial and uplift capacities along with allowable lateral capacities can be provided during the final geotechnical exploration once a site grading plan and structural loads are available.

Pile Type	Length Below Existing Ground Surface (feet)	Allowable Vertical Compressive Capacity (tons)	Allowable Vertical Uplift Capacity (tons)
12-inch Precast Concrete	70	60 to 70	35
HP 12x53	70 to 75	40 to 50	25

All piles should extend to the above indicated depths which are based on depth below existing ground surface. If practical refusal is encountered at depths less than these, S&ME should be notified for further analysis. For the precast concrete pile it should be expected that preaugering in the upper 20 to 30 feet will be required to allow this pile to penetrate the teen to 40 blows per foot soils. We recommend that piles have a center-to-center spacing of at least 2.5 times the pile diameter. It should be noted that the North Carolina Building Code, Section 1807.2.85, requires that the uplift capacity of a pile group be the lesser of: 1) "The proposed individual pile uplift working load times the number of piles in the group." 2) Two-thirds of the effective weight of the pile group and the soil contained within a block defined by the perimeter of the group and the length of pile."

Piles should be driven using a hammer having a rated energy of at least 32,000 foot-pounds per stroke. After selection of a pile type and contractor, we recommend the contractor submit for our review the specification data of the hammer that will be used to drive the piles. The hammer and pile system will then be analyzed using a "Wave Equation" program to determine the suitability of the hammer for its intended purpose. Driving criteria will also be established by Wave Equation Analysis. The North Carolina Building Code requires that a pile load test be conducted or a pile dynamic analyzer (PDA) be used to determine pile design capacities of greater than 40 tons. It is recommended that at least three indicator piles be driven across the proposed foundation areas prior to ordering production piles. Results of indicator pile installation will be essential in estimating production pile lengths.

Based on the performed borings it is anticipated that the ultimate capacity of the driven piles may be realized several days after initial driving due to potential "set up" of clays and sands. In other words, the number of blows it takes for the same hammer to drive a pile one foot will increase with time, to a point, before becoming constant. In order to allow proper installation of piles at this site, "set up" of the soil needs to be estimated.

This can be conducted by restriking a driven pile (indicator piles) several days after initial driving. It is assumed that an increase in the number of blows per foot to move a pile from initial driving to the restrike is the "set up" of the soil. Utilizing an estimate of the "set up" potential of the subsurface soils, a reduced blow count criteria can be used in estimating pile capacity. We recommend that the pile load test not be performed until restrikes of indicator piles have been conducted and "set-up" confirmed.

Installation of piles should be monitored by an experienced engineer working under the direction of a senior geotechnical engineer. Monitoring of pile installation is essential for verification of anticipated subsurface conditions and to confirm that the piles are properly installed in accordance with our recommendations.

Floor Slabs

Ground floor slabs may be constructed above suitable well-compacted fill or natural subgrade soils provided that the recommendations presented above are implemented. Slabs should be separated from wall and column footings to allow for relative displacement. A modulus of subgrade reaction value of 100 pci may be used to design floor slabs that will only support relatively light distributed loads (less than 100 pounds per square foot). We recommend that at least 6 inches of compacted aggregate base course (ABC) stone be placed beneath all floor slabs to provide more uniform slab support and to reduce damage to subgrade soils during construction.

Floor slabs subjected to large distributed loads (greater than 100 pounds per square foot) will increase stresses introduced in the deeper soil layers. Deeper stress influence results in a lower subgrade modulus for a given soil profile. The subgrade modulus is a function of the size of the loaded area (which depends on the rigidity of the floor slab) and the compressibility of the subgrade soils. We can provide appropriate subgrade modulus values for large distributed loads once actual loads and specific storage areas have been determined. To reduce the potential for cracking and undesired deflection, special slab design measures will be required in areas of large distributed loads. Such measures could include: increasing the slab thickness, increasing the amount of reinforcing steel, doweling across joints, separating the slab from columns and walls, pile supporting the slab or using Geopiers, or some combination of these methods. Actual design measures to reduce deflection and cracking should be determined by the structural engineer.

Surcharging slab areas or use of Geopiers will reduce settlements resulting from the floor loading. The surcharge height and duration will be depended on the area and magnitude of distributed loads. A more accurate time frame can be determined during the performance of a final geotechnical exploration once more developed structural plans are developed and laboratory consolidation testing is performed on more compressible soils. The surcharge fill should meet the off-site borrow requirements presented above so once it is removed it can be used as structural fill in pavement areas. Since weight is the main consideration for the surcharge fill, specified compaction is not necessary. Prior to placement of the surcharge, settlement plates should be installed at the design subgrade elevations. The elevations of the settlement plates should be measured once the surcharge is in place and then at least twice weekly. This data should be supplied to us for review. Surcharge fill removal can occur once the settlements due to the surcharge have stabilized.

Exposure to the environment and construction activities will weaken the floor slab subgrade soils. Therefore, we recommend that subgrade soils in slab areas be evaluated prior to ABC stone placement. If deterioration of the soils occur, undercutting may be necessary.

Log Storage Area

The log storage loading will cause substantial settlement. If actual aerial loads are 5,200 psf in the log storage areas, settlements on the order 12 to 18 inches could occur beneath these loads. Over 40 feet of surcharging would be needed to equate to this loading, which obviously is impractical. Some height of surcharging of these areas would help reduce the overall settlement. We would assume the logs will be placed on a soil or ABC stone subgrade or paved area. Additional understanding of this loading condition and acceptable levels of settlement are necessary to provide geotechnical recommendations.

Seismic Considerations

Based on the results of the test borings and information provided in section 1615 of the North Carolina Building Code, it is our opinion the site should be considered **Class E** with respect to seismic design considerations.

Pavement Thickness Design Considerations

A detailed pavement design was not performed since detailed traffic information was not available and laboratory CBR testing was not performed. Based on the near surface soils encountered at this site, we would anticipate these soils would have soaked CBR values of 3 to 6% when compacted to 98% of their standard Proctor maximum dry density. Assuming these CBR values, typical pavement sections for areas subjected only to light vehicular traffic would consist of at least 2 to 3 inches of asphaltic concrete underlain by 6 to 8 inches of crushed stone base course. In heavy duty pavement areas subjected to tractor-trailer traffic, a typical pavement section would consist of at least 4 to 5 inches of asphaltic concrete underlain by 8 to 10 inches of crushed stone base course. Also where more plastic soils exist and heavy traffic occurs, the use of a woven geotextile fabric beneath the ABC stone may be required.

The above pavement sections are provided as general guidelines and do not represent actual design sections. Once specific traffic information is provided and laboratory CBR testing is performed, we can provide more detailed pavement design recommendations.

All materials and workmanship should conform to the specifications provided by the North Carolina Department of Transportation "Standard Specifications for Roads and Structures". The most important factors regarding pavement performance are the condition of subgrade soils at time of construction and post construction drainage. We recommended that all pavement subgrade areas be evaluated prior to ABC stone placement. Any areas that deflect or rut during proofrolling must be repaired prior to stone placement. Base course stone should be compacted to at least 100 percent of the modified Proctor maximum dry density. Additionally, it is recommended that site grades allow positive drainage so that water does not pond in paved areas, which include areas adjacent to pavement edges or areas behind curbs. Clayey near surface soils at this site will be very moisture sensitive. It will be very important to maintain positive site drainage during roadway construction to not allow ponding of water and to reduce the possible need for extensive subgrade repair. Also, water should not be allowed to pond adjacent to curbs or pavement edges. Water entering the pavement structure will soften soils lending to premature pavement failure.

FURTHER EXPLORATION

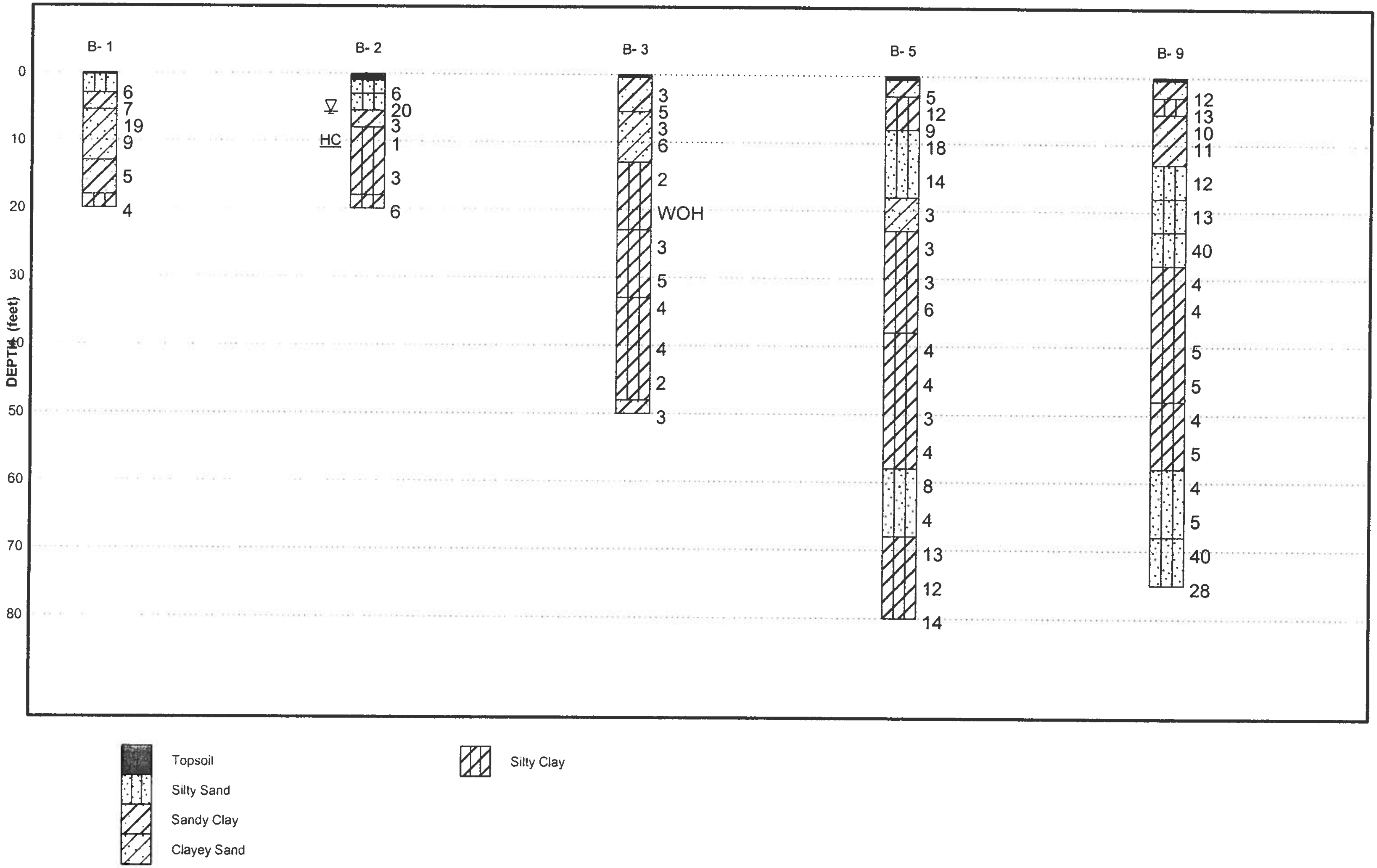
Further subsurface exploration will be required as specific site development plans are finalized. Performance of additional soil test borings and laboratory testing will allow development of final geotechnical recommendations. Site grading plans, building locations and makeup and anticipated structural loadings will be required prior to performing a final subsurface exploration and providing geotechnical recommendations that can be used for project design.

QUALIFICATIONS OF REPORT

This report has been prepared in accordance with generally accepted engineering practice for specific application to this project. Any wetland, environmental, or contaminant assessment efforts are beyond the scope of this geotechnical exploration; and therefore, those issues are not addressed in this report. The conclusions and recommendations contained in this report are based on the applicable standards of our profession at the time this report was prepared. No other warranty, express or implied, is made.

Conclusions and recommendations submitted in this report are based, in part, upon the data obtained from the geotechnical exploration. The nature and extent of variations between and outside the borings made may not become evident until further exploration is performed. If variations appear evident, then it will be necessary to re-evaluate the recommendations of this report. In the event that any changes in the nature or design of the proposed development are planned, the conclusions and recommendations contained in this report should be reviewed and conclusions of this report modified or verified in writing.

GENERALIZED SUBSURFACE CONDITIONS



N = Standard Penetration Test resistance value (blows per foot). The depicted stratigraphy is shown for illustrative purposes only. The actual subsurface conditions will vary between boring locations.

SCALE:	(V) 1" = 20'
CHECKED BY:	JAB
DATE:	9/24/2011
JOB NO:	1051-11-271

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GENERALIZED SUBSURFACE CONDITIONS

Shearin Property

Enfield, NC

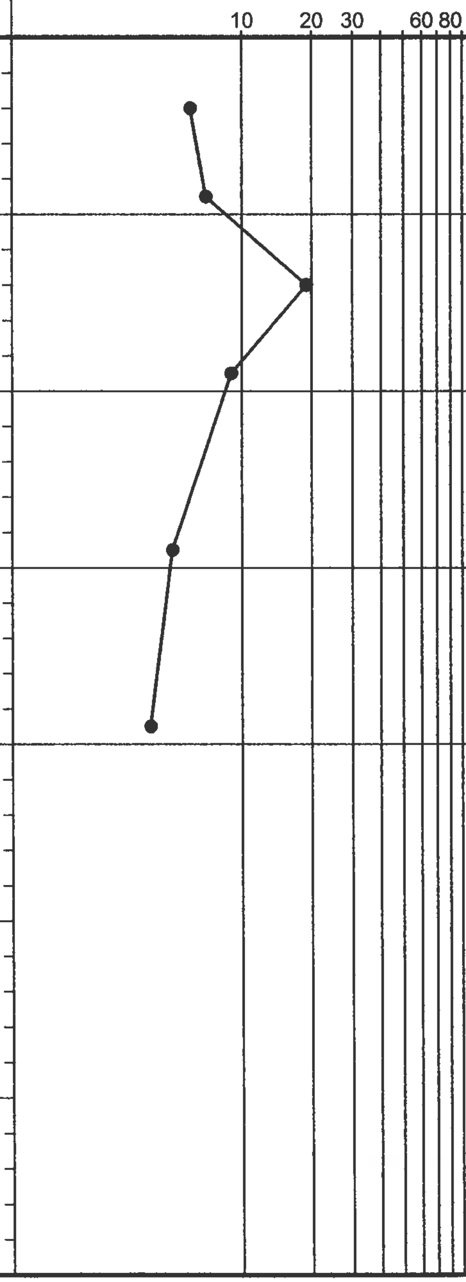
FIGURE NO. **2**

PROJECT: Shearin Property, Enfield, NC, 1051-11-271	TEST BORING RECORD B- 1

DATE DRILLED: 9/13/11	ELEVATION: Ground Surface	NOTES: **Boring location is approximate. Standard Penetration Testing (SPT) performed with a safety hammer.**
DRILLING METHOD: N Casing 2-15/16 Tri	BORING DEPTH: 20.0 ft	
LOGGED BY: S. Hatfield	WATER LEVEL: Dry @ TOB	
DRILLER: R. Norwood	DRILL RIG: CME-550x	

DEPTH (feet)	MATERIAL DESCRIPTION	N-Value
	TOPSOIL (3 inches)	
	Loose Brown-Tan Silty Fine **SAND** (SM), Moist	6
5	Firm Orange-Tan Sandy **CLAY** (CL-CH), Moist	7
10	Medium Dense to Loose Clayey Fine to Medium **SAND** (SM) with Gravel, Wet (~30% Fines)	19 9
15	Firm Orange-Tan Sandy **CLAY** (CL-CH), Moist	5
20	Soft Blue-Gray Silty **CLAY** (CH) with Shell Hash, Wet	4
	Boring terminated at 20 feet below existing ground surface.	
25		
30		

STANDARD PENETRATION TEST DATA (blows/ft)



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3. PENETRATION (N-VALUE) IS THE NUMBER OF BLOWS OF 140 LB. HAMMER FALLING 30 IN. REQUIRED TO DRIVE 1.4 IN. I.D. SAMPLER 1 FT.
4. STRATIFICATION AND GROUNDWATER DEPTHS ARE NOT EXACT.
5. WATER LEVEL IS AT TIME OF EXPLORATION AND WILL VARY.

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PROJECT:	Shearin Property Enfield, NC 1051-11-271	TEST BORING RECORD	B- 2

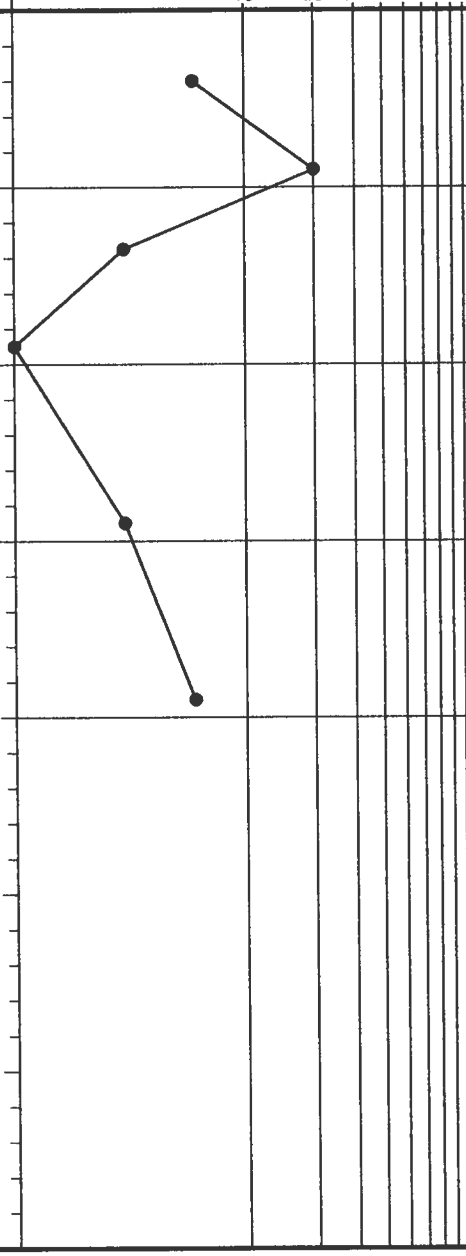
DATE DRILLED:	9/12/11	ELEVATION:	Ground Surface
DRILLING METHOD:	N Casing 2-15/16 Tri	BORING DEPTH:	20.0 ft
LOGGED BY:	S. Hatfield	WATER LEVEL:	5.7' @ TOB
DRILLER:	R. Norwood	DRILL RIG:	CME-550x

NOTES: **Boring location is approximate. Standard Penetration Testing (SPT) performed with a safety hammer.**

MATERIAL DESCRIPTION	N-Value
TOPSOIL (12 inches)	
Loose Gray-White Silty Fine **SAND** (SM), Moist (~45% Fines)	6
Medium Dense Tan-Orange Silty Fine to Medium **SAND** (SM), Moist (~40% Fines)	20
Soft Blue-Gray Sandy **CLAY** (CL-CH), Wet	3
Very Soft to Soft Blue-Gray Silty **CLAY** (CH), Wet	1
	3
Firm Blue-Gray Silty **CLAY** (CH) with Shell Hash, Wet	6
Boring terminated at 20 feet below existing ground surface. Borehole caved at a depth of 10.7 feet below existing ground surface. Water was observed in borehole at a depth of 5.7 feet at termination of boring.	

Water level: ∇ (approx. 5.7 ft); HC (approx. 10.7 ft)

STANDARD PENETRATION TEST DATA (blows/ft)



S&ME COMPANY STANDARD 11-271.GPJ S&ME.GDT 9/24/11

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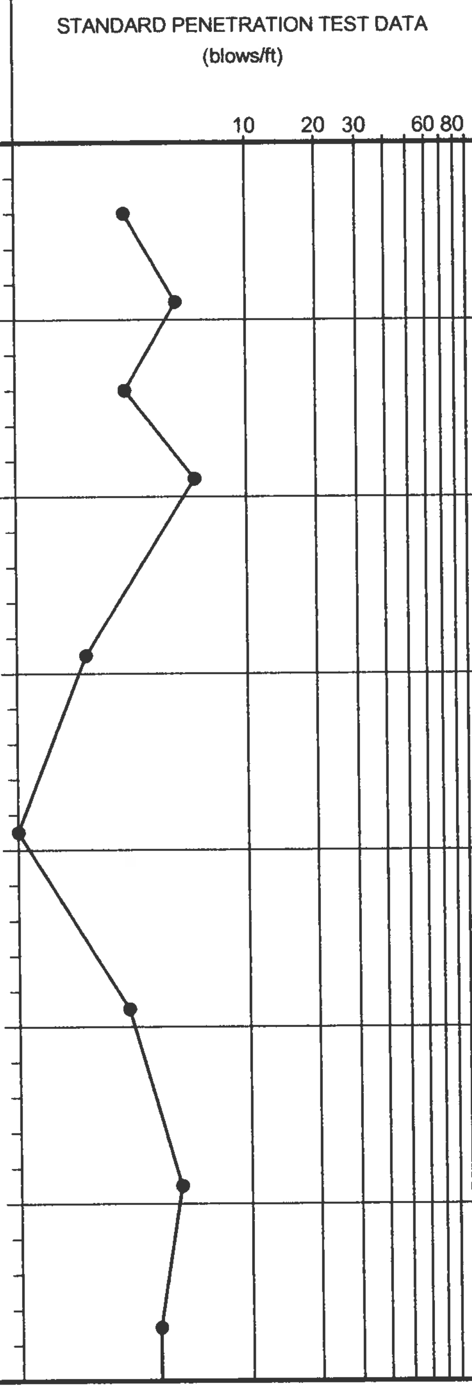
PROJECT: Shearin Property Enfield, NC 1051-11-271	TEST BORING RECORD	B- 3

DATE DRILLED:	9/12/11	ELEVATION:	Ground Surface
DRILLING METHOD:	3-1/4" HSA 2-15/16 Tri	BORING DEPTH:	50.0 ft
LOGGED BY:	S. Hatfield	WATER LEVEL:	Dry @ TOB
DRILLER:	R. Norwood	DRILL RIG:	CME-550x

NOTES: **Boring location is approximate. Standard Penetration Testing (SPT) performed with a safety hammer.**

DEPTH (feet)	MATERIAL DESCRIPTION	N-Value
0	**TOPSOIL** (4 inches)	
	Soft to Firm Orange-Tan Sandy **CLAY** (CL), Moist	3
5		5
	Very Loose to Loose Gray Clayey Fine **SAND** (SM), Moist	3
10		6
	Very Soft Gray-Blue Silty **CLAY** (CH), Wet	2
15		
20		WOH
	Soft to Firm Blue-Gray Silty **CLAY** (CH) with Shell Hash, Wet	
25		3
30		5
	Soft to Very Soft Blue-Gray Silty **CLAY** (CH) with Shell Hash, Wet	4

Column headings: DEPTH (feet) | GRAPHIC LOG | MATERIAL DESCRIPTION | WATER LEVEL | SAMPLE NO/TYPE | ELEVATION (feet) | STANDARD PENETRATION TEST DATA (blows/ft) | N-Value



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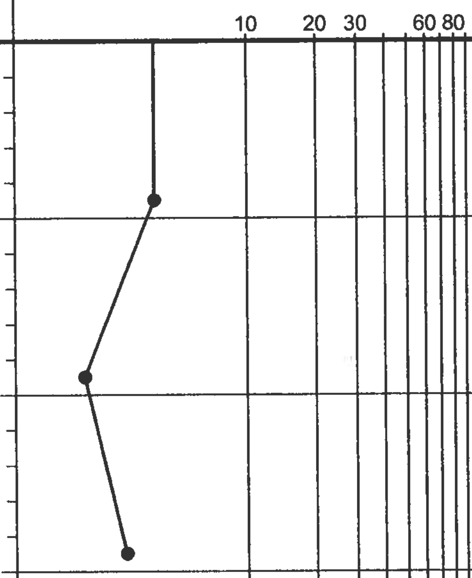
PROJECT: Shearin Property Enfield, NC 1051-11-271	TEST BORING RECORD	B- 3

DATE DRILLED:	**9/12/11**	ELEVATION:	**Ground Surface**
DRILLING METHOD:	**3-1/4" HSA 2-15/16 Tri**	BORING DEPTH:	**50.0 ft**
LOGGED BY:	**S. Hatfield**	WATER LEVEL:	**Dry @ TOB**
DRILLER:	**R. Norwood**	DRILL RIG:	**CME-550x**

NOTES: **Boring location is approximate. Standard Penetration Testing (SPT) performed with a safety hammer.**

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	SAMPLE NO/TYPE	ELEVATION (feet)	STANDARD PENETRATION TEST DATA (blows/ft)	N-Value
40							4
45							2
		Soft Blue-Gray Sandy **CLAY** (CH) with Shell Hash, Wet					3
50		Boring terminated at 13.8 feet below existing ground surface. Borehole was observed dry at termination of boring.					
55							
60							
65							



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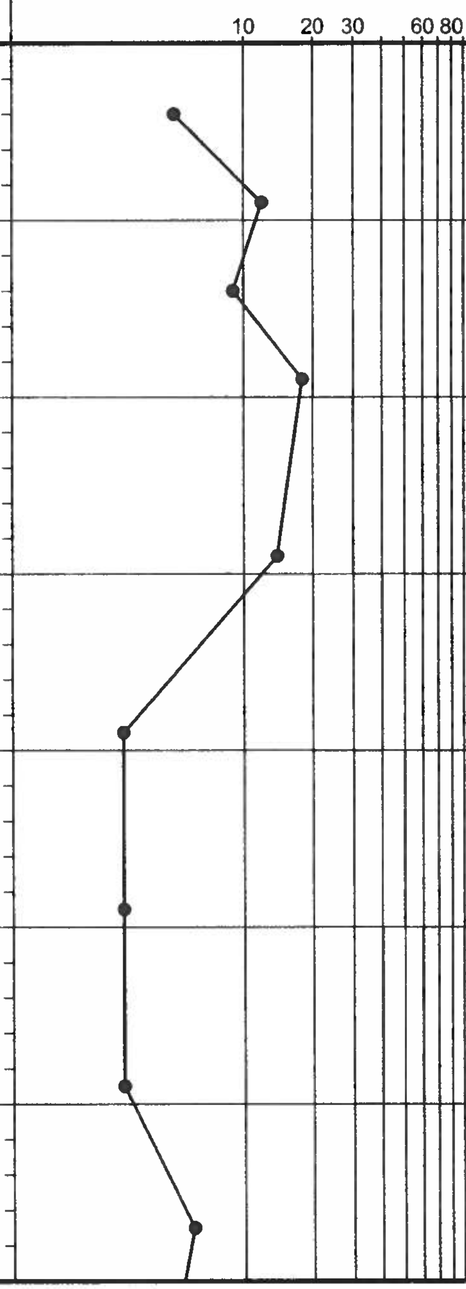
PROJECT: Shearin Property Enfield, NC 1051-11-271	TEST BORING RECORD	B- 5

DATE DRILLED:	9/13/11	ELEVATION:	Ground Surface
DRILLING METHOD:	N Casing 2-15/16 Tri	BORING DEPTH:	80.0 ft
LOGGED BY:	S. Hatfield	WATER LEVEL:	Dry @ TOB
DRILLER:	R. Norwood	DRILL RIG:	CME-550x

NOTES: **Boring location is approximate. Standard Penetration Testing (SPT) performed with a safety hammer.**

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	SAMPLE NO/TYPE	ELEVATION (feet)	N-Value
		TOPSOIL (5 inches)				
		Firm Orange-Tan Sandy **CLAY** (CH), Moist				5
5		Stiff Orange-Tan Silty **CLAY** (CH), Moist				12
						9
10		Medium Dense Orange-Tan Silty Fine to Coarse **SAND** (SM) with Gravel, Moist to Wet (~10% Fines)				18
15						14
20		Very Loose Gray Clayey Fine **SAND** (SC), Wet (~40% Fines)				3
25		Soft to Firm Blue-Gray Silty **CLAY** (CH) with Sand and Shell Hash, Wet				3
30						3
						6

STANDARD PENETRATION TEST DATA (blows/ft)



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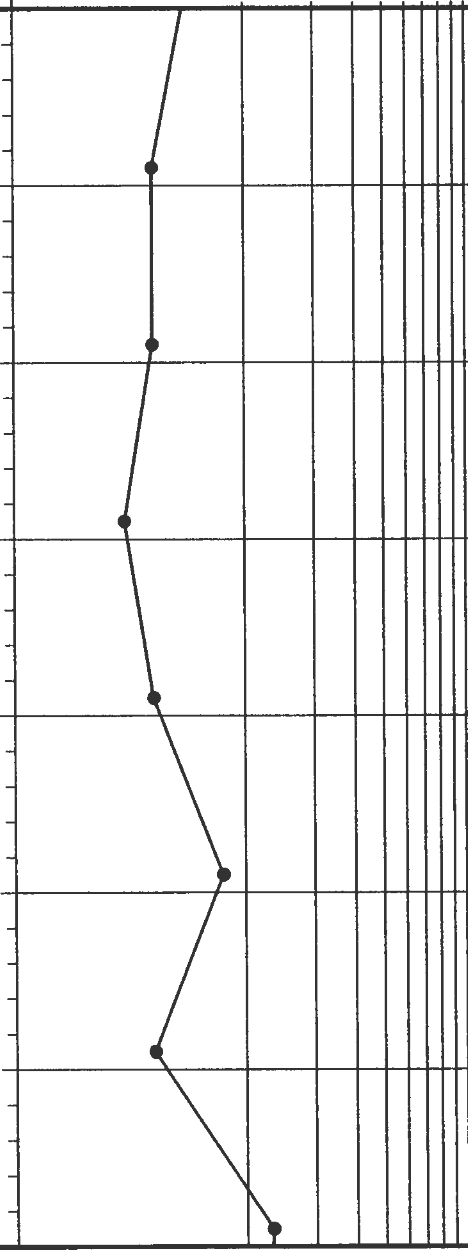
PROJECT: Shearin Property Enfield, NC 1051-11-271		TEST BORING RECORD	B- 5
DATE DRILLED: 9/13/11	ELEVATION: Ground Surface	NOTES: Boring location is approximate. Standard Penetration Testing (SPT) performed with a safety hammer.	
DRILLING METHOD: N Casing 2-15/16 Tri	BORING DEPTH: 80.0 ft		
LOGGED BY: S. Hatfield	WATER LEVEL: Dry @ TOB		
DRILLER: R. Norwood	DRILL RIG: CME-550x		

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	SAMPLE NO/TYPE	ELEVATION (feet)	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N-Value
		Soft Blue-Gray Silty **CLAY** (CH) with Sand and Shell Hash, Wet					4
40							
45							4
50							3
55							4
		Loose to Very Loose Gray-Tan Silty Fine **SAND** (SM) with Shell Pieces, Wet (~30% Fines)					8
60							
65							4
		Stiff Black Silty **CLAY** (CH), Wet					13



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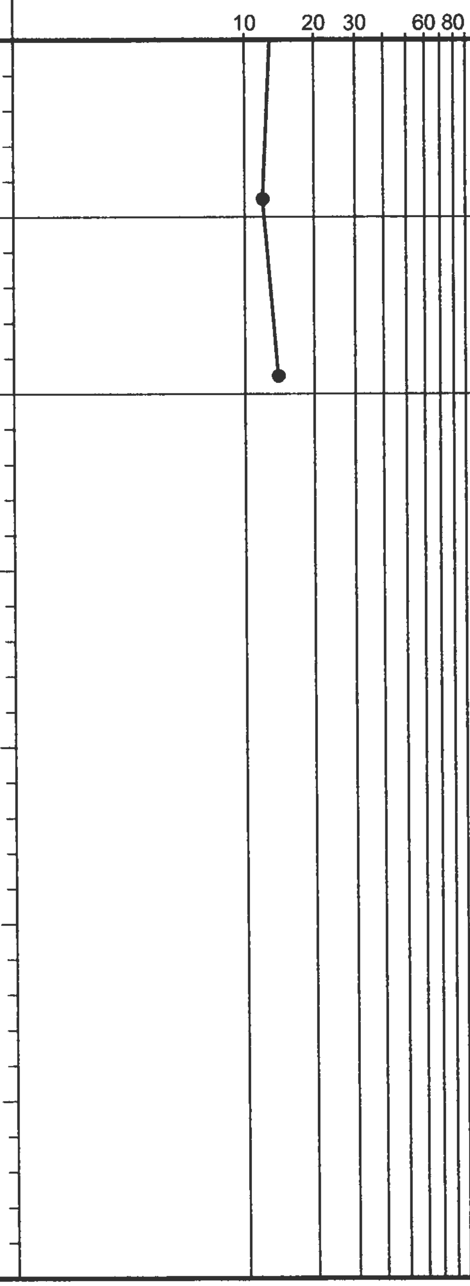
PROJECT: Shearin Property Enfield, NC 1051-11-271	TEST BORING RECORD	B- 5

DATE DRILLED: **9/13/11**	ELEVATION: **Ground Surface**	NOTES: **Boring location is approximate. Standard Penetration Testing (SPT) performed with a safety hammer.**
DRILLING METHOD: **N Casing 2-15/16 Tri**	BORING DEPTH: **80.0 ft**	
LOGGED BY: **S. Hatfield**	WATER LEVEL: **Dry @ TOB**	
DRILLER: **R. Norwood**	DRILL RIG: **CME-550x**	

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	SAMPLE NO/TYPE	ELEVATION (feet)	STANDARD PENETRATION TEST DATA (blows/ft)	N-Value
75							12
80							14
		Boring terminated at 80 feet below existing ground surface.					
85							
90							
95							
100							



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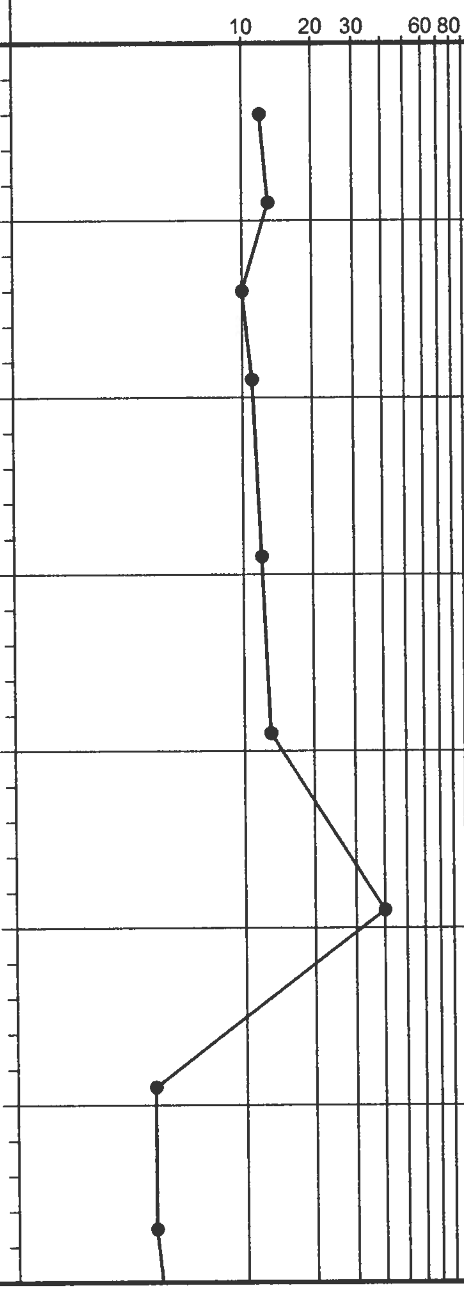
PROJECT: Shearin Property Enfield, NC 1051-11-271	TEST BORING RECORD	B- 9

DATE DRILLED:	9/13/11	ELEVATION:	Ground Surface
DRILLING METHOD:	N Casing 2-15/16 Tri	BORING DEPTH:	75.0 ft
LOGGED BY:	S. Hatfield	WATER LEVEL:	Dry @ TOB
DRILLER:	R. Norwood	DRILL RIG:	CME-550x

NOTES: **Boring location is approximate. Standard Penetration Testing (SPT) performed with a safety hammer.**

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	SAMPLE NO/TYPE	ELEVATION (feet)	STANDARD PENETRATION TEST DATA (blows/ft)	N-Value
		TOPSOIL (4 inches)					
		Stiff Orange-Tan Sandy **CLAY** (CH), Moist					12
		Stiff Pink-Gray Silty **CLAY** (CH), Moist					13
5		Stiff Orange-Gray Sandy **CLAY** (CL-CH), Moist to Wet					10
10							11
		Medium Dense Orange Silty Fine **SAND** (SM), Wet (~40% Fines)					12
15							
		Medium Dense Orange-Brown Silty Fine to Medium **SAND** (SM), Wet (~40% Fines)					13
20							
		Dense Orange-Black Silty Medium to Coarse Silty **SAND** (SM), Moist (~30% Fines)					40
25							
		Soft to Firm Blue-Gray Silty **CLAY** (CH) with Shell Hash, Wet					4
30							4



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PROJECT: Shearin Property Enfield, NC 1051-11-271		TEST BORING RECORD	B- 9
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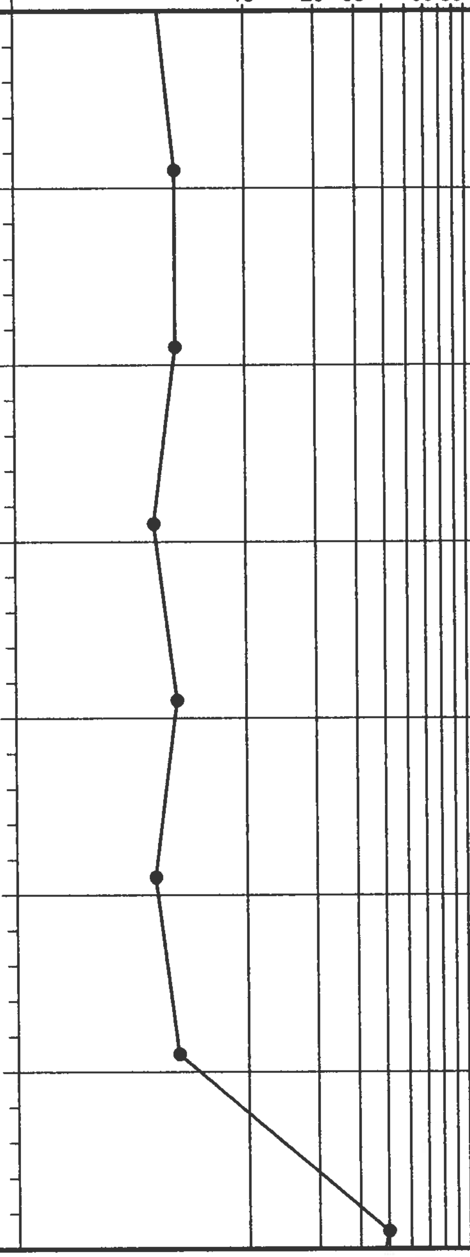
DRILLING METHOD: N Casing 2-15/16 Tri	BORING DEPTH: 75.0 ft		
LOGGED BY: S. Hatfield	WATER LEVEL: Dry @ TOB		
DRILLER: R. Norwood	DRILL RIG: CME-550x		

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	SAMPLE NO/TYPE	ELEVATION (feet)	N-Value
40				☒		5
45				☒		5
50		Soft to Firm Blue-Gray Silty **CLAY** (CH) with Shell Hash and Some Sand, Wet		☒		4
55				☒		5
60		Very Loose to Loose Blue-Gray Silty Fine **SAND** (SM) with Shell Pieces, Wet (45% Fines)		☒		4
65				☒		5
		Dense to Medium Dense Gray Silty Fine **SAND** (SM), Wet (~45% Fines)		☒		40

STANDARD PENETRATION TEST DATA (blows/ft)



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PROJECT: Shearin Property, Enfield, NC, 1051-11-271	TEST BORING RECORD	B- 9

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DRILLING METHOD: N Casing 2-15/16 Tri	BORING DEPTH: 75.0 ft	
LOGGED BY: S. Hatfield	WATER LEVEL: Dry @ TOB	
DRILLER: R. Norwood	DRILL RIG: CME-550x	

DEPTH (feet)	GRAPHIC LOG	MATERIAL DESCRIPTION	WATER LEVEL	SAMPLE NO/TYPE	ELEVATION (feet)	STANDARD PENETRATION TEST DATA (blows/ft) 10 20 30 60 80	N-Value
75		Boring terminated at 75 feet below existing ground surface.					28
80							
85							
90							
95							
100							

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