The subsurface information and the subsurface investigation on which it is based were made for the purpose of study, planning and design and not for construction or pay purposes. This Subsurface Geotechnical Exploration report and all related information are not part of the contract.

The Department does not warrant or guarantee the sufficiency or accuracy of the investigation made, nor the interpretation made or the opinion of the Department as the type of materials and conditions to be encountered. The bidder or contractor is cautioned to make such independent subsurface investigation as he deems necessary to satisfy himself as to conditions to be encountered on the project. The contractor shall have no claim for additional compensation or for an extension of time for any reason resulting from the actual conditions encountered at the site differing from those indicated in the subsurface information.

Notes

1. The information contained herein is not implied or guaranteed by the N.C. Department of Transportation as accurate nor is it considered part of the Plans, Specifications or Contract for the project.
2. By having requested this information the contractor specifically waives any claims for increased compensation extension of time based difference between the conditions indicated herein and the actual conditions at the project site.

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CATLIN
Engineers and Scientists

Post Office Box 10279
Wilmington, NC 28404-0279

Phone (910) 452-5861
Fax (910) 452-7563
www.catlinusa.com

November 4, 2010

Kimley-Horn and Associates, Inc.
Attn: Mr. Matthew West
3001 Weston Parkway
Cary, North Carolina 27513

Re: **AMENDMENT to Subsurface Geotechnical Exploration**
Old Chapel Hill Road Proposed Widening Project
Box Culvert Extension
Durham, North Carolina
CATLIN Project Number: 208074

Dear Mr. West:

Based on conversations with Josh Griffin, E.I. regarding the structural design for the culvert and wingwalls on the above-referenced project, CATLIN Engineers and Scientists (CATLIN) agrees to amend a portion of the recommendations from the original submittal of the *Subsurface Geotechnical Exploration*, dated December 2, 2008.

An evaluation of the design bearing elevations, boring log data, and preliminary wingwall design data (provided by Kimley-Horn) indicates a gross allowable bearing pressure of up to 2,500 pounds per square foot (psf) may be utilized for design of foundations. This recommendation is based on the over-excavation of footing subgrades in order to remove the soft/loose material to a depth of 10 to 12 feet below land surface (BLS), or at least to the depth of the Triassic Basin material, which generally consists of residual reddish-brown to greenish-gray silty clays (CL) of low plasticity that are generally found to be hard, dry, and friable.

Please note that care should be taken during excavation and construction activities to prevent water intrusion (i.e. rainwater or groundwater) from impacting the foundation subgrade surface. Excavation of Triassic material can be similar to rock excavation due to the hardness of the material; however, as soon as the material gets wet, it becomes very unstable and takes on a very soft "mud-like" consistency, which is unsuitable for foundation support. Therefore, it is also recommended that a "mudmat" of lean concrete be placed immediately upon completion of foundation excavation in order to protect the foundation subgrade surface prior to placing stone bedding material, reinforcing steel, and/or footing concrete.

If you have any questions or require any additional information, please do not hesitate to contact us at (910) 452-5861.

Sincerely,

NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 030395 JACOB C. WESSELL

Jacob C. Wessell
11-4-10

Jacob C. Wessell, P.E.
Project Manager

208074_KHAboxculvert_Geotech_ltrrpt_amend

CATLIN
Engineers and Scientists

Post Office Box 10279
Wilmington, NC 28404-0279

Phone (910) 452-5861
Fax (910) 452-7563
www.catlinusa.com

December 2, 2008

Kimley-Horn and Associates, Inc.
Attn: Mr. Matthew West
3001 Weston Parkway
Cary, North Carolina 27513

Re: **Subsurface Geotechnical Exploration**
Old Chapel Hill Road Proposed Widening Project
Box Culvert Extension
Durham, North Carolina
CATLIN Project Number: 208-074

Dear Mr. West:

CATLIN Engineers and Scientists (CATLIN) is pleased to submit the above-referenced report for your use.

If you have any questions or require any additional information, please do not hesitate to contact us at (910) 452-5861.

Sincerely,

Jacob C. Wessell, P.E.
Project Manager

Richard G. Catlin, P.E., P.G.
President

Enclosures
208074_KHAboxculvert_Geotech_ltrrpt.doc

SUBSURFACE GEOTECHNICAL EXPLORATION

FOR

OLD CHAPEL HILL ROAD PROPOSED WIDENING PROJECT
BOX CULVERT EXTENSION
DURHAM, NORTH CAROLINA

December 2, 2008

PREPARED FOR:

KIMLEY-HORN AND ASSOCIATES, INC.
3001 WESTON PARKWAY
CARY, NORTH CAROLINA 27513

CATLIN PROJECT NO.: 208-074

PREPARED BY:

CATLIN ENGINEERS AND SCIENTISTS
220 OLD DAIRY ROAD
WILMINGTON, NORTH CAROLINA 28405
(910) 452-5861

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SUBSURFACE GEOTECHNICAL EXPLORATION

Old Chapel Hill Road Proposed Widening Project
Box Culvert Extension
Durham, North Carolina

December 2, 2008

1.0 INTRODUCTION

1.1 AUTHORIZATION

CATLIN was authorized by Kimley-Horn and Associates, Inc. to perform geotechnical borings at the subject site and to prepare a geotechnical report through acceptance of CATLIN Proposal Number P28099 dated July 31, 2008.

1.2 PROJECT DESCRIPTION

The project site is located along a section of Old Chapel Hill Road, just east of Buchanan Drive, in Durham, NC. It is our understanding that the project consists of the proposed widening of Old Chapel Hill Road, which necessitates the extension of the reinforced concrete box culvert that carries stream flow under Old Chapel Hill Road. It must be noted that project details, including design plans/profiles and anticipated structural loads, for the box culvert were unavailable prior to this subsurface investigation.

1.3 PURPOSE OF INVESTIGATION

The purpose of this investigation was to collect subsurface geotechnical information in order to determine the estimated allowable bearing capacity of site soils and to identify existing soil conditions, which would affect site preparation for the construction of a reinforced concrete box culvert at this site in Durham, North Carolina. The borings provided information with respect to the type, distribution, density, and moisture content of soil material in addition to the location of the groundwater table present during the investigation. Recommendations for site development were made from the results of the analysis of the boring data. Note that conclusions discussed in this report may change subject to actual site conditions found during construction.

It is recommended that your design staff and contractor(s) be advised of the results of this investigation, since the conditions disclosed and the recommendations contained herein may affect proposed design and construction.

2.0 SCOPE OF INVESTIGATION

The work scope for this investigation was conducted in general accordance with the previously referenced approved scope of work. The scope of the investigation for this project included the following field and laboratory testing activities.

2.1 FIELD EXPLORATION

On November 11, 2008, four exploratory borings were advanced at the site to a depth of approximately 22 to 24.5 feet below land surface (BLS). The boring locations were located by CATLIN personnel utilizing GPS technology as well as taping distances based on scaled site maps and existing site features, as shown on Figure 1. It must be noted that all four borings were offset from the original proposed locations due to conflicts with underground utilities, rip-rap near the stream bed, other drainage structures, and the actual location of the stream itself.

Borings B-01 and B-02 were advanced near the north end of the proposed box culvert extension and borings B-03 and B-04 were advanced near the south end of the proposed box culvert extension. All borings were advanced with a Gemco articulating all terrain vehicle (ATV) mounted Central Mine Equipment (CME) 45B drilling rig utilizing hollow stem auger (HAS) drilling techniques. Performance of standard penetration testing (SPT) and split-barrel sampling of soils in each boring was conducted in general accordance with ASTM Method D-1586. In performing the SPT test, borings were advanced to the desired test depth by the drilling method specified, whereupon the drill bit was withdrawn and the penetration test performed using a standard 1.4-inch I.D., 2.0-inch O.D., split-barrel sampler. Spacing between each test interval varies by no more than 2.5 feet within the top ten feet of each boring, and by no more than five feet below that depth. A 140-pound hammer falling 30 inches drives the sampler. Because of disturbance effects, the number of blows required to drive the sampler the first six inches is not considered in the SPT value. The SPT value is based on the second and third 6-inch increments and this resistance is designated the "penetration resistance." Penetration resistance is an index of the soil strength and density that is used in engineering design. The SPT data also allows estimation of soil properties such as continuity, compressibility, and permeability. After each SPT test, the soil from the split-barrel sampler is classified according to color, texture, material type, and moisture content. A portion of each sample is collected and placed in a sealed container and transported to the laboratory for further analysis to verify field condition. The samples are temporarily stored in the laboratory for future reference.

The following activities were performed during the field exploration:

- Advanced two geotechnical borings (two at each end of the proposed box culvert extension) to depths of 22 to 25 feet BLS;

- Depth intervals (in feet) for penetration testing and collection of soil samples were as follows:

1.0 – 2.5	13.5 – 15.0
3.5 – 5.0	18.5 – 20.0
6.0 – 7.5	23.5 – 25.0
8.5 – 10.0	

- Visually classified split spoon samples during drilling according to the Unified Soil Classification System (USCS). A qualified geologist, conducted supervision of borings and soil descriptions;

- Groundwater depths were recorded at the time the borings were drilled (zero-hour) and again at the end of the day (except at B-02), before backfilling each borehole;

- Final boring locations were surveyed in the field by taping distances from existing features and the original proposed boring locations due to the unavailability of a GPS signal.

2.2 GEOTECHNICAL LABORATORY TESTING

Representative soil samples were collected from each boring and submitted for geotechnical laboratory testing per the following analyses:

Moisture Content	D-2216
Visual Classification	D-2488
Wash 200 Sieve Analysis	D-1140
Atterberg Limits	D-4318

The results of the laboratory analyses were utilized to assist in classification of the site soils in addition to determining the geotechnical characteristics of the subsurface soils. Laboratory results are included on the boring logs located in Appendix A, as well as in a separate Appendix B.

3.0 RESULTS OF GEOTECHNICAL INVESTIGATION

3.1 SUBSURFACE CONDITIONS

Subsurface soils encountered in the vicinity of all borings consisted primarily of brown to orange-brown, low to medium plasticity, silty to very fine sandy clays (SC/CL) with some interlayered silty to clayey sands (SM/SC) from the ground surface to a depth of approximately 8 to 11 feet BLS, with some root fragments, rock fragments, asphalt fragments, and rip-rap noted near the ground surface in some borings. In addition, a trace amount of quartzite stream gravels were encountered at the bottom of this stratum within borings B-01 and B-02, located on the north side of Old Chapel Hill Road.

For geotechnical engineering, SPT N-values (blow counts) allow a description of consistency or relative density (hardness) to be assigned. This assigned hardness is universal throughout the industry and allows continuity in reporting. The hardness values are listed in two categories, "sands" and "clays and silts", and are as follows:

SANDS		CLAYS AND SILTS	
BLOWS/FOOT	***DESCRIPTION***	***BLOWS/FOOT***	***DESCRIPTION***
0-4	Very Loose	0-1	Very Soft
4-10	Loose	2-4	Soft
10-30	Medium Dense	4-8	Medium
30-50	Dense	8-15	Stiff
Over 50	Very Dense	15-30	Very Stiff
		Over 30	Hard

Field blow counts (N-values) within the upper stratum (described above) generally ranged from less than 1 (weight of SPT hammer) to 9 blows per foot (BPF), indicating a consistency of very loose/soft to loose/stiff. It should be noted that the blow count of 28 in the last six-inch interval of the 1.0 to 2.5 ft SPT test in boring B-04 was influenced by rip-rap just below the split-spoon sampler and does not represent an accurate soil strength at that depth. The very soft clays encountered in this stratum may exhibit high compressibility and low cohesion due to saturation near the water table.

Below the soft upper silty/sandy clay layer in all borings, residual soils consisting of reddish-brown to greenish-gray silty clays (CL) of low plasticity were encountered to the boring termination and/or auger refusal depths of approximately 22 to 25 feet BLS. This stratum was generally found to be hard, dry, and friable with saprolitic rock encountered at the boring termination depth in boring B-03 and auger refusal encountered in hard rock (possibly greenschist-grade meta-sediment) at 22 feet BLS in boring B-04. Field N-values within this stratum were all in excess of 100 BPF, indicating a very dense or hard material, which is consistent with the mudstones found in the Triassic Basin (geologic formation that runs through central North Carolina, particularly Durham).

A site map illustrating the soil test boring locations is included as Figure 1 and boring logs are included in Appendix A.

3.2 GROUNDWATER CONDITIONS

Groundwater was encountered in all borings immediately after drilling, with the exception of B-04, at depths ranging from approximately 8.5 to 16.9 feet BLS. Groundwater was then gauged again at the end of the day in all borings, except B-02, at depths ranging from approximately 5.7 to 6.6 feet BLS. Due to the proximity of the soil borings to the stream, as well as the nature and purpose of the proposed structure, it is anticipated that groundwater will be encountered at very shallow depths during construction of the box culvert. Some fluctuation in groundwater levels can occur with climatic and seasonal changes, with the highest groundwater levels expected during the winter and early spring. Seasonal low groundwater levels are expected in late summer and early fall. Therefore, subsurface water conditions at other times may be different from those described in this report.

4.0 SUMMARY AND RECOMMENDATIONS

4.1 GENERAL GEOTECHNICAL CONSIDERATIONS

The conclusions and recommendations presented in this report are based on the project description and anticipated structural loads provided, soil data obtained from our field and laboratory testing, SPT blow counts, assumed continuity of the soils between borings and generally accepted geotechnical engineering practice. The recommendations contained herein are based solely on the limited subsurface data and design information available to us, general assumptions for structural loads and our knowledge of the subsurface conditions in the vicinity of this project. The borings performed at this site represent subsurface conditions at the location of the borings only; therefore, undisclosed subsurface conditions requiring special preparation may be revealed during construction. Please refer to Appendix C for additional information related to the geotechnical portion of this report.

4.2 FOUNDATION SUPPORT

We believe the site is suitable for foundation support of the proposed box culvert provided the recommendations in this report are implemented during both the design and construction phases of the project. Based on the assumption that similar subsurface conditions exist at this site between the boring locations, the proposed structures can be adequately supported on a shallow foundation system consisting of spread footings and/or mat foundations bearing on undisturbed and approved residual soils or on newly placed controlled structural fill overlying undisturbed and approved residual soils. However, based on the results of our borings, the existing very loose/soft soils, medium plasticity clays, and root fragments encountered within upper stratum of the subsurface are not suitable for direct support of the proposed foundations. We recommend that this soft and otherwise unsuitable material be removed from foundation subgrades as described in the sections below. Structures supported by spread footings bearing on the existing loose and/or unsuitable subsurface soils may potentially result in unacceptably large foundation settlements that could be deleterious to structural and/or mechanical connections.

4.3 GROSS ALLOWABLE BEARING CAPACITY

We recommend a gross allowable bearing pressure of up to 1,500 pounds per square foot (psf) be used for design of the foundations, provided that the recommendations in this report are implemented. The recommended gross allowable bearing pressure is predicated on the verification of suitable bearing subgrade soils through testing by a geotechnical engineer during foundation construction. CATLIN also recommends that the foundations not be seated on high plasticity soils due to their shrink/swell potential, or on very soft, saturated clays due to their high compressibility. Foundation bearing material that is composed of high plasticity soils or very soft clays should be undercut in order to reduce the potential for structural deflection due to volumetric changes and increased compressibility in the soil.

Based on the preliminary design plans provided to us and conversations with the structural engineer, it appears that foundation material for the proposed box culvert and shallow spread footings for the wing wall portions may consist of a stone bedding. This type of foundation material should be suitable for support of the proposed structures provided that unsuitable material (organics, debris, soft/loose soil, high plasticity clays) is removed and replaced with clean structural fill, compacted in accordance with the sections below. In addition, the stone bedding should be placed at minimum dimensions extending at least 12 inches outside the footprint of the box culvert and spread footings, and should be wrapped in a geotextile filter fabric to prevent the movement of fines into the stone bedding. The "migration" of fine material into the stone bedding could result in excessive surface settlement due to the possibility of groundwater fluctuations and/or scour washing the fine material from the voids between the stone, thus creating the opportunity for more fines from above to migrate into the underlying stone bedding. The geotextile filter fabric should be placed in the excavation bottom perpendicular to the proposed box culvert barrel or long side of the proposed wing wall footing prior to placement of stone bedding material, with sufficient overhang to allow a minimum 3 feet of overlap when the fabric is wrapped on top of the stone bedding. Perpendicular sections of fabric should be continuous and a minimum 2 feet of overlap should be provided between sections of fabric.

4.4 SETTLEMENT CONSIDERATIONS

Based on the information provided in this report and provided that our recommendations are implemented, the estimated settlement of the proposed structures may be limited to tolerable amounts of less than one inch. However, since anticipated structural loads (in excess of backfill weight and assumption of standard pedestrian/traffic loads), proposed structure geometry, and final footing elevations were not available at the time of this report, we were unable to calculate a precise estimated settlement potential. In addition, using the recommended gross allowable bearing pressure for foundation design may result in a large degree of settlement if foundations bear on the very soft, compressible clay layer encountered within the top 8 to 11 feet of the subsurface.

The actual magnitude of settlement that may occur beneath the structure will depend on the quality of earthwork and foundation construction, as well as variations and differing conditions in the subsurface soil profile encountered during construction activities. However, due to the cohesive nature of the majority of the subsurface soils at this site, if these soils are left in place, the total settlement may exceed tolerable amounts and may not be fully realized within a reasonable timeframe, as deflection due to pore pressure dissipation and primary consolidation of the clayey soils can take several months or years to occur.

4.5 LATERAL EARTH PRESSURES

The lateral earth pressure coefficients presented in this report are intended for design of cast-in-place reinforced concrete retaining walls. These recommendations are based on the assumption that on-site soils will be used as backfill. Therefore, if select granular soils from an off-site source are specified for backfill, they should be evaluated by an experienced geotechnical engineer prior to use.

Assuming the on-site soils (consisting of mainly silty/clayey sands and sandy/silty clays with an estimated angle of internal friction, ϕ, of 25 degrees) will be used as backfill, a passive earth pressure coefficient, K_p, of 2.46 and an active earth pressure coefficient, K_a, of 0.41 is recommended for calculation of lateral earth pressures.

For analysis of the retaining wall against sliding, we recommend using a Coefficient of Friction (μ) of 0.33, based on the soil's angle of internal friction, ϕ, of 25 degrees.

5.0 FOUNDATION CONSTRUCTION RECOMMENDATIONS

5.1 SITE PREPARATION

Following excavation activities for each foundation, the exposed subgrade bearing materials should be compacted and proof rolled as discussed in the following sections. Any unsuitable material found during construction (i.e. organic material, debris, plastic clay, and soft/loose soil) should be removed and replaced with compacted inorganic granular backfill. All backfill should be compacted to the density specified in the following sections. Excavation of unsuitable material should extend beyond the footprint of the proposed structure a minimum distance of at least half the depth of the excavation below the bottom of footing. This minimum distance will assure proper distribution of foundation pressures within the structural fill material. Temporary slopes in open excavations may be adequately maintained at inclinations of 1(H):1(V), although they should be evaluated by a geotechnical engineer during construction. The crests of all slopes should also be maintained at least 5 feet from any building or other structure limits.

5.2 PROOF ROLLING

Proof rolling is an important part of site preparation that will help provide a level of assurance that the foundation bearing subgrades are uniform in density. Therefore, this portion of the site preparation should be monitored carefully to verify compliance with our recommendations.

Following the foundation excavation activities, the exposed bearing subgrade material should be compacted as described in the next section. Subsequently, the compacted subgrade should be proof rolled either by a minimum of three passes of a 10-ton roller or by a fully loaded tandem axle truck. The proof rolling should be performed under the observation of a geotechnical engineer or his designate in order to inspect the subgrade for any areas of yielding or soft soil.

5.3 COMPACTION

Foundation bearing subgrade material, including any structural fill or backfill, should be compacted with a minimum weight 10-ton smooth drum vibratory roller (for granular material) or sheepsfoot roller (for cohesive material), if access to the area by a large roller is possible. Foundation subgrades or fill in areas not accessible by a large roller should be compacted by smaller equipment that can operate in confined spaces. All fill and backfill should be placed in loose lifts not to exceed 8 inches in thickness for large powered compaction equipment, and not to exceed 4 inches (loose thickness) for smaller hand-operated compaction equipment. These lift thicknesses should be adjusted to obtain the optimum compaction that meets or exceeds the requirement discussed in the following paragraph. Compaction of each lift of soil and/or foundation subgrade surface should consist of at least 5 passes of compaction equipment, in a criss-cross pattern. This manner of compaction should help to collapse zones of potential surface settlement that may exist, while also creating a stable working mat for successive lifts of fill.

All fill should consist of inorganic granular material free of debris. Each lift of soil should be compacted to at least 95% of its Modified Proctor maximum dry density, and the preferred moisture content should be within $\pm$ 2% of the optimum moisture content for maximum density, in accordance with ASTM D-1557. The upper 18 inches of each foundation bearing subgrade should be compacted to at least 98% of the Modified Proctor maximum dry density.

5.4 GROUNDWATER CONSIDERATIONS

Due to the shallow groundwater table (approximately 5 to 7 feet BLS) and the proximity of the proposed structure to the stream, it is anticipated that groundwater will be encountered during excavation operations and may need to be dealt with through the use of dewatering techniques such as well points or sumps. Not only will dewatering the subsurface several feet aid in excavation activities, but it may also assist with compaction efforts for the soft/loose zone of clayey sands and sandy clays encountered within the upper 5 to 10 feet BLS.

5.5 QUALITY CONTROL AND TESTING

Quality control and testing for the foundations and earthwork should be performed by competent and qualified personnel under the general supervision of a geotechnical engineer familiar with the design considerations for this project. Foundation bearing surfaces should be observed by a geotechnical engineer or his designate prior to the placement of reinforcing steel or concrete for footings in order to confirm that the footing will be placed on suitable soils. Density testing should be utilized to control and verify the compaction of foundation subgrade material and fill. Density testing should be performed during construction at the subgrade level, at each lift of fill, and at the bottom of footing elevations in order to assure uniform compaction. The minimum frequency for density testing should be at least one density test per 2,500 square feet of each lift of fill, or fraction thereof. In addition, at least one density test should be performed for each 25 linear feet of bearing wall or continuous strip footing, or fraction thereof.

Additional testing should be performed on the foundation bearing subgrade material to confirm the design bearing pressure. We recommend that at least one Dynamic Cone Penetrometer (DCP) test be performed per 25 linear feet of bearing wall or continuous strip footing. In addition, a minimum of one DCP test should be performed for every 500 square feet of foundation area, or fraction thereof. The DCP tests should be performed to a minimum depth of 4 feet below the bottom of footing, or as directed by the geotechnical engineer.

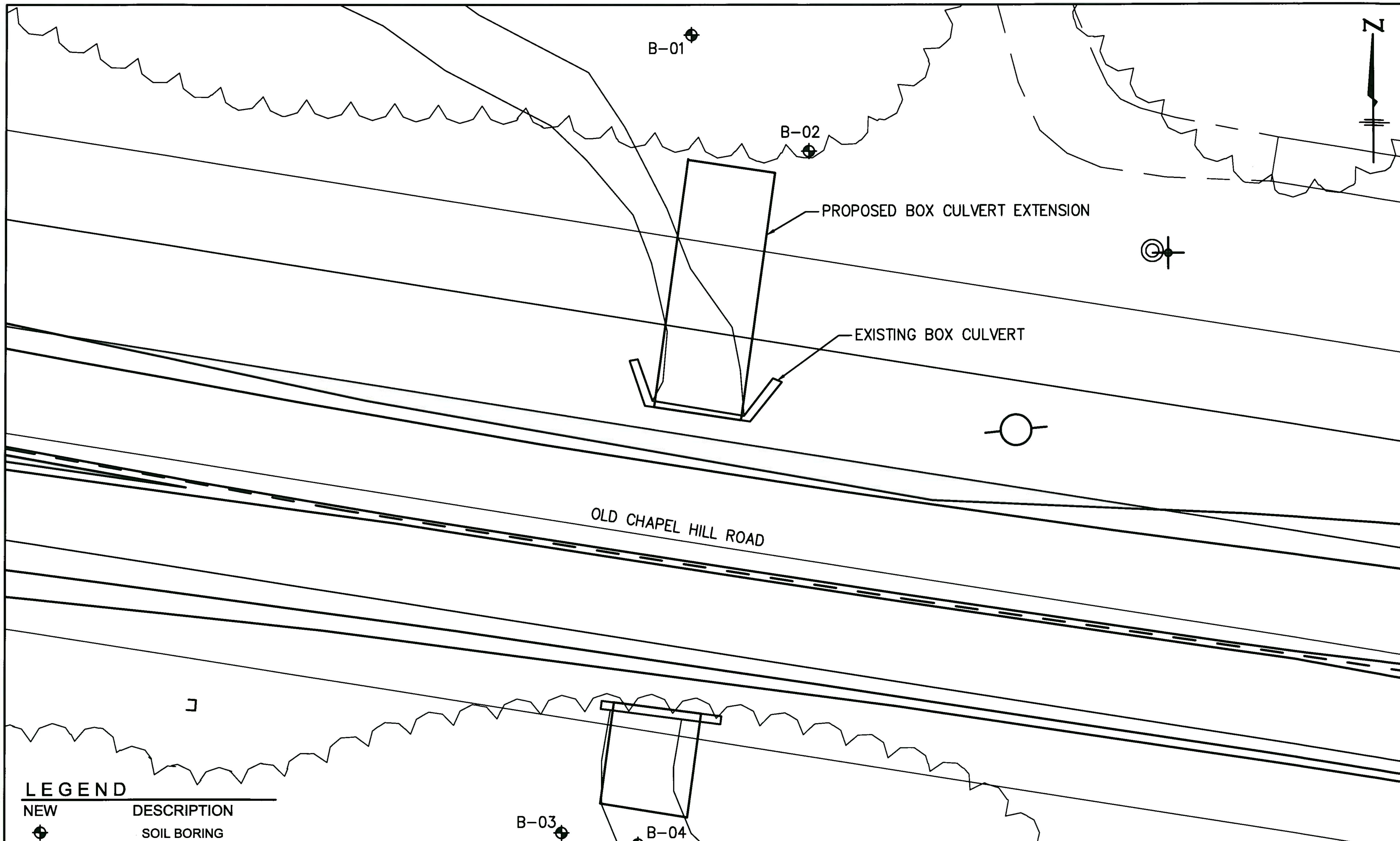
6.0 LIMITATIONS

This investigation and analysis covers only the soil zones and deposits associated with the subsurface investigation. It is not intended to include deep soil or rock strata where cavities or caverns may exist. Furthermore, this study does not deal with or accept responsibility for the possibility of sinkhole development. Deep structural borings, geophysical investigation, or resistivity surveys must be conducted in order to evaluate the structural conditions and stability of soil and rock formations and is beyond the scope of this investigation. The preliminary findings in this report are based on analysis of the soils from each of the indicated borings with an interpolation of soil conditions and assumption of reasonable variation in the soil uniformity and properties between boring locations. Should any condition at variance with our report or different than those shown by borings be encountered during future explorations, we should be notified immediately so that supplemental data can be provided at minimal cost to our client. It is the responsibility of the client to see that these findings are brought to the attention of those concerned.

7.0 REPRODUCTIONS

The reproduction of this report, or any part hereof, in plans or other engineering documents supplied to persons other than the client should bear the language indicating that the information contained therein is for general information only and not for reconstruction or bidding purposes and that the client and *CATLIN Engineers and Scientists* are not liable to such other person for and representation made therein.

FIGURES



LEGEND

NEW	DESCRIPTION
⌖	SOIL BORING

NOTES:
1. BASE MAP PROVIDED BY KIMLEY-HORN AND ASSOCIATES, INC.
2. BORING LOCATIONS ARE APPROXIMATE, BASED ON GPS COORDINATES AND FIELD MEASUREMENTS FROM EXISTING STRUCTURES.
3. BORINGS WERE OFFSET FROM ORIGINAL LOCATIONS DUE TO THE EXISTENCE OF UNDERGROUND UTILITIES AND RIP RAP ASSOCIATED WITH THE STREAM AND OTHER DRAINAGE STRUCTURES.

10 5 0 10
SCALE IN FEET

CATLIN
Engineers and Scientists

PROJECT	TITLE	FIGURE
OLD CHAPEL HILL ROAD PROPOSED WIDENING PROJECT BOX CULVERT EXTENSION DURHAM, NORTH CAROLINA	SITE MAP WITH SOIL BORING LOCATIONS	1

JOB NO.	DATE:	SCALE:	DRAWN BY:	CHECKED BY:
208-074	DEC 2008	1" = 10'	JCW	RGC

208074_KHAboxculvert_Fig1

APPENDICES

APPENDIX A

BORING LOGS

BORING LOG

CATLIN ENGINEERS and SCIENTISTS
208-074
Wilmington, NC

SHEET 1 OF 1

PROJECT NO.: 208-074	**STATE:** NC	**COUNTY:** Durham	**LOCATION:** Old. Chapel Hill Rd.
PROJECT NAME: Old Chapel Hill Rd. Culvert Extension	**LOGGED BY:** Tom Stetler	**DRILLER:** Bobbie D. Fowler	**BORING ID:** B-01
NORTHING: 798265.0	**EASTING:** 2005571.0	**CREW:** John Wood	
SYSTEM: NCSP NAD 83 (USft)	**BORING LOCATION:** North of existing culvert.		**LAND ELEV.:** 247.50
DRILL MACHINE: CME 45B ATV	**METHOD:** H.S. Augers	**0 HOUR DTW:** 8.5	**TOTAL DEPTH:** 24.5
START DATE: 11/11/08	**FINISH DATE:** 11/11/08	**24 HOUR DTW:** 5.7	**ROCK DEPTH:** ---

ELEV. (ft.)	DEPTH (ft.)	BLOW COUNT 0.5ft.	0.5ft.	0.5ft.	BLOWS PER FOOT (0 20 40 60 80 100)	SAMP	LAB	USCS
246.5	1.0	1	2	2	4			SM / CL
244.0	3.5	0	0	0	0			SC
241.5	6.0	0	0	0	0	SS-01	MC=27.5	SC/ CL
239.0	8.5	50/ 5"						CL
234.0	13.5	31	50/ 2"					CL
229.0	18.5	50/ 4"						CL
224.0	23.5	15	50/ 4"					CL

DEPTH	SOIL AND ROCK DESCRIPTION	ELEVATION
0.0	LAND SURFACE	247.5
1.0		246.5
1.5	Orange-brown, SILTY f. SAND. Moist. (M)	246.0
2.5	Brown, SILTY CLAY. Low plasticity. Soft. Moist. Tr. root fragments. (M)	245.0
3.5		244.0
5.0	Brown, SILTY to CLAYEY f. SAND. Moist to wet. V. loose (weight of hammer/18"). High component of fines. (M)	242.5
6.0		241.5
7.5	Same as above, but almost a SANDY CLAY. Tr. mod. rounded stream gravels. V. loose (weight of hammer/18"). Wet. (W)	240.0
8.5		239.0
10.0	Brown to reddish-brown, low plasticity SILT CLAY. Hard. Dry. (D)	237.5
13.5		234.0
15.0	Same as above. Hard. Dry. Tr. greenish-gray mottling. (D)	232.5
18.5		229.0
20.0	Same as above. Brown to reddish-brown, low plasticity SILTY CLAY. Hard. Dry. Friable. Casing of spoon is saturated, but sample is dry (water coming from above ~8' BLS?). (D)	227.5
23.5		224.0
25.0	Same as above. Reddish-brown, low plasticity SILTY CLAY. Hard. Dry. Tr. greenish-gray mottling. (D)	222.5
	Boring Terminated w/ refusal at Elevation 223.0 ft. 24 hr. DTW is end of day measurement.	

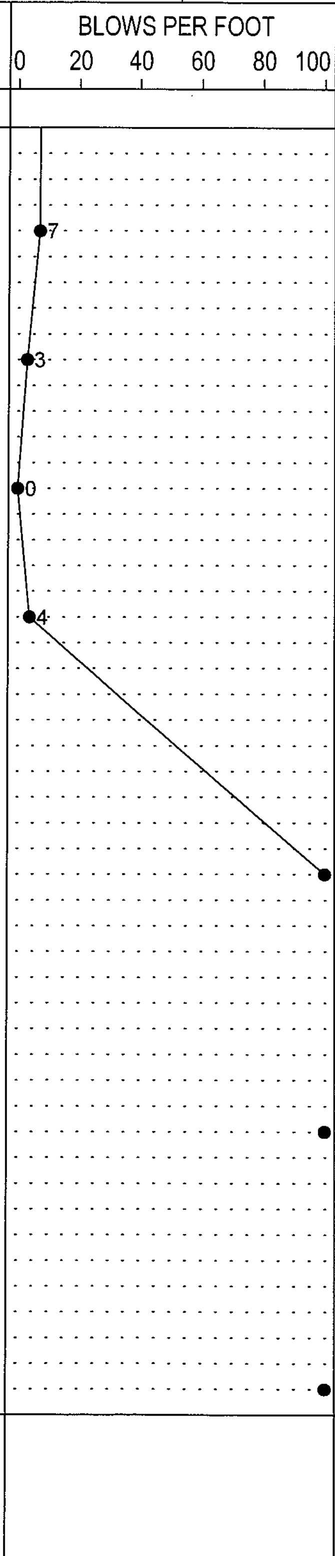
BORING LOG

CATLIN ENGINEERS and SCIENTISTS 208-074 Wilmington, NC

SHEET 1 OF 1

PROJECT NO.: 208-074	STATE: NC	COUNTY: Durham	LOCATION: Old. Chapel Hill Rd.
PROJECT NAME: Old Chapel Hill Rd. Culvert Extension		LOGGED BY: Tom Stetler	BORING ID: B-02
		DRILLER: Bobbie D. Fowler	
NORTHING: 798252.0	EASTING: 2005585.0	CREW: John Wood	
SYSTEM: NCSP NAD 83 (USft)	BORING LOCATION: North of existing culvert.		LAND ELEV.: 248.50
DRILL MACHINE: CME 45B ATV	METHOD: H.S. Augers	0 HOUR DTW: 16.9	TOTAL DEPTH: 24.5
START DATE: 11/11/08	FINISH DATE: 11/11/08	24 HOUR DTW: NM	ROCK DEPTH: ---

ELEV. (ft.)	DEPTH (ft.)	BLOW COUNT 0.5ft.	0.5ft.	0.5ft.	BLOWS PER FOOT	SAMP	LAB	USCS	LOG	DEPTH	SOIL AND ROCK DESCRIPTION	ELEVATION
										0.0	LAND SURFACE	248.5
247.5	1.0	1	3	4	7			CL		1.0 – 2.0	Brown, SILTY to f. SANDY CLAY. Moist. Med. stiff. (M)	247.5 – 246.5
								SM		2.5	Orange-brown, SILTY f. SAND. Loose. (M)	246.0
245.0	3.5	1	1	2	3	SS-02	MC=20.7	CL		3.5 – 5.0	Brown, to orange-brown, SILTY CLAY. Med. plasticity. Mottled. Moist. Soft. (M)	245.0 – 243.5
242.5	6.0	0	0	0	0			SC/CL		6.0 – 7.5	Brown, CLAYEY f. SAND to SANDY CLAY. Moist to wet. V. soft/v. loose (weight of hammer/18"). (W)	242.5 – 241.0
240.0	8.5	0	2	2	4	SS-03	LL=34 PL=16 PI=18	SC/CL		8.5 – 10.0	Grayish-brown, SANDY CLAY. Tr. quartzite stream gravels. Higher clay content than above. V. soft to soft (1st count WOH/6"). (W)	240.0 – 238.5
235.0	13.5	50/4"						CL		13.5 – 15.0	Reddish-brown, SILTY CLAY. Low plasticity. Dry. Hard. Friable. (D)	235.0 – 233.5
230.0	18.5	50/4"						CL		18.5 – 20.0	Same as above. Dry. Hard. (D)	230.0 – 228.5
225.0	23.5	13	50/3"					CL		23.5 – 25.0	Same as above. Reddish-brown, SILTY CLAY. Low plasticity. Dry. Hard. (D)	225.0 – 223.5
											Boring Terminated w/ Refusal at Elevation 224.0 ft. 24 hr. DTW not measured.	



BORING LOG

CATLIN ENGINEERS and SCIENTISTS
208-074
Wilmington, NC

SHEET 1 OF 1

PROJECT NO.: 208-074	STATE: NC	COUNTY: Durham	LOCATION: Old. Chapel Hill Rd.
PROJECT NAME: Old Chapel Hill Rd. Culvert Extension		LOGGED BY: Tom Stetler	BORING ID: B-03
		DRILLER: Bobbie D. Fowler	
NORTHING: 798174.0	EASTING: 2005556.0	CREW: John Wood	
SYSTEM: NCSP NAD 83 (USft)	BORING LOCATION: South of existing culvert.		LAND ELEV.: 247.50
DRILL MACHINE: CME 45B ATV	METHOD: H.S. Augers	0 HOUR DTW: 14.1	TOTAL DEPTH: 24.0
START DATE: 11/11/08	FINISH DATE: 11/11/08	24 HOUR DTW: 6.6	ROCK DEPTH: ---

ELEV. (ft.)	DEPTH (ft.)	BLOW COUNT 0.5ft.	0.5ft.	0.5ft.	BLOWS PER FOOT	SAMP	LAB	USCS	DEPTH	SOIL AND ROCK DESCRIPTION	ELEVATION
									0.0	LAND SURFACE	247.5
									1.0	Riprap in sandy clay matrix at surface.	246.5
246.5	1.0	6	5	4	9			CL	2.5	Brown, SILTY to f. SANDY CLAY. Tr. asphalt fragments. Med. stiff to stiff. Moist. Low plasticity (M)	245.0
244.0	3.5	1	2	2	4			SC	3.5 – 5.0	Brown to orange-brown, SILTY to CLAYEY f. SAND. Loose to v. loose. Moist. (M)	244.0 – 242.5
241.5	6.0	0	0	1	1			CL/ SC	6.0 – 7.5	Brown, f. SANDY CLAY w/ interlayered clayey sand. Moist to wet. V. soft (weight of hammer/12"). Med. plasticity. (W)	241.5 – 240.0
239.0	8.5	2	2	4	6	SS-04	LL=49 PL=20 PI=29	CL	8.5 – 10.0	Brown, SILTY CLAY. Moist to dry at base. Med. stiff. Tr. gray to reddish-brown mottling. (M)	239.0 – 237.5
234.0	13.5	13	50/ 5"					CL	13.5 – 15.0	Dark brown, SILTY CLAY. Dry. Hard. Tr. reddish to greenish-gray mottling. (D)	234.0 – 232.5
229.0	18.5	7	50/ 5"					CL	18.5 – 20.0	Reddish-brown, SILTY CLAY w/ green-gray mottling. Dry (Sample is dry, but water coming down from interval above ~10' BLS). Hard. Low plasticity. Tr. rock fragments. (D)	229.0 – 227.5
224.0	23.5	43	50/ 1"					CL	23.5 – 25.0	Reddish-brown, friable, SILTY CLAY. Hard. Dry. Refusal at 24' BLS. (D)	224.0 – 222.5

Boring Terminated w/ refusal at Elevation 223.5 ft. 24 hr. DTW is end of day measurement.

BORING LOG

CATLIN ENGINEERS and SCIENTISTS
208-074
Wilmington, NC

SHEET 1 OF 1

PROJECT NO.: 208-074 | **STATE:** NC | **COUNTY:** Durham | **LOCATION:** Old. Chapel Hill Rd.

PROJECT NAME: Old Chapel Hill Rd. Culvert Extension | **LOGGED BY:** Tom Stetler | **DRILLER:** Bobbie D. Fowler | **CREW:** John Wood

BORING ID: B-04

NORTHING: 798173.0 | **EASTING:** 2005565.0

SYSTEM: NCSP NAD 83 (USft) | **BORING LOCATION:** South of existing culvert. | **LAND ELEV.:** 246.50

DRILL MACHINE: CME 45B ATV | **METHOD:** H.S. Augers | **0 HOUR DTW:** 22.0 | **TOTAL DEPTH:** 22.0

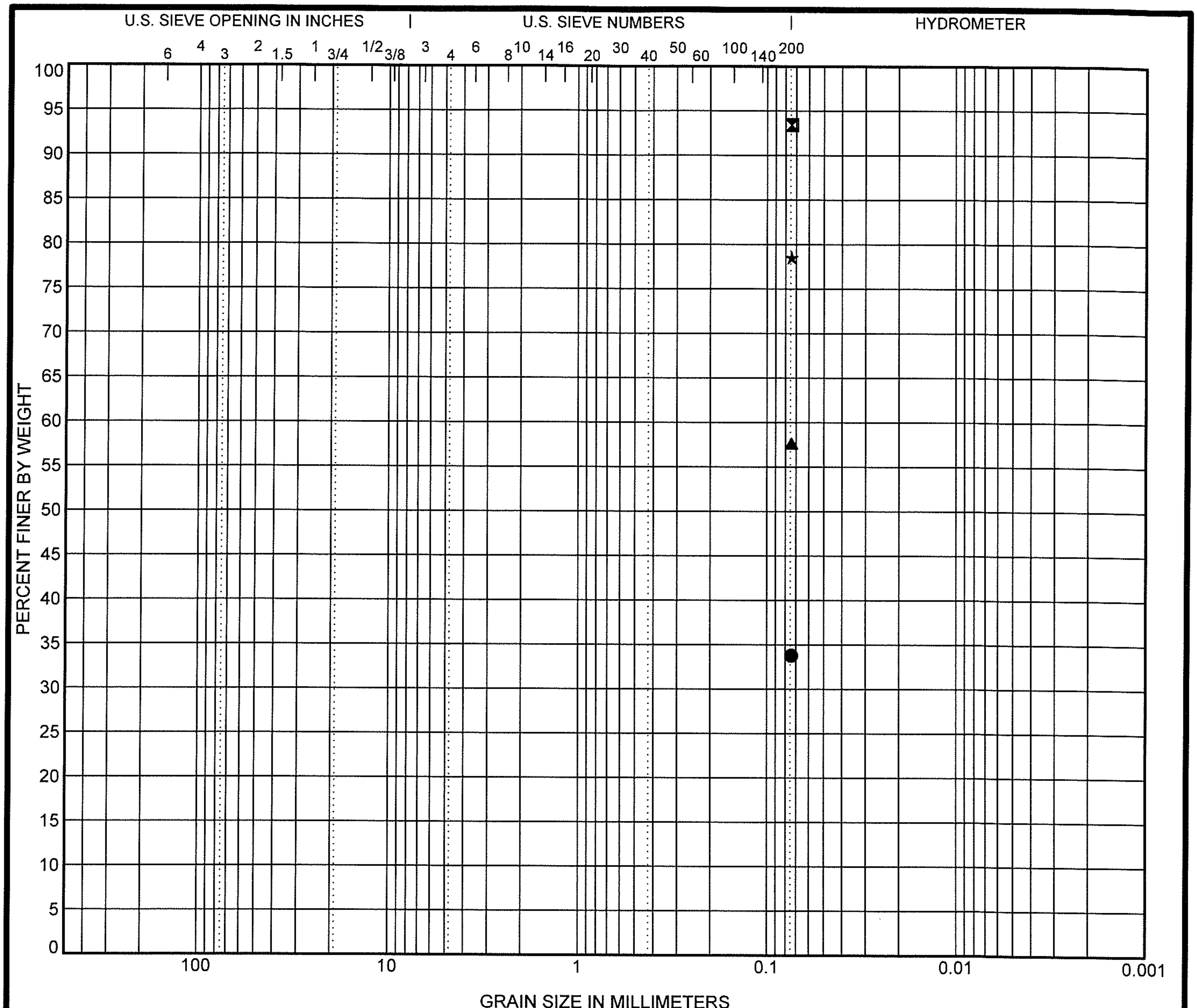
START DATE: 11/11/08 | **FINISH DATE:** 11/11/08 | **24 HOUR DTW:** 6.5 | **ROCK DEPTH:** ---

ELEV. (ft.)	DEPTH (ft.)	BLOW COUNT 0.5ft.	0.5ft.	0.5ft.	BLOWS PER FOOT (0 20 40 60 80 100)	SAMP	LAB	USCS	DEPTH	SOIL AND ROCK DESCRIPTION	ELEVATION
									0.0	LAND SURFACE	246.5
									1.0	Riprap in sandy to clayey matrix.	245.5
245.5	1.0	1	4	28	32			SC	2.5	Brown, SILTY to CLAYEY f. SAND. Tr. rock fragments. Moist. Last count influenced by riprap. Tr. root fragments. Loose. (M)	244.0
243.0	3.5	2	2	2	4	SS-05	MC=17.3	SC	3.5–4.0	Same as above. (M)	243.0–242.5
								CL	5.0	Brown, low plasticity, SILTY CLAY. Moist. Soft. (M)	241.5
240.5	6.0	1	3	6	9	SS-06	MC=26.8	CL	6.0–7.5	Brown to orange-brown, low plasticity, SILTY CLAY. Moist to dry at base of interval. Stiff. (M)	240.5–239.0
238.0	8.5	4	9	11	20			CL	8.5–10.0	Same as above. Dry. V. stiff. (D)	238.0–236.5
233.0	13.5	32	50/ 2"					CL	13.5–15.0	Reddish-brown, SILTY CLAY. Low plasticity. Dry. Hard. Contains weak horizontal cleavage (bedding?). (D)	233.0–231.5
228.0	18.5	11	50/ 2"					CL	18.5–20.0	Same as above. Reddish-brown SILTY CLAY. Low plasticity. Tr. gray mottling. Tr. white mica flecks? Dry. Hard. (D)	228.0–226.5
									22.0	Auger refusal at 22' BLS.	224.5
224.5	22.0	50/ 0"						CL	22.0–23.5	Return consists of greenish-gray rock fragments. Mod. well indurated. Greenschist meta-sediment? Possibly just sedimentary. (D)	224.5–223.0

Boring Terminated at Elevation 224.0 ft
24 hr. DTW is end of day measurement.

APPENDIX B

GEOTECHNICAL LABORATORY RESULTS



COBBLES	GRAVEL		SAND			SILT OR CLAY
	coarse	fine	coarse	medium	fine	

	Specimen ID	Depth	Classification	LL	PL	PI	Cc	Cu
●	**B-01**	**6.0**	**Moisture Content 27.5%**					
⌧	**B-02**	**3.5**	**Moisture Content 20.7%**					
▲	**B-04**	**3.5**	**Moisture Content 17.3%**					
★	**B-04**	**6.0**	**Moisture Content 26.8%**					

	Specimen ID	Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**B-01**	**6.0**	**0.074**							
⌧	**B-02**	**3.5**	**0.074**							
▲	**B-04**	**3.5**	**0.074**							
★	**B-04**	**6.0**	**0.074**							

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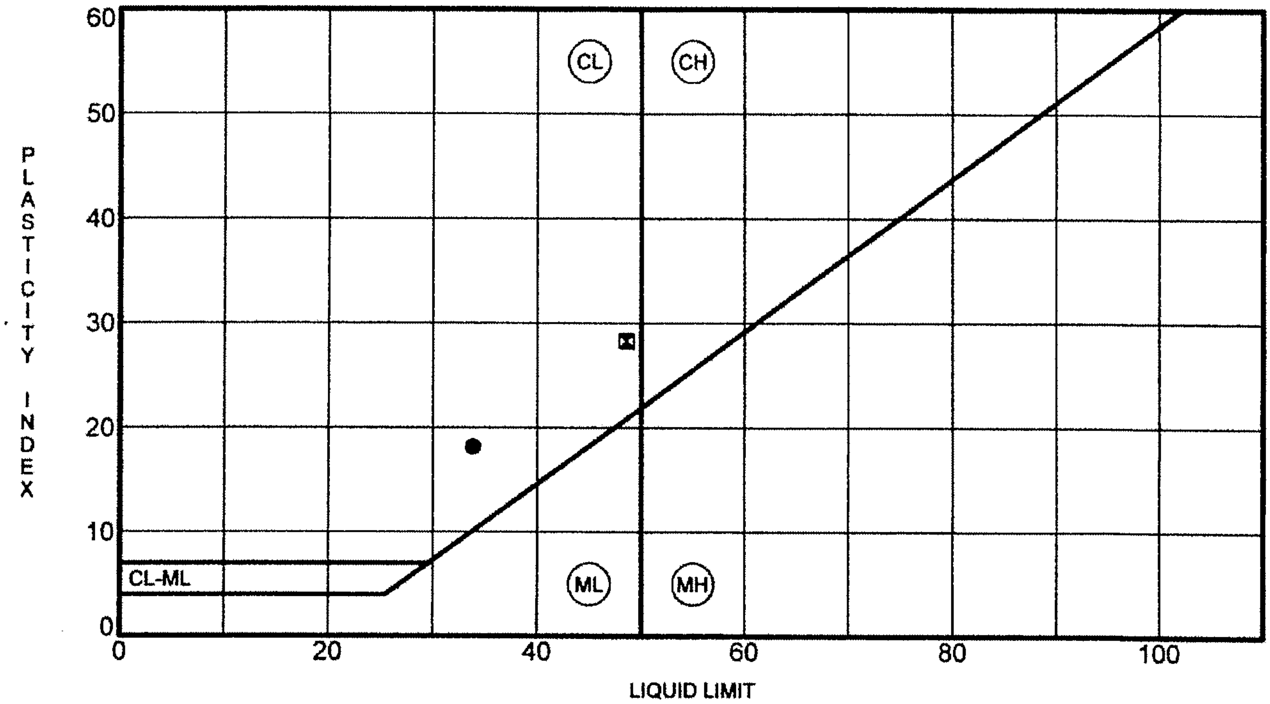
CATLIN NAME: Culvert Exten.
CATLIN NUM.: 208-074

GRAIN SIZE DISTRIBUTION

PROJECT NAME: Old Chapel Hill Rd. Culvert Extension
CITY: Durham, North Carolina
PREPARED FOR: Kimley-Horn



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**B-02**	**8.5**	**34**	**16**	**18**		
⊠	**B-03**	**8.5**	**49**	**20**	**29**		

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Wilmington, NC

CATLIN NAME: Culvert Exten.
CATLIN NUM.: 208-074

ATTERBERG LIMITS' RESULTS

PROJECT NAME: Old Chapel Hill Rd. Culvert Extension
CITY: Durham, North Carolina
PREPARED FOR: Kimley-Horn

APPENDIX C

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL ENGINEERING REPORT

IMPORTANT INFORMATION
ABOUT YOUR
GEOTECHNICAL ENGINEERING REPORT

A GEOTECHNICAL ENGINEERING REPORT IS BASED ON A UNIQUE SET OF PROJECT-SPECIFIC FACTORS

A geotechnical engineering report is passed on a subsurface plan designed to incorporate a unique set of project-specific factors. These typically include: the general nature of the structure involved, its size and its orientation; physical concomitants such as access roads, parking lots, and underground utilities and the level of additional risk which the client assumed by the virtue of limitations imposed upon the exploratory system. To help costly problems, consult the geotechnical engineer to determine how any factors which change subsequent to the date of this report may affect his recommendations.

Unless your consulting geotechnical engineer indicates otherwise, your *geotechnical report should not be used:*

- When the nature of the proposed structure is changed, for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one;
- When the size or configuration of the proposed structure is altered;
- When the location or orientation of the proposed structure is modified;
- When there is a change of ownership, or
- For application to adjacent site.

A geotechnical engineer cannot accept responsibility for problems which may develop if he is not consulted after factors considered in his report's development have changed.

MOST GEOTECHNICAL "FINDINGS" ARE PROFESSIONAL ESTIMATES

Site exploration identifies actual subsurface conditions only at those points where samples are taken, when they are taken. Data derived through sampling and subsequent laboratory testing are extrapolated by the geotechnical engineer who then renders an opinion about overall subsurface conditions, their likely reaction to proposed construction activity, and appropriate foundation design. Even under optimal circumstances actual conditions may differ from those opined to exist, because no geotechnical engineer, no matter how qualified, and no subsurface exploration program, no matter how comprehensive, can reveal what is hidden by earth, rock, and time. For example, the actual interface between materials may be far more gradual or abrupt than the report indicates, and actual conditions in areas not sampled may differ from predictions. *Nothing can be done to prevent the unanticipated, but steps can be taken to help minimize their impact.* For this reason, *most experienced owners retain their geotechnical consultant through the construction state,* to identify variance, conduct additional tests which may be needed, and to recommend solutions to problems encountered on site.

SUBSURFACE CONDITIONS CAN CHANGE

Subsurface conditions may be modified by constantly-changing natural forces. Because a geotechnical engineering report is based on conditions which exist at the time of subsurface exploration, *construction decisions should not be based on the geotechnical engineering report which may be affected by time.* Speak with the geotechnical consultant to learn if additional tests are advisable before construction starts.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes or groundwater fluctuations may also affect subsurface conditions and, thus the continuing adequacy of a geotechnical report. The geotechnical engineer should be kept appraised for any such events, and should be consulted to determine if additional tests are necessary.

A GEOTECHNICAL ENGINEERING REPORT IS SUBJECT TO MISINTERPRETATION

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a geotechnical engineering report. To avoid these problems, the geotechnical engineer should be retained to work with other appropriate design professionals to explain relevant geotechnical findings and to review their adequacy.