FINAL REPORT
SUBGRADE EXPLORATION
FRA-665-5.18
FRANKLIN COUNTY, OHIO
PID#: 116359

Prepared For:

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NEAS PROJECT 24-0036

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EXECUTIVE SUMMARY

The Ohio Department of Transportation (ODOT) has proposed a roadway improvement project FRA-665-5.18 (PID no. 116359) at the intersection of London Groveport Road (SR-665) and Lambert Road in Franklin County, Ohio. The project includes converting a two way stop controlled intersection to a single lane roundabout to improve traffic flow and safety.

National Engineering & Architectural Services, Inc. (NEAS) has been contracted to perform geotechnical engineering services for the project. The purpose of the geotechnical engineering services was to perform geotechnical explorations within the project limits to obtain information concerning the subsurface soil and groundwater conditions relevant to the design and construction of the project. The scope of work performed by NEAS as part of the referenced project included: a review of published geotechnical information; performing 7 test borings for the proposed construction; laboratory testing of soil samples in accordance with the SGE; performing geotechnical engineering analysis to assess subgrade stabilization requirements, pavement design parameters; and development of this summary report.

A subgrade exploration and subsequent analysis was completed for the referenced project. The exploration was conducted in general accordance with NEAS's proposal to Colliers Engineering & Design, dated February 27, 2024, and with the provisions of ODOT's Specifications for Geotechnical Explorations (SGE) (ODOT, 2024). The subgrade analysis was performed in accordance with ODOT's Geotechnical Design Manual (ODOT [1], 2024) and Pavement Design Manual (PDM) (ODOT, 2024).

The subgrade conditions in the project area are relatively uniform, consisting mainly of existing pavement sections or topsoil underlain by predominantly cohesive fine-grained soils, with minor amounts of non-cohesive coarse-grained soils. The asphalt pavement layer is 8 to 9 inches thick, while the topsoil measures 5 to 6 inches. The non-cohesive coarse-grained soils are classified as A-4a, and the cohesive fine-grained soils are classified as A-4a, A-6a, A-6b, and A-7-6.

According to our subgrade analysis, unstable and high moisture content soils were encountered in 27% of the proposed subgrade surface. These soils exhibited an N_{60} value below 12 bpf and/or a moisture content exceeding the optimum level by more than 3 percent within 3 feet of subgrade. Therefore, NEAS recommends local stabilization in the form of either Item 204, Excavate and Replace with Geotextile to a depth of 12 inches, or Item 206, Cement Stabilization to a depth of 12 inches. The designer should use bid tabs to generate a cost analysis for the options.

Stabilization limits should extend 18-inches beyond the edge of the proposed paved roadway, shoulder or median and it is recommended removing any topsoil, existing pavement materials or abandoned structure foundation materials.

NEAS's opinion that the subgrade soils will provide adequate pavement support assuming it is designed and constructed in accordance with the recommendations provided within this report, as well as all applicable ODOT standards and specifications.

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1. INTRODUCTION

1.1. General

National Engineering & Architectural Services, Inc. (NEAS) presents our Subgrade Exploration Report for the FRA-665-5.18 project (PID no. 116359) in Franklin County, Ohio. NEAS understands that Colliers Engineering & Design is collaborating with ODOT to design and construct a new roundabout at the intersection of SR 665 and Lambert Road in Franklin County, Ohio. This report presents a summary of the project encountered surficial and subsurface conditions and our recommendations for subgrade stabilization and pavement design parameters for the planned improvements. The pavement subgrade analysis and recommendations presented are in accordance with ODOT's *Geotechnical Design Manual* (GDM) (ODOT [1], 2024) and *Pavement Design Manual* (PDM) (ODOT, 2024).

The exploration was conducted in general accordance with NEAS's proposal to Colliers Engineering & Design dated February 27, 2024, and with the provisions of ODOT's *Specifications for Geotechnical Explorations* (SGE) (ODOT, 2024).

The scope of work performed by NEAS as part of the referenced project included: 1) a review of published geotechnical information; 2) performing 7 total test borings; 3) laboratory testing of collected samples in accordance with the SGE; 4) performing geotechnical engineering analysis to assess subgrade stabilization requirements and recommended pavement design parameters; and, 5) development of this summary report.

2. GEOLOGY AND OBSERVATIONS OF THE PROJECT

2.1. Geology and Physiography

The project site is located within the Columbus Lowland Till Plains, a subdivision of the Southern Ohio Loamy Till Plain. This is a moderately low relief (25 ft) lowland surrounded in all directions by relative uplands, having a broad regional slope toward the Scioto Valley, containing many larger streams. Elevations of the region range from 600 to 850 ft above mean sea level (amsl) (950 ft amsl near Powell Moraine). The geology within this region is described as Wisconsinan-age till that is high lime in the west to medium-lime in the east. The geology is also described as containing extensive outwash in Scioto Valley overlying deep Devonian- to Mississippian-age carbonate rocks, shales and siltstones (ODGS, 1998).

Based on the Quaternary geology map of Ohio, the geology at the project site is mapped as Silty loam till (Darby, Bellfontaine, Centerburg tills, Ground moraine), flat to gently undulating. (Pavey, et al 1999).

Based on the Bedrock Geologic Units Map of Ohio (USGS & ODGS, 2006), bedrock within the project area consists of a combination of dolomite and Limestone, of the Salina group and Columbus limestone group formations. The formation is comprised of Silurian-age and Devonian-age. The Silurian-age formation is described as gray, yellow-gray to olive-gray, laminated to thin bedded; occasional thin bed and laminae of dark gray shale and anhydrite and/or gypsum; brecciated zones in part. The Devonian-age formation is described as gray to brown, weathers brown; massive bedding; upper 2/3 fossiliferous, gray limestone, lower 1/3 brown dolomite; 0 to 105 feet thick.

The bedrock appears to follow the natural topography of the site which slopes upward from east to west. The bedrock is relatively level throughout the project (ODGS, 2003). Based on the ODNR bedrock topography map of Ohio, bedrock elevations at the project site can be expected to be between 700 ft amsl to 750 ft amsl, putting bedrock at depths of between 115 and 140 ft below ground surface (bgs).

The soils at the project site have been mapped (Web Soil Survey) by the Natural Resources Conservation Service (USDA, 2024) as a mix of Celina silt loam, Chill loam, and Hennepin and Miamian loams. Celina silt loam series is comprised of fine-grained soils and classified as A-6, A-7, and A-7-6 type soils according to the AASHTO method of soil classification. Hennepin and Miamian loams series is comprised of fine-grained soils and classified as A-6, A-7, and A-7-6 type soils according to the AASHTO method of soil classification.

2.2. Hydrology/Hydrogeology

Groundwater at the project site can be expected at an elevation consistent with that of the nearby Hellbranch Run as it is the most dominant hydraulic influence in the vicinity of the project's boundaries. The water level of the Hellbranch Run may be generally representative of the local groundwater table. However, it should be noted that perched groundwater systems may be existent in areas due to the presence of fine-grained soils making it difficult for groundwater to permeate to the phreatic surface.

The project site is not located within a regulatory flood hazard area based on available mapping by the Federal Emergency Management Agency's (FEMA) National Flood Hazard mapping program (FEMA, 2024). However, the east side of the project vicinity is located under zone AE special flood hazard area.

2.3. Mining and Oil/Gas Production

No mines were noted on ODNR's Abandoned Underground Mine Locator in the vicinity of the project site. (ODNR [1], 2024).

No oil or gas wells were noted on ODNR's Oil and Gas Well Locator in the vicinity of the project site (ODNR [1], 2024).

2.4. Historical Records and Previous Phases of Project Exploration

No historical information was found according to ODOT TIMS.

2.5. Field Reconnaissance

A field reconnaissance visit for the overall project area was conducted on August 19, 2024, during which observations and photographs of the conditions at the intersection of SR-665 and Lambert Road were recorded. Photographs of notable geotechnical and drainage observations were taken and a summary of our observations by roadway segment are provided below.

2.5.1. Land Use and Cover

The land use of most of the project area consists of residential properties.

2.5.2. The intersection of SR-665 and Lambert Road

In general, the pavement condition at the intersection was observed to be good, with signs of weathering and surface wear (Photograph 1 & 2). High severity edge cracking was noted at the intersection and along London Groveport Rd, with occasional low severity transverse cracking along Lambert Rd (Photograph 3). Extensive medium severity longitudinal cracking was observed along the westbound side of London Groveport Rd (Photograph 4). No evidence of standing water was found in the project area. The terrain along Lambert Road slopes to the northeast, directing drainage toward the ditch adjacent to the northbound

lane. Conversely, the slope along London Groveport Road is to the northwest, with drainage direct into the adjacent ditch. During the reconnaissance survey, no signs of geotechnical instability were observed.

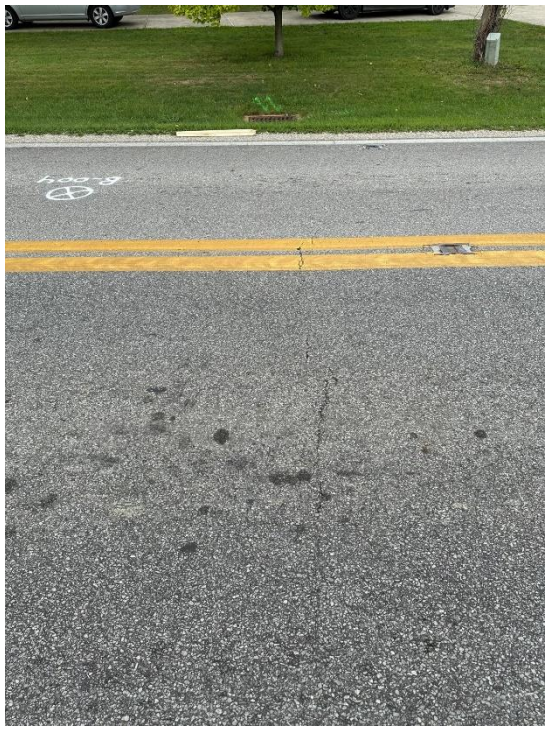
Photograph 1: Overall Pavement Condition at the Intersection



Photograph 2: Edge Cracking



Photograph 3: Low Severity Transverse Cracking



Photograph 4: Longitudinal Cracking



3. GEOTECHNICAL EXPLORATION

3.1. Exploration Program

The subsurface exploration was conducted by NEAS on August 21, 2024, which included 7 borings drilled to depths ranging between 7.5 ft below ground surface (bgs) to 10 ft bgs. The boring locations were selected by NEAS in general accordance with the guidelines contained in the SGE with the intent to evaluate subgrade soil and groundwater conditions. Borings were located within the project area planned to be constructed that were not restricted by underground utilities or dictated terrain (i.e., steep embankment slopes). Boring information: (Latitude/ Longitude, Elevation) as shown on Table 1 below.

Table 1: Project Boring Information

Boring Number	Latitude	Longitude	Elevation (ft)	Depth (ft)
B-001-0-24	39.847920	-83.158940	861.5	7.5
B-002-0-24	39.848750	-83.159000	861.3	10
B-003-0-24	39.848840	-83.158630	859.7	10
B-004-0-24	39.849310	-83.158690	862.5	7.5
B-005-0-24	39.849640	-83.160730	861.4	7.5
B-006-0-24	39.849250	-83.159790	861.4	7.5
B-007-0-24	39.848180	-83.157820	839.3	7.5
Notes:	*1. All the boring locations were stake locations surveyed in the field After drilling by the Client*			

Borings were drilled using a CME 45B truck-mounted drilling rigs utilizing 3.25-inch (inner diameter) hollow stem augers. Soil samples for subgrade borings were typically recovered continuously to end of boring depth (EOB). However, B-002-0-23 and B-003-0-23 was recovered in 2.5 ft intervals to the end of boring (EOB). Each boring was sampled using an 18-inch split spoon sampler (AASHTO T-206 “Standard Method for Penetration Test and Split Barrel Sampling of Soils.”). The soil samples obtained from the exploration program were visually observed in the field by NEAS field representative and preserved for review by a geologist for possible laboratory testing. Standard penetration tests (SPT) were conducted using a CME auto hammer that has been calibrated on March 08, 2024, to be 79 % efficient as indicated on the boring logs (Appendix B).

Field boring logs were prepared by drilling personnel and included pavement description, lithological description, SPT results recorded as blows per 6-inch increment of penetration and estimated unconfined shear strength values on specimens exhibiting cohesion (using a hand-penetrometer). After completing the borings, the boreholes were backfilled with either auger cuttings, or a combination of these materials and patched accordingly with cold patch asphalt when drilling through the roadway.

3.2. Laboratory Testing Program

The laboratory testing program consisted of classification testing, moisture content and sulfate content determinations. Data from the laboratory testing program were incorporated on the boring logs (Appendix B).

3.2.1. Classification Testing

Representative soil samples were selected for index properties (Atterberg limits) and gradation testing for classification purposes. At each boring location, the upper two samples obtained below the proposed top of subgrade elevation were generally tested while additional samples in each boring were selected for testing with the intent of properly classifying the subsurface soil and groundwater conditions within the planned project limits. Soils not selected for testing were compared to laboratory tested samples and classified

visually. Moisture content testing was conducted on all samples. The laboratory testing was performed in general accordance with applicable AASHTO specifications and ODOT Supplements.

Final classification of soil strata in accordance with AASHTO M-145 "Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes," as modified by ODOT "Classification of Soils" was made once laboratory test results became available. The results of the soil classification are presented on the boring logs in Appendix B.

3.2.2. Standard Penetration Test Results

Standard Penetration Tests (SPT) and split-barrel (commonly known as split-spoon) sampling of soils were performed at 1.5-ft interval in the project borings performed. To account for the high efficiency (automatic) hammers used during SPT sampling, field SPT N-values were converted based on the calibrated efficiency (energy ratio) of the specific drill rig's hammer. Field N-values were converted to an equivalent rod energy of 60% (N_{60}) for use in analysis or for correlation purposes. The resulting N_{60} values are shown on the boring logs provided in Appendix B.

3.2.3. Sulfate testing

Sulfate testing was generally performed on one sample from each subgrade/roadway boring performed for pavement/subgrade design purposes. The selected samples were tested in accordance with ODOT Supplement 1122, "Determining Sulfate Content in Soils" dated July 17, 2015. In general, the upper most sample (within 3 ft of the proposed subgrade elevation) from each boring was tested when feasible. Testing results are summarized in Table 2 below, and presented on the boring logs within Appendix B.

Table 2: Sulfate Test Summary by Boring

Boring ID	Sample	Depth (ft)	Dilution Ratio	Average Sulfate Content (ppm)
B-001-0-24	SS-2	3.0 - 4.5	20	0
B-002-0-24	SS-1	1.0 - 2.5	20	0
B-003-0-24	SS-1	1.0 - 2.5	20	0
B-004-0-24	SS-1	1.5 - 3.0	20	60
B-005-0-24	SS-1	1.5 - 3.0	20	20
B-006-0-24	SS-1	1.5 - 3.0	20	20
B-007-0-24	SS-1	1.5 - 3.0	20	20

4. FINDINGS

The subsurface conditions encountered during NEAS's explorations are described in the following subsections and/or on each boring log presented in Appendix B. The boring logs represent NEAS's interpretation of the subsurface conditions encountered at each boring location based on our site observations, field logs, visual review of the soil samples by NEAS's geologist, and laboratory test results. The lines designating the interfaces between various soil strata on the boring logs represent the approximate interface location; the actual transition between strata may be gradual and indistinct. The subsurface soil and groundwater characterizations included herein, including summary test data, are based on the subsurface findings from the geotechnical explorations performed by NEAS as part of the referenced project. It should be noted that for the purposes of this report and our analysis the term 'subgrade' has been assumed to represent soils and/or soil conditions from 1.5 ft below proposed final pavement grades to a depth of 7.5 ft below the proposed pavement grades.

4.1. Existing Pavement

The pavement section thicknesses in terms of asphalt, brick, sand, concrete and granular base were measured at representative project subgrade borings during the subsurface exploration for the project and are recorded on the test boring logs provided in Appendix B. A summary of these measurements is provided in Table 3 below.

Table 3: Measured Pavement Thickness at Boring Locations

Boring ID	Drilled Depth (ft)	Asphalt Thickness (in)	Concrete Thickness (in)	Base Thickness (in)	Total Thickness (in)
B-001-0-24	7.5	8.0	-	-	8.0
B-004-0-24	7.5	9.0	-	-	9.0
B-005-0-24	7.5	8.0	-	-	8.0
B-007-0-24	7.5	8.0	-	-	8.0

4.2. Subgrade Conditions

The subgrade conditions in the project area are relatively uniform, consisting mainly of existing pavement sections or topsoil underlain by predominantly cohesive fine-grained soils, with minor amounts of non-cohesive coarse-grained soils. The asphalt pavement layer is 8 to 9 inches thick, while the topsoil measures 5 to 6 inches. The non-cohesive coarse-grained soils are classified as A-4a, and the cohesive fine-grained soils are classified as A-4a, A-6a, A-6b, and A-7-6. A summary of the subgrade conditions encountered along the project site is provided below.

4.2.1. SR-665

This section consists of 3 borings along SR-665, designated as B-005-0-24, B-006-0-24 and B-007-0-24.

Along SR-665, one hundred percent (100%) of the samples taken were classified as cohesive fine-grained soils and were comprised of: 1) Sandy Silt (A-4a, 17% of the samples); 2) Silt and Clay (A-6a, 42% of the samples); 3) Silty Clay (A-6b, one sample); and 4) Clay (A-7-6, 33% of the samples). In terms of consistency of the cohesive soils, the description varies from very stiff to hard correlating to converted SPT-N values (N_{60}) ranging from 7 blows per foot (bpf) to 38 bpf and hand penetration readings from 2.75 tsf to 4.50 tsf. Natural moisture contents ranged from 12 to 26 percent. Based on Atterberg limits test performed on representative samples of the cohesive soils, the liquid and plastic limit were estimated to range from 22 to 43 percent and from 15 to 22 percent, respectively.

4.2.2. Lambert Road

This section consists of 2 borings along Lambert Road, designated as B-001-0-24 and B-004-0-24.

Along Lambert Road, one hundred percent (100%) of the samples taken were classified as cohesive fine-grained soils and were comprised of: 1) Sandy Silt (A-4a, 71% of the samples); and 2) Silty Clay (A-6b, 29% of the samples). In terms of consistency of the cohesive soils, the description varies from very stiff to hard correlating to converted SPT-N values (N_{60}) ranging from 11 blows per foot (bpf) to 17 bpf and hand penetration readings from 3.50 tsf to 4.25 tsf. Natural moisture contents ranged from 10 to 17 percent. Based on Atterberg limits test performed on representative samples of the cohesive soils, the liquid and plastic limit were estimated to range from 24 to 35 percent and from 16 to 19 percent, respectively.

4.2.3. Roundabout

This section consists of 2 borings along roundabout, designated as B-002-0-24 and B-003-0-24.

Along roundabout, eighty-six percent (86%) of the samples taken were classified as cohesive fine-grained soils and were comprised of: 1) Sandy Silt (A-4a, 29% of the samples); 2) Silt and Clay (A-6a, one sample); 3) Silty Clay (A-6b, 29% of the samples); and 4) Clay (A-7-6, one sample). In terms of consistency of the cohesive soils, the description varies from stiff to hard correlating to converted SPT-N values (N_{60}) ranging from 8 blows per foot (bpf) to 38 bpf and hand penetration readings from 3.50 tsf to 4.50 tsf. Natural moisture contents ranged from 11 to 19 percent. Based on Atterberg limits test performed on representative samples of the cohesive soils, the liquid and plastic limit were estimated to range from 27 to 53 percent and from 17 to 22 percent, respectively.

Fourteen percent (14%) of the samples taken were classified as non-cohesive coarse-grained soils and were comprised of Sandy Silt (A-4a, one sample). In terms of consistency of the non-cohesive soils, the description is medium dense correlating to converted SPT-N value (N_{60}) of 12 blows per foot (bpf). Natural moisture content is 17 percent.

4.2.4. Groundwater

Groundwater measurements were taken during the boring drilling procedures and/or immediately following the completion of each borehole. Groundwater was encountered in one boring, B-002-0-24, at a depth of 1.3 ft bgs (elevation 860.0 ft amsl) during drilling.

It should be noted that groundwater is affected by many hydrologic characteristics in the area and may vary from those measured at the time of the exploration.

5. ANALYSES AND RECOMMENDATIONS

NEAS understands that Colliers Engineering & Design is working with the ODOT to design and construct a new roundabout at the intersection of SR-665 and Lambert Road in Franklin County, Ohio. The subgrade exploration and subsequent analyses were completed for the referenced project. The subgrade analysis was performed in accordance with ODOT's GDM criteria utilizing the ODOT provided subgrade analysis spreadsheet (GB1_ SubgradeAnalysis.xls, version 14.7 dated April 04, 2024). Input information for the spreadsheet was based on the soil characteristics gathered during NEAS's exploration (i.e., SPT results, laboratory test results, etc.).

5.1. Subgrade Analysis

Subgrade analyses were performed to identify the method, location, and dimensions (including depth) of required subgrade stabilization for the project. In addition to identifying stabilization recommendations, pavement design parameters are also determined to aid in pavement section design. The subsections below present the results of our subgrade analyses including pavement design parameters and unsuitable subgrade conditions identified within the project limits. Subgrade analysis spreadsheets are provided in Appendix C.

It should be noted that for the purposes of this report and our analysis, the term 'proposed subgrade' has been assumed to represent soils and/or soil conditions extending to a depth of 7.5 ft below the bottom of proposed pavement section (i.e., top of subgrade).

5.1.1. Pavement Design Recommendations

It is our understanding that pavement analysis and design is to be performed to determine the proposed pavement section within the project limits to undergo the proposed improvements. A subgrade analysis was performed using the subgrade soil data obtained during our field exploration program to evaluate the soil characteristics to develop pavement parameters for use in pavement design. The subgrade analysis

parameters recommended for use in pavement design are presented in Table 4 below. Provided in the table are ranges of maximum, minimum and average N_{60L} values for the indicated segments as well as the design CBR value recommended for use in pavement design.

Table 4: Pavement Design Parameters

FRA-665-5.18 Subgrade Analysis Summary					
Segment	**Maximum N_{60L}**	**Minimum N_{60L}**	**Average N_{60L}**	**Average PI Values**	**Design CBR**
SR-665	21	7	12	14	6
Lambert Road	13	11	12	13	7
Roundabout	14	8	11	25	6
Entire Project	**21**	**7**	**12**	**15**	**6**

5.1.2. Unsuitable Soils

Per ODOT's GDM, the presence of select subgrade conditions are prohibited within the subgrade zone for new pavement construction. These prohibited subgrade conditions generally include the presence of rock, specific soil types, and soils with a liquid limit greater than 65 percent. With respect to the proposed improvement project these subgrade conditions are further discussed in the following subsections.

5.1.2.1. Rock

Rock was not encountered at or close to subgrade elevation at the boring locations performed within the project limits. Per ODOT's GDM, if rock is encountered within 6 inches of the bottom of the proposed asphalt or concrete pavement it is to be removed in accordance with 204.05 of the ODOT CMS and replaced with Item 204 Embankment.

5.1.2.2. Prohibited Soils

Prohibited soil types per the GDM include A-4b, A-2-5, A-5, A-7-5, A-8a, A-8b, and soils with liquid limits greater than 65. No prohibited soils were encountered in any boring along the project limits.

5.1.3. Unstable Soils

The GDM recommends subgrade stabilization for soils in which the N_{60} value of a particular soil sample (SS) at a referenced boring location is less than 12 bpf and in some cases less than 15 bpf (i.e., where moisture content is greater than optimum plus 3 percent). Based on the specific N_{60} value at the subject boring, *Figure B - Subgrade Stabilization* within the subgrade analysis recommends a depth of subgrade stabilization for ODOT standard stabilization methods. For the purposes of this report, the term 'weak soils' has been assumed to represent subgrade soils of these conditions. It should be noted that although a soil sample's N_{60} value may meet the criteria to be considered a weak soil, the depth in which the weak soil is encountered in relation to the proposed subgrade is considered when each individual subgrade boring is analyzed. For example, if the GDM recommends an excavate and replace of 12 inches within a weak soil underlying 18 inches of stable material, it would be unreasonable to recommend the removal of both the stable and unstable material for a total of 30 inches of excavate and replace.

Information on the boring location where weak soils were encountered and determined to have a potential impact on subgrade performance is shown in Table 5 below.

Table 5: Unstable (Weak) Soils Location Summary

Boring ID	N_{60L}	Depth Below Subgrade (ft)
Lambert Road		
B-004-0-24	11	0.0 - 0.9
SR-665		
B-005-0-24	8	0.2 - 1.7
B-005-0-24	7	1.7 - 3.2

5.1.3.1. High Moisture Content Soils

High moisture content soils are defined by the GDM as soils that exceed the estimated optimum moisture content (per *Figure A - Optimum Moisture Content* within the GDM) for a given classification by 3 percent or more. Per the GDM, soils determined to be above the identified moisture content levels are a likely indication of the presence of an unstable subgrade and may require some form of subgrade stabilization. Similar to our analysis of weak soils, although a soil sample's moisture content may meet the criteria to be considered high, the depth in which the high moisture soil is encountered in relation to the proposed subgrade is considered when each individual subgrade boring is analyzed for stabilization recommendations. Based on the subsurface exploration performed, high moisture content soils within the proposed subgrade of the project were encountered in borings as shown in Table 6 below.

Table 6: High Moisture Content Soils Summary

Boring ID	Sample ID	Soil Type	Moisture Content (%)	Optimum Moisture Content (%)	Moisture Above Optimum (%)	Depth Below Subgrade (ft)
Roundabout						
B-002-0-24	SS-2	A-4a	13	10	3	0.8 - 2.3
SR-665						
B-005-0-24	SS-1	A-4a	18	14	4	0.2 - 1.7
B-005-0-24	SS-2	A-7-6	23	18	5	1.7 - 3.2

5.2. Stabilization Recommendations

5.2.1. Subgrade Stabilization

According to our subgrade analysis, unstable and high moisture content soils were encountered in 25% of the proposed subgrade surface. These soils exhibited an N_{60} value below 12 bpf and a moisture content exceeding the optimum level by more than 3 percent within 3 feet of subgrade. **Therefore, NEAS recommends local stabilization in the form of either Item 204, Excavate and Replace with Geotextile to a depth of 12 inches, or Item 206, Cement Stabilization to a depth of 12 inches,** as shown in Table 7 below. The designer should use bid tabs to generate a cost analysis for the options.

Table 7: Stabilization Recommendation

Start Station	End Station	Excavate and Replace w/ Item 204[(1)] (inches)	Chemical Stabilization (inches)	Unsuitable Subgrade Conditions	Borings Considered
Lambert Road					
21+32.9	End Work	12	12	-	B-004-0-24
SR - 665					
Begin Project	270+60	12	12	-	B-005-0-24

Stabilization limits should extend 18-inches beyond the edge of the proposed paved roadway, shoulder or median and it is recommended removing any topsoil, existing pavement materials or abandoned structure foundation materials. The mix design should be conducted in accordance with ODOT's CMS Supplement

1120 (Mixture Design for Chemically Stabilized Soils). For design purposes it may be assumed that the cement addition will be 5% using the following formula.

$$\text{Cement: } C = 0.75 \times T \times 115 \times 0.05$$

Where:

C = amount of chemical in pounds / square yard and

T = thickness of the treatment zone in inches

A dry density of 115-pounds per cubic foot (pcf) is assumed.

It should be noted that per ODOT's GDM, *typical chemical stabilization equipment cannot stabilize areas less than 8 ft in width.* If it is anticipated that the project will require multiple maintenance of traffic phases, it is recommended that the roadway work is coordinated with the maintenance of traffic schemes in such a way that an 8-ft minimum width for chemical stabilization exists. If areas of less than 8 ft in width are anticipated, subgrade soils may be excavated out, mixed with stabilization chemical, and compacted in place, though this method is not practical for large areas.

NEAS's opinion that the subgrade soils will provide adequate pavement support assuming it is designed and constructed in accordance with the recommendations provided within this report, as well as all applicable ODOT standards and specifications.

6. QUALIFICATIONS

The investigation was performed in accordance with accepted geotechnical engineering practice for the purpose of characterizing the subsurface and groundwater within the project limits. This report has been prepared for Colliers Engineering & Design and their design consultants to be used solely in evaluating the roadway subgrade and pavement design parameter that will serve as the basis for development of design and construction of the roadway improvement project. The assessment of general site environmental conditions or the presence of pollutants in the soil, rock and groundwater of the site was beyond the scope of this geotechnical exploration. Our recommendations are based on the results of our field explorations, laboratory tests results from representative soil samples, and geotechnical engineering analyses. The results of the field explorations and laboratory tests, which form the basis of our recommendations, are presented in the appendices as noted. This report does not reflect any variations that may occur between the borings or elsewhere on the site, or variations whose nature and extent may not become evident until a later stage of construction. If any changes occur in the nature, design or location of the proposed roadway, the conclusions and recommendations contained in this report should not be considered valid until they are reviewed and have been modified or verified in writing by a geotechnical engineer.

It has been a pleasure to be of service to Colliers Engineering & Design in performing this geotechnical exploration for the FRA-665-5.18 project. Please call if there are any questions, or if we can be of further service.

Respectfully Submitted,

Chunmei (Melinda) He, Ph.D., P.E.
Geotechnical Engineer

Derar Tarawneh, Ph.D., P.E.
Staff Engineer

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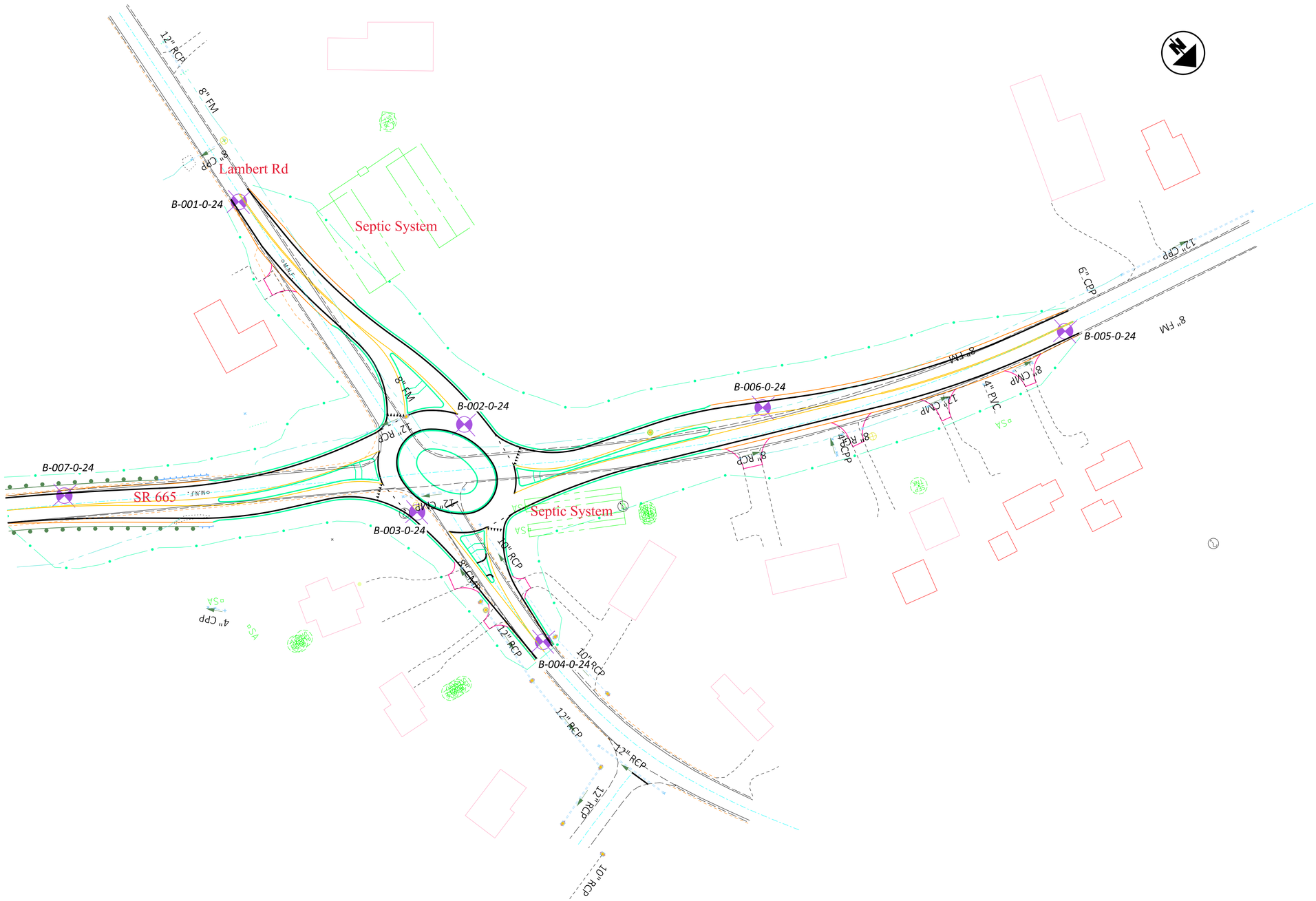
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APPENDIX A

BORING LOCATION PLAN



Note: Avoid septic System in the northwest corner of the intersection.

HORIZONTAL SCALE IN FEET
0 25 50 100

TARGET BORING PLAN
FRA-665-5.18

DESIGN AGENCY
EAS Engineering & Architectural Services, Inc.

DESIGNER	DT
REVIEWER	CH 02-27-2024
PROJECT ID	116359
SHEET	P.0
TOTAL	0

FRA-665-5.18

MODEL: 116359_SBP PAPERSIZE: 34x22 (in.) DATE: 2/27/2024 TIME: 2:32:31 PM USER: dtarawneh
P:\OHDOT_v3\WorkSets\116359\400-Engineering\Geotechnical\Basemaps\116359_BI001.dgn

APPENDIX B

BORING LOGS

PROJECT: FRA-665-5.18	DRILLING FIRM / OPERATOR: NEAS INC. / RW	DRILL RIG: CME 45B	STATION / OFFSET: 16+85, 4' RT.
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: NEAS INC. / TA	HAMMER: CME AUTOMATIC	ALIGNMENT: LAMBERT ROAD
PID: 116359 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/8/24	ELEVATION: 861.5 (MSL) EOB: 7.5 ft.
START: 8/21/24 END: 8/21/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79	LAT / LONG: 39.847920, -83.158940

EXPLORATION ID B-001-0-24

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 861.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
8.0" ASPHALT (DRILLERS DESCRIPTION)	860.7																		
HARD, BROWN, **SILTY CLAY**, SOME SAND, TRACE GRAVEL, SS-2 CONTAINS ASPHALT FRAGMENTS, DAMP SS-1 NO RECOVERY	857.0	1 2 3 4	3 4 6	13	0	SS-1	-	-	-	-	-	-	-	-	-	-		-	
			1 6 6	16	50	SS-2	4.25	9	11	13	35	32	35	19	16	17	A-6b (9)	0	
HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP	854.0	5 6	4 6 7	17	22	SS-3	4.25	8	16	17	37	22	24	16	8	13	A-4a (5)	-	
		EOB 7	3 4 6	13	17	SS-4	4.25	-	-	-	-	-	-	-	-	12	A-4a (V)	-	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE CAVED-IN AT 3.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; POURED 1 BAG HOLE PLUG; SHOVELED SOIL CUTTINGS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 9/18/24 11:52 - X:\1ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\FRA-665-5.18\GINT FILES\FRA-665-5.18.GPJ

PROJECT: FRA-665-5.18	DRILLING FIRM / OPERATOR: NEAS INC. / RW	DRILL RIG: CME 45B	STATION / OFFSET: 1+09, 12' RT.
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: NEAS INC. / TA	HAMMER: CME AUTOMATIC	ALIGNMENT: ROUNDABOUT
PID: 116359 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/8/24	ELEVATION: 861.3 (MSL) EOB: 10.0 ft.
START: 8/21/24 END: 8/21/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79	LAT / LONG: 39.848750, -83.159000

EXPLORATION ID B-002-0-24

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 861.3	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
6.0" TOPSOIL (DRILLERS DESCRIPTION)	860.8																		
HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP		W 860.0	7 11 18	38	56	SS-1	4.50	9	10	14	39	28	27	17	10	11	A-4a (6)	0	
			3 7 9	21	67	SS-2	4.50	-	-	-	-	-	-	-	-	13	A-4a (V)	-	
	855.8																		
MEDIUM DENSE, BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, WET SS-3 CONTAINS NO INTACT SOIL FOR HP READINGS			3 5 4	12	50	SS-3	-	11	13	33	31	12	NP	NP	NP	17	A-4a (2)	-	
	853.3																		
VERY STIFF, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, MOIST			1 3 3	8	56	SS-4	4.00	-	-	-	-	-	-	-	-	14	A-4a (V)	-	
	851.3	EOB																	

NOTES: GROUNDWATER ENCOUNTERED AT 1.3' DURING DRILLING. HOLE CAVED-IN AT 8.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 9/18/24 11:52 - X:\1ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\FRA-665-5.18\GINT FILES\FRA-665-5.18.GPJ

PROJECT: FRA-665-5.18	DRILLING FIRM / OPERATOR: NEAS INC. / RW	DRILL RIG: CME 45B	STATION / OFFSET: 2+33, 23' RT.	EXPLORATION ID B-003-0-24
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: NEAS INC. / JH	HAMMER: CME AUTOMATIC	ALIGNMENT: ROUNDABOUT	
PID: 116359 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/8/24	ELEVATION: 859.7 (MSL) EOB: 10.0 ft.	PAGE 1 OF 1
START: 8/21/24 END: 8/21/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79	LAT / LONG: 39.848840, -83.158630	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
5.0" TOPSOIL (DRILLERS DESCRIPTION)	859.7																		
	859.3																		
HARD, BROWN MOTTLED WITH GRAY, **CLAY**, "AND" SILT, LITTLE SAND, TRACE GRAVEL, IRON STAINING, DAMP		1	5 9 14	30	22	SS-1	4.50	3	4	9	37	47	53	22	31	18	A-7-6 (19)	0	
	856.7	2																	
STIFF TO VERY STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, CONTAINS ROOTS, DAMP		3																	
		4	4 5 9	18	28	SS-2	3.50	9	5	15	37	34	40	22	18	19	A-6b (10)	-	
		5																	
SS-3 CONTAINS NO INTACT SOIL FOR HP READINGS		6	3 6 5	14	6	SS-3	-	-	-	-	-	-	-	-	-	17	A-6b (V)	-	
	851.7	7																	
VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP		8																	
SS-4 CONTAINS NO INTACT SOIL FOR HP READINGS	849.7	9	3 5 15	26	6	SS-4	-	-	-	-	-	-	-	-	-	16	A-6a (V)	-	
	EOB	10																	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE CAVED-IN AT 7.6'. BORING OFFSET 10' EAST

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 1 BAG HOLE PLUG; SHOVELED SOIL CUTTINGS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 9/18/24 11:52 - X:\1ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\FRA-665-5.18\GINT FILES\FRA-665-5.18.GPJ

PROJECT: FRA-665-5.18	DRILLING FIRM / OPERATOR: NEAS INC. / RW	DRILL RIG: CME 45B	STATION / OFFSET: 22+05, 4' LT.
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: NEAS INC. / TA	HAMMER: CME AUTOMATIC	ALIGNMENT: LAMBERT ROAD
PID: 116359 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/8/24	ELEVATION: 862.5 (MSL) EOB: 7.5 ft.
START: 8/21/24 END: 8/21/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79	LAT / LONG: 39.849310, -83.158690

EXPLORATION ID B-004-0-24

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 862.5	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
9.0" ASPHALT (DRILLERS DESCRIPTION)	861.7																		
VERY STIFF, BROWN, **SILTY CLAY**, SOME SAND, LITTLE GRAVEL, DAMP	859.5	1																	
		2	4 3 5	11	28	SS-1	3.50	16	14	13	31	26	34	17	17	15	A-6b (7)	60	
VERY STIFF TO HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP		3	1 3 7	13	50	SS-2	4.25	6	13	14	40	27	27	17	10	14	A-4a (6)	-	
		4																	
		5	1 3 8	14	33	SS-3	4.00	-	-	-	-	-	-	-	-	12	A-4a (V)	-	
		6																	
	855.0	7	3 6 6	16	28	SS-4	3.75	-	-	-	-	-	-	-	-	10	A-4a (V)	-	
		EOB																	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE CAVED-IN AT 3.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; POURED 1 BAG HOLE PLUG; SHOVELED SOIL CUTTINGS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 9/18/24 11:52 - X:\1ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\FRA-665-5.18\GINT FILES\FRA-665-5.18.GPJ

PROJECT: FRA-665-5.18	DRILLING FIRM / OPERATOR: NEAS INC. / RW	DRILL RIG: CME 45B	STATION / OFFSET: 269+10, 6' LT.
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: NEAS INC. / JH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-665
PID: 116359 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/8/24	ELEVATION: 861.4 (MSL) EOB: 7.5 ft.
START: 8/21/24 END: 8/21/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79	LAT / LONG: 39.849640, -83.160730

EXPLORATION ID B-005-0-24

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 861.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GR	CS	FS	SI	CL	LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
8.0" ASPHALT (DRILLERS DESCRIPTION)	860.8																	
VERY STIFF, BROWNISH GRAY, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, SLIGHT PETROLIFEROUS ODOR, DAMP	858.4	1	1 3 3	8	72	SS-1	3.75	4	11	13	48	24	27	19	8	18	A-4a (7)	
VERY STIFF, BROWN MOTTLED WITH GRAY AND ORANGISH BROWN, **CLAY**, "AND" SILT, LITTLE SAND, TRACE GRAVEL, SS-2 CONTAINS TRACE IRON STAINING, MOIST		2	1 3 2	7	56	SS-2	2.75	3	6	11	38	42	41	19	22	23	A-7-6 (13)	
		3	1 3 4	9	50	SS-3	3.00	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
		4																
		5																
		6	2 3 3	8	56	SS-4	3.00	-	-	-	-	-	-	-	-	26	A-7-6 (V)	
	853.9	7 EOB																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE CAVED-IN AT 3.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; POURED 1 BAG HOLE PLUG; SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 11/25/24 12:30 - X:\1ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\FRA-665-5.18\GINT FILES\FRA-665-5.18.GPJ

PROJECT: FRA-665-5.18	DRILLING FIRM / OPERATOR: NEAS INC. / RW	DRILL RIG: CME 45B	STATION / OFFSET: 272+10, 9' RT.	EXPLORATION ID B-006-0-24
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: NEAS INC. / JH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-665	
PID: 116359 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/8/24	ELEVATION: 861.4 (MSL) EOB: 7.5 ft.	PAGE 1 OF 1
START: 8/21/24 END: 8/21/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79	LAT / LONG: 39.849250, -83.159790	

MATERIAL DESCRIPTION AND NOTES	ELEV. 861.4	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
5.0" TOPSOIL (DRILLERS DESCRIPTION)	861.0																	
HARD, BROWN AND ORANGISH BROWN, **CLAY**, SOME SILT, LITTLE SAND, TRACE GRAVEL, IRON STAINING, DAMP	858.4	1	4 7 9	21	61	SS-1	4.50	2	5	11	33	49	43	22	21	19	A-7-6 (13)	
HARD, BROWN AND ORANGISH BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP		2	2 9 11	26	50	SS-2	4.50	4	8	13	43	32	28	16	12	13	A-6a (9)	
		3	2 7 10	22	61	SS-3	4.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
	853.9	4	11 13 16	38	89	SS-4	4.50	-	-	-	-	-	-	-	-	13	A-6a (V)	
		EOB 5																
		6																
		7																

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE CAVED-IN AT 3.0'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: POURED 1 BAG HOLE PLUG; SHOVELED SOIL CUTTINGS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 11/25/24 12:30 - X:\1ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\FRA-665-5.18\GINT FILES\FRA-665-5.18.GPJ

PROJECT: FRA-665-5.18	DRILLING FIRM / OPERATOR: NEAS INC. / RW	DRILL RIG: CME 45B	STATION / OFFSET: 278+95, 11' RT.
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: NEAS INC. / JH	HAMMER: CME AUTOMATIC	ALIGNMENT: SR-665
PID: 116359 SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/8/24	ELEVATION: 839.3 (MSL) EOB: 7.5 ft.
START: 8/21/24 END: 8/21/24	SAMPLING METHOD: SPT	ENERGY RATIO (%): 79	LAT / LONG: 39.848180, -83.157820

EXPLORATION ID B-007-0-24

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	SO4 ppm	BACK FILL
8" ASPHALT (DRILLERS DESCRIPTION)	838.6																		
HARD, BROWN AND GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP	834.8	1	4 7 8	20	72	SS-1	4.50	7	7	11	46	29	30	18	12	15	A-6a (9)	20	
		2	5 5 5	13	56	SS-2	4.25	-	-	-	-	-	-	-	-	18	A-6a (V)	-	
		3																	
HARD, BROWN, **SANDY SILT**, SOME CLAY, TRACE GRAVEL, DAMP	833.3	4	3 3 3	8	50	SS-3	4.50	9	14	17	39	21	22	15	7	12	A-4a (5)	-	
		5																	
VERY STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, DAMP	831.8	6	2 3 4	9	56	SS-4	3.00	-	-	-	-	-	-	-	-	19	A-6b (V)	-	
EOB		7																	

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE CAVED-IN AT 3.3'.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; POURED 1 BAG HOLE PLUG; SHOVELED SOIL CUTTINGS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 9/18/24 11:52 - X:\1ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\FRA-665-5.18\GINT FILES\FRA-665-5.18.GPJ

APPENDIX C

SUBGRADE ANALYSIS SPREADSHEET

ENTIRE PROJECT

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Design Manual Section 600

Instructions: Enter data in the shaded cells only.
(Enter state route number, project description,county, consultant's name, prepared by name, and date prepared. This information will be transferred to all other sheets. The date prepared must be entered in the appropriate cell on this sheet to remove these instructions prior to printing.)

FRA-665-5.18
116359

Design and construct a roundabout at the intersection of SR 665 and Lambert Road-Entire project

NEAS, Inc.

Prepared By: Derar M. Tarawneh, Ph.D., P.E.
Date prepared: Wednesday, August 28, 2024

Chunmei (Melinda) He, Ph.D., P.E.
2800 Corporate Exchange Drive
Suite 240
Columbus, OH 43231
614.714.0299 Ext 111
che@neasinc.com

NO. OF BORINGS: 7

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.7 4/4/2024

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-001-0-24	Lambert Road	16+85	4	RT	CME 45B	79	861.5	860.1	1.4 C
2	B-002-0-24	Roundabout	1+09	12	RT	CME 45B	79	861.3	858.6	2.7 C
3	B-003-0-24	Roundabout	2+33	23	RT	CME 45B	79	859.7	858.6	1.1 C
4	B-004-0-24	Lambert Road	22+05	4	LT	CME 45B	79	862.5	860.3	2.1 C
5	B-005-0-24	SR-665	269+10	6	LT	CME 45B	79	861.4	860.1	1.3 C
6	B-006-0-24	SR-665	272+10	9	RT	CME 45B	79	861.4	860.3	1.1 C
7	B-007-0-24	SR-665	278+95	11	RT	CME 45B	79	839.3	838.5	0.7 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.7 4/4/2024

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-1	1.5	3.0	0.1	1.6	13																		
	001-0	SS-2	3.0	4.5	1.6	3.1	16		4.25	35	19	16	35	32	67	17	16	A-6b	9	0					
	24	SS-3	4.5	6.0	3.1	4.6	17		4.25	24	16	8	37	22	59	13	11	A-4a	5						
		SS-4	6.0	7.5	4.6	6.1	13	13	4.25							12	10	A-4a	8						
2	B	SS-1	1.0	2.5	-1.7	-0.2	38		4.5	27	17	10	39	28	67	11	12	A-4a	6	0					
	002-0	SS-2	3.5	5.0	0.8	2.3	21		4.5							13	10	A-4a	8			Mc			
	24	SS-3	6.0	7.5	3.3	4.8	12			NP	NP	NP	31	12	43	17	11	A-4a	2						
		SS-4	8.5	10.0	5.8	7.3	8	8	4							14	10	A-4a							
3	B	SS-1	1.0	2.5	-0.1	1.4	30		4.5	53	22	31	37	47	84	18	19	A-7-6	19	0					
	003-0	SS-2	3.5	5.0	2.4	3.9	18		3.5	40	22	18	37	34	71	19	17	A-6b	10						
	24	SS-3	6.0	7.5	4.9	6.4	14									17	16	A-6b	16						
		SS-4	8.5	10.0	7.4	8.9	26	14								16	14	A-6a							
4	B	SS-1	1.5	3.0	-0.6	0.9	11		3.5	34	17	17	31	26	57	15	16	A-6b	7	60		N_{60}		**12"**	
	004-0	SS-2	3.0	4.5	0.9	2.4	13		4.25	27	17	10	40	27	67	14	12	A-4a	6						
	24	SS-3	4.5	6.0	2.4	3.9	14		4							12	10	A-4a	8						
		SS-4	6.0	7.5	3.9	5.4	16	11	3.75							10	10	A-4a	8						
5	B	SS-1	1.5	3.0	0.2	1.7	8		3.75	27	19	8	48	24	72	18	14	A-4a	7	20		N_{60} & Mc		**12"**	
	005-0	SS-2	3.0	4.5	1.7	3.2	7		2.75	41	19	22	38	42	80	23	18	A-7-6	13			N_{60} & Mc			
	24	SS-3	4.5	6.0	3.2	4.7	9		3							26	18	A-7-6	16						
		SS-4	6.0	7.5	4.7	6.2	8	7	3							26	18	A-7-6	16						
6	B	SS-1	1.5	3.0	0.4	1.9	21		4.5	43	22	21	33	49	82	19	19	A-7-6	13	20					
	006-0	SS-2	3.0	4.5	1.9	3.4	26		4.5	28	16	12	42	32	74	13	14	A-6a	9						
	24	SS-3	4.5	6.0	3.4	4.9	22		4.5							13	14	A-6a	10						
		SS-4	6.0	7.5	4.9	6.4	38	21	4.5							13	14	A-6a	10						
7	B	SS-1	1.5	3.0	0.8	2.3	20		4.5	30	18	12	46	29	75	15	14	A-6a	9	20					
	007-0	SS-2	3.0	4.5	2.3	3.8	13		4.25							18	14	A-6a	10						
	24	SS-3	4.5	6.0	3.8	5.3	8		4.5	22	15	7	39	21	60	12	10	A-4a	5						
		SS-4	6.0	7.5	5.3	6.8	9	8	3							19	16	A-6b							

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.7 4/4/2024

PID: 116359

County-Route-Section: FRA-665-5.18

No. of Borings: 7

Geotechnical Consultant: NEAS, Inc.

Prepared By: Derar M. Tarawneh, Ph.D., P.E.

Date prepared: 8/28/2024

Chemical Stabilization Options		
320	Rubblize & Roll	No
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	12''

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L):	12''
Average(HP):	0''
Global Geogrid Average(N60L):	0''
Average(HP):	0''

Design CBR	6

% Samples within 3 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	0%
$N_{60} < 12$	12%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	15%	1 < HP ≤ 2	0%
$N_{60} \geq 20$	19%	HP > 2	54%
M+	12%		
Rock	0%		
Unsuitable Soil	0%		

Excavate and Replace at Surface	
Average	0''
Maximum	0''
Minimum	0''

% Proposed Subgrade Surface	
Unstable & Unsuitable	29%
Unstable	29%
Unsuitable (Soil & Rock)	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	16	12	3.98	34	19	15	38	31	69	16	14	10
Maximum	38	21	4.50	53	22	31	48	49	84	26	19	19
Minimum	7	7	2.75	22	15	7	31	12	43	10	10	2

Classification Counts by Sample

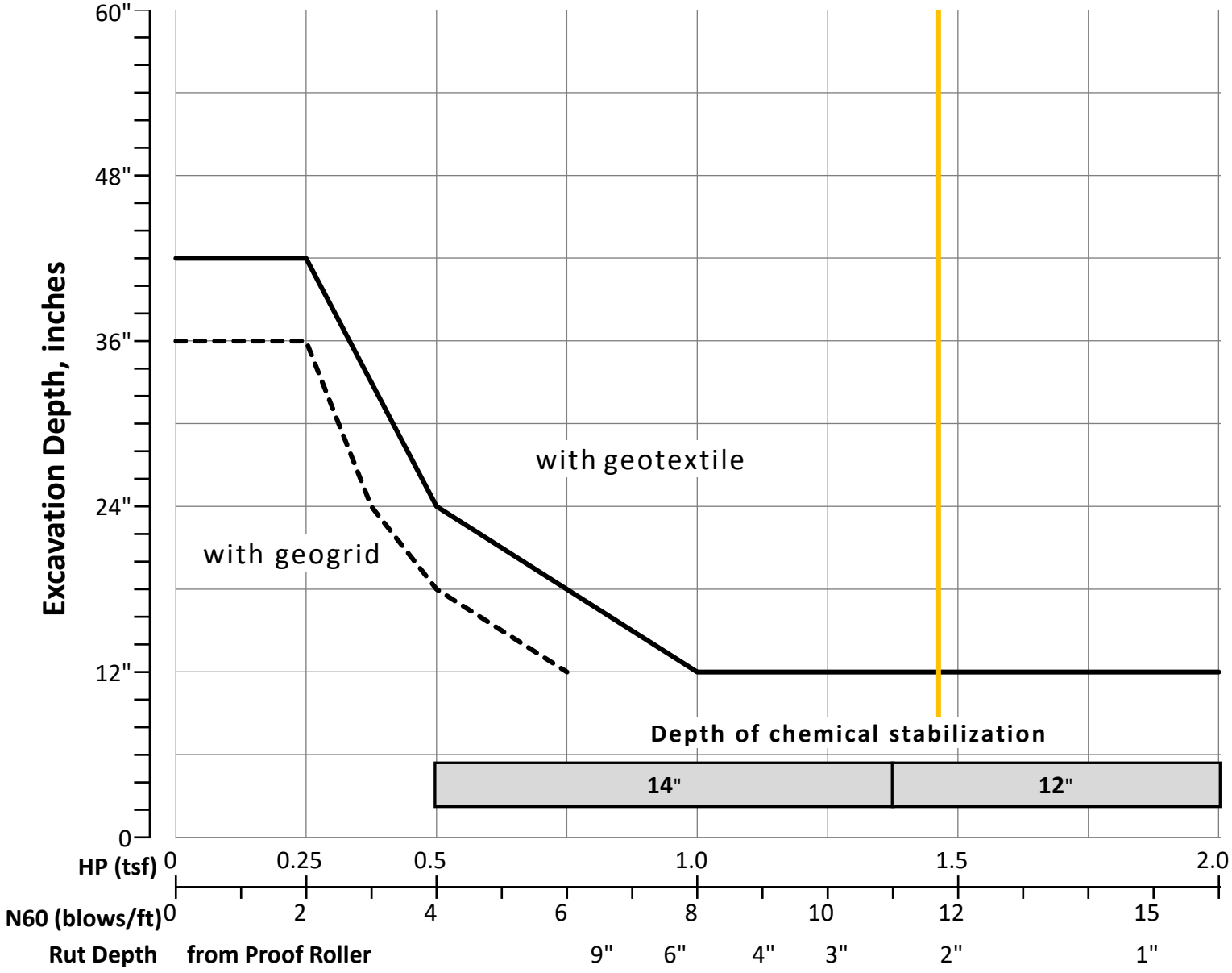
ODOT Class	UCF	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	0	0	0	0	0	0	0	0	0	10	0	0	6	5	0	5	0	0	26
Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	38%	0%	0%	23%	19%	0%	19%	0%	0%	100%
% Rock|Granular|Cohesive	0%	0%	38%									62%								100%
Surface Class Count	0	0	0	0	0	0	0	0	0	0	5	0	0	3	3	0	3	0	0	14
Surface Class Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	36%	0%	0%	21%	21%	0%	21%	0%	0%	100%

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.7 4/4/2024

Fig. 600-1 – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
3.98	0.50	☐ HP
11.71	6.00	☐ N60L

Average HP

Average N_{60L}

SR-665

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Design Manual Section 600

Instructions: Enter data in the shaded cells only.
(Enter state route number, project description,county, consultant's name, prepared by name, and date prepared. This information will be transferred to all other sheets. The date prepared must be entered in the appropriate cell on this sheet to remove these instructions prior to printing.)

FRA-665-5.18
116359

Design and construct a roundabout at the intersection of SR 665 and Lambert Road-SR-665

NEAS, Inc.

Prepared By: Derar M. Tarawneh, Ph.D., P.E.
Date prepared: Wednesday, August 28, 2024

Chunmei (Melinda) He, Ph.D., P.E.
2800 Corporate Exchange Drive
Suite 240
Columbus, OH 43231
614.714.0299 Ext 111
che@neasinc.com

NO. OF BORINGS: 3

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-005-0-24	SR-665	269+10	6	LT	CME 45B	79	861.4	860.1	1.3 C
2	B-006-0-24	SR-665	272+10	9	RT	CME 45B	79	861.4	860.3	1.1 C
3	B-007-0-24	SR-665	278+95	11	RT	CME 45B	79	839.3	838.5	0.7 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.7 4/4/2024

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-1	1.5	3.0	0.2	1.7	8		3.75	27	19	8	48	24	72	18	14	A-4a	7	20		N_{60} & Mc		12"	
	005-0	SS-2	3.0	4.5	1.7	3.2	7		2.75	41	19	22	38	42	80	23	18	A-7-6	13			N_{60} & Mc			
	24	SS-3	4.5	6.0	3.2	4.7	9		3							26	18	A-7-6	16						
		SS-4	6.0	7.5	4.7	6.2	8	7	3							26	18	A-7-6	16						
2	B	SS-1	1.5	3.0	0.4	1.9	21		4.5	43	22	21	33	49	82	19	19	A-7-6	13	20					
	006-0	SS-2	3.0	4.5	1.9	3.4	26		4.5	28	16	12	42	32	74	13	14	A-6a	9						
	24	SS-3	4.5	6.0	3.4	4.9	22		4.5							13	14	A-6a	10						
		SS-4	6.0	7.5	4.9	6.4	38	21	4.5							13	14	A-6a	10						
3	B	SS-1	1.5	3.0	0.8	2.3	20		4.5	30	18	12	46	29	75	15	14	A-6a	9	20					
	007-0	SS-2	3.0	4.5	2.3	3.8	13		4.25							18	14	A-6a	10						
	24	SS-3	4.5	6.0	3.8	5.3	8		4.5	22	15	7	39	21	60	12	10	A-4a	5						
		SS-4	6.0	7.5	5.3	6.8	9	8	3							19	16	A-6b							

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.7 4/4/2024

PID: 116359

County-Route-Section: FRA-665-5.18

No. of Borings: 3

Geotechnical Consultant: NEAS, Inc.

Prepared By: Derar M. Tarawneh, Ph.D., P.E.

Date prepared: 8/28/2024

Chemical Stabilization Options		
320	Rubblize & Roll	Option
206	Cement Stabilization	Option
	Lime Stabilization	No
206	Depth	12''

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L):	12''
Average(HP):	0''
Global Geogrid Average(N60L):	0''
Average(HP):	0''

Design CBR	6

% Samples within 3 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	0%
$N_{60} < 12$	17%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	8%	1 < HP ≤ 2	0%
$N_{60} \geq 20$	25%	HP > 2	50%
M+	17%		
Rock	0%		
Unsuitable Soil	0%		

Excavate and Replace at Surface	
Average	0''
Maximum	0''
Minimum	0''

% Proposed Subgrade Surface	
Unstable & Unsuitable	33%
Unstable	33%
Unsuitable (Soil & Rock)	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	16	12	3.90	32	18	14	41	33	74	18	15	11
Maximum	38	21	4.50	43	22	22	48	49	82	26	19	16
Minimum	7	7	2.75	22	15	7	33	21	60	12	10	5

Classification Counts by Sample

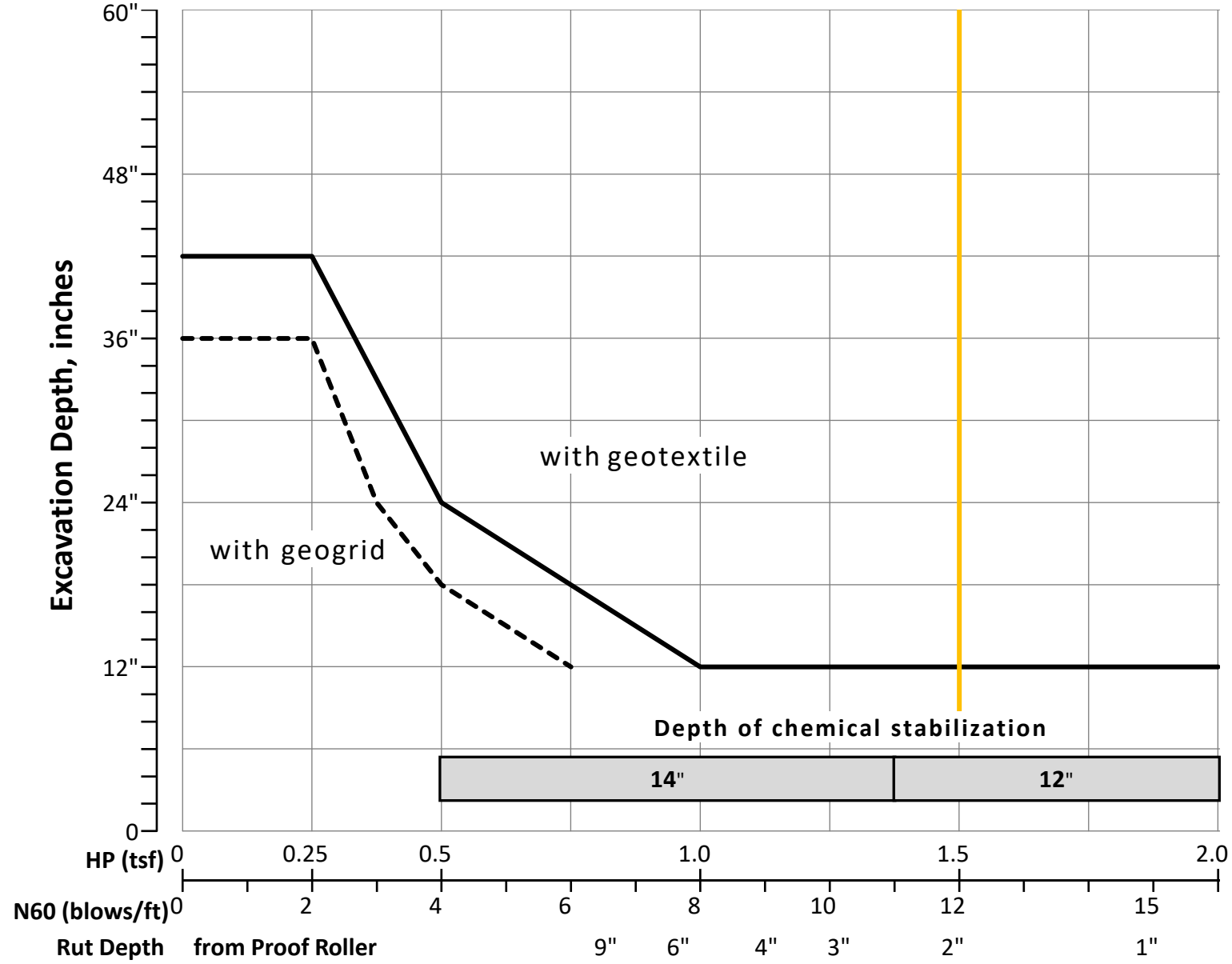
ODOT Class	UCF	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	0	0	0	0	0	0	0	0	0	2	0	0	5	1	0	4	0	0	12
Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	17%	0%	0%	42%	8%	0%	33%	0%	0%	100%
% Rock|Granular|Cohesive	0%	0%	17%									83%								100%
Surface Class Count	0	0	0	0	0	0	0	0	0	0	1	0	0	3	0	0	2	0	0	6
Surface Class Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	17%	0%	0%	50%	0%	0%	33%	0%	0%	100%

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.7 4/4/2024

Fig. 600-1 – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
3.90	0.50	☐ HP
12.00	6.00	☐ N60L

Average HP

Average N_{60L}

LAMBERT ROAD

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Design Manual Section 600

Instructions: Enter data in the shaded cells only.
(Enter state route number, project description,county, consultant's name, prepared by name, and date prepared. This information will be transferred to all other sheets. The date prepared must be entered in the appropriate cell on this sheet to remove these instructions prior to printing.)

FRA-665-5.18
116359

Design and construct a roundabout at the intersection of SR 665 and Lambert Road-Lambert Road

NEAS, Inc.

Prepared By: Derar M. Tarawneh, Ph.D., P.E.
Date prepared: Wednesday, August 28, 2024

Chunmei (Melinda) He, Ph.D., P.E.
2800 Corporate Exchange Drive
Suite 240
Columbus, OH 43231
614.714.0299 Ext 111
che@neasinc.com

NO. OF BORINGS: 4

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-001-0-24	Lambert Road	16+85	4	RT	CME 45B	79	861.5	860.1	1.4 C
2	B-002-0-24	Lambert Road	19+79	30	LT	CME 45B	79	861.3	857.6	3.7 C
3	B-003-0-24	Lambert Road	20+50	50	RT	CME 45B	79	859.7	858.4	1.3 C
4	B-004-0-24	Lambert Road	22+05	4	LT	CME 45B	79	862.5	860.3	2.1 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.7 4/4/2024

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-1	1.5	3.0	0.1	1.6	13										16	A-6b	16						
	001-0	SS-2	3.0	4.5	1.6	3.1	16		4.25	35	19	16	35	32	67	17	16	A-6b	9	0					
	24	SS-3	4.5	6.0	3.1	4.6	17		4.25	24	16	8	37	22	59	13	11	A-4a	5						
		SS-4	6.0	7.5	4.6	6.1	13	13	4.25							12	10	A-4a	8						
2	B	SS-1	1.0	2.5	-2.7	-1.2	38		4.5	27	17	10	39	28	67	11	12	A-4a	6	0					
	002-0	SS-2	3.5	5.0	-0.2	1.3	21		4.5							13	10	A-4a	8			Mc			
	24	SS-3	6.0	7.5	2.3	3.8	12			NP	NP	NP	31	12	43	17	11	A-4a	2						
		SS-4	8.5	10.0	4.8	6.3	8	8	4							14	10	A-4a	8						
3	B	SS-1	1.0	2.5	-0.3	1.2	30		4.5	53	22	31	37	47	84	18	19	A-7-6	19	0					
	003-0	SS-2	3.5	5.0	2.2	3.7	18		3.5	40	22	18	37	34	71	19	17	A-6b	10						
	24	SS-3	6.0	7.5	4.7	6.2	14									17	16	A-6b	16						
		SS-4	8.5	10.0	7.2	8.7	26	14								16	14	A-6a							
4	B	SS-1	1.5	3.0	-0.6	0.9	11		3.5	34	17	17	31	26	57	15	16	A-6b	7	60		N_{60}		**12"**	
	004-0	SS-2	3.0	4.5	0.9	2.4	13		4.25	27	17	10	40	27	67	14	12	A-4a	6						
	24	SS-3	4.5	6.0	2.4	3.9	14		4							12	10	A-4a	8						
		SS-4	6.0	7.5	3.9	5.4	16	11	3.75							10	10	A-4a	8						

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.7 4/4/2024

PID: 116359

County-Route-Section: FRA-665-5.18

No. of Borings: 4

Geotechnical Consultant: NEAS, Inc.

Prepared By: Derar M. Tarawneh, Ph.D., P.E.

Date prepared: 8/28/2024

Chemical Stabilization Options		
320	Rubblize & Roll	No
206	Cement Stabilization	Option
	Lime Stabilization	Option
206	Depth	12''

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L):	12''
Average(HP):	0''
Global Geogrid Average(N60L):	0''
Average(HP):	0''

Design CBR	6

% Samples within 3 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	0%
$N_{60} < 12$	7%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	29%	1 < HP ≤ 2	0%
$N_{60} \geq 20$	14%	HP > 2	57%
M+	7%		
Rock	0%		
Unsuitable Soil	0%		

Excavate and Replace at Surface	
Average	0''
Maximum	0''
Minimum	0''

% Proposed Subgrade Surface	
Unstable & Unsuitable	20%
Unstable	20%
Unsuitable (Soil & Rock)	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	16	12	4.07	36	19	17	35	29	64	15	13	9
Maximum	38	14	4.50	53	22	31	40	47	84	19	19	19
Minimum	8	8	3.50	24	16	8	31	12	43	10	10	2

Classification Counts by Sample

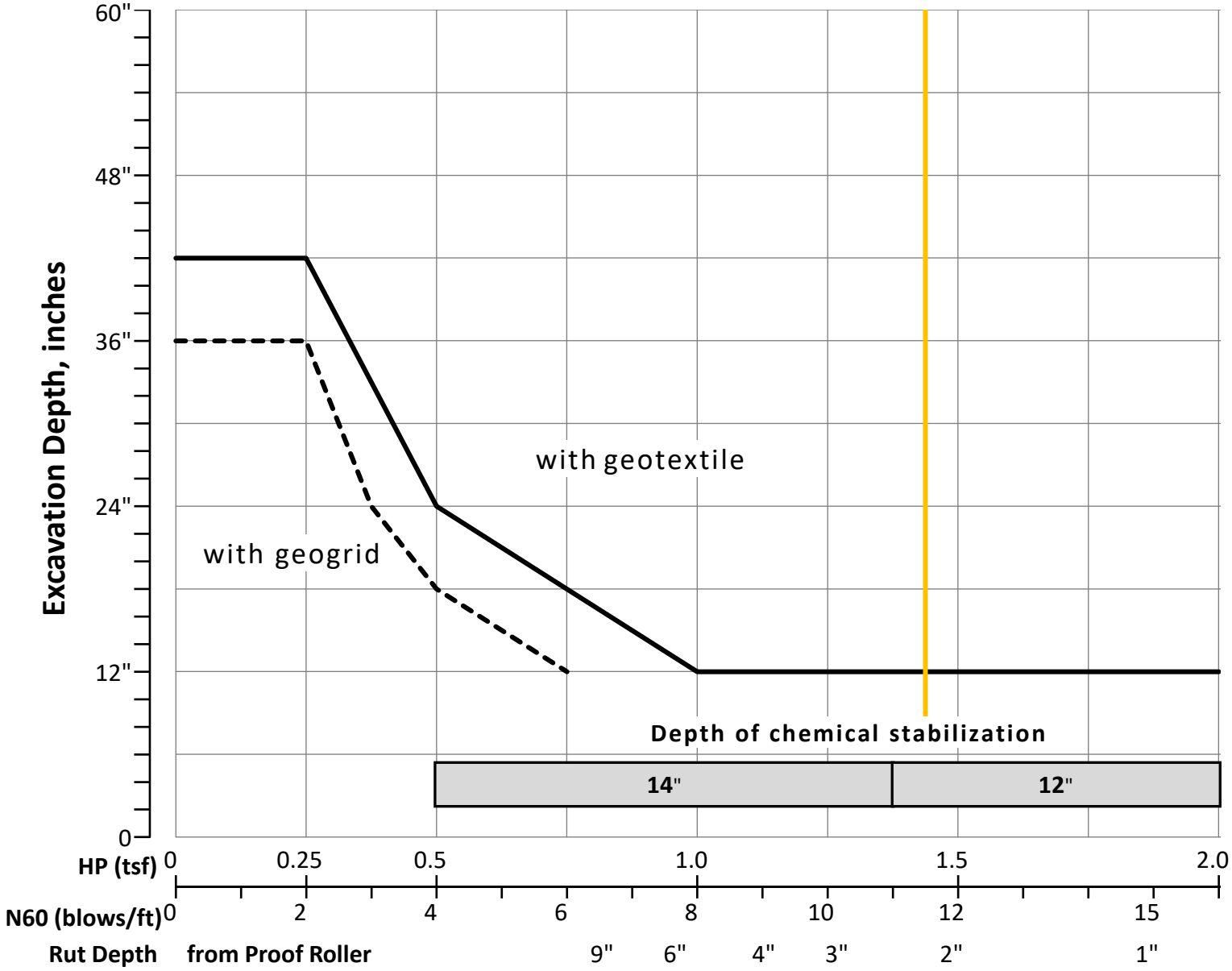
ODOT Class	UCF	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	0	0	0	0	0	0	0	0	0	8	0	0	1	5	0	1	0	0	15
Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	53%	0%	0%	7%	33%	0%	7%	0%	0%	100%
% Rock|Granular|Cohesive	0%	0%	53%									47%								100%
Surface Class Count	0	0	0	0	0	0	0	0	0	0	5	0	0	0	4	0	1	0	0	10
Surface Class Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	40%	0%	10%	0%	0%	100%

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.7 4/4/2024

Fig. 600-1 – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
4.07	0.50	☐ HP
11.50	6.00	☐ N60L

Average HP

Average N_{60L}

ROUNDABOUT

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Design Manual Section 600

Instructions: Enter data in the shaded cells only.
(Enter state route number, project description,county, consultant's name, prepared by name, and date prepared. This information will be transferred to all other sheets. The date prepared must be entered in the appropriate cell on this sheet to remove these instructions prior to printing.)

FRA-665-5.18
116359

Design and construct a roundabout at the intersection of SR 665 and Lambert Road-SR-665

NEAS, Inc.

Prepared By: Derar M. Tarawneh, Ph.D., P.E.
Date prepared: Wednesday, August 28, 2024

Chunmei (Melinda) He, Ph.D., P.E.
2800 Corporate Exchange Drive
Suite 240
Columbus, OH 43231
614.714.0299 Ext 111
che@neasinc.com

NO. OF BORINGS: 2

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.7 4/4/2024

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-002-0-24	Roundabout	1+09	12	RT	CME 45B	79	861.3	858.6	2.7 C
2	B-003-0-24	Roundabout	2+33	23	RT	CME 45B	79	859.7	858.6	1.1 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.7 4/4/2024

#	Boring	Sample	Sample Depth		Subgrade Depth		Standard Penetration		HP (tsf)	Physical Characteristics						Moisture		Ohio DOT		Sulfate Content (ppm)	Problem		Excavate and Replace (Item 204)		Recommendation (Enter depth in inches)
			From	To	From	To	N_{60}	N_{60L}		LL	PL	PI	% Silt	% Clay	P200	M_C	M_{OPT}	Class	GI		Unsuitable	Unstable	Unsuitable	Unstable	
1	B	SS-1	1.0	2.5	-1.7	-0.2	38		4.5	27	17	10	39	28	67	11	12	A-4a	6	0					
	002-0	SS-2	3.5	5.0	0.8	2.3	21		4.5							13	10	A-4a	8			Mc			
	24	SS-3	6.0	7.5	3.3	4.8	12			NP	NP	NP	31	12	43	17	11	A-4a	2						
		SS-4	8.5	10.0	5.8	7.3	8	8	4							14	10	A-4a							
2	B	SS-1	1.0	2.5	-0.1	1.4	30		4.5	53	22	31	37	47	84	18	19	A-7-6	19	0					
	003-0	SS-2	3.5	5.0	2.4	3.9	18		3.5	40	22	18	37	34	71	19	17	A-6b	10						
	24	SS-3	6.0	7.5	4.9	6.4	14									17	16	A-6b	16						
		SS-4	8.5	10.0	7.4	8.9	26	14								16	14	A-6a							

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

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PID: 116359

County-Route-Section: FRA-665-5.18

No. of Borings: 2

Geotechnical Consultant: NEAS, Inc.

Prepared By: Derar M. Tarawneh, Ph.D., P.E.

Date prepared: 8/28/2024

Chemical Stabilization Options		
320	Rubblize & Roll	No
206	Cement Stabilization	No
	Lime Stabilization	Option
206	Depth	12''

Excavate and Replace Stabilization Options	
Global Geotextile Average(N60L):	12''
Average(HP):	0''
Global Geogrid Average(N60L):	0''
Average(HP):	0''

Design CBR	6

% Samples within 3 feet of subgrade			
$N_{60} \leq 5$	0%	HP ≤ 0.5	0%
$N_{60} < 12$	0%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	0%	1 < HP ≤ 2	0%
$N_{60} \geq 20$	33%	HP > 2	50%
M+	17%		
Rock	0%		
Unsuitable Soil	0%		

Excavate and Replace at Surface	
Average	0''
Maximum	0''
Minimum	0''

% Proposed Subgrade Surface	
Unstable & Unsuitable	25%
Unstable	25%
Unsuitable (Soil & Rock)	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	18	11	4.13	47	22	25	35	31	66	16	14	11
Maximum	38	14	4.50	53	22	31	39	47	84	19	19	19
Minimum	8	8	3.50	27	17	10	31	12	43	11	10	2

Classification Counts by Sample

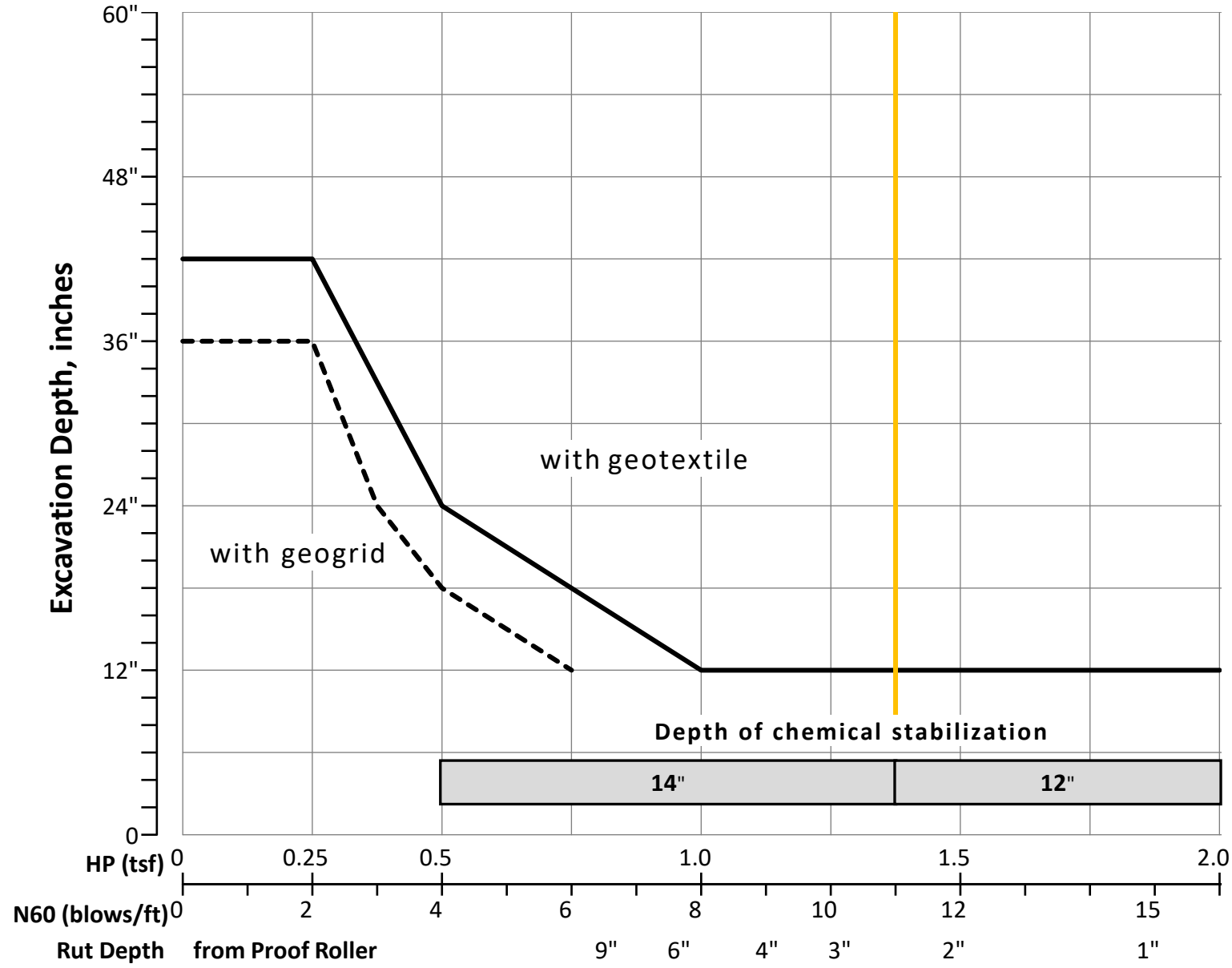
ODOT Class	UCF	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals
Count	0	0	0	0	0	0	0	0	0	0	3	0	0	1	2	0	1	0	0	7
Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	43%	0%	0%	14%	29%	0%	14%	0%	0%	100%
% Rock|Granular|Cohesive	0%	0%	43%									57%								100%
Surface Class Count	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	1	0	0	4
Surface Class Percent	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	25%	0%	25%	0%	0%	100%

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Fig. 600-1 – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
4.13	0.50	☐ HP
11.00	6.00	☐ N60L

Average HP

Average N_{60L}