FROEHLING & ROBERTSON, INC.

ROADWAY SUBSURFACE INVESTIGATION AND GEOTECHNICAL EVALUATIONS

WBS Element No. 50000.1.STR03T1B TIP No. P-5208A
Haydock to Junker (H2J) Double Track Project
Cabarrus County, North Carolina
F&R PROJECT NO. 63P-0090

Prepared for:

HDR Engineering
440 S. Church Street – Suite 1000
Charlotte, North Carolina 28202

January 23, 2013

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January 23, 2013

Mr. Kevin V. La Greca
HDR Engineering, Inc.
440 South Church Street – Suite 1000
Charlotte, North Carolina 28202

Re: **Subsurface Investigation and Geotechnical Evaluation**

TIP No.:	P-5208A
County:	Cabarrus
Description:	Haydock to Junker 2nd Main Track
F&R Project No.:	63P-0090

Dear Mr. La Greca,

Froehling & Robertson, Inc. (F&R) has completed the subsurface investigation and geotechnical evaluation for the proposed 2nd main track from Haydock to Junker in Concord, Cabarrus County, North Carolina. The work was performed in general accordance with the executed "Subconsultant Agreement" between F&R and HDR. This report contains a description of the project information provided to F&R, a discussion of the general subsurface conditions encountered during the exploration, and engineering recommendations for design of the proposed 2nd main track.

Please do not hesitate to contact us if you have any questions regarding this report or if you need additional services.

Sincerely,

FROEHLING & ROBERTSON, INC.

Robert E. Kral, E.I.
Project Manager

Michael J. Walko, P.E.
Senior Engineer
N.C. Registration No. 26917

NORTH CAROLINA PROFESSIONAL SEAL 026917 ENGINEER MICHAEL J. WALKO

1/23/13

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1.0 PURPOSE AND SCOPE OF SERVICES

The purpose of this subsurface investigation and geotechnical engineering evaluation was to explore the subsurface conditions at the site and to provide geotechnical recommendations for design of the 2nd main track. Foundation design recommendations for the proposed bridge and culvert will be provided in separate reports at a later date.

F&R's scope of services included the following:

- Advancing 6 bridge borings to depths ranging from approximately 36.0 to 81.0 feet below existing grades;
- Advancing 2 culvert borings to depths ranging from approximately 8.5 and 16.0 feet below existing grades;
- Advancing 8 roadway borings to depths ranging from approximately 7.5 to 26 feet below existing grades;
- Performing geotechnical laboratory testing on representative soil and rock core samples;
- Preparing typed NCDOT Borelog Reports and Core Boring Reports;
- Performing a geotechnical engineering evaluation of the subsurface conditions with regard to their suitability for the proposed construction; and
- Preparing this geotechnical report by staff professionals and professional engineers.

This report is organized to discuss Project Information (Section 2.0), Exploration Procedures (Section 3.0), Regional Geology (Section 4.0), Subsurface Conditions (Section 5.0) and Engineering Evaluations and Recommendations (Section 6.0).

2.0 PROJECT INFORMATION

Based on the information provided, we understand the project will consist of the construction of a railroad roadway from Milepost 360.0 (CP Haydock) and south to Pharr Mill Road (SR 1158) at Milepost 361.77. The design will consist of a new 2nd main track and improvements to horizontal curves. The project will also include the design of a new railroad bridge over Coddle

Creek at Milepost 361.13 and the extension of a 16' x 14' concrete arch culvert at Milepost 360.60.

Based on our discussions with Norfolk Southern (NS), we understand the existing main track will remain operational while the proposed 2nd main track is constructed. Also, based on review of the provided 65% plans, the existing main track will undergo isolated realignments and horizontal curve improvements throughout. We understand the design will be based on Norfolk Southern Railway (NSR) standards and AREMA design guidelines. The mainline track geometry will be designed to Class 5 standards (80 mph freight maximum and 90 mph passenger).

The profiles and cross-sections indicate that the proposed alignment will require maximum cut/fill depths on the order of approximately 25 to 30 feet. In the vicinity of the culvert extension, fill depths up to approximately 35 feet are anticipated. The drawings indicate that cuts and fills will be constructed on a 2 horizontal:1 vertical (H:V) side slope or flatter.

3.0 EXPLORATION PROCEDURES

3.1 Field Exploration

A subsurface exploration was conducted by F&R between August and November 2012 during which eight roadway borings (R-1 through R-8), six bridge borings (EB1-A, EB1-B, B1-A, B1-B, and EB2-A and EB2-B), and two culvert borings (C-1 and C-2) were performed. The locations of the borings are shown in plan view (Drawing No.'s 3 through 6 in Appendix A) and corresponding Borelog Reports and Core Boring Reports are included in Appendix A.

The borings were located in the field by F&R with the aid of a handheld Garmin GPSMAP 60CSx GPS unit using northing and easting coordinates provided by HDR. Due to accessibility issues at the interior Bent 2 location for the proposed bridge, Borings B2-A and B2-B were omitted. After the completion of drilling, the final northing and easting coordinates and boring collar elevations were obtained by Mulkey, Inc., a subcontract surveyor.

A rubber-tired ATV CME-550X drill rig was used to advance the borings into the ground to obtain samples for our engineering evaluation. The soil test borings were performed using hollow-stem, continuous-flight auger drilling techniques in general compliance with ASTM standards. Representative soil samples were obtained using a standard two-inch outside diameter (O.D.) split-barrel sampler in general accordance with ASTM D-1586, Penetration Test and Split-Barrel Sampling of Soils (Standard Penetration Test). The number of blows required to drive the split-barrel sampler three consecutive 6-inch increments was recorded and the blows of the last two 6-inch increments were added together to obtain the Standard Penetration Test (SPT) N-value representing the penetration resistance of the soil.

An automatic hammer was used to perform the SPT on this project. Research has shown that the Standard Penetration Resistance (N-value) determined by an automatic hammer is different than the N-value determined by the safety hammer method. Most correlations that are published in the technical literature are based on the N-value determined by the safety hammer method. This is commonly termed N_{60} as the rope and cathead with a safety hammer delivers about 60 percent of the theoretical energy delivered by a 140-pound hammer falling 30 inches. Several researchers have proposed correction factors for the use of hammers other than the safety hammer to correct the values to be equivalent to the safety hammer SPT N_{60}-values. The correction is made using the following equation:

$$N_{60} = N_{field} \times C_E$$

N_{field} is the value recorded in the field and C_E is the drill rod energy ratio for the hammer utilized in the field. When using an automatic hammer, it is recommended that a correction factor (C_E) of 1.3 be utilized to covert N_{field} values to N_{60} values in accordance with guidelines provided in the Performance and Use of the Standard Penetration Test in Geotechnical Engineering Practice manual published by the Center for Geotechnical Practice and Research at the Virginia Polytechnical Institute and State University. The N-values reported on the Boring Logs included in this report are the actual, uncorrected, field derived values (N_{field}).

A representative portion of the soil was obtained from each SPT sample, sealed, labeled and transported to our office for classification testing. The soil samples were visually classified in the field using visual-manual identification procedures (ASTM D-2488) and American Association of State Highway and Transportation Officials (AASHTO) nomenclature. The Borelog Reports are presented in Appendix A. Groundwater levels were recorded in the soil test borings immediately after drilling activities were completed and after a stabilization period of at least 24-hours.

3.2 Laboratory Testing

Representative SPT soil samples were selected and tested for gradation and Atterberg Limits in accordance with AASHTO T-87, T-88, T-89, and T-90 as modified by the NCDOT Materials and Tests Unit. The natural soil moisture content was also determined for these samples in accordance with AASHTO T-265. The purpose of the index testing was to aid in our classification of the soil samples and development of engineering recommendations. The laboratory test results are presented in Appendix B of this report.

4.0 REGIONAL GEOLOGY

The referenced site is located within the Charlotte Belt of the Piedmont Geologic Province. According to the Geologic Map of North Carolina, (1985), the site is located in an area mapped as metavolcanic rock (CZv) with interbedded felsic to mafic tuffs and flowrock.

The virgin soils of the Piedmont encountered at the project site are the residual product of in-place chemical weathering of rock that was similar to the rock presently underlying the site. In areas not altered by erosion or disturbed by the activities of man, the typical residual soil profile consists of clayey soils near the surface, where soil weathering is more advanced, underlain by silts and sandy silts above weathered rock and crystalline rock.

The boundary between soil and rock is not sharply defined and a transitional zone termed "Weathered Rock" is typically found overlying the more competent bedrock. Weathered Rock (WR) is defined, for engineering purposes, as residual material exhibiting Standard Penetration Test (SPT) resistances in excess of 100 blows per foot (bpf). The degree of weathering is facilitated

by fractures, joints, and by the presence of less resistant rock types. Consequently, the profile of residual soil, partially weathered rock and rock can be irregular and erratic, even over short horizontal distances. The weathered rock sampled in our borings at the site was generally identified as granite.

5.0 SUBSURFACE AND GROUNDWATER CONDITIONS

General subsurface conditions encountered at the site during our subsurface exploration are described herein. The horizontal stratification lines designating the interface between various strata on the NCDOT Borelog Reports represent approximate boundaries. The actual transition from one soil type to another may be gradual or occur between soil samples. For more detailed soil descriptions and stratifications at a particular boring location, the respective Borelog Report contained in Appendix A should be reviewed.

5.1 Stratigraphy

The stratigraphy discussion below includes conditions encountered in the Roadway Borings (R-1 through R-8), Bridge Borings (EB1-A, EB1-B, B1-A, B1-B, EB2-A and EB2-B), and the Culvert Borings (C-1 and C-2) performed by F&R at this site. Please note that the recommendations in this report will only include Roadway Borings (R-1 through R-8).

Railroad Roadway Borings

Surficial Organic Materials: A layer of surficial organic-laden soils, approximately 1 to 6 inches thick, was encountered at the surface of Borings R-1 through R-6. The surficial organic-laden soil is typically a dark-colored soil material containing roots, fibrous matter, and/or other organic components, and is generally considered unsuitable for engineering purposes. F&R has not performed any laboratory testing to determine the organic content or other horticultural properties of the observed surficial organic-laden soils. Therefore, the phrase "surficial organic-laden soil" is not intended to indicate suitability for landscaping and/or other purposes. We note that these measurements were made by the drillers from field observations and should be considered approximate. Please note that the transition from surficial organic-laden soils to underlying materials may be gradual, and therefore the observation and measurement of the

surficial organic-laden soil depth is subjective. Actual surficial organic-laden soil depths should be expected to vary and generally increase with the amount of vegetation present over the site.

Artificial Fill / Roadway Embankment: Artificial fill / roadway embankment were encountered at Borings R-2, R-3, and R-5 through R-7. The artificial fill / roadway embankment extended to depths ranging from approximately 1½ to 8½ feet below existing grades and consisted of CLAYS (A-6, A-7-6) and SANDS (A-2-4). Aggregate Base Course (ABC) stone, approximately 1½ foot thick, was encountered at Boring R-7. Standard Penetration Resistances (N-values) in the artificial fill / roadway embankment soils ranged from 3 to 19 blows per foot (bpf) with a majority of the N-values ranging from 9 to 13 bpf.

Residual Soils: Residual soils along the proposed alignment consisted of CLAYS (A-7-5, A-7-6) and SANDS (A-2-4, A-2-6) with N-values ranging from 7 to 84 bpf that generally increase with depth. Soil lenses within the weathered rock zone were encountered at Borings R-1 from approximately 13½ to 19 feet and at Boring R-3 from approximately 8½ to 13½ feet. Boring R-4 was terminated in the residual soils at a depth of approximately 20 feet below existing grades.

Weathered Rock: Weathered rock (WR) was encountered at Borings R-1, R-2, R-3, and R-5 and was typically sampled as Granite. In accordance with the NCDOT legend, weathered rock is defined as residual material exhibiting an SPT N-value of at least 100 blows per foot.

In the Roadway Borings (R-1, R-2, R-3 and R-5), the top of weathered rock was encountered at depths ranging from approximately 13½ to 19 feet below existing grades. Additionally, lenses of weathered rock were encountered at Borings R-1 from approximately 9 to 13½ feet and R-3 from approximately 4 to 8½ feet. Borings R-1 and R-3 were terminated in the weathered rock at depths of approximately 19.8 feet and 18.7 feet, respectively, below existing grades.

Standard Penetration Test Refusal: Borings R-2, R-5, R-6, R-7 and R-8 were drilled to where auger refusal was encountered. Once auger refusal was encountered, the driller performed a Standard Penetration Test (SPT) to confirm refusal conditions. Per NCDOT, SPT refusal is defined as penetration equal to or less than 0.1 foot per 60 blows.

Culvert Borings

Surficial Organic Materials: A layer of surficial organic-laden soil, approximately 6 inches thick, was encountered at the surface of Boring C-2. No surficial organic-laden soil was encountered at culvert Boring C-1.

Roadway Embankment: Below the surficial soils, roadway embankment was encountered at Boring C-2 and extended to depths of approximately 8 feet below existing grades. The roadway embankment consisted of SANDS (A-2-4) with N-values ranging from 7 to 11 bpf. The roadway embankment was most likely placed during construction of the existing concrete arch culvert.

Residual Soils: Residual soils encountered in both borings at the proposed culvert location consisted of SANDS (A-2-4) with N-values ranging from 2 to 87 bpf that generally increase with depth.

Weathered Rock: Weathered rock (WR) was encountered at Boring C-1 at a depth of approximately 4 feet below existing grades and was typically sampled as Granite. In accordance with the NCDOT legend, weathered rock is defined as residual material exhibiting an SPT N-value of at least 100 blows per foot.

Standard Penetration Test Refusal: Borings C-1 and C-2 were drilled to where auger refusal was encountered. Once auger refusal was encountered, the driller performed a Standard Penetration Test (SPT) to confirm refusal conditions. Per NCDOT, SPT refusal is defined as penetration equal to or less than 0.1 foot per 60 blows.

Bridge Borings

Surficial Organic Materials: A layer of surficial organic-laden soils, approximately 3 to 5 inches thick, was encountered at the surface of Borings EB1-A, EB1-B, B1-A and B1-B.

Artificial Fill / Roadway Embankment: Artificial fill / roadway embankment was encountered at Borings EB1-A, EB1-B, B1-A, B1-B, EB2-A and EB2-B. The artificial fill / roadway embankment extended to depths ranging from approximately 5 to 18½ feet below existing grades and generally consisted of CLAYS (A-6, A-7-6) and SANDS (A-2-4). N-values in the artificial fill /

roadway embankment soils ranged from 2 to 30 blows per foot (bpf) with a majority of the N-values ranging from 6 to 10 bpf. At Borings EB2-A and EB2-B, approximately 8½ feet and 2 feet, respectively, of Aggregate Base Course (ABC) stone was encountered. In addition, wood was encountered within the roadway embankment at Boring EB1-B from approximately 13½ to 15 feet.

Alluvial Soils: Alluvial (water deposited) soils were encountered at Borings EB1-B, B1-A and B1-B and extended to depths ranging from approximately 5 to 28 feet below existing grades. The alluvial soils consisted of CLAYS (A-6, A-7-6), SILTS (A-4) and SANDS (A-2-4) with N-values ranging from 0 (weight of hammer) to 16 bpf.

Residual Soils: Residual soils encountered at the Bridge Borings consisted of SILTS (A-4) and SANDS (A-2-4) with N-values ranging from 3 to 84 bpf that generally increase with depth. A soil lens located between the weathered rock was encountered at Boring EB2-A from approximately 53 to 58½ feet below existing grades.

Weathered Rock: Weathered rock (WR) was encountered at Borings EB1-A, B1-A, B1-B, EB2-A and EB2-B and was typically sampled as Granite. In accordance with the NCDOT legend, weathered rock is defined as residual material exhibiting an SPT N-value of at least 100 blows per foot. The top of weathered rock was encountered at depths ranging from approximately 23½ to 38½ feet below existing grades. Lenses of weathered rock were encountered at Boring EB1-B from approximately 34 to 38 feet.

Standard Penetration Test Refusal: Borings EB1-A and EB1-B were drilled to where auger refusal was encountered. Once auger refusal was encountered, the driller performed a Standard Penetration Test (SPT) to confirm refusal conditions. Per NCDOT, SPT refusal is defined as penetration equal to or less than 0.1 foot per 60 blows.

Crystalline Rock: In accordance with the NCDOT legend, crystalline rock is defined by SPT refusal (i.e., 60/0.1' or 60/0.0'). Rock coring was performed bridge borings B1-A, B1-B, EB2-A and EB2-B to continue the exploration after auger/SPT refusal was obtained. In general, the

crystalline rock (CR) encountered generally consisted of moderately hard to very hard, fresh to moderately weathered, very close to closely spaced fractured granitic rock.

The Recovery of each core run (Recovery = length of the recovered core divided by the length of the core run) and the Rock quality Designation (RQD) of each core run (RQD = total length of recovered pieces longer than 4 inches divided by the length of the core run) were measured by F&R staff. The RQD gives a relative indication of the degree of fracturing, soundness and continuity of the rock. Both the core Recovery and RQD are indicated on the Core Boring Reports. The recoveries ranged from 77% to 100% and the RQD's ranged from 55% to 100%. Photographs of the recovered rock core are included with the Core Boring Reports in Appendix A.

5.2 Groundwater Conditions

Groundwater levels were measured both immediately after drilling and after a stabilization period of at least 24 hours. At the time of drilling, water was encountered in Borings R-2, R-5, and R-6 at elevation ranging from approximately 526 feet to 553 feet (approximate depths ranging from 13 to 18 feet bgs). After a stabilization period of 24 hours, water was measured in Borings R-5 and R-6 at elevations ranging from approximately 530 feet to 541 feet. Borings R-7 and R-8 were dry at the completion of drilling activities and at the time stabilized readings were taken. Borings R-1 through R-4 were backfilled upon termination of drilling activities due to proximity to the existing main track.

It should be noted that soil moisture and groundwater elevations vary depending on seasonal factors such as precipitation and temperature. As such, soil moisture and groundwater conditions at other times of the year may vary or be different from those observed at the time of this exploration and described in this report.

Due to the presence of fine-grained silty and clayey soils, trapped or perched water conditions could develop during periods of inclement weather and during seasonally wet periods. Such conditions could cause a flow of water into excavations and deeper cuts. In addition, if site

grading is performed during the seasonally wet months or after extended periods of inclement weather, wet and water softened near surface soil conditions should be expected.

6.0 ENGINEERING EVALUATION AND RECOMMENDATIONS

6.1 General Development Considerations

The conclusions and recommendations contained in this section of the report are based upon the subsurface conditions encountered in the Roadway Borings (R-1 through R-8), site observations, and information regarding the proposed construction.

It is our opinion that a majority of the subsurface soils encountered along the proposed alignment are considered suitable for subgrade stability or fill placement. Based on the results of the soil test borings, loose near-surface soils (N-value of 5 bpf or less) were encountered at Borings R-6 and R-7 and extend to depths ranging from approximately 1½ to 5 feet below existing grades. If these soils are found to be unstable in near grade areas and/or areas to receive fill, they should be repaired as directed by the geotechnical engineer. Remedial repairs, such as in-place densification of the near-surface sandy soils, are typically recommended to provide a suitable subgrade prior to fill placement or at-grade construction. Areas that cannot be densified in place may require additional remediation, such as undercutting and replacement. Remedial repair recommendations will be discussed in greater detail in Section 6.2 titled "Site Preparation".

We recommend that the embankments are constructed in accordance with the recommendations included in this report and also in accordance with the Norfolk Southern (NS) Standard Specifications, with adequate engineering construction oversight, testing and observation. As the design progresses, F&R should be afforded an opportunity to review project plans and specifications to confirm that the recommendations presented in this report have been properly interpreted and implemented, and to determine if additional geotechnical evaluations and recommendations are needed.

6.2 Site Preparation

Initial site preparation should include the removal and wasting of the existing vegetation, surficial organic soil, and other deleterious materials. Upon completion of the stripping operations, the exposed subgrade soils at the finished subgrade level and in fill sections should be proofrolled in accordance with Section 260 of the 2012 NCDOT Standard Specifications. The proofroll operations should be observed by a geotechnical engineer or their representative. If proofrolling reveals unstable conditions, the method of repair should be as directed by the project geotechnical engineer. Methods of repair may include, but are not necessarily limited to, in-place densification of the near-surface soils; undercutting and replacement with suitable structural fill; or other remedial methods deemed appropriate by the project geotechnical engineer.

Clay layers (A-6, A-7-5, A-7-6) were encountered at Boring R-2 from approximately 0 to 8½ feet; at R-3 from approximately 0 to 1½ feet; at R-6 from approximately 8 to 13 feet; and R-8 at depths from approximately 0 to 3 feet. N-values in these soils ranged from 8 to 19 bpf, indicating a firm to very stiff consistency. Therefore, widespread undercutting of these soils is not anticipated.

Other than the previously mentioned clay layers, a majority of the subgrade soils encountered along the proposed alignment are sandy soils. However, the intermittent clay layers are considered to be moisture sensitive. When exposed, these soils may become unstable (*i.e.,* pump or rut) during normal construction activities when in the presence of excess moisture. As such, we recommend that earthwork be performed during the dryer/warmer months (mid-May through October) when weather conditions are more conducive to moisture conditioning of fill materials. If earthwork is performed during seasonally wet times, then it may be more difficult to place and compact structural fill and additional subgrade repairs (*e.g.,* deeper undercutting) may be required. Soils with moisture contents greater than 3 percent above the optimum moisture content are generally considered to have excessive moisture.

6.3 Embankment Construction

Based on the profile and cross sections provided, construction will involve newly placed embankment (structural fill) in some areas utilizing excavation from the proposed cut areas and/or possibly material obtained from an off-site borrow source. Based on a review of the Borelog Reports, it is our opinion that a majority of the materials encountered at this site would be considered suitable for use in the compacted embankment. Areas in cut sections where clay layers were encountered should be laboratory tested to verify if they meet the Piedmont criteria outlined in the Standard Specifications, Section 1018-2(A). We would like to point out that the laboratory testing of the split-spoon samples indicated that a majority of the clayey soils encountered would be considered suitable for borrow since their Plasticity Index (PI) is less than 25. Imported structural fill should be approved by the project geotechnical engineer prior to use. F&R would be happy to evaluate other potential borrow sources, if requested.

Grading work shall be performed in accordance with the NS Standard Specifications for Materials and Construction (January 2011), Section "GR-Grading". Embankments should be constructed in accordance with Section 235 of the NCDOT Standard Specifications. Backfilling and compaction shall be in accordance with subsections GR-3 and GR-4 of the NS Standard Specifications. Structural earth fill should be placed under the full-time observation of a qualified engineering technician including evaluation of subgrades prior to embankment construction and repair of any unstable subgrades. The placement and compaction of fill material should be tested in accordance with the requirements of the NS Standard Specifications in order to confirm that the recommended degree of compaction is being obtained and the soils are placed at moisture contents within the recommended range.

We recommend that field density tests, including one-point Proctor verification tests, be performed on the structural fill as it is being placed, and at a frequency determined by the geotechnical engineer to verify the compaction criteria. Where fill is placed against the existing track embankment, the side slope should be plowed, benched/stepped, and leveled to assure that fill is placed on near level surfaces and bonded to the existing embankment. Structural fill material should be placed and compacted under the full time control and supervision of a

qualified geotechnical engineer or engineering technician working under the direction of a geotechnical engineer. The placement and compaction of fill material should be tested in order to confirm that the recommended degree of compaction is obtained.

During earthwork and construction activities, surface water runoff must be drained away from the construction areas to prevent water from ponding on or saturating the soils within excavations or on subgrades. If water is allowed to pond in excavations or on improperly sloped subgrades, it will likely saturate the underlying soils and can result in additional undercutting that would not have been necessary if the site had been properly graded and protected.

6.4 Borrow Material

Any borrow required for the embankment construction should meet the NCDOT Statewide Borrow Criteria as described in Article 1018-2, Section A of the NCDOT Standard Specifications, which states that borrow materials shall consist of natural earth materials with a Plasticity Index (PI) of 25 or less. Soils with a PI of 26 through 35 are acceptable, but not to be used in the top 2 feet of the embankment. Soils with a PI greater than 35 are not acceptable as borrow. As previously mentioned, a majority of the clayey soils encountered would be considered suitable for borrow since their Plasticity Index (PI) is less than 25.

6.5 Shrinkage

Based on the location of the project site, we recommend a shrinkage factor of 20 percent for earthwork quantity calculations on this project. This number is based on the Roadway Design Shrinkage Factor Map.

6.6 Cut/Fill Slope Design

If the above site preparation and construction procedures are followed, F&R recommends that the cut/fill slopes on the project be constructed no steeper than 2H:1V. Slope stability analyses were performed at selected cut and fill locations using the computer program GSTABL7 and the modified Bishop method of analysis. Assumed soil parameters were used with the proposed 2:1 (H:V) slope geometry. Factors of safety of at least 1.3 were obtained for the proposed 2:1 slopes, which are considered acceptable.

Our experience indicates that slopes with a height of 20 to 30 feet or more and are graded on a slope of 2H:1V or steeper tend to have issues with shallow slope sloughing. The sloughing is more prone to occurring especially if the outside portions of the slope are not well compacted and if slope protection is not installed soon after construction. As such, the embankment slopes should be vegetated as soon as possible to prevent surface sloughing and erosion and should be maintained after construction. Also, the use of a vegetation/erosion control mat, turf reinforcement material, or geotextile and rip rap will help minimize the potential for shallow slope sloughing. We recommend that fill slopes be observed by a geotechnical engineer or their representative during construction. Additional slope drainage protection measures and/or grading modification may be required in certain areas depending upon conditions observed at the time of slope construction.

6.7 Embankment Settlement

Settlement calculations were performed at selected locations along the proposed 2nd Main Track. For our analysis, Cooper E 80 train loads were assumed to act over a tie length of 8½ feet; the settlement analysis modeled an 8½-foot wide applied load of 1,882 psf. Based on our analysis, settlements of up to 3 to 4 inches can be anticipated under the sustained train loading. Due to the granular nature of the underlying material along a majority of the alignment, the settlement is anticipated to occur rapidly. However, we recommend settlement plates be installed in the deeper fill areas to evaluate the settlement data (install at approximate Stations 10250+00, 10255+50, 10276+50, and 10282+00). Settlement plate details and the Special Provision are included in Appendix C of this report.

After the subgrade has been prepared and the track has been constructed, we recommend running a fully loaded ballast train back and forth along the alignment to further densify the underlying sands. Once the underlying soils have been further densified, equipment can be brought in to re-level the track where additional settlement has occurred.

6.8 Construction Quality Control

The Geotechnical Engineer of record should be retained to monitor and test earthwork activities and subgrade preparations. It should be noted that the actual soil conditions may vary along the project and thus the presence of the geotechnical engineer and/or their representative during construction will serve to observe the subsurface conditions and recommendations presented in this report. Our continued involvement on the project will aid in the proper implementation of the recommendations discussed herein. The following is a recommended scope of services:

- Review of project plans and construction specifications to verify that the recommendations presented in this report have been properly interpreted and implemented;
- Observe the earthwork process to document that subsurface conditions encountered during construction are consistent with the conditions described in this report;
- Observe the subgrade conditions before placing structural fill including proofrolling observations and subgrade repairs, if required;
- Observe the placement and compaction of structural fill and backfill, and perform laboratory and field compaction testing of the fill; and
- Observe the construction of cut and fill slopes for potential repair measures required during construction.

7.0 LIMITATIONS

This report has been prepared for the exclusive use of HDR Engineering, Inc. and their agents for specific application to the referenced site in accordance with generally accepted soil and foundation engineering practices. No other warranty, expressed or implied, is made. These conclusions and recommendations do not reflect variations in subsurface conditions that could exist intermediate of the boring locations or in unexplored areas of the site. Should such variations become apparent during construction, we reserve the right to re-evaluate our conclusions and recommendations based upon on-site observations of the conditions. In the event changes are made in the proposed construction plans, the recommendations presented in this report shall not be considered valid unless reviewed by our firm and conclusions of this report modified or verified in writing. Prior to final design, F&R should be afforded the opportunity to review the project plans and specifications to determine if additional or modified recommendations are necessary.

APPENDIX A

NCDOT LEGEND SHEET, SITE LOCATION PLAN, BORING LOCATION PLAN

BORELOG REPORTS, CORE BORING REPORTS, ROCK CORE PHOTOS

PROJECT REFERENCE NO.	SHEET NO.
P-5208A	1

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS
GEOTECHNICAL ENGINEERING UNIT

SUBSURFACE INVESTIGATION

SOIL AND ROCK LEGEND, TERMS, SYMBOLS, AND ABBREVIATIONS

SOIL DESCRIPTION

SOIL IS CONSIDERED TO BE THE UNCONSOLIDATED, SEMI-CONSOLIDATED, OR WEATHERED EARTH MATERIALS THAT CAN BE PENETRATED WITH A CONTINUOUS FLIGHT POWER AUGER, AND YIELD LESS THAN 100 BLOWS PER FOOT ACCORDING TO STANDARD PENETRATION TEST (AASHTO T206, ASTM D-1586). SOIL CLASSIFICATION IS BASED ON THE AASHTO SYSTEM. BASIC DESCRIPTIONS GENERALLY SHALL INCLUDE: CONSISTENCY, COLOR, TEXTURE, MOISTURE, AASHTO CLASSIFICATION, AND OTHER PERTINENT FACTORS SUCH AS MINERALOGICAL COMPOSITION, ANGULARITY, STRUCTURE, PLASTICITY, ETC. EXAMPLE:

VERY STIFF, GRAY, SILTY CLAY, MOIST WITH INTERBEDDED FINE SAND LAYERS, HIGHLY PLASTIC, A-7-6

SOIL LEGEND AND AASHTO CLASSIFICATION

GENERAL CLASS.	GRANULAR MATERIALS (≤ 35% PASSING #200)							SILT-CLAY MATERIALS (> 35% PASSING #200)				ORGANIC MATERIALS		
GROUP CLASS.	A-1		A-3	A-2				A-4	A-5	A-6	A-7	A-1, A-2 A-3	A-4, A-5 A-6, A-7	
	A-1-a	A-1-b		A-2-4	A-2-5	A-2-6	A-2-7				A-7-5 A-7-6			
SYMBOL														
% PASSING #10 #40 #200	50 MX 30 MX 15 MX		50 MX 25 MX	51 MN 10 MX	35 MX	35 MX	35 MX	35 MX	36 MN	36 MN	36 MN	36 MN	GRANULAR SOILS	SILT-CLAY SOILS	MUCK, PEAT
LIQUID LIMIT PLASTIC INDEX	6 MX		NP	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	40 MX 10 MX	41 MN 10 MX	40 MX 11 MN	41 MN 11 MN	SOILS WITH LITTLE OR MODERATE AMOUNTS OF ORGANIC MATTER		HIGHLY ORGANIC SOILS
GROUP INDEX	0		0	0		4 MX		8 MX	12 MX	16 MX	No MX			
USUAL TYPES OF MAJOR MATERIALS	STONE FRAGS. GRAVEL, AND SAND		FINE SAND	SILTY OR CLAYEY GRAVEL AND SAND				SILTY SOILS		CLAYEY SOILS				
GEN. RATING AS A SUBGRADE	EXCELLENT TO GOOD							FAIR TO POOR				FAIR TO POOR	POOR	UNSUITABLE

PI OF A-7-5 SUBGROUP IS ≤ LL - 30 ; PI OF A-7-6 SUBGROUP IS > LL - 30

CONSISTENCY OR DENSENESS

PRIMARY SOIL TYPE	COMPACTNESS OR CONSISTENCY	RANGE OF STANDARD PENETRATION RESISTENCE (N-VALUE)	RANGE OF UNCONFINED COMPRESSIVE STRENGTH ($TONS/FT^2$)
GENERALLY GRANULAR MATERIAL (NON-COHESIVE)	VERY LOOSE	<4	N/A
	LOOSE	4 TO 10	
	MEDIUM DENSE	10 TO 30	
	DENSE	30 TO 50	
	VERY DENSE	>50	
GENERALLY SILT-CLAY MATERIAL (COHESIVE)	VERY SOFT	<2	<0.25
	SOFT	2 TO 4	0.25 TO 0.50
	MEDIUM STIFF	4 TO 8	0.5 TO 1.0
	STIFF	8 TO 15	1 TO 2
	VERY STIFF	15 TO 30	2 TO 4
	HARD	>30	>4

TEXTURE OR GRAIN SIZE

U.S. STD. SIEVE SIZE	4	10	40	60	200	270
OPENING (MM)	4.76	2.00	0.42	0.25	0.075	0.053

BOULDER (BLDR.)	COBBLE (COB.)	GRAVEL (GR.)	COARSE SAND (CSE. SD.)	FINE SAND (F SD.)	SILT (SL.)	CLAY (CL.)

GRAIN SIZE	MM	305	75	2.0	0.25	0.05	0.005
	IN.	12	3				

SOIL MOISTURE - CORRELATION OF TERMS

SOIL MOISTURE SCALE (ATTERBERG LIMITS)	FIELD MOISTURE DESCRIPTION	GUIDE FOR FIELD MOISTURE DESCRIPTION
	- SATURATED - (SAT.)	USUALLY LIQUID; VERY WET, USUALLY FROM BELOW THE GROUND WATER TABLE
LL — LIQUID LIMIT		
PLASTIC RANGE (PI)	- WET - (W)	SEMISOLID; REQUIRES DRYING TO ATTAIN OPTIMUM MOISTURE
PL — PLASTIC LIMIT		
OM — OPTIMUM MOISTURE	- MOIST - (M)	SOLID; AT OR NEAR OPTIMUM MOISTURE
SL — SHRINKAGE LIMIT		
	- DRY - (D)	REQUIRES ADDITIONAL WATER TO ATTAIN OPTIMUM MOISTURE

PLASTICITY

	PLASTICITY INDEX (PI)	DRY STRENGTH
NONPLASTIC	0-5	VERY LOW
LOW PLASTICITY	6-15	SLIGHT
MED. PLASTICITY	16-25	MEDIUM
HIGH PLASTICITY	26 OR MORE	HIGH

COLOR

DESCRIPTIONS MAY INCLUDE COLOR OR COLOR COMBINATIONS (TAN, RED, YELLOW-BROWN, BLUE-GRAY). MODIFIERS SUCH AS LIGHT, DARK, STREAKED, ETC. ARE USED TO DESCRIBE APPEARANCE.

GRADATION

WELL GRADED - INDICATES A GOOD REPRESENTATION OF PARTICLE SIZES FROM FINE TO COARSE.
UNIFORM - INDICATES THAT SOIL PARTICLES ARE ALL APPROXIMATELY THE SAME SIZE. (ALSO POORLY GRADED)
GAP-GRADED - INDICATES A MIXTURE OF UNIFORM PARTICLES OF TWO OR MORE SIZES.

ANGULARITY OF GRAINS

THE ANGULARITY OR ROUNDNESS OF SOIL GRAINS IS DESIGNATED BY THE TERMS: ANGULAR, SUBANGULAR, SUBROUNDED, OR ROUNDED.

MINERALOGICAL COMPOSITION

MINERAL NAMES SUCH AS QUARTZ, FELDSPAR, MICA, TALC, KAOLIN, ETC. ARE USED IN DESCRIPTIONS WHENEVER THEY ARE CONSIDERED OF SIGNIFICANCE.

COMPRESSIBILITY

SLIGHTLY COMPRESSIBLE	LIQUID LIMIT LESS THAN 31
MODERATELY COMPRESSIBLE	LIQUID LIMIT EQUAL TO 31-50
HIGHLY COMPRESSIBLE	LIQUID LIMIT GREATER THAN 50

PERCENTAGE OF MATERIAL

ORGANIC MATERIAL	GRANULAR SOILS	SILT - CLAY SOILS	OTHER MATERIAL	
TRACE OF ORGANIC MATTER	2 - 3%	3 - 5%	TRACE	1 - 10%
LITTLE ORGANIC MATTER	3 - 5%	5 - 12%	LITTLE	10 - 20%
MODERATELY ORGANIC	5 - 10%	12 - 20%	SOME	20 - 35%
HIGHLY ORGANIC	>10%	>20%	HIGHLY	35% AND ABOVE

GROUND WATER

- WATER LEVEL IN BORE HOLE IMMEDIATELY AFTER DRILLING
- STATIC WATER LEVEL AFTER 24 HOURS
- PW — PERCHED WATER, SATURATED ZONE, OR WATER BEARING STRATA
- SPRING OR SEEP

MISCELLANEOUS SYMBOLS

- ROADWAY EMBANKMENT (RE) WITH SOIL DESCRIPTION
- SOIL SYMBOL
- ARTIFICIAL FILL (AF) OTHER THAN ROADWAY EMBANKMENT
- INFERRED SOIL BOUNDARY
- INFERRED ROCK LINE
- ALLUVIAL SOIL BOUNDARY
- 25/025 — DIP & DIP DIRECTION OF ROCK STRUCTURES
- SPT / CPT / DMT / VST / PMT — TEST BORING
- AUGER BORING
- CORE BORING
- MW — MONITORING WELL
- PIEZOMETER INSTALLATION
- SLOPE INDICATOR INSTALLATION
- CONE PENETROMETER TEST
- SOUNDING ROD
- TEST BORING W/ CORE
- SPT N-VALUE
- REF — SPT REFUSAL

ABBREVIATIONS

AR - AUGER REFUSAL
BT - BORING TERMINATED
CL. - CLAY
CPT - CONE PENETRATION TEST
CSE. - COARSE
DMT - DILATOMETER TEST
DPT - DYNAMIC PENETRATION TEST
e - VOID RATIO
F - FINE
FOSS. - FOSSILIFEROUS
FRAC. - FRACTURED, FRACTURES
FRAGS. - FRAGMENTS
HI. - HIGHLY
MED. - MEDIUM
MICA. - MICACEOUS
MOD. - MODERATELY
NP - NON PLASTIC
ORG. - ORGANIC
PMT - PRESSUREMETER TEST
SAP. - SAPROLITIC
SD. - SAND, SANDY
SL. - SILT, SILTY
SLI. - SLIGHTLY
TCR - TRICONE REFUSAL
w - MOISTURE CONTENT
V - VERY
VST - VANE SHEAR TEST
WEA. - WEATHERED
γ - UNIT WEIGHT
γ_d - DRY UNIT WEIGHT

SAMPLE ABBREVIATIONS
S - BULK
SS - SPLIT SPOON
ST - SHELBY TUBE
RS - ROCK
RT - RECOMPACTED TRIAXIAL
CBR - CALIFORNIA BEARING RATIO

EQUIPMENT USED ON SUBJECT PROJECT

DRILL UNITS:
- [ ] MOBILE B-__
- [ ] BK-51
- [ ] CME-45C
- [X] CME-550X
- [ ] PORTABLE HOIST
- [ ] _____
- [ ] _____

ADVANCING TOOLS:
- [ ] CLAY BITS
- [ ] 6" CONTINUOUS FLIGHT AUGER
- [X] 8" HOLLOW AUGERS
- [ ] HARD FACED FINGER BITS
- [ ] TUNG.-CARBIDE INSERTS
- [ ] CASING [ ] W/ ADVANCER
- [ ] TRICONE __" STEEL TEETH
- [ ] TRICONE __" TUNG.-CARB.
- [ ] CORE BIT
- [ ] _____

HAMMER TYPE:
- [X] AUTOMATIC [ ] MANUAL

CORE SIZE:
- [ ] -B__
- [ ] -N__
- [ ] -H__

HAND TOOLS:
- [ ] POST HOLE DIGGER
- [ ] HAND AUGER
- [ ] SOUNDING ROD
- [ ] VANE SHEAR TEST
- [ ] _____

ROCK DESCRIPTION

HARD ROCK IS NON-COASTAL PLAIN MATERIAL THAT IF TESTED, WOULD YIELD SPT REFUSAL. AN INFERRED ROCK LINE INDICATES THE LEVEL AT WHICH NON-COASTAL PLAIN MATERIAL WOULD YIELD SPT REFUSAL. SPT REFUSAL IS PENETRATION BY A SPLIT SPOON SAMPLER EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS. IN NON-COASTAL PLAIN MATERIAL, THE TRANSITION BETWEEN SOIL AND ROCK IS OFTEN REPRESENTED BY A ZONE OF WEATHERED ROCK.
ROCK MATERIALS ARE TYPICALLY DIVIDED AS FOLLOWS:

WEATHERED ROCK (WR)	NON-COASTAL PLAIN MATERIAL THAT WOULD YIELD SPT N VALUES > 100 BLOWS PER FOOT IF TESTED.
CRYSTALLINE ROCK (CR)	FINE TO COARSE GRAIN IGNEOUS AND METAMORPHIC ROCK THAT WOULD YIELD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES GRANITE, GNEISS, GABBRO, SCHIST, ETC.
NON-CRYSTALLINE ROCK (NCR)	FINE TO COARSE GRAIN METAMORPHIC AND NON-COASTAL PLAIN SEDIMENTARY ROCK THAT WOULD YEILD SPT REFUSAL IF TESTED. ROCK TYPE INCLUDES PHYLLITE, SLATE, SANDSTONE, ETC.
COASTAL PLAIN SEDIMENTARY ROCK (CP)	COASTAL PLAIN SEDIMENTS CEMENTED INTO ROCK, BUT MAY NOT YIELD SPT REFUSAL. ROCK TYPE INCLUDES LIMESTONE, SANDSTONE, CEMENTED SHELL BEDS, ETC.

WEATHERING

FRESH	ROCK FRESH, CRYSTALS BRIGHT, FEW JOINTS MAY SHOW SLIGHT STAINING. ROCK RINGS UNDER HAMMER IF CRYSTALLINE.
VERY SLIGHT (V SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED, SOME JOINTS MAY SHOW THIN CLAY COATINGS IF OPEN, CRYSTALS ON A BROKEN SPECIMEN FACE SHINE BRIGHTLY. ROCK RINGS UNDER HAMMER BLOWS IF OF A CRYSTALLINE NATURE.
SLIGHT (SLI.)	ROCK GENERALLY FRESH, JOINTS STAINED AND DISCOLORATION EXTENDS INTO ROCK UP TO 1 INCH. OPEN JOINTS MAY CONTAIN CLAY. IN GRANITOID ROCKS SOME OCCASIONAL FELDSPAR CRYSTALS ARE DULL AND DISCOLORED. CRYSTALLINE ROCKS RING UNDER HAMMER BLOWS.
MODERATE (MOD.)	SIGNIFICANT PORTIONS OF ROCK SHOW DISCOLORATION AND WEATHERING EFFECTS. IN GRANITOID ROCKS, MOST FELDSPARS ARE DULL AND DISCOLORED, SOME SHOW CLAY. ROCK HAS DULL SOUND UNDER HAMMER BLOWS AND SHOWS SIGNIFICANT LOSS OF STRENGTH AS COMPARED WITH FRESH ROCK.
MODERATELY SEVERE (MOD. SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. IN GRANITOID ROCKS, ALL FELDSPARS DULL AND DISCOLORED AND A MAJORITY SHOW KAOLINIZATION. ROCK SHOWS SEVERE LOSS OF STRENGTH AND CAN BE EXCAVATED WITH A GEOLOGIST'S PICK. ROCK GIVES 'CLUNK' SOUND WHEN STRUCK. *IF TESTED, WOULD YIELD SPT REFUSAL*
SEVERE (SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC CLEAR AND EVIDENT BUT REDUCED IN STRENGTH TO STRONG SOIL. IN GRANITOID ROCKS ALL FELDSPARS ARE KAOLINIZED TO SOME EXTENT. SOME FRAGMENTS OF STRONG ROCK USUALLY REMAIN. *IF TESTED, YIELDS SPT N VALUES > 100 BPF*
VERY SEVERE (V SEV.)	ALL ROCK EXCEPT QUARTZ DISCOLORED OR STAINED. ROCK FABRIC ELEMENTS ARE DISCERNIBLE BUT THE MASS IS EFFECTIVELY REDUCED TO SOIL STATUS, WITH ONLY FRAGMENTS OF STRONG ROCK REMAINING. SAPROLITE IS AN EXAMPLE OF ROCK WEATHERED TO A DEGREE SUCH THAT ONLY MINOR VESTIGES OF THE ORIGINAL ROCK FABRIC REMAIN. *IF TESTED, YIELDS SPT N VALUES < 100 BPF*
COMPLETE	ROCK REDUCED TO SOIL. ROCK FABRIC NOT DISCERNIBLE, OR DISCERNIBLE ONLY IN SMALL AND SCATTERED CONCENTRATIONS. QUARTZ MAY BE PRESENT AS DIKES OR STRINGERS. SAPROLITE IS ALSO AN EXAMPLE.

ROCK HARDNESS

VERY HARD	CANNOT BE SCRATCHED BY KNIFE OR SHARP PICK. BREAKING OF HAND SPECIMENS REQUIRES SEVERAL HARD BLOWS OF THE GEOLOGIST'S PICK.
HARD	CAN BE SCRATCHED BY KNIFE OR PICK ONLY WITH DIFFICULTY. HARD HAMMER BLOWS REQUIRED TO DETACH HAND SPECIMEN.
MODERATELY HARD	CAN BE SCRATCHED BY KNIFE OR PICK. GOUGES OR GROOVES TO 0.25 INCHES DEEP CAN BE EXCAVATED BY HARD BLOW OF A GEOLOGIST'S PICK. HAND SPECIMENS CAN BE DETACHED BY MODERATE BLOWS.
MEDIUM HARD	CAN BE GROOVED OR GOUGED 0.05 INCHES DEEP BY FIRM PRESSURE OF KNIFE OR PICK POINT. CAN BE EXCAVATED IN SMALL CHIPS TO PEICES 1 INCH MAXIMUM SIZE BY HARD BLOWS OF THE POINT OF A GEOLOGIST'S PICK.
SOFT	CAN BE GROVED OR GOUGED READILY BY KNIFE OR PICK. CAN BE EXCAVATED IN FRAGMENTS FROM CHIPS TO SEVERAL INCHES IN SIZE BY MODERATE BLOWS OF A PICK POINT. SMALL, THIN PIECES CAN BE BROKEN BY FINGER PRESSURE.
VERY SOFT	CAN BE CARVED WITH KNIFE. CAN BE EXCAVATED READILY WITH POINT OF PICK. PIECES 1 INCH OR MORE IN THICKNESS CAN BE BROKEN BY FINGER PRESSURE. CAN BE SCRATCHED READILY BY FINGERNAIL.

FRACTURE SPACING

TERM	SPACING
VERY WIDE	MORE THAN 10 FEET
WIDE	3 TO 10 FEET
MODERATELY CLOSE	1 TO 3 FEET
CLOSE	0.16 TO 1 FEET
VERY CLOSE	LESS THAN 0.16 FEET

BEDDING

TERM	THICKNESS
VERY THICKLY BEDDED	> 4 FEET
THICKLY BEDDED	1.5 - 4 FEET
THINLY BEDDED	0.16 - 1.5 FEET
VERY THINLY BEDDED	0.03 - 0.16 FEET
THICKLY LAMINATED	0.008 - 0.03 FEET
THINLY LAMINATED	< 0.008 FEET

INDURATION

FOR SEDIMENTARY ROCKS, INDURATION IS THE HARDENING OF THE MATERIAL BY CEMENTING, HEAT, PRESSURE, ETC.

FRIABLE	RUBBING WITH FINGER FREES NUMEROUS GRAINS; GENTLE BLOW BY HAMMER DISINTEGRATES SAMPLE.
MODERATELY INDURATED	GRAINS CAN BE SEPARATED FROM SAMPLE WITH STEEL PROBE; BREAKS EASILY WHEN HIT WITH HAMMER.
INDURATED	GRAINS ARE DIFFICULT TO SEPARATE WITH STEEL PROBE; DIFFICULT TO BREAK WITH HAMMER.
EXTREMELY INDURATED	SHARP HAMMER BLOWS REQUIRED TO BREAK SAMPLE; SAMPLE BREAKS ACROSS GRAINS.

TERMS AND DEFINITIONS

ALLUVIUM (ALLUV.) - SOILS THAT HAVE BEEN TRANSPORTED BY WATER.

AQUIFER - A WATER BEARING FORMATION OR STRATA.

ARENACEOUS - APPLIED TO ROCKS THAT HAVE BEEN DERIVED FROM SAND OR THAT CONTAIN SAND.

ARGILLACEOUS - APPLIED TO ALL ROCKS OR SUBSTANCES COMPOSED OF CLAY MINERALS, OR HAVING A NOTABLE PROPORTION OF CLAY IN THEIR COMPOSITION, AS SHALE, SLATE, ETC.

ARTESIAN - GROUND WATER THAT IS UNDER SUFFICIENT PRESSURE TO RISE ABOVE THE LEVEL AT WHICH IT IS ENCOUNTERED, BUT WHICH DOES NOT NECESSARILY RISE TO OR ABOVE THE GROUND SURFACE.

CALCAREOUS (CALC.) - SOILS THAT CONTAIN APPRECIABLE AMOUNTS OF CALCIUM CARBONATE.

COLLUVIUM - ROCK FRAGMENTS MIXED WITH SOIL DEPOSITED BY GRAVITY ON SLOPE OR AT BOTTOM OF SLOPE.

CORE RECOVERY (REC.) - TOTAL LENGTH OF ALL MATERIAL RECOVERED IN THE CORE BARREL DIVIDED BY TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

DIKE - A TABULAR BODY OF IGNEOUS ROCK THAT CUTS ACROSS THE STRUCTURE OF ADJACENT ROCKS OR CUTS MASSIVE ROCK.

DIP - THE ANGLE AT WHICH A STRATUM OR ANY PLANAR FEATURE IS INCLINED FROM THE HORIZONTAL.

DIP DIRECTION (DIP AZIMUTH) - THE DIRECTION OR BEARING OF THE HORIZONTAL TRACE OF THE LINE OF DIP, MEASURED CLOCKWISE FROM NORTH.

FAULT - A FRACTURE OR FRACTURE ZONE ALONG WHICH THERE HAS BEEN DISPLACEMENT OF THE SIDES RELATIVE TO ONE ANOTHER PARALLEL TO THE FRACTURE.

FISSILE - A PROPERTY OF SPLITTING ALONG CLOSELY SPACED PARALLEL PLANES.

FLOAT - ROCK FRAGMENTS ON SURFACE NEAR THEIR ORIGINAL POSITION AND DISLODGED FROM PARENT MATERIAL.

FLOOD PLAIN (FP) - LAND BORDERING A STREAM, BUILT OF SEDIMENTS DEPOSITED BY THE STREAM.

FORMATION (FM.) - A MAPPABLE GEOLOGIC UNIT THAT CAN BE RECOGNIZED AND TRACED IN THE FIELD.

JOINT - FRACTURE IN ROCK ALONG WHICH NO APPRECIABLE MOVEMENT HAS OCCURRED.

LEDGE - A SHELF-LIKE RIDGE OR PROJECTION OF ROCK WHOSE THICKNESS IS SMALL COMPARED TO ITS LATERAL EXTENT.

LENS - A BODY OF SOIL OR ROCK THAT THINS OUT IN ONE OR MORE DIRECTIONS.

MOTTLED (MOT.) - IRREGULARLY MARKED WITH SPOTS OF DIFFERENT COLORS. MOTTLING IN SOILS USUALLY INDICATES POOR AERATION AND LACK OF GOOD DRAINAGE.

PERCHED WATER - WATER MAINTAINED ABOVE THE NORMAL GROUND WATER LEVEL BY THE PRESENCE OF AN INTERVENING IMPERVIOUS STRATUM.

RESIDUAL (RES.) SOIL - SOIL FORMED IN PLACE BY THE WEATHERING OF ROCK.

ROCK QUALITY DESIGNATION (RQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF CORE RUN AND EXPRESSED AS A PERCENTAGE.

SAPROLITE (SAP.) - RESIDUAL SOIL THAT RETAINS THE RELIC STRUCTURE OR FABRIC OF THE PARENT ROCK.

SILL - AN INTRUSIVE BODY OF IGNEOUS ROCK OF APPROXIMATELY UNIFORM THICKNESS AND RELATIVELY THIN COMPARED WITH ITS LATERAL EXTENT, THAT HAS BEEN EMPLACED PARALLEL TO THE BEDDING OR SCHISTOSITY OF THE INTRUDED ROCKS.

SLICKENSIDE - POLISHED AND STRIATED SURFACE THAT RESULTS FROM FRICTION ALONG A FAULT OR SLIP PLANE.

STANDARD PENETRATION TEST (PENETRATION RESISTANCE) (SPT) - NUMBER OF BLOWS (N OR BPF) OF A 140 LB. HAMMER FALLING 30 INCHES REQUIRED TO PRODUCE A PENETRATION OF 1 FOOT INTO SOIL WITH A 2 INCH OUTSIDE DIAMETER SPLIT SPOON SAMPLER. SPT REFUSAL IS PENETRATION EQUAL TO OR LESS THAN 0.1 FOOT PER 60 BLOWS.

STRATA CORE RECOVERY (SREC.) - TOTAL LENGTH OF STRATA MATERIAL RECOVERED DIVIDED BY TOTAL LENGTH OF STRATUM AND EXPRESSED AS A PERCENTAGE.

STRATA ROCK QUALITY DESIGNATION (SRQD) - A MEASURE OF ROCK QUALITY DESCRIBED BY TOTAL LENGTH OF ROCK SEGMENTS WITHIN A STRATUM EQUAL TO OR GREATER THAN 4 INCHES DIVIDED BY THE TOTAL LENGTH OF STRATA AND EXPRESSED AS A PERCENTAGE.

TOPSOIL (TS.) - SURFACE SOILS USUALLY CONTAINING ORGANIC MATTER.

BENCH MARK: SURVEY INFORMATION PROVIDED BY MULKEY, INC.

_____ ELEVATION: _____ FT.

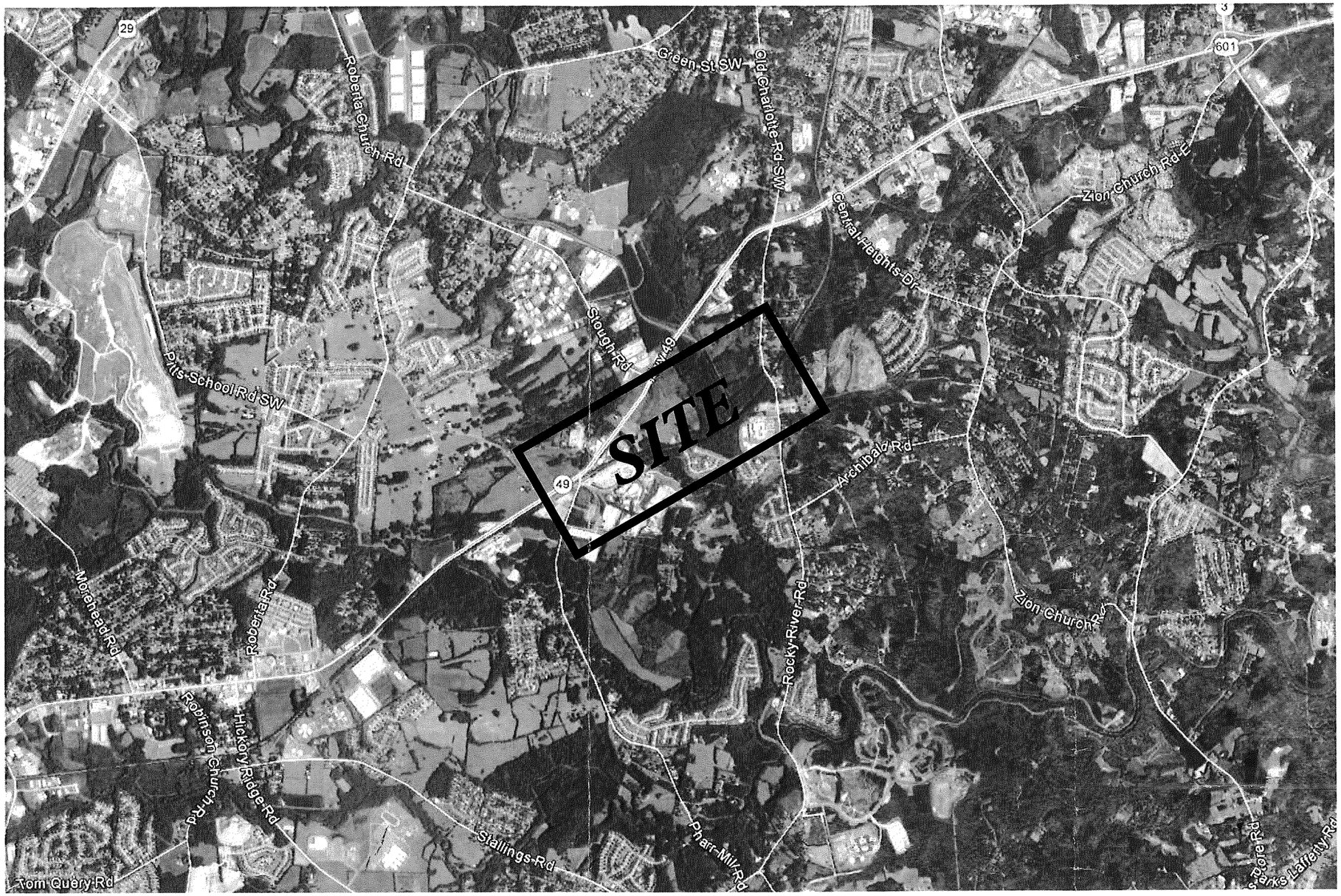
NOTES:
_

REVISED 09/23/09

SINCE
F&R
1881

PROJECT REFERENCE NO.	SHEET
P-5208A	2

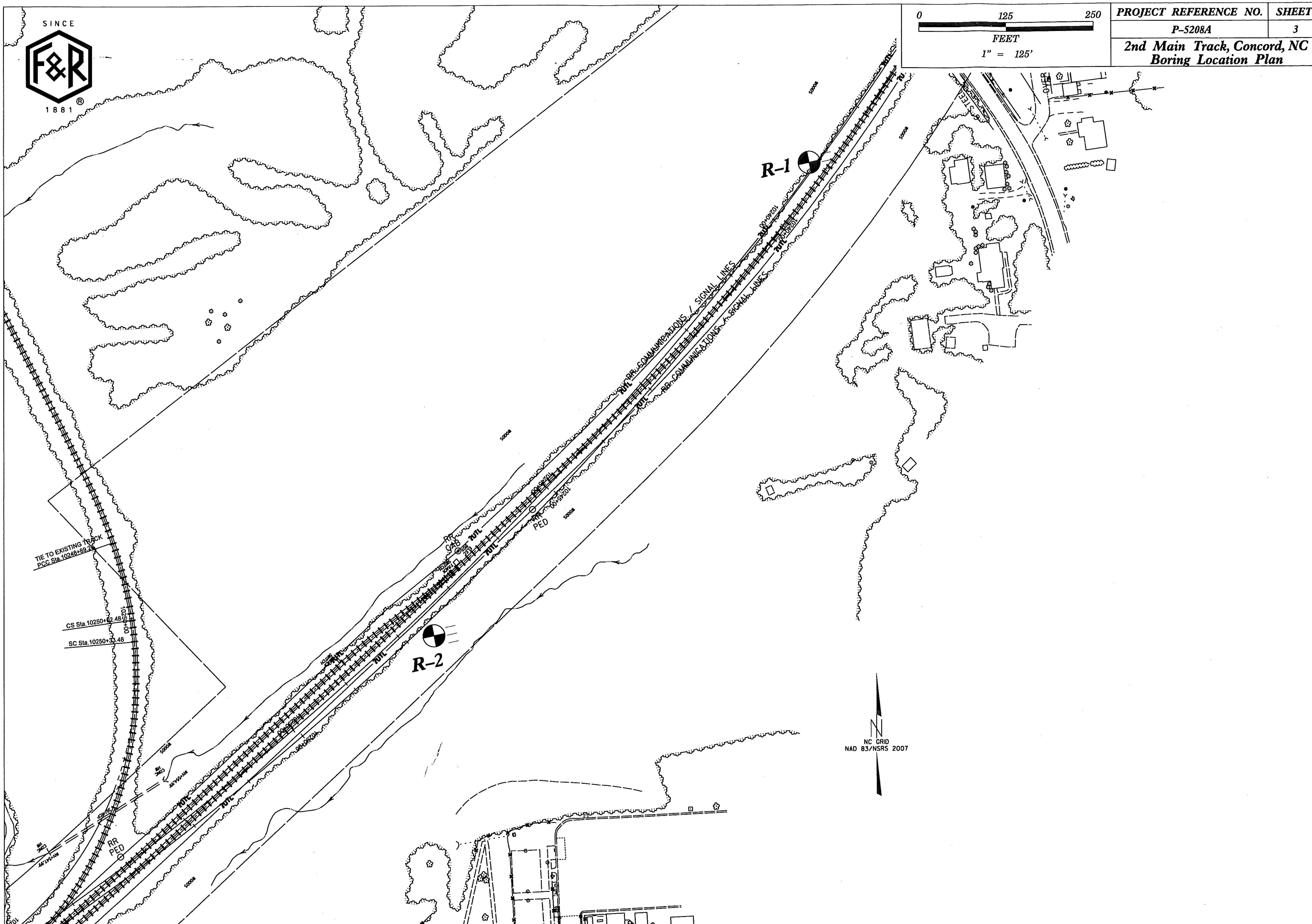
2nd Main Track, Concord, NC
Site Location Plan



PROJECT REFERENCE NO.	SHEET
P-5208A	3

2nd Main Track, Concord, NC
Boring Location Plan

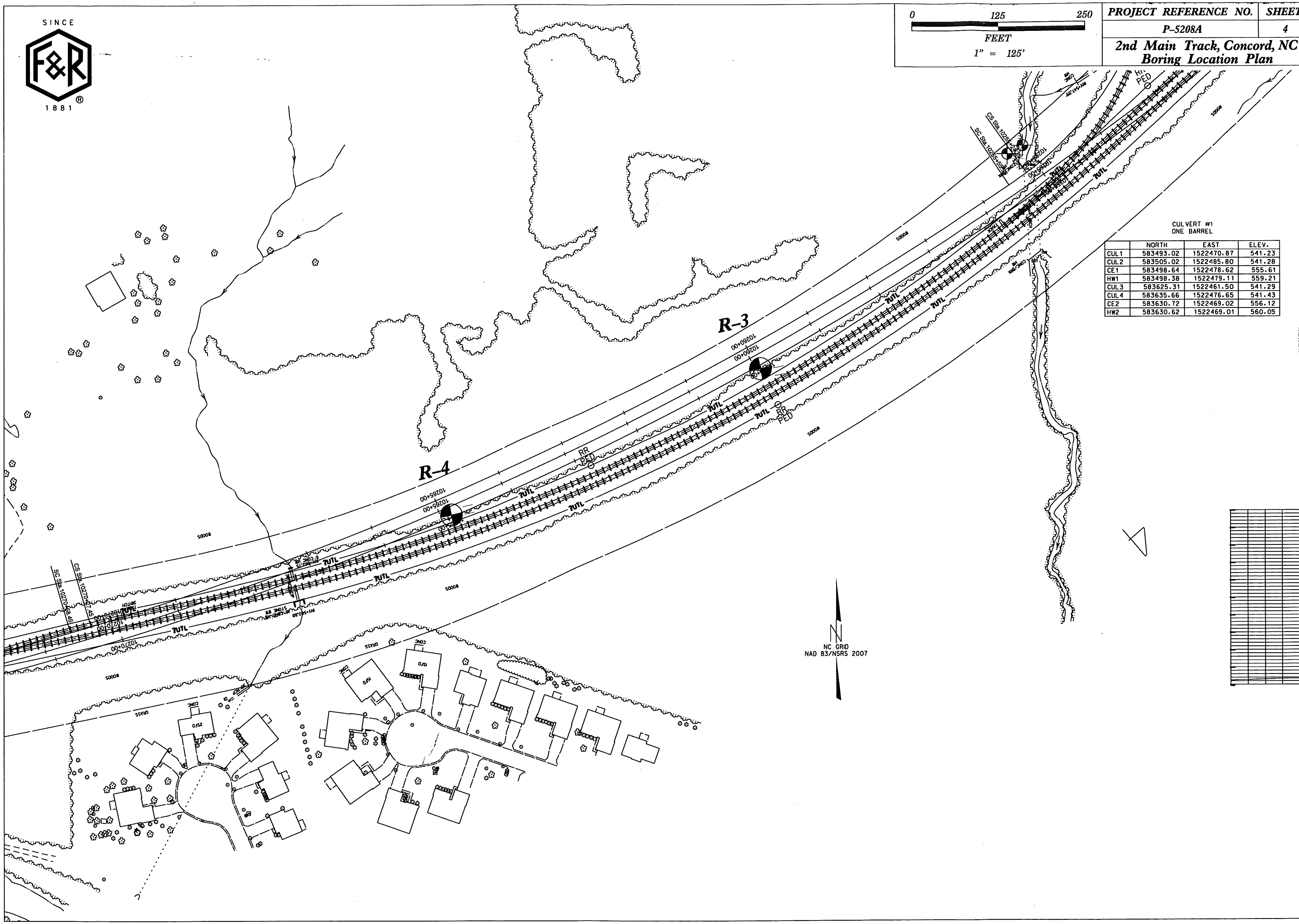
0 125 250
FEET
1" = 125'



PROJECT REFERENCE NO.	SHEET
P-5208A	4

2nd Main Track, Concord, NC
Boring Location Plan

0 125 250
FEET
1" = 125'



CULVERT #1
ONE BARREL

	NORTH	EAST	ELEV.
CUL1	583493.02	1522470.87	541.23
CUL2	583505.02	1522485.80	541.28
CE1	583498.64	1522478.62	555.61
HW1	583498.38	1522479.11	559.21
CUL3	583625.31	1522461.50	541.29
CUL4	583635.66	1522476.65	541.43
CE2	583630.72	1522469.02	556.12
HW2	583630.62	1522469.01	560.05

SINCE F&R 1881

0 125 250
FEET
1" = 125'

PROJECT REFERENCE NO.	SHEET
P-5208A	5

2nd Main Track, Concord, NC
Boring Location Plan

R-5

R-6

MP 361

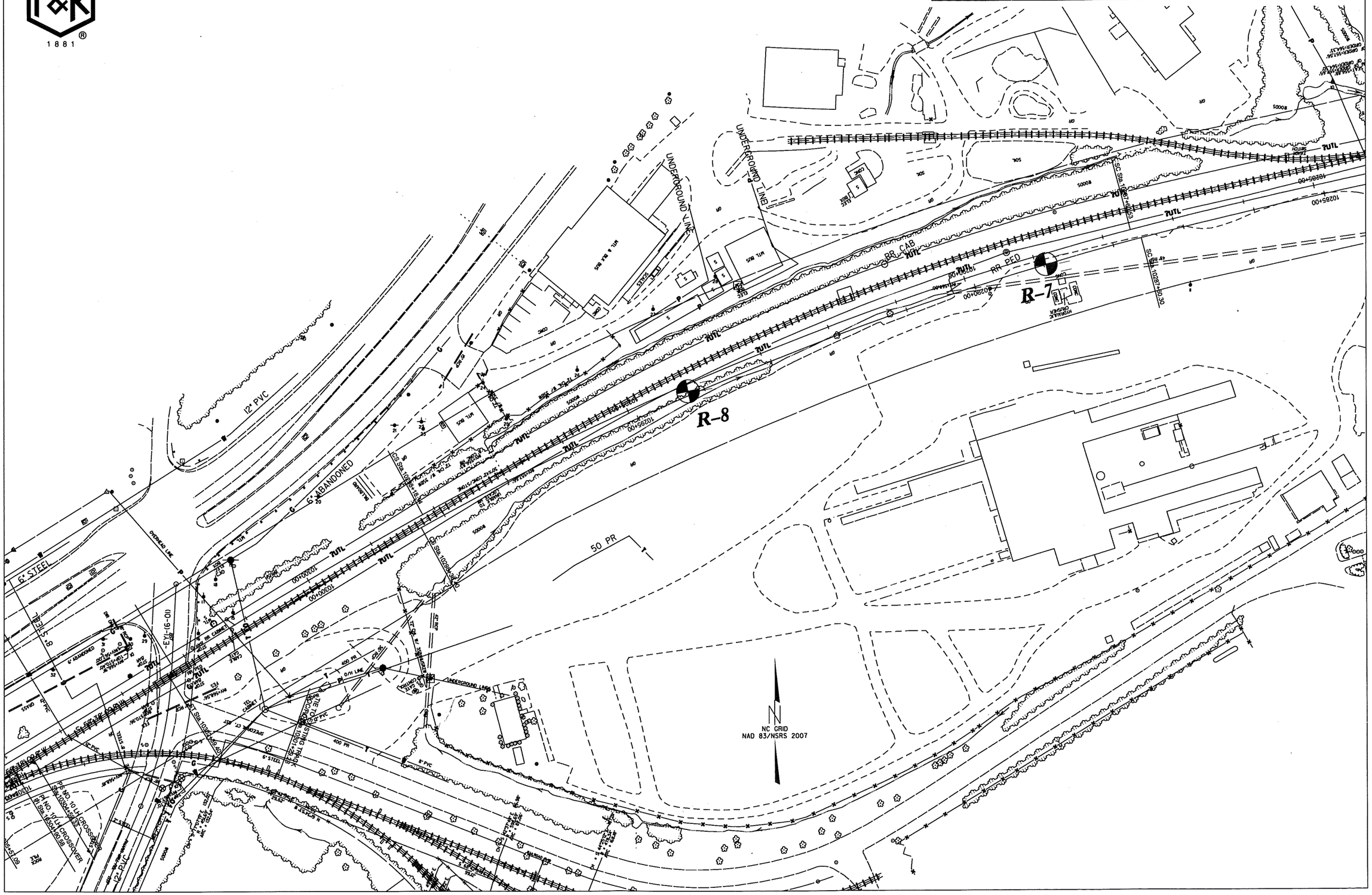
NC GRID
NAD 83/NSRS 2007

SINCE F&R 1881

0	125	250
FEET		
1" = 125'		

PROJECT REFERENCE NO.	SHEET
P-5208A	6

2nd Main Track, Concord, NC
Boring Location Plan



NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

SHEET

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral
SITE DESCRIPTION P-5208A Haydock to Junker Double Track			GROUND WTR (ft)
BORING NO. R-1	STATION 10239+06	OFFSET 25 ft RT	ALIGNMENT MAIN TRK #1	0 HR. Dry
COLLAR ELEV. 593.1 ft	TOTAL DEPTH 19.8 ft	NORTHING 584,723	EASTING 1,523,626	24 HR. FIAD
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 11/19/12	COMP. DATE 11/19/12	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
595										
	593.1	0.0								593.1 GROUND SURFACE 0.0
			2	3	4	7		D		**RESIDUAL** Brown, tan, and black silty fine to coarse SAND (A-2-4(0))
590	589.6	3.5								
			5	15	31	46	SS-2	5%		
585	584.6	8.5								584.1 9.0
			39	54	46/0.2	100/0.7				**WEATHERED ROCK** Gray, tan, and brown (GRANITE)
580	579.6	13.5								579.6 13.5
			23	22	19	41		M		**RESIDUAL** Brown, black, and tan silty fine to coarse SAND (A-2-4)
575	574.6	18.5								574.1 19.0
			20	39	61/0.3	100/0.8				573.3 19.8 **WEATHERED ROCK** Tan and orange (GRANITE)

Boring Terminated at Elevation 573.3 ft In WEATHERED ROCK (GRANITE)

1) Driller indicated approximately 1 inch of Surficial Organic Laden soil.

NCDOT BORE SINGLE 63P-0090 HADOCK TO JUNKER.GPJ NC_DOT.GDT 1/22/13

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral
SITE DESCRIPTION P-5208A Haydock to Junker Double Track			GROUND WTR (ft)
BORING NO. R-2	STATION 10247+66	OFFSET 20 ft LT	ALIGNMENT MAIN TRK #1	0 HR. 18.0
COLLAR ELEV. 571.3 ft	TOTAL DEPTH 26.0 ft	NORTHING 584,052	EASTING 1,523,088	24 HR. FIAD
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 11/19/12	COMP. DATE 11/19/12	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
575										
	571.3	0.0								571.3 GROUND SURFACE 0.0
570			3	5	8	13		D		**ROADWAY EMBANKMENT** Brown and tan silty CLAY (A-7-6(14))
	567.8	3.5								
			5	9	10	19	SS-7	16%		
565										
	562.8	8.5								562.8 8.5
			24	17	24	41		D		**RESIDUAL** White, gray, and tan silty fine SAND (A-2-4)
560										
	557.8	13.5								557.8 13.5
			100/0.4			100/0.4				**WEATHERED ROCK** Black and tan (GRANITE)
555										
	552.8	18.5								
			100/0.5			100/0.5				
550										
	547.8	23.5								
			100/0.2			100/0.2				
	545.3	26.0								545.3 26.0
			60/0.0			60/0.0				Boring Terminated with Standard Penetration Test Refusal at Elevation 545.3 ft On CRYSTALLINE ROCK (GRANITE)

1) Driller indicated approximately 1 inch of Surficial Organic Laden soil.

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral
SITE DESCRIPTION P-5208A Haydock to Junker Double Track			GROUND WTR (ft)
BORING NO. R-3	STATION 10260+02	OFFSET 5 ft LT	ALIGNMENT MAIN TRK #1	0 HR. Dry
COLLAR ELEV. 577.7 ft	TOTAL DEPTH 18.7 ft	NORTHING 583,336	EASTING 1,522,081	24 HR. FIAD
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 11/20/12	COMP. DATE 11/20/12	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
580											
	577.7	0.0	3	5	11	16		D		577.7 GROUND SURFACE	0.0
575										576.2 **ROADWAY EMBANKMENT** Brown silty sandy CLAY (A-6)	1.5
	574.2	3.5	20	47	53/0.3	100/0.8				573.7 **RESIDUAL** Gray, tan, and pink silty fine to coarse SAND (A-2-4), some rock fragments	4.0
570										**WEATHERED ROCK** Gray, tan, and pink (GRANITE)	
	569.2	8.5	19	21	52	73		D		569.2	8.5
565										**RESIDUAL** Gray, tan, and pink silty fine to coarse SAND (A-2-4), some rock fragments	
	564.2	13.5	100/0.4			100/0.4				564.2 **WEATHERED ROCK** Tan (GRANITE)	13.5
560											
	559.2	18.5	100/0.2			100/0.2				559.0	18.7

Boring Terminated at Elevation 559.0 ft In WEATHERED ROCK (GRANITE)

1) Driller Indicated approximately 3 inches of Surficial Organic Laden soil.

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral	
SITE DESCRIPTION P-5208A Haydock to Junker Double Track				GROUND WTR (ft)
BORING NO. R-4	STATION 10264+94	OFFSET 3 ft RT	ALIGNMENT MAIN TRK #1	0 HR. Dry
COLLAR ELEV. 573.3 ft	TOTAL DEPTH 20.0 ft	NORTHING 583,127	EASTING 1,521,635	24 HR. FIAD
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 11/20/12	COMP. DATE 11/20/12	SURFACE WATER DEPTH N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
575										
	573.3	0.0								573.3 GROUND SURFACE 0.0
			5	4	6	10		M		**RESIDUAL** Tan, white, brown, and gray silty fine to coarse SAND (A-2-4(0))
570	569.8	3.5								
			19	10	10	20		M		
565	564.8	8.5								
			9	13	13	26	SS-19	11%		
560	559.8	13.5								
			10	16	30	46		M		
555	554.8	18.5								
			23	40	44	84		M		553.3 20.0
										Boring Terminated at Elevation 553.3 ft In RESIDUAL SOILS
										1) Driller indicated approximately 3 inches of Surficial Organic Laden soil.

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

SHEET

WBS 50000.1.STR03T1B	**TIP** P-5208A	**COUNTY** Cabarrus	**GEOLOGIST** R. Kral
SITE DESCRIPTION P-5208A Haydock to Junker Double Track			**GROUND WTR (ft)**
BORING NO. R-5	**STATION** 10272+91	**OFFSET** 23 ft LT	**ALIGNMENT** MAIN TRK #1	**0 HR.** 15.0 Dry
COLLAR ELEV. 550.5 ft	**TOTAL DEPTH** 22.0 ft	**NORTHING** 582,849	**EASTING** 1,520,887	**24 HR.** 9.0
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER C. Boyce	**START DATE** 08/29/12	**COMP. DATE** 08/29/12	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
555										
550	550.5	0.0	4	5	8	13		D		550.5 GROUND SURFACE 0.0
	549.0	1.5								ROADWAY EMBANKMENT Brown silty fine to coarse SAND (A-2-4)
	547.0	3.5	9	30	40	70		D		RESIDUAL Tan, gray, and black silty fine to coarse SAND (A-2-4)
545										
	542.0	8.5	15	32	30	62		D		
540										
	537.5	13.0								Brown and orange clayey fine to coarse SAND (A-2-6)
	537.0	13.5	4	8	11	19		M		
535										
	532.0	18.5	42	58/0.3		100/0.8				WEATHERED ROCK Tan and black (GRANITE)
530										
	528.5	22.0	60/0.0			60/0.0				Boring Terminated with Standard Penetration Test Refusal at Elevation 528.5 ft On CRYSTALLINE ROCK (GRANITE)

1) Driller indicated approximately 6 inches of Surficial Organic Laden soil.

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

SHEET

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral	
SITE DESCRIPTION P-5208A Haydock to Junker Double Track				GROUND WTR (ft)
BORING NO. R-6	STATION 10276+98	OFFSET 16 ft LT	ALIGNMENT MAIN TRK #1	0 HR. 13.0
COLLAR ELEV. 539.5 ft	TOTAL DEPTH 22.0 ft	NORTHING 582,768	EASTING 1,520,487	24 HR. 9.0
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 08/24/12	COMP. DATE 08/24/12	SURFACE WATER DEPTH N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
540										
	539.5	0.0	2	2	3	5		M		539.5 GROUND SURFACE 0.0 **ROADWAY EMBANKMENT** Orange, brown, and gray silty fine SAND (A-2-4)
	536.0	3.5								
535			3	4	5	9		M		
	531.0	8.5								531.5 8.0
530			3	4	4	8		M		**RESIDUAL** Gray and tan silty CLAY (A-7-6)
	526.0	13.5								526.5 13.0
525			5	7	9	16		M		Orange, brown, and gray silty fine to coarse SAND (A-2-4)
	521.0	18.5								
520			16	17	22	39		M		
	517.5	22.0	60/0.0			60/0.0				517.5 22.0 Boring Terminated with Standard Penetration Test Refusal at Elevation 517.5 ft On CRYSTALLINE ROCK (GRANITE) 1) Driller indicated approximately 4 inches of Surficial Organic Laden soil.

NCDOT BORE SINGLE 63P-0090 HADOCK TO JUNKER.GPJ NC_DOT.GDT 1/22/13

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 50000.1.STR03T1B	**TIP** P-5208A	**COUNTY** Cabarrus	**GEOLOGIST** R. Kral	
SITE DESCRIPTION P-5208A Haydock to Junker Double Track				**GROUND WTR (ft)**
BORING NO. R-7	**STATION** 10288+97	**OFFSET** 1 ft RT	**ALIGNMENT** MAIN TRK #1	**0 HR.** Dry
COLLAR ELEV. 565.0 ft	**TOTAL DEPTH** 8.0 ft	**NORTHING** 582,523	**EASTING** 1,519,314	**24 HR.** Dry
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		**DRILL METHOD** H.S. Augers		**HAMMER TYPE** Automatic
DRILLER C. Boyce	**START DATE** 09/04/12	**COMP. DATE** 09/04/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
565										565.0 GROUND SURFACE 0.0
	565.0	0.0	7	7	5	12		D		563.5 **ARTIFICIAL FILL** 1.5 Gray ABC Stone
	561.5	3.5								Tan and gray silty fine to coarse SAND (A-2-4), some gravel
560			2	2	1	3		D		
	557.0	8.0	60/0.0			60/0.0				557.0 8.0 Boring Terminated with Standard Penetration Test Refusal at Elevation 557.0 ft On CRYSTALLINE ROCK (GRANITE)

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral	
SITE DESCRIPTION P-5208A Haydock to Junker Double Track				GROUND WTR (ft)
BORING NO. R-8	STATION 10294+22	OFFSET 6 ft RT	ALIGNMENT MAIN TRK #1	0 HR. Dry
COLLAR ELEV. 565.2 ft	TOTAL DEPTH 7.5 ft	NORTHING 582,350	EASTING 1,518,818	24 HR. Dry
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 09/04/12	COMP. DATE 09/04/12	SURFACE WATER DEPTH N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
570										
565	565.2	0.0	3	4	5	9		M		565.2 GROUND SURFACE 0.0 RESIDUAL Gray and brown silty CLAY (A-7-5)
	561.7	3.5	5	9	10	19		D		562.2 3.0 Dark brown silty fine SAND (A-2-4)
560	557.7	7.5	60/0.0			60/0.0				557.7 7.5 Boring Terminated with Standard Penetration Test Refusal at Elevation 557.7 ft On CRYSTALLINE ROCK (GRANITE)

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

SHEET

WBS 50000.1.STR03T1B	**TIP** P-5208A	**COUNTY** Cabarrus	**GEOLOGIST** R. Kral
SITE DESCRIPTION P-5208A Haydock to Junker Double Track			**GROUND WTR (ft)**
BORING NO. C-1	**STATION** N/A	**OFFSET** N/A	**ALIGNMENT** MAIN TRK #1 — **0 HR.** 0.0
COLLAR ELEV. 541.9 ft	**TOTAL DEPTH** 8.5 ft	**NORTHING** 583,655	**EASTING** 1,522,460 — **24 HR.** 0.0
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER C. Boyce	**START DATE** 08/30/12	**COMP. DATE** 08/30/12	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) / DEPTH (ft)
545										
	541.9	0.0								541.9 GROUND SURFACE 0.0
540			0	0	2	2		W		**RESIDUAL** Brown and tan silty fine to coarse SAND (A-2-4)
	538.4	3.5								537.9 4.0
			6	94/0.4		100/0.9				**WEATHERED ROCK** Brown and tan (GRANITE)
535										
	533.4	8.5								533.4 8.5
			60/0.0			60/0.0				Boring Terminated with Standard Penetration Test Refusal at Elevation 533.4 ft On CRYSTALLINE ROCK (GRANITE)

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 50000.1.STR03T1B	**TIP** P-5208A	**COUNTY** Cabarrus	**GEOLOGIST** R. Kral
SITE DESCRIPTION P-5208A Haydock to Junker Double Track			**GROUND WTR (ft)**
BORING NO. C-2	**STATION** N/A	**OFFSET** N/A	**ALIGNMENT** MAIN TRK #1 — **0 HR.** 10.0
COLLAR ELEV. 549.6 ft	**TOTAL DEPTH** 16.0 ft	**NORTHING** 583,643	**EASTING** 1,522,438 — **24 HR.** 6.0
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic
DRILLER C. Boyce	**START DATE** 08/31/12	**COMP. DATE** 08/31/12	**SURFACE WATER DEPTH** N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
550	549.6	0.0	4	4	7	11		D		549.6 — GROUND SURFACE — 0.0
	546.1	3.5								**ROADWAY EMBANKMENT** Brown silty fine SAND (A-2-4(0)), trace gravel
545			3	3	4	7	SS-5	18%		
	541.1	8.5								541.6 — 8.0
540			3	3	6	9		W		**RESIDUAL** Brown and gray silty fine to coarse SAND (A-2-4), some rock fragments
	536.1	13.5								
535			8	17	70	87		W		
	533.6	16.0	60/0.0			60/0.0				533.6 — 16.0

Boring Terminated with Standard Penetration Test Refusal at Elevation 533.6 ft On CRYSTALLINE ROCK (GRANITE)

1) Driller Indicated approximately 6 inches of Surficial Organic Laden soil.

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

SHEET

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral	
SITE DESCRIPTION P-5208A Haydock to Junker Double Track				GROUND WTR (ft)
BORING NO. EB1-A	STATION 10281+67	OFFSET 29 ft LT	ALIGNMENT MAIN TRK #1	0 HR. 13.0
COLLAR ELEV. 541.0 ft	TOTAL DEPTH 36.0 ft	NORTHING 582,659	EASTING 1,520,031	24 HR. 15.5
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 08/20/12	COMP. DATE 08/20/12	SURFACE WATER DEPTH N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
545										
	541.0	0.0								541.0 GROUND SURFACE 0.0
540			2	3	4	7		M		**ROADWAY EMBANKMENT** Brown silty fine to coarse SAND (A-2-4)
	537.5	3.5								
535			3	3	3	6		M		
	532.5	8.5								
530			2	2	2	4		M		
										529.0 12.0
	527.5	13.5								**RESIDUAL** Brown and gray fine to coarse sandy SILT (A-4(0))
525			2	1	3	4	SS-4	23%		* Some rock fragments from 18.5 to 20 feet
	522.5	18.5								
520			6	22	21	43		W		
	517.5	23.5								
515			21	46	45	91		W		
	512.5	28.5								512.0 29.0
510			29	51	49/0.4	100/0.9				**WEATHERED ROCK** Tan and brown (GRANITE)
	507.5	33.5								
505	505.0	36.0	70	30/0.2		100/0.7				505.0 36.0
			60/0.0			60/0.0				Boring Terminated with Standard Penetration Test Refusal at Elevation 505.0 ft On CRYSTALLINE ROCK (GRANITE)

1) Driller indicated approximately 5 inches of Surficial Organic Laden soil.

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral
SITE DESCRIPTION P-5208A Haydock to Junker Double Track			GROUND WTR (ft)
BORING NO. EB1-B	STATION 10281+63	OFFSET 1 ft LT	ALIGNMENT MAIN TRK #1 — 0 HR. 18.0
COLLAR ELEV. 549.0 ft	TOTAL DEPTH 42.5 ft	NORTHING 582,687	EASTING 1,520,029 — 24 HR. 12.0
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 08/21/12	COMP. DATE 08/21/12	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) / DEPTH (ft)
550	549.0	0.0								549.0 — GROUND SURFACE — 0.0
			2	3	5	8		M		**ROADWAY EMBANKMENT** Brown, tan, and orange silty fine to coarse SAND (A-2-4), trace to some gravel
545	545.5	3.5	5	5	5	10		M		* Wood encountered from 13.5 to 15 feet
540	540.5	8.5	5	4	4	8		M		
535	535.5	13.5	4	4	4	8		M		
530	530.5	18.5	4	4	3	7	SS-9	28%		531.0 — 18.0 **ALLUVIAL** Brown and gray sandy CLAY (A-6(10))
525	525.5	23.5	0	1	1	2		W		526.0 — 23.0 Gray and tan silty fine to coarse SAND (A-2-4)
520	520.5	28.5	16	25	37	62		W		521.0 — 28.0 **RESIDUAL** Gray and tan silty fine to coarse SAND (A-2-4)
515	515.5	33.5	10	30	70/0.2	100/0.7				515.0 — 34.0 **WEATHERED ROCK** Tan and brown (GRANITE)
510	510.5	38.5	22	30	54	84		M		511.0 — 38.0 **RESIDUAL** Tan and brown silty fine to coarse SAND (A-2-4)
	506.5	42.5	60/0.0			60/0.0				506.5 — 42.5 Boring Terminated with Standard Penetration Test Refusal at Elevation 506.5 ft On CRYSTALLINE ROCK (GRANITE)

1) Driller indicated approximately 4 inches of Surficial Organic Laden soil.

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

SHEET

WBS 50000.1.STR03T1B	**TIP** P-5208A	**COUNTY** Cabarrus	**GEOLOGIST** R. Kral / J. Harris	
SITE DESCRIPTION P-5208A Haydock to Junker Double Track				**GROUND WTR (ft)**
BORING NO. B1-A	**STATION** 10282+14	**OFFSET** 21 ft LT	**ALIGNMENT** MAIN TRK #1	**0 HR.** 5.0
COLLAR ELEV. 538.8 ft	**TOTAL DEPTH** 51.5 ft	**NORTHING** 582,657	**EASTING** 1,519,983	**24 HR.** 10.0
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER C. Boyce	**START DATE** 08/21/12	**COMP. DATE** 08/24/12	**SURFACE WATER DEPTH** N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) / DEPTH (ft)
540										
	538.8	0.0								538.8 — GROUND SURFACE — 0.0
			1	2	1	3		M		**ROADWAY EMBANKMENT** Dark brown fine to coarse sandy CLAY (A-6), trace gravel
535	535.3	3.5								535.3 — 3.5
			3	4	5	9		D		Tan and brown silty fine sand (A-2-4)
530	530.3	8.5								530.8 — 8.0
			0	0	0	0	SS-16	34%		**ALLUVIAL** Brown and gray fine to coarse sandy SILT (A-4(0))
525	525.3	13.5								526.8 — 12.0
			0	0	3	3		M		Gray silty CLAY (A-7-6) with organic odor
520	520.3	18.5								520.8 — 18.0
			35	21	23	44		M		**RESIDUAL** Brown, tan, and black silty fine to coarse SAND (A-2-4(0))
515	515.3	23.5								
			8	9	15	24	SS-19	16%		
510	510.3	28.5								509.8 — 29.0
			28	43	57/0.6	100/1.0				**WEATHERED ROCK** Brown and tan (GRANITE)
	507.3	31.5	60/0.0			60/0.0				507.3 — 31.5
505										**CRYSTALLINE ROCK** Gray, pink, and white (GRANITE)
500										
										497.3 — 41.5
495										**CRYSTALLINE ROCK** Gray, pink, and white (GRANITE)
490										
										487.3 — 51.5
										Boring Terminated at Elevation 487.3 ft In CRYSTALLINE ROCK (GRANITE)

1) Driller indicated approximately 3 inches of Surficial Organic Laden soil.

NCDOT BORE SINGLE 63P-0090 HADOCK TO JUNKER.GPJ NC_DOT.GDT 1/22/13

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

SHEET

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral / J. Harris	
SITE DESCRIPTION P-5208A Haydock to Junker Double Track				GROUND WTR (ft)
BORING NO. B1-A	STATION 10282+14	OFFSET 21 ft LT	ALIGNMENT MAIN TRK #1	0 HR. 5.0
COLLAR ELEV. 538.8 ft	TOTAL DEPTH 51.5 ft	NORTHING 582,657	EASTING 1,519,983	24 HR. 10.0
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 08/21/12	COMP. DATE 08/24/12	SURFACE WATER DEPTH N/A	
CORE SIZE NQ2	TOTAL RUN 20.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
507.3											Begin Coring @ 31.5 ft
505	507.3	31.5	5.0	*N=60/0.0* 00:42/1.0 01:20/1.0 01:18/1.0 01:28/1.0 01:42/1.0	(4.8) 97%	(3.4) 68%		(9.8) 98%	(7.5) 75%		507.3 **CRYSTALLINE ROCK** 31.5 Gray pink and white, moderately hard to very hard, very slightly to slightly weathered, very close to moderately closely spaced fractured (GRANITE)
	502.3	36.5									
500			5.0	01:53/1.0 02:03/1.0 01:58/1.0 01:58/1.0 01:38/1.0	(5.0) 100%	(4.1) 82%					
	497.3	41.5									497.3 41.5
495			5.0	01:53/1.0 01:56/1.0 01:54/1.0 02:04/1.0 02:21/1.0	(5.0) 100%	(4.9) 98%		(10.0) 100%	(9.5) 95%		**CRYSTALLINE ROCK** Gray pink and white, very hard, fresh to very slightly weathered, close to moderately closely spaced fractured (GRANITE)
	492.3	46.5									
490			5.0	02:08/1.0 01:57/1.0 02:03/1.0 01:57/1.0 02:51/1.0	(5.0) 100%	(4.6) 92%					
	487.3	51.5									487.3 51.5

Boring Terminated at Elevation 487.3 ft In CRYSTALLINE ROCK (GRANITE)

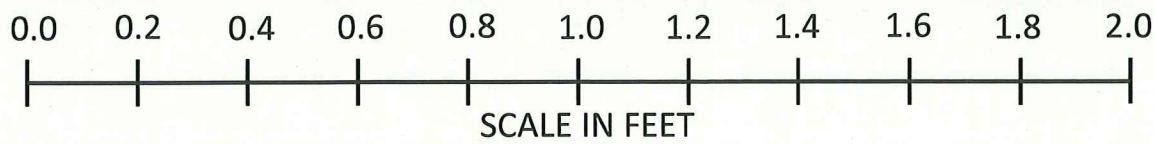
1) Driller indicated approximately 3 inches of Surficial Organic Laden soil.

Railroad Bridge across Coddle Creek

CORE PHOTOGRAPHS: B1-A: Station 10282+14

31.5 feet

41.5 feet



NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral / J. Harris
SITE DESCRIPTION P-5208A Haydock to Junker Double Track			GROUND WTR (ft)
BORING NO. B1-B	STATION 10282+31	OFFSET 6 ft LT	ALIGNMENT MAIN TRK #1	0 HR. 11.0
COLLAR ELEV. 538.4 ft	TOTAL DEPTH 51.5 ft	NORTHING 582,668	EASTING 1,519,964	24 HR. 8.5
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 08/23/12	COMP. DATE 08/23/12	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
540	538.4	0.0								538.4 GROUND SURFACE 0.0
			1	1	3	4		M		**ROADWAY EMBANKMENT** Dark brown silty fine SAND (A-2-4), trace gravel
535	534.9	3.5	3	3	3	6		W		533.4 5.0
530	529.9	8.5	0	0	0	0	SS-23	45%		**ALLUVIAL** Gray and black silty CLAY (A-7-6(18)) with organic odor
525	524.9	13.5	11	9	7	16		W		
520	519.9	18.5	27	34	45	79	SS-25	9%		520.4 18.0 **RESIDUAL** Brown, orange, and gray silty fine to coarse SAND (A-2-4(0))
515	514.9	23.5	37	63/0.4		100/0.9				514.9 23.5 **WEATHERED ROCK** Brown and tan (GRANITE)
510	509.9	28.5	36	28	72/0.3	100/0.8				
	506.9	31.5	60/0.0			60/0.0				506.9 31.5 **CRYSTALLINE ROCK** Gray, green, and pink (GRANITE)
505										
500										496.9 41.5 **CRYSTALLINE ROCK** Pink, gray, and white (GRANITE)
495										
490										486.9 51.5
										Boring Terminated with Standard Penetration Test Refusal at Elevation 486.9 ft In CRYSTALLINE ROCK (GRANITE)

1) Driller indicated approximately 4 inches of Surficial Organic Laden soil.

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

SHEET

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral / J. Harris	
SITE DESCRIPTION P-5208A Haydock to Junker Double Track				GROUND WTR (ft)
BORING NO. B1-B	STATION 10282+31	OFFSET 6 ft LT	ALIGNMENT MAIN TRK #1	0 HR. 11.0
COLLAR ELEV. 538.4 ft	TOTAL DEPTH 51.5 ft	NORTHING 582,668	EASTING 1,519,964	24 HR. 8.5
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 08/23/12	COMP. DATE 08/23/12	SURFACE WATER DEPTH N/A	
CORE SIZE NQ2	TOTAL RUN 20.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
506.9											Begin Coring @ 31.5 ft
505	506.9	31.5	5.0	N=60/0.0 01:42/1.0 01:46/1.0 01:55/1.0 02:00/1.0 02:20/1.0	(5.0) 100%	(3.0) 60%		(10.0) 100%	(6.7) 67%		506.9 ELEV. (ft) **CRYSTALLINE ROCK** 31.5 DEPTH (ft) Gray green and pink, moderately hard to hard, very slightly to moderately weathered, very close to moderately closely spaced fractured (GRANITE)
	501.9	36.5									
500			5.0	03:00/1.0 03:01/1.0 02:32/1.0 02:33/1.0 02:47/1.0	(5.0) 100%	(3.7) 73%					
	496.9	41.5									496.9 41.5
495			5.0	02:32/1.0 02:17/1.0 02:25/1.0 02:32/1.0 02:38/1.0	(5.0) 100%	(4.2) 83%		(10.0) 100%	(8.2) 82%		**CRYSTALLINE ROCK** Pink gray and white, hard, very slightly weathered, very close to moderately closely spaced fractured (GRANITE)
	491.9	46.5									
490			5.0	02:05/1.0 02:59/1.0 03:02/1.0 02:32/1.0 02:35/1.0	(5.0) 100%	(4.0) 80%					
	486.9	51.5									486.9 51.5
											Boring Terminated with Standard Penetration Test Refusal at Elevation 486.9 ft In CRYSTALLINE ROCK (GRANITE) 1) Driller indicated approximately 4 inches of Surficial Organic Laden soil.

Railroad Bridge across Coddle Creek

CORE PHOTOGRAPHS: B1-B: Station 10282+31

31.5 feet

41.5 feet

NCDOT GEOTECHNICAL ENGINEERING UNIT
BOREHOLE REPORT

SHEET

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral / J. Harris	
SITE DESCRIPTION P-5208A Haydock to Junker Double Track				GROUND WTR (ft)
BORING NO. EB2-A	STATION 10283+75	OFFSET 8 ft LT	ALIGNMENT MAIN TRK #1	0 HR. 43.0
COLLAR ELEV. 562.3 ft	TOTAL DEPTH 81.0 ft	NORTHING 582,636	EASTING 1,519,823	24 HR. 23.0
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 09/07/12	COMP. DATE 09/07/12	SURFACE WATER DEPTH N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft) / DEPTH (ft)
	562.3	0.0								562.3 GROUND SURFACE 0.0
560			5	12	18	30		D		ARTIFICIAL FILL Gray ABC Stone
	558.8	3.5	8	9	5	14		D		
555	553.8	8.5	1	3	4	7		M		553.8 8.5 Brown fine to coarse sandy CLAY (A-6) with intermittent ABC stone layers
550	548.8	13.5	0	1	2	3		M		548.8 13.5 RESIDUAL Tan, orange, and brown fine to coarse sandy SILT (A-4(0))
545	543.8	18.5	3	3	2	5	SS-32	22%		
540	538.8	23.5	8	12	17	29		M		539.3 23.0 Tan, orange, gray, and white silty fine to coarse SAND (A-2-4)
535	533.8	28.5	14	20	28	48		M		
530	528.8	33.5	51	49/0.2		100/0.7				528.8 33.5 WEATHERED ROCK Tan and gray (GRANITE)
525	523.8	38.5	61	39/0.0		100/0.5				
520	518.8	43.5	69	31/0.0		100/0.5				
515	513.8	48.5	46	54/0.3		100/0.8				
510	508.8	53.5	11	13	51	64		M		509.3 53.0 RESIDUAL Tan and gray silty fine to coarse SAND (A-2-4)
505	503.8	58.5	100/0.4			100/0.4				503.8 58.5 WEATHERED ROCK Tan and gray (GRANITE)
500	501.3	61.0	60/0.0			60/0.0				501.3 61.0 CRYSTALLINE ROCK Gray, white, and pink (GRANITE)
495										496.3 66.0 CRYSTALLINE ROCK Gray, white, and pink (GRANITE)
490										
485										

NCDOT BORE SINGLE 63P-0090 HADOCK TO JUNKER.GPJ NC_DOT.GDT 1/22/13

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

SHEET

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral / J. Harris
SITE DESCRIPTION P-5208A Haydock to Junker Double Track			GROUND WTR (ft)
BORING NO. EB2-A	STATION 10283+75	OFFSET 8 ft LT	ALIGNMENT MAIN TRK #1 — 0 HR. 43.0
COLLAR ELEV. 562.3 ft	TOTAL DEPTH 81.0 ft	NORTHING 582,636	EASTING 1,519,823 — 24 HR. 23.0
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 09/07/12	COMP. DATE 09/07/12	SURFACE WATER DEPTH N/A

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION ELEV. (ft)	DEPTH (ft)
485						Match Line					
										CRYSTALLINE ROCK Gray, white, and pink (GRANITE) *(continued)*	
										481.3	81.0
										Boring Terminated at Elevation 481.3 ft In CRYSTALLINE ROCK (GRANITE)	

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

SHEET

WBS 50000.1.STR03T1B	**TIP** P-5208A	**COUNTY** Cabarrus	**GEOLOGIST** R. Kral / J. Harris	
SITE DESCRIPTION P-5208A Haydock to Junker Double Track				**GROUND WTR (ft)**
BORING NO. EB2-A	**STATION** 10283+75	**OFFSET** 8 ft LT	**ALIGNMENT** MAIN TRK #1	**0 HR.** 43.0
COLLAR ELEV. 562.3 ft	**TOTAL DEPTH** 81.0 ft	**NORTHING** 582,636	**EASTING** 1,519,823	**24 HR.** 23.0
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		**DRILL METHOD** H.S. Augers	**HAMMER TYPE** Automatic	
DRILLER C. Boyce	**START DATE** 09/07/12	**COMP. DATE** 09/07/12	**SURFACE WATER DEPTH** N/A	
CORE SIZE NQ2	**TOTAL RUN** 20.0 ft			

ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
501.3											Begin Coring @ 61.0 ft
500	501.3	61.0	5.0	*N=60/0.0* 00:54/1.0 01:58/1.0 01:56/1.0 01:46/1.0 02:10/1.0	(3.8) 77%	(2.8) 55%		(3.8) 77%	(2.8) 55%		ELEV. 501.3 DEPTH 61.0 **CRYSTALLINE ROCK** Gray white and pink, moderately hard to very hard, fresh to moderately weathered, very close to moderately closely spaced fractured (GRANITE)
	496.3	66.0									ELEV. 496.3 DEPTH 66.0
495			5.0	03:31/1.0 02:30/1.0 03:07/1.0 03:09/1.0 03:24/1.0	(5.0) 100%	(4.7) 93%		(15.0) 100%	(14.1) 94%		**CRYSTALLINE ROCK** Gray white and pink, very hard, fresh to very slightly weathered, close to moderately closely spaced fractured (GRANITE)
	491.3	71.0									
490			5.0	02:41/1.0 02:52/1.0 02:31/1.0 02:47/1.0 02:45/1.0	(5.0) 100%	(5.0) 100%					
	486.3	76.0									
485			5.0	02:47/1.0 02:39/1.0 03:02/1.0 02:20/1.0 03:30/1.0	(5.0) 100%	(4.4) 88%					
	481.3	81.0									ELEV. 481.3 DEPTH 81.0 Boring Terminated at Elevation 481.3 ft In CRYSTALLINE ROCK (GRANITE)

Railroad Bridge across Coddle Creek

CORE PHOTOGRAPHS: EB2-A: Station 10283+75

61.0 feet

0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0

SCALE IN FEET

71.0 feet

0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0

SCALE IN FEET

NCDOT GEOTECHNICAL ENGINEERING UNIT
BORELOG REPORT

SHEET

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral / J. Harris	
SITE DESCRIPTION P-5208A Haydock to Junker Double Track				GROUND WTR (ft)
BORING NO. EB2-B	STATION 10283+83	OFFSET 10 ft RT	ALIGNMENT MAIN TRK #1	0 HR. 43.0
COLLAR ELEV. 563.0 ft	TOTAL DEPTH 81.0 ft	NORTHING 582,652	EASTING 1,519,812	24 HR. 23.0
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 09/04/12	COMP. DATE 09/05/12	SURFACE WATER DEPTH N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
565										
	563.0	0.0	8	10	8	18		D		563.0 GROUND SURFACE 0.0
560	559.5	3.5	3	4	1	5		M		561.0 ARTIFICIAL FILL Gray ABC Stone 2.0
555	554.5	8.5	2	1	1	2		M		Tan and gray silty fine to coarse SAND (A-2-4), some gravel
550	549.5	13.5	2	1	3	4	SS-44	25%		555.0 8.0 Brown and gray silty CLAY (A-7-6(9)), trace gravel
545	544.5	18.5	3	5	6	11		M		544.5 18.5 RESIDUAL Tan, orange, and brown silty fine to coarse SAND (A-2-4(0))
540	539.5	23.5	6	10	13	23		M		
535	534.5	28.5	14	14	26	40	SS-47	8%		
530	529.5	33.5	23	27	34	61		M		
525	524.5	38.5	47	53/0.3		100/0.8				524.5 38.5 WEATHERED ROCK Tan, brown, and orange (GRANITE)
520	519.5	43.5	100/0.2			100/0.2				* Hard rock lens from 40.5 to 43 feet
515	514.5	48.5	100/0.4			100/0.4				
510	509.5	53.5	32	63/0.3		100/0.8				
505	504.5	58.5	60/0.1			60/0.1				504.5 58.5 CRYSTALLINE ROCK Tan, brown, and orange (GRANITE)
500	502.0	61.0	60/0.0			60/0.0				502.0 61.0 CRYSTALLINE ROCK Gray, pink, and white (GRANITE)
495										
490										
485										

NCDOT BORE SINGLE 63P-0090 HADDOCK TO JUNKER.GPJ NC_DOT.GDT 1/22/13

NCDOT GEOTECHNICAL ENGINEERING UNIT
BOREHOLE REPORT

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral / J. Harris	
SITE DESCRIPTION P-5208A Haydock to Junker Double Track				GROUND WTR (ft)
BORING NO. EB2-B	STATION 10283+83	OFFSET 10 ft RT	ALIGNMENT MAIN TRK #1	0 HR. 43.0
COLLAR ELEV. 563.0 ft	TOTAL DEPTH 81.0 ft	NORTHING 582,652	EASTING 1,519,812	24 HR. 23.0
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers		HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 09/04/12	COMP. DATE 09/05/12	SURFACE WATER DEPTH N/A	

ELEV (ft)	DRIVE ELEV (ft)	DEPTH (ft)	BLOW COUNT 0.5ft	0.5ft	0.5ft	BLOWS PER FOOT 0 25 50 75 100	SAMP. NO.	MOI	LOG	SOIL AND ROCK DESCRIPTION
										ELEV. (ft) DEPTH (ft)
485						Match Line				
										CRYSTALLINE ROCK Gray, pink, and white (GRANITE) *(continued)* 482.0 81.0
										Boring Terminated at Elevation 482.0 ft In CRYSTALLINE ROCK (GRANITE) 1) Driller indicated lens of hard rock from 40.5 to 42 feet.

NCDOT GEOTECHNICAL ENGINEERING UNIT
CORE BORING REPORT

SHEET

WBS 50000.1.STR03T1B	TIP P-5208A	COUNTY Cabarrus	GEOLOGIST R. Kral / J. Harris
SITE DESCRIPTION P-5208A Haydock to Junker Double Track			GROUND WTR (ft)
BORING NO. EB2-B	STATION 10283+83	OFFSET 10 ft RT	ALIGNMENT MAIN TRK #1	0 HR. 43.0
COLLAR ELEV. 563.0 ft	TOTAL DEPTH 81.0 ft	NORTHING 582,652	EASTING 1,519,812	24 HR. 23.0
DRILL RIG/HAMMER EFF./DATE F&R968 CME-550X 81% 12/28/2011		DRILL METHOD H.S. Augers	HAMMER TYPE Automatic
DRILLER C. Boyce	START DATE 09/04/12	COMP. DATE 09/05/12	SURFACE WATER DEPTH N/A
CORE SIZE NQ2	TOTAL RUN 20.0 ft		

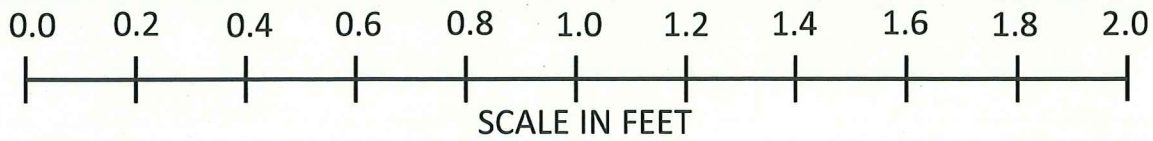
ELEV (ft)	RUN ELEV (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN REC. (ft) %	RUN RQD (ft) %	SAMP. NO.	STRATA REC. (ft) %	STRATA RQD (ft) %	LOG	DESCRIPTION AND REMARKS
502											Begin Coring @ 61.0 ft
500	502.0	61.0	5.0	*N=60/0.0* 02:00/1.0 03:10/1.0 02:10/1.0 02:40/1.0 02:24/1.0	(4.8) 97%	(4.3) 87%		(19.8) 99%	(17.5) 87%		ELEV. 502.0 DEPTH 61.0 **CRYSTALLINE ROCK** Gray pink and white, very hard, fresh to very slightly weathered, close to moderately closely spaced fractured (GRANITE)
	497.0	66.0									
495			5.0	02:38/1.0 03:03/1.0 02:34/1.0 02:11/1.0 02:08/1.0	(5.0) 100%	(4.8) 97%					
	492.0	71.0									
490			5.0	02:25/1.0 02:17/1.0 02:35/1.0 02:22/1.0 02:49/1.0	(5.0) 100%	(4.5) 90%					
	487.0	76.0									
485			5.0	02:29/1.0 03:33/1.0 03:44/1.0 02:58/1.0 02:50/1.0	(5.0) 100%	(3.8) 77%					
	482.0	81.0									ELEV. 482.0 DEPTH 81.0 Boring Terminated at Elevation 482.0 ft In CRYSTALLINE ROCK (GRANITE) 1) Driller indicated lens of hard rock from 40.5 to 42 feet.

Railroad Bridge across Coddle Creek

CORE PHOTOGRAPHS: EB2-B: Station 10283+83

61.0 feet

71.0 feet



APPENDIX B

LABORATORY TEST RESULTS

SINCE F&R 1881

North Carolina Department of Transportation
Division of Highways
Materials and Test Unit
Soils Laboratory

M&T Form 503

T.I.P. ID NO.: P-5208A

REPORT ON SAMPLES OF: SOIL FOR QUALITY

PROJECT:	H2J Double Track Project	COUNTY:	Cabarrus
DATE SAMPLED:	12-14-2012	RECEIVED:	12-14-2012
SAMPLED FROM:	On Site	REPORTED:	12-30-2012
SUBMITTED BY:	F&R Inc.	BY:	B. Aziz

TEST RESULTS

PROJ. SAMPLE NO.	R-1	R-2	R-4	C-2	EB1-A	EB-1B	B1-A
LAB SAMPLE NO.	SS-2	SS-7	SS-19	SS-5	SS-4	SS-9	SS-16
Retained #4 Sieve %	0.0	0.0	0.0	24.5	0.0	0.0	0.0
Passing #10 Sieve %	99.5	100.0	98.2	51.9	100.0	100.0	97.7
Passing #40 Sieve %	92.4	90.0	73.8	33.8	99.2	93.2	82.4
Passing #200 Sieve %	28.3	67.0	31.7	13.6	40.9	70.0	40.3

MINUS #10 FRACTION

SOIL MORTAR - 100%							
Coarse Sand Ret - #60 %	14.4	19.7	36.5	49.5	8.0	9.0	26.0
Fine Sand Ret - #270 %	66.1	16.1	38.0	28.3	58.9	29.2	36.9
Silt 0.053 - 0.010 mm %	16.6	19.9	19.1	16.1	19.7	36.5	17.5
Clay < 0.010 mm %	2.9	44.3	6.4	6.1	13.4	25.3	19.6
L.L.	16	46	26	28	24	36	28
P.L.	15	24	23	23	21	20	21
P.I.	1	22	3	5	3	16	7
AASHTO Classification	A-2-4(0)	A-7-6(14)	A-2-4(0)	A-2-4(0)	A-4(0)	A-6(10)	A-4(0)
Station	10239+06	10247+66	10264+94	N/A	10281+67	10281+63	10282+14
Offset	25' RT	20' LT	3' RT	N/A	29' LT	1' LT	21' LT
Depth (ft.)	3.5	3.5	8.5	3.5	13.5	18.5	8.5
to	5.0	5.0	10.0	5.0	15.0	20.0	10.0
Moisture Content	4.7	16.1	11.1	17.7	22.8	27.9	33.8
Organic Content	NT	NT	NT	NT	NT	NT	NT

NT = Not Tested
NP = Not Plastic
NA = Not Applicable

Michael J. Walko, P.E.
Soils Engineer

SINCE F&R 1881

North Carolina Department of Transportation
Division of Highways
Materials and Test Unit
Soils Laboratory

M&T Form 503

T.I.P. ID NO.: P-5208A

REPORT ON SAMPLES OF: SOIL FOR QUALITY

PROJECT:	H2J Double Track Project	COUNTY:	Cabarrus
DATE SAMPLED:	12-14-2012	RECEIVED:	12-14-2012
SAMPLED FROM:	On Site	REPORTED:	12-30-2012
SUBMITTED BY:	F&R Inc.	BY:	B. Aziz

TEST RESULTS

PROJ. SAMPLE NO.	B1-A	B1-B	B1-B	EB-2A	EB-2B	EB-2B	
LAB SAMPLE NO.	SS-19	SS-23	SS-25	SS-32	SS-44	SS-47	
Retained #4 Sieve %	17.4	0.0	14.8	0.0	0.0	4.8	
Passing #10 Sieve %	55.7	100.0	58.6	100.0	100.0	77.2	
Passing #40 Sieve %	30.3	98.9	34.2	87.5	77.0	52.9	
Passing #200 Sieve %	11.5	83.9	14.4	53.7	57.3	22.3	

MINUS #10 FRACTION

SOIL MORTAR - 100%							
Coarse Sand Ret - #60 %	58.2	2.6	53.4	21.9	28.6	44.2	
Fine Sand Ret - #270 %	24.9	17.4	25.8	29.8	16.8	31.9	
Silt 0.053 - 0.010 mm %	13.7	41.2	14.3	27.7	14.9	17.4	
Clay < 0.010 mm %	3.2	38.8	6.5	20.6	39.7	6.5	
L.L.	26	47	24	26	41	29	
P.L.	24	27	21	22	21	25	
P.I.	2	20	3	4	20	4	
AASHTO Classification	A-2-4(0)	A-7-6(18)	A-2-4(0)	A-4(0)	A-7-6(9)	A-2-4(0)	
Station	10282+14	10282+31	10282+31	10283+75	10283+83	10283+83	
Offset	21' LT	6' LT	6' LT	8' LT	10' RT	10' RT	
Depth (ft.)	23.5	8.5	18.5	18.5	13.5	28.5	
to	25.0	10.0	20.0	20.0	15.0	30.0	
Moisture Content	15.7	45.1	8.9	22.0	25.4	8.4	
Organic Content	NT	NT	NT	NT	NT	NT	

NT = Not Tested
NP = Not Plastic
NA = Not Applicable

Michael J. Walko, P.E.
Soils Engineer

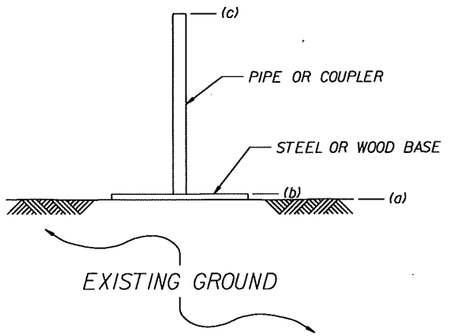
APPENDIX C

SETTLEMENT PLATE DETAILS & SPECIAL PROVISION

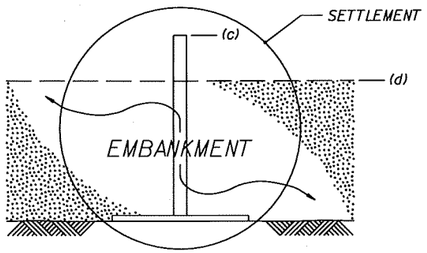
PROJECT REFERENCE NO.	SHEET
P-5208A	1

GEOTECHNICAL ENGINEER	ROADWAY DESIGN ENGINEER
SIGNATURE DATE	SIGNATURE DATE

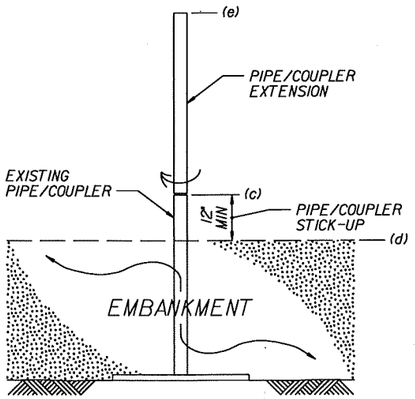
EMBANKMENT MONITORING SEQUENCE



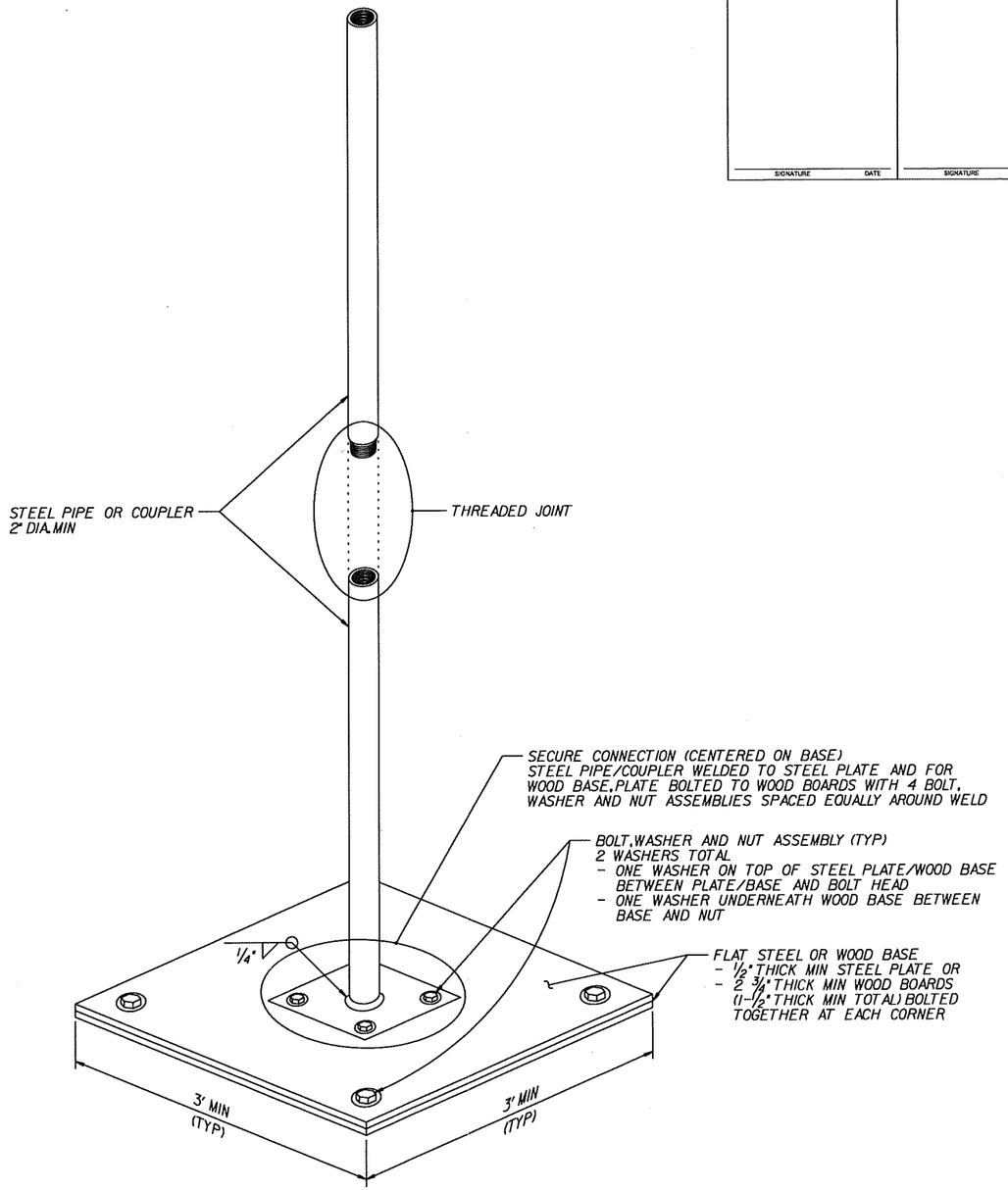
1. PLACE STEEL/WOOD BASE AT APPROXIMATE GAUGE LOCATIONS SHOWN IN THE PLANS AS DETERMINED BY THE ENGINEER.
2. SET BASE ON LEVEL GROUND SO PIPE/COUPLER IS PLUMB.
3. BEFORE CONSTRUCTING EMBANKMENT, NOTIFY ENGINEER TO SURVEY AND RECORD THE FOLLOWING:
   (a) EXISITING GROUND ELEVATION,
   (b) TOP OF BASE ELEVATION AND
   (c) TOP OF PIPE ELEVATION.



4. MAKE SETTLEMENT GAUGE HIGHLY VISIBLE SO GAUGE IS NOT HIT OR DAMAGED.
5. PLACE AND COMPACT FILL MATERIAL AROUND SETTLEMENT GAUGE WITHOUT DISTURBING GAUGE.
6. NOTIFY ENGINEER WEEKLY TO SURVEY AND RECORD THE FOLLOWING:
   (c) TOP OF PIPE ELEVATION AND
   (d) EMBANKMENT ELEVATION.



7. CONNECT PIPE/COUPLER EXTENSION TO EXISTING PIPE/COUPLER AS NEEDED TO MAINTAIN A PIPE/COUPLER STICK-UP OF AT LEAST 12" WHILE MONITORING SETTLEMENT.
8. SCREW PIPES/COUPLERS TOGETHER HAND TIGHT AND THEN TIGHTEN 2 TO 3 FULL TURNS WITH A WRENCH.
9. NOTIFY ENGINEER TO SURVEY AND RECORD THE FOLLOWING:
   (c) TOP OF PIPE ELEVATION,
   (d) EMBANKMENT ELEVATION AND
   (e) TOP OF EXTENSION ELEVATION.
10. RETURN TO STEP 4 WITH NEW TOP OF PIPE ELEVATION EQUAL TO TOP OF EXTENSION ELEVATION.



SETTLEMENT GAUGE

NOTES:

1. SEE ROADWAY SUBSURFACE INVESTIGATION AND GEOTECHNICAL EVALUATION REPORT FOR APPROXIMATE SETTLEMENT GAUGE LOCATIONS.
2. FOR STANDARD EMBANKMENT MONITORING, SEE EMBANKMENT SETTLEMENT GAUGES PROVISION.
3. INSTALL SETTLEMENT GAUGES AFTER CLEARING AND GRUBBING GAUGE LOCATIONS AND BEFORE CONSTRUCTING EMBANKMENTS WITH EMBANKMENT MONITORING.

GEOTECHNICAL ENGINEERING UNIT

STATE OF NORTH CAROLINA DEPARTMENT OF TRANSPORTATION RALEIGH

STANDARD DRAWING NO. 1804.01

STANDARD EMBANKMENT MONITORING

DATE: 2-19-13

EMBANKMENT MONITORING (SETTLEMENT GAUGES):

(7-1-95) (Rev 11-17-09) SP2 R75

Description

This work consists of furnishing and installing settlement gauges as shown in the plans.

Materials

Provide threaded pipe with a black finish in accordance with ASTM A53 Type F of the diameter shown in the plans.

Construction Methods

Furnish and install Settlement Gauges as shown in the plans at locations designated in the plans. Place the base on a level surface near the natural ground as shown in the plans. Extend the metal pipe by adding pipe sections at threaded couplings as the embankment is progressed. Make sure that the top of the extension section is no less than 1 ft. above the embankment surface and no higher than 6 ft. Make the exposed length of pipe conspicuous to avoid chance of damage.

Conduct operations in such a manner that the gauges are not damaged. Compact fill around the gauge pipes and plates to the same density as the surrounding material. Restore or replace any settlement gauge pipe damaged or destroyed. Perform installation operations such that the pipe remains plumb.

SINCE

1881

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