# FINAL REPORT
# ROADWAY EXPLORATION REPORT
# FRA-33-21.71
# FRANKLIN COUNTY, OHIO
# PID#: 113744

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**NEAS PROJECT 22-0008**

**September 3, 2025**

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# 1. INTRODUCTION

## 1.1. General

National Engineering & Architectural Services, Inc. (NEAS) presents our Roadway Exploration Report for the proposed Ohio Department of Transportation (ODOT) project FRA-33-21.71 (PID 113744) at the current U.S. Route 33 (US-33), James Road (Rd), and Winchester Pike interchange within the City of Columbus, Franklin County, Ohio. It is our understanding that the objective of the proposed project is to improve the safety of the existing interchange as well as to rehabilitate the associated roadways and interchange. Based on the FRA-033-21.71 Stage 2 plans prepared by GPD dated November 1, 2022, the proposed safety improvements will consist of the reconfiguration/reconstruction of: 1) portions of US-33 mainline; 2) James Rd/US-33 on and off ramps; 3) Winchester Pike/US-33 on and off ramps; and, 4) the addition of turnaround lanes for US-33 in both eastbound (EB) and westbound (WB) directions. This report presents a summary of the project encountered surficial and subsurface conditions and our recommendations for subgrade stabilization, pavement design parameters and embankment construction. The roadway analysis performed as part of this report has been performed in accordance with ODOT's January 2023 revision of *ODOT Geotechnical Design Manual* (GB1) (ODOT [1], 2023) and *Pavement Design Manual* (PDM) (ODOT, 2022).

The exploration was conducted in general accordance with NEAS's proposal to GPD Group (GPD), dated January 6, 2023, and with the provisions of the January 2023 (ODOT, 2023) revisions of ODOT's *Specifications for Geotechnical Explorations* (SGE).

The scope of work performed by NEAS as part of the referenced project included: a review of published geotechnical information; performing 37 total test borings; laboratory testing of soil samples in accordance with the SGE; performing geotechnical engineering analysis to assess proposed embankment, subgrade stabilization requirements and recommended pavement design parameters; and 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 the Scioto Valley overlying deep Devonian- to Mississippian-age carbonate rocks, shales, and siltstones (ODGS, 1998).

The geology at the project site is generally mapped as an average of 20 ft of Wisconsinan-age loam till underlain by about 40 ft of Wisconsinan-age sand and gravel, followed by about 30 ft of till of an unspecified age, followed by up to 120 ft of complexly interbedded deposits of clay, sit, sand, gravel and till of an unspecified age. Each overburden material is underlain by Devonian- age Shale bedrock (ODGS, 2002). The geology at the southwestern corner of the project site is mapped as about 50 ft of Wisconsinan-age sand and gravel, followed by up to 20 ft of Wisconsinan-age silt, followed by about 160 ft of sand and gravel of an unspecified age, all underlain by Devonian-age Shale bedrock (ODGS, 2005)

The loam till is described as having a high carbonate content, containing silt, sand and gravel lenses, as well as clay and silt beds. The sand and gravel soils are described as intermixed and interbedded sand and gravel commonly containing thin, discontinuous layers of silt, clay, and till. The till is described as being of an unspecified age and designated where insufficient data prohibits designating other till units. The silt is described as massive or laminated, commonly contains thin sand partings, may locally contain clay, and or gravel layers, and clay content commonly increases with depth.

Based on the Bedrock Geologic Units Map of Ohio (USGS & ODGS, 2006), bedrock within the project area consists of shale of the Ohio Shale formation. This formation is comprised of Devonian-age bedrock. The shale in this formation is described as brownish black to greenish gray, and weathers to brown in color, laminated to thin bedded, carbonaceous to clayey and having petroliferous odor. The bedrock appears to follow the natural topography of the site which slopes upwards from southeast to northwest (ODGS, 2003). Based on the ODNR bedrock topography map of Ohio, bedrock elevations at the project site can be expected to be around 550 to 625 ft amsl, putting bedrock at depths of between 135 to 195 ft below ground surface (bgs).

The soils at the project site have been mapped (Web Soil Survey) by the Natural Resources Conservation Service (USDA, 2015) as primarily Udorthents and urban land complex. Udorthents are described as soils that have been disturbed by cutting and or filling, and as such are not rated according to the AASHTO method of soil classification. Urban land complex is similar to Udorthents but are specifically described as soils that have been altered or obscured by urban works and structures.

## 2.2. Hydrology/Hydrogeology

Groundwater at the project site can be expected at an elevation consistent with that of the nearby Alum Creek as it is the most dominant hydraulic influence in the vicinity of the project's boundaries. The water level of Alum Creek 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.

Though none of the project roadways are located within a special flood hazard area, some areas immediately adjacent to the northeastern side of the US-33 EB ramp to Refugee Rd (Ramp 1) near the southeast boundary of the project site is located within a 0.2% Annual Chance Flood Hazard area based on available mapping by the Federal Emergency Management Agency's (FEMA) National Flood Hazard mapping program (FEMA, 2016).

## 2.3. Mining and Oil/Gas Production

No abandoned mines are noted on ODNR's Abandoned Underground Mine Locator within the immediate vicinity of the project's boundaries (ODNR [1], 2016).

No oil or gas wells are noted on ODNR's Ohio Oil & Gas Locator within the immediate vicinity of the project's boundaries (ODNR [2], 2016).

## 2.4. Historical Records and Previous Phases of Project Exploration

A historic record search was performed through ODOT's Transportation Information Mapping System (TIMS). The following report/plans were available for review and evaluation for this report:

- Project boring logs and Soil Profile Sheets for Ohio Department of Highways project FRA-33-21.82 prepared by Ohio State Highway Testing Laboratory, dated August 8, 1961;

- Structure Foundation Exploration sheets, exploration results and boring logs for Bridge FRA-33-2334 under Refugee Road, Bridge FRA-33-2309 over northbound US-33 lanes, and Bridge FRA-33-2269 under New York Central Railroad, as part of Ohio Department of Highways project FRA-33-21.82 prepared by the Ohio State Highway Testing Laboratory, submitted June 12, 1961;
- Project boring logs and Soil Profile Sheets for Ohio Department of Highways project FRA-40-17.26 prepared by Ohio State Highway Testing Laboratory, dated February 7, 1962;
- Structure Foundation Exploration sheets, exploration results, sheets and boring logs for Bridge FRA-40-2288 over northbound US-33 and College Avenue, as part of Ohio Department of Highways project FRA-40-17.26 prepared by the Ohio State Highway Testing Laboratory, submitted February 19, 1962; and,
- Project boring logs and Soil Profile Sheets for Ohio Department of Highways project FRA-33-22.95 prepared by Ohio State Highway Testing Laboratory, submitted February 3, 1961.

Historical soil borings associated with the above plans were reviewed, however, they were not utilized for our analysis, and therefore, are not referenced or presented within this report.

## 2.5. Field Reconnaissance

A field reconnaissance visit for the overall project area was conducted on March 2, 2023 at the US-33, James Rd and Winchester Pike interchange. Site conditions were noted and photographed during the visit. Photographs of notable geotechnical 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 the project area consists of a combination of residential, commercial, and woodland properties as well as ODOT Right of Way (ROW).

### *2.5.2. U.S. Route 33 Eastbound*

In general, the pavement condition along the project portion of US-33 EB was observed to be fair to good. Signs of weathering and surface wear observed included moderate severity longitudinal and transverse cracking as well as moderate severity edge cracking and crack sealing deficiencies (Photograph 1). The segment of US-33 EB within the project limits is generally supported on embankment with side slopes of approximately 2 horizontal to 1 vertical (2H:1V) or at a similar grade to the surrounding land. The project portion of US-33 EB generally drains to either the drainage swale located off the northeastern shoulder of the roadway or into the wooded area off the southwestern shoulder. The area appeared to be well drained with no apparent signs of standing water/ponding in the roadway observed at the time of our visit. No signs of distress due to geotechnical concerns were observed.

Photograph 1: General Pavement Condition of US-33 SB


### *2.5.3. U.S. Route 33 Westbound*

In general, the pavement condition along the project portion of US-33 WB was observed to be good. Signs of weathering and surface wear observed included frequent moderate severity longitudinal and transverse cracking, as well as occasional crack sealing deficiencies (Photograph 2). The project portions of US-33 WB are generally located at similar grades to the surrounding area with the exception of the northern most segment which lies in a cut. Within the cut, heavily vegetated side slopes exist along the northeastern side of the roadway that ascend at approximately 2.5H:1V. The project portion of US-33 WB generally drains directly off both shoulders to drainages swales, basins or large grassy areas. Some standing water was observed within the noted swales and grassland located off the northeastern shoulder of US-33 WB (Photographs 3 and 4). It should be noted that no ponding in the roadway itself was observed during our visit nor were signs of distress due to geotechnical concerns.

Photograph 2: General Pavement Condition of US-33 WB

Photograph 3: Standing Water Observed Off Northeastern Shoulder of US-33 WB

Photograph 4: Standing Water Observed Off Northeastern Shoulder of US-33 WB

*2.5.4. Ramps 1 and 1A*

In general, the pavement condition of the existing Ramps 1 and 1A was observed to be poor with signs of weathering and surface wear that included moderate severity longitudinal and high severity transverse cracking, as well as moderate severity patching, wheel track cracking, edge cracking and crack sealing deficiencies (Photograph 5). The project portion of Ramps 1 and 1A is supported by embankment with side slopes of approximately 2.5H:1V. The referenced roadway drains either directly off the western shoulder of the roadway to a heavily wooded area or to the drainage swale and basin located in between Ramp 1 and Ramp 1A. The area appeared to be well drained with no apparent signs of standing water/ponding in the roadway observed at the time of our visit. No signs of distress due to geotechnical concerns were observed.

Photograph 5: General Pavement Condition of Ramps 1 and 1A

### *2.5.5. Winchester Pike Northbound*

In general, the pavement condition along the existing Winchester Pike NB was observed to be good with signs of weathering and surface wear consisting of occasional moderate severity transverse cracking, as well as low severity crack sealing deficiencies (Photograph 6). The southern segment of Winchester Pike NB sits atop an embankment with 2.5H:1V side slopes then transitions to similar grades as the surrounding area along the northern segment. The roadway in this section of the project drains directly off both shoulders to drainage ditches and large grassy areas. Some standing water was observed in areas off the roadway, though no ponding in the roadway itself was observed during our visit. No signs of distress due to geotechnical concerns were observed.

Photograph 6: General Pavement Condition of Winchester Pike

### *2.5.6. James Road Southbound to Ramp 2*

In general, the pavement condition of the existing James Rd SB was observed to be poor with signs of weathering and surface wear that included moderate severity longitudinal and high severity transverse cracking, as well as occasional low severity map cracking, potholing, patching, and crack sealing deficiencies (Photograph 7). The referenced roadway segment was observed atop an embankment with side slopes of approximately 2H:1V. The project portion of James Rd SB drains directly off the

eastern/southeastern shoulder into drainage ditches and large grassy areas. Some standing water was observed in areas off the roadway, though no ponding in the roadway itself was observed during our visit. No signs of distress due to geotechnical concerns were observed.

Photograph 7: General Pavement Condition of James Road SB to Ramp 2

## 3. GEOTECHNICAL EXPLORATION

### 3.1. Exploration Program

The subsurface exploration for the project was conducted by NEAS between March 21, 2023 and March 29, 2023 and included 37 borings drilled to depths between 7.5 and 20 ft bgs. The boring locations were selected by NEAS in general accordance with the guidelines contained in the SGE with the intent to evaluate subsurface soil and groundwater conditions. Borings were typically located either within existing pavement areas that are planned to undergo full-depth replacement or within areas where widening and/or realignment is planned. Target boring locations were located in the field by NEAS prior to drilling utilizing handheld GPS equipment. The boring locations were drilled in areas that were not restricted by underground utilities or dictated by terrain (i.e., steep embankment slopes). Each as-drilled project boring location and corresponding ground surface elevation was surveyed in the field following drilling. Each individual project boring log (included within Appendix B) includes the recorded boring latitude and longitude location (based on the surveyed Ohio State Plane South, NAD83, location) and the corresponding ground surface elevation. The boring locations are depicted within the boring location plan provided in Appendix A.

Borings were drilled using either a CME 45 truck-mounted or CME 55X track-mounted drilling rig, utilizing 3.25-inch (inner diameter) hollow stem augers. Soil samples for subgrade borings were typically recovered continuously to a depth of 7.5 ft bgs, while samples for roadway/embankment borings were typically recovered at 2.5-ft intervals to varying termination depths, each 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 the NEAS field representative and preserved for review by a Geologist for possible laboratory testing. Standard penetration tests (SPT) were conducted using CME auto hammers that had been calibrated to be between 72.6% and 79.0% efficient (depending on the specific rig used and the calibration date of the hammer) as indicated on the boring logs (Appendix B).

Field boring logs were prepared by drilling personnel and included pavement description (where present), 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). Groundwater level observations were recorded both during and after the completion of drilling. These groundwater level observations are included on the individual boring logs (provided in Appendix B). After completing the borings, the boreholes were backfilled with either auger cuttings, bentonite chips, or a combination of these materials and patched accordingly with cold patch asphalt and/or cement when drilled through the roadway.

## 3.2. Pavement Coring Exploration Program

The coring investigation program for this project was conducted by NEAS between March 21, 2023 and March 28, 2023 and included a total of eight (8) pavement cores. Of the cores performed, five (5) cores were located within the existing US-33 EB shoulder or gore, two (2) cores were located within the existing Ramp 1 shoulder and one (1) core was located within the existing US-33 WB shoulder. The cores performed were located in close proximity to select roadway soil borings that were drilled through the existing pavement, with the exception of the core performed along the US-33 WB shoulder. Each core location was located in the field by NEAS prior to coring utilizing handheld GPS equipment. Measurements, photographs and other details of each core sample can be found in the Pavement Core Logs included within Appendix C. The approximate location for each core is depicted on the Boring Location Plan provided in Appendix A.

Cores were drilled using a portable, truck-mounted, electric powered coring drill with a 4-inch (outer diameter) diamond tipped drill bit and utilizing water as the circulating fluid. Asphalt and concrete thicknesses were measured in the field after the cores were extracted and down-hole measurements were made. Each core sample was then photographed, logged, and placed in a core box for transportation to NEAS's laboratory. Following field documentation and photographs, the core hole was backfilled to existing grade with either asphalt patch or quick-set concrete (where appropriate). Once in the laboratory the cores were: 1) re-measured for thickness verification and photographed; 2) checked for composition; and, 3) reviewed for individual layer identification and subsequent measurements.

## 3.3. Laboratory Testing Program

The laboratory testing program consisted of classification testing, moisture content determinations, and sulfate content testing. Data from the laboratory testing program were incorporated onto the boring logs (Appendix B). Soil samples are retained at the laboratory for 60 days following report submittal, after which time they will be discarded.

### *3.3.1. Classification Testing*

Representative soil samples were selected for index property (Atterberg Limits) and gradation testing for classification purposes on approximately forty-seven percent (47%) of the samples. At each subgrade boring location, the upper two samples obtained below the proposed top of subgrade elevation were generally tested while additional samples 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/strata 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.

### *3.3.2. Standard Penetration Test Results*

Standard Penetration Tests (SPT) and split-barrel (commonly known as split-spoon) sampling of soils were performed continuously 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.

### *3.3.3. Sulfate Testing*

Sulfate testing was generally performed on one sample from each subgrade 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 1 below, provided in Appendix D and presented on the boring logs within Appendix B.

Table 1: Sulfate Test Summary by Boring

| Boring ID | Sample | Depth (ft) | Dilution Ratio | Average Sulfate Content (ppm) | Boring ID | Sample | Depth (ft) | Dilution Ratio | Average Sulfate Content (ppm) |
|---|---|---|---|---|---|---|---|---|---|
| B-001-0-22 | SS-1 | 1.5-3.0 | 20 | 93 | B-022-0-22 | SS-1 | 1.5-3.0 | 20 | 100 |
| B-002-0-22 | SS-1 | 1.5-3.0 | 20 | 53 | B-023-0-22 | SS-1 | 1.5-3.0 | 20 | 160 |
| B-003-0-22 | SS-1 | 1.5-2.2 | 20 | 307 | B-025-0-21 | SS-1 | 1.5-3.0 | 20 | 13 |
| B-004-0-22 | SS-1 | 1.5-3.0 | 20 | 540 | B-026-0-21 | SS-1 | 1.5-3.0 | 100 | 2767 |
| B-005-0-22 | SS-1 | 1.5-3.0 | 20 | 293 | B-027-0-21 | SS-1 | 1.5-3.0 | 20 | 233 |
| B-006-0-22 | SS-1 | 1.5-3.0 | 20 | 367 | B-028-0-21 | SS-1 | 1.5-3.0 | 20 | 120 |
| B-007-0-22 | SS-1 | 1.5-3.0 | 20 | 380 | B-029-0-21 | SS-1 | 1.5-3.0 | 20 | 587 |
| B-008-0-22 | SS-1 | 1.5-3.0 | 40 | 947 | B-030-0-21 | SS-1 | 1.5-3.0 | 20 | 913 |
| B-009-0-22 | SS-1 | 1.5-3.0 | 20 | 380 | B-031-0-21 | SS-1 | 1.5-3.0 | 100 | >8000 |
| B-010-0-22 | SS-1 | 1.5-3.0 | 20 | 640 | B-032-0-21 | SS-1 | 1.5-3.0 | 20 | 0 |
| B-011-0-22 | SS-1 | 1.5-3.0 | 20 | 240 | B-033-0-21 | SS-1 | 1.5-3.0 | 20 | 0 |
| B-012-0-22 | SS-1 | 1.5-3.0 | 20 | 60 | B-034-0-21 | SS-1 | 1.5-3.0 | 40 | 1920 |
| B-014-0-22 | SS-1 | 1.5-3.0 | 20 | 493 | B-035-0-21 | SS-1 | 1.5-3.0 | 20 | 260 |
| B-019-0-22 | SS-1 | 1.5-3.0 | 20 | 667 | B-036-0-21 | SS-1 | 1.5-3.0 | 20 | 1007 |
| B-020-0-22 | SS-1 | 1.5-3.0 | 20 | 167 | B-037-0-21 | SS-1 | 1.5-3.0 | 20 | 80 |
| B-021-0-22 | SS-1 | 1.5-3.0 | 20 | 100 | | | | | |

## 4. FINDINGS

The pavement and 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. Core Results

The thicknesses of the cores were measured at the indicated core locations shown on the Boring Location Plan provided in Appendix A. A summary of these measurements along with the material encountered is summarized in Table 2. Laboratory photographs and logs of each of the cores are presented in the Pavement Core Logs included within Appendix C.

Table 2: Pavement Core Summary

| Core ID | Alignment | Asphalt Thickness (in) | Concrete Thickness (in) | Total Thickness (in) |
|---|---|---|---|---|
| X-001-0-22 | US-33 EB | 10.50 | - | 10.50 |
| X-002-0-22 | US-33 EB | 10.25 | - | 10.25 |
| X-003-0-22 | US-33 EB | 9.00 | - | 9.00 |
| X-004-0-22 | Ramp 1 | 11.25 | - | 11.25 |
| X-005-0-22 | US-33 EB | 12.00 | - | 12.00 |
| X-006-0-22 | Ramp 1 | 4.00 | 9.50 | 13.50 |
| X-007-0-22 | US-33 EB | 4.75 | 9.25 | 14.00 |
| X-008-0-22 | US-33 WB | 11.25 | - | 11.25 |

## 4.2. Existing Pavement

The pavement section thicknesses in terms of asphalt, 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 | Proposed Alignment | Drilled Depth (ft) | Asphalt Thickness (in) | Concrete Thickness (in) | Base Thickness (in) | Total Thickness (in) |
|---|---|---|---|---|---|---|
| B-003-0-22 | US-33 EB | 7.5 | 8.0 | 0.0 | 10.0 | 18.0 |
| B-004-0-22 | Ramp 1 | 7.5 | 8.0 | 0.0 | 10.0 | 18.0 |
| B-005-0-22 | US-33 EB | 10.0 | 7.0 | 0.0 | 11.0 | 18.0 |
| B-006-0-22 | Ramp 1 | 7.5 | 9.5 | 0.0 | 11.0 | 20.5 |
| B-007-0-22 | Ramp 1 | 7.5 | 9.5 | 0.0 | 11.0 | 20.5 |
| B-008-0-22 | Ramp 1 | 7.5 | 7.0 | 0.0 | 11.0 | 18.0 |
| B-009-0-22 | Ramp 3 | 7.5 | 10.0 | 0.0 | 8.0 | 18.0 |
| B-010-0-22 | Ramp 1 | 7.5 | 4.0 | 7.0 | 7.0 | 18.0 |
| B-011-0-22 | Ramp 1 | 7.5 | 10.0 | 0.0 | 8.0 | 18.0 |
| B-012-0-22 | Ramp 1 | 7.5 | 4.0 | 7.0 | 7.0 | 18.0 |
| B-013-0-22 | Ramp 1A | 20.0 | 4.0 | 8.0 | 6.0 | 18.0 |
| B-014-0-22 | Ramp 2 | 7.5 | 8.0 | 0.0 | 10.0 | 18.0 |
| B-019-0-22 | US-33 EB | 7.5 | 4.0 | 7.0 | 7.0 | 18.0 |
| B-020-0-22 | US-33 EB | 7.5 | 3.5 | 6.0 | 9.5 | 19.0 |
| B-021-0-22 | US-33 EB | 7.5 | 9.5 | 0.0 | 11.0 | 20.5 |
| B-022-0-22 | US-33 EB | 7.5 | 9.5 | 0.0 | 8.5 | 18.0 |
| B-023-0-22 | US-33 EB | 7.5 | 2.5 | 9.5 | 6.0 | 18.0 |
| B-027-0-22 | Winchester Ramp A | 7.5 | 2.5 | 11.0 | 4.5 | 18.0 |
| B-028-0-22 | Winchester Ramp B | 7.5 | 2.5 | 11.0 | 4.5 | 18.0 |
| B-029-0-22 | US-33 WB | 7.5 | 4.0 | 8.0 | 6.0 | 18.0 |
| B-030-0-22 | US-33 WB | 7.5 | 4.0 | 7.0 | 7.0 | 18.0 |
| B-034-0-22 | US-33 WB | 7.5 | 4.0 | 7.0 | 7.0 | 18.0 |
| B-035-0-22 | US-33 WB | 7.5 | 4.0 | 7.0 | 7.0 | 18.0 |
| B-036-0-22 | US-33 WB | 7.5 | 3.0 | 10.0 | 5.0 | 18.0 |
| B-037-0-22 | US-33 WB | 7.5 | 4.0 | 8.0 | 6.0 | 18.0 |

## 4.3. Subgrade Conditions

The subgrade conditions within the project limits are relatively consistent and are generally comprised of either fill soils (i.e., embankment fill) or natural soils consisting of gravel, sand and silt, or low to moderately plastic sandy silt and silt/clay combinations. The subgrade soils encountered within the project limits are generally classified as either A-1-a, A-1-b, A-2-4, A-4a, A-4b, A-6a, A-6b or A-7-6 type soils. With respect to sulfate within the subgrade soil, based on the project laboratory testing program, each subgrade soil sample tested was determined to have a sulfate content of less than 5,000 parts per million (ppm) (i.e., the level which ODOT considers high and may prevent the use of chemical stabilization) with the exception of a sample tested from boring B-031-0-22 which was determined to have a sulfate content greater than 8,000 ppm.

The following subsections present a summary of the subsurface conditions by ramp/roadway segment with problem areas highlighted where present.

### *4.3.1. US-33 Westbound*

Project portions of US-33 WB are planned to undergo full depth pavement replacement. The borings performed along this portion of roadway included borings B-029-0-22 and B-030-0-22 as well as borings B-034-0-22 through B-037-0-22.

Along US-33 WB, forty-eight percent (48%) of the soil samples were identified as fine-grained soils and were comprised of cohesive Sandy Silt (A-4a). With respect to the consistency of the fine-grained soils, the descriptions varied from medium stiff to hard correlating to converted SPT-N values ($N_{60}$) between 7 and 44 blows per foot (bpf). Natural moisture contents ranged from 8 to 12 percent. Based on Atterberg Limit

tests performed on representative samples of the fine-grained subgrade soils obtained along the project portions of US-33 WB, the liquid and plastic limits ranged from 22 to 27 percent and from 15 to 17 percent, respectively.

Fifty-two percent (52%) of the samples taken along the proposed roadway were classified as coarse-grained, non-cohesive soils and were comprised of: 1) Gravel (A-1-a, 1 sample); 2) Gravel and/or Stone Fragments with Sand (A-1-b, 43% of samples); and, 3) Gravel and Stone Fragments with Sand and Silt (A-2-4, 1 sample). With respect to the relative density of the coarse-grained soils, the descriptions varied from dense to very dense correlating to $N_{60}$ values between 34 and 50 bpf. Natural moisture contents ranged from 5 to 11 percent.

#### *4.3.2. US-33 Eastbound*

Project portions of US-33 EB are planned to undergo full depth pavement replacement. The borings performed along this portion of roadway included borings B-003-0-22, B-004-0-22, and B-025-0-22 as well as borings B-019-0-22 through B-023-0-22.

Along US-33 EB, fifty-two percent (52%) of the soil samples were identified as fine-grained soils and were comprised of cohesive Sandy Silt (A-4a 26% of samples) and Silt and Clay (A-6a, 26% of samples). With respect to the consistency of the fine-grained soils, the descriptions varied from medium stiff to very stiff correlating to $N_{60}$ values between 7 and 27 bpf. Natural moisture contents ranged from 11 to 18 percent. Based on Atterberg Limit tests performed on representative samples of the fine-grained subgrade soils obtained along the project portions of US-33 EB, the liquid and plastic limits ranged from 21 to 32 percent and from 14 to 20 percent, respectively.

Forty-eight percent (48%) of the samples taken along the proposed roadway were classified as coarse-grained, non-cohesive soils and were comprised of: 1) Gravel and/or Stone Fragments (A-1-a, 32% of samples sample); 2) Gravel with Sand (A-1-b, 1 sample); and, 3) Gravel and/or Stone Fragments with Sand and Silt (A-2-4, 13% of samples). With respect to the relative density of the coarse-grained soils, the descriptions varied from loose to dense correlating to $N_{60}$ values between 6 and 41 bpf. Natural moisture contents ranged from 5 to 13 percent.

#### *4.3.3. Ramp 1 and 1A*

Ramps 1 and 1A form the exit ramp from US-33 EB to Frank-Refugee Expressway (Expy) which is planned for full depth pavement replacement and realignment along portions. The borings performed along Ramps 1 and 1A included borings B-003-0-22 through B-013-0-22.

Sixty-eight percent (68%) of the soil samples taken along the proposed ramps were identified as fine-grained soils and were comprised of cohesive Sandy Silt (A-4a, 39% of samples), Silt (A-4b, 1 sample), Silt and Clay (A-6a, 24% of samples) and Clay (A-7-6, 1 sample). With respect to the consistency of the fine-grained soils, the descriptions varied from stiff to hard correlating to $N_{60}$ values between 11 and 51 bpf. Natural moisture contents ranged from 8 to 17 percent. Based on Atterberg Limit tests performed on representative samples of the fine-grained subgrade soils obtained along Ramps 1 and 1A, the liquid and plastic limits ranged from 23 to 41 percent and from 15 to 19 percent, respectively.

Thirty-two percent (32%) of the samples taken along the ramps were classified as coarse-grained, non-cohesive soils and were comprised of Gravel and/or Stone Fragments (A-1-a, 15% of samples) and Gravel and/or Stone Fragments with Sand and Silt (A-2-4, 17% of samples). With respect to the relative density of the coarse-grained soils, the descriptions varied from loose to dense correlating to $N_{60}$ values of 8 and 41 bpf. Natural moisture contents ranged from 6 to 13 percent.

#### *4.3.4. Ramp 2*

Ramp 2 is a newly proposed ramp with new pavement which will direct traffic from James Rd SB to both Ramp 3 and US-33 SB. The borings that represent the subgrade soils of this portion of Ramp 2 included borings B-007-0-22 and B-014-0-22.

All but one (1) of the soil samples taken along the proposed ramp were identified as fine-grained soils and were comprised of cohesive Sandy Silt (A-4a, 50% of samples) and Silt and Clay (A-6a, 38% of samples). With respect to the consistency of the fine-grained soils, the descriptions varied from very stiff to hard correlating to $N_{60}$ values between 16 and 51 bpf. Natural moisture contents ranged from 8 to 15 percent. Based on Atterberg Limit tests performed on a representative sample of the fine-grained subgrade soils obtained along Ramp 2, the liquid and plastic limits ranged from 26 to 31 percent and from 16 to 17 percent, respectively.

One (1) sample taken along the indicated ramp was identified as coarse-grained, non-cohesive soils and classified on the log as Gravel with Sand and Silt (A-2-4). With respect to the relative density of the coarse-grained soils, the soils can be described as medium dense correlating to an $N_{60}$ value of 16 bpf. The natural moisture content of the non-cohesive sample was determined to be 9 percent.

#### *4.3.5. Ramp 3*

Ramp 3 is a newly proposed ramp with new pavement which will direct traffic from the proposed Ramp 2 to Ramp 1. One boring (B-009-0-22) was performed along the proposed Ramp 3 to represent the subgrade soils of this segment.

Two (2) of the four samples taken along the ramp were identified as fine-grained soils and classified on the log as cohesive Silt (A-4b, 1 of sample) and Silt and Clay (A-6a, 1 sample). With respect to the consistency of the fine-grained soils, the soil can be described as very stiff correlating to $N_{60}$ values of 16 and 24 bpf. The natural moisture content of both fine-grained samples were determined to be 12 percent. Based on Atterberg Limit tests performed on a representative sample of the fine-grained subgrade soils obtained for Ramp 3, the liquid and plastic limits ranged from 26 to 28 percent and from 16 to 17 percent, respectively.

Two (2) of the four samples taken along Ramp 3 were identified as coarse-grained, non-cohesive soils and classified on the log as Gravel (A-1-a, 1 sample) and Gravel and Stone Fragments with Sand and Silt (A-2-4, 1 sample). With respect to the relative density of the coarse-grained soils, the soil can be described as loose to medium dense correlating to $N_{60}$ values of 10 and 12 bpf. Natural moisture contents of the non-cohesive samples were determined to be 9 and 10 percent.

#### *4.3.6. Winchester Ramp A*

Winchester Ramp A is a newly proposed ramp with new pavement that will direct traffic from US-33 EB to both the newly proposed Winchester Turn Around and Winchester Pike NB. The borings performed along the proposed Winchester Ramp A alignment included borings B-025-0-22 through B-028-0-22.

Eighty-six percent (86%) of the soil samples taken along the proposed ramp were identified as fine-grained soils and were comprised of cohesive Sandy Silt (A-4a, 29% of samples), Silt and Clay (A-6a, 36% of samples) and Silty Clay (A-6b, 21% of samples). With respect to the consistency of the fine-grained soils, the descriptions varied from stiff to very stiff correlating to $N_{60}$ values between 10 and 27 bpf. Natural moisture contents ranged from 14 to 21 percent. Based on Atterberg Limit tests performed on representative samples of the fine-grained subgrade soils obtained along Winchester Ramp A, the liquid and plastic limits ranged from 23 to 40 percent and from 15 to 20 percent, respectively.

Fourteen percent (14%) of the samples taken along the ramps were identified as coarse-grained, non-cohesive soils that classified on the logs as Gravel with Sand (A-1-b). With respect to the relative density of the coarse-grained material, these soils can be described as very dense correlating to $N_{60}$ values of 67 and 72 bpf. Natural moisture contents ranged from 8 to 9 percent.

#### *4.3.7. Winchester Ramp B*

Winchester Ramp B is a newly proposed ramp with new pavement that will direct traffic from Winchester Pike SB to US-33 WB. The borings performed along the proposed ramp alignment included boring B-028-0-22 as well as borings B-030-0-22 through B-033-0-22.

Seventy-six percent (76%) of the soil samples taken along the proposed ramp were identified as fine-grained soils and were comprised of cohesive Sandy Silt (A-4a, 53% of samples) and Silt and Clay (A-6a, 24% of samples). With respect to the consistency of the fine-grained soils, the descriptions varied from stiff to hard correlating to $N_{60}$ values between 10 and 46 bpf. Natural moisture contents ranged from 8 to 16 percent. Based on Atterberg Limit tests performed on representative samples of the fine-grained subgrade soils obtained along Winchester Ramp B, the liquid and plastic limits ranged from 22 to 30 percent and from 15 to 17 percent, respectively.

Twenty-four percent (24%) of the samples taken along the ramps were identified as coarse-grained, non-cohesive soils that classified on the logs as Gravel with Sand (A-1-b). With respect to the relative density of the coarse-grained material, these soils can be described dense to very dense correlating to $N_{60}$ values ranging from 48 to 95 bpf. Natural moisture contents ranged from 5 to 8 percent.

#### *4.3.8. Winchester Turn Around*

The Winchester Turn Around is a newly proposed turnaround lane with new pavement that will allow US-33 EB traffic to access US-33 WB more easily via the proposed Winchester Ramps A and B. The borings performed to represent the subgrade soils of the proposed Winchester Turn Around included borings B-025-0-22 and B-032-0-22.

One hundred percent (100%) of the samples taken along the ramp were identified as fine-grained soils and are classified on the logs as cohesive Sandy Silt (A-4a). With respect to the consistency of the fine-grained soils, the descriptions varied from stiff to hard correlating to $N_{60}$ values between 11 and 46 bpf. Natural moisture contents ranged from 8 to 15 percent. Based on Atterberg Limit tests performed on representative samples of the fine-grained subgrade soils obtained along the Winchester Turn Around, the liquid and plastic limits ranged from 22 to 26 percent and from 15 to 16 percent, respectively.

#### *4.3.9. Northern Turn Around*

The Northern Turn Around is a newly proposed turnaround lane with new pavement that will allow US-33 WB traffic to access US-33 EB more easily via the proposed turnaround lane. The borings performed to represent the subgrade soils of the proposed Northern Turn Around included borings B-001-0-22 and B-002-0-22.

One hundred percent (100%) of the samples taken along the ramp were identified as fine-grained soils and are classified on the logs as cohesive Sandy Silt (A-4a, 80% of samples) and Silt and Clay (A-6a, 1 sample). With respect to the consistency of the fine-grained soils, the descriptions varied from stiff to very stiff correlating to $N_{60}$ values between 12 and 26 bpf. Natural moisture contents ranged from 14 to 15 percent. Based on Atterberg Limit tests performed on representative samples of the fine-grained subgrade soils obtained along the Northern Turn Around, the liquid and plastic limits ranged from 24 to 30 percent and from 16 to 18 percent, respectively.

#### *4.3.10. Groundwater*

Groundwater measurements were taken during the boring drilling procedures and/or immediately following the completion of each borehole. Groundwater was observed during and/or upon completion of drilling in five (5) of the project borings performed as part of the project exploration (B-003-0-22, B-017-0-22, B-022-0-22, B-023-0-22 and B-029-0-22). With respect to groundwater within subgrade soils, groundwater was encountered within proposed subgrade depths in each of the referenced borings with the exception of boring B-017-0-22. Based on measurements at each boring location, groundwater was encountered at depths ranging from 4.5 ft to 11.0 ft (elevations ranging from 620.5 ft amsl to 633.6 ft amsl).

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. The specific groundwater readings are included on the individual test boring logs located within Appendix B.

## 5. ANALYSES AND RECOMMENDATIONS

We understand that reconstruction and reconfiguration of portions of the US-33, James Rd, and Winchester Pike interchange including associated ramps are planned as part of the FRA-33-21.71 project (PID 113744) in Columbus, Ohio. For this purpose, a subgrade exploration and subsequent analysis was completed for the referenced project. The analysis completed for the proposed reconstruction and reconfiguration included a subgrade (GB1) analysis and embankment stability analyses (i.e., global stability and settlement). The subgrade (GB1) analysis performed in accordance with ODOT's GB1 criteria utilizing the ODOT provided *GB1: Subgrade Analysis Spreadsheet* (GB1_SubgradeAnalysis.xls, Version 14.6 dated February 11, 2022). Input information for the spreadsheet was based on the soil characteristics gathered during NEAS's subgrade exploration (i.e., SPT results, laboratory test results, etc.). A GB1 analysis was performed for the entire project as well as for each of the referenced mainline and ramp segments individually.

Based on our evaluation of the subsurface conditions and our geotechnical engineering analyses of the proposed reconstruction/rehabilitation, it is our opinion that subgrade conditions are generally satisfactory, and pavement can be designed without the need for extreme levels of remediation. In general, the subgrade soils throughout the project can be stabilized by standard compaction (subgrade preparation) practices; however, isolated locations noted in the sections below will require further remediation consisting of 12 inches of excavate and replace with geotextile. The following sections provide further details about the analysis performed and the recommended remediation.

### 5.1. Subgrade Analysis and Recommendations

A GB1 analysis was 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 GB1 analysis including pavement design parameters and unsuitable subgrade conditions identified within the project limits. GB1 analysis spreadsheets are provided in Appendix E.

Again, 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 from 1.5 ft below proposed final pavement grades to a depth of 7.5 ft below the proposed pavement grades.

### *5.1.1. Pavement Design Recommendations*

It is our understanding that pavement analysis and design is to be performed to determine the proposed pavement sections for the new alignments as well as roadway segments within the project limits to undergo full depth replacement. A GB1 analysis was performed using the subgrade soil data obtained during our field exploration program to evaluate the soil characteristics and develop pavement parameters for use in pavement design. The subgrade 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 Values

| Segment | Maximum $N_{60L}$ | Minimum $N_{60L}$ | Average $N_{60L}$ | Average PI Values | Design CBR |
|---|---|---|---|---|---|
| US-33 Westbound | 30 | 7 | 22 | 8 | 11 |
| US-33 Eastbound | 29 | 6 | 12 | 10 | 9 |
| Ramps 1 & 1A | 29 | 6 | 15 | 11 | 8 |
| Ramp 2 | 25 | 16 | 21 | 11 | 8 |
| Ramp 3 | 10 | 10 | 10 | 11 | 9 |
| Winchester Ramp A | 20 | 10 | 13 | 12 | 7 |
| Winchester Ramp B | 30 | 10 | 22 | 9 | 8 |
| Winchester Turn Around | 28 | 11 | 20 | 8 | 8 |
| Northern Turn Around | 17 | 12 | 15 | 10 | 8 |
| **Entire Project** | **30** | **6** | **16** | **10** | **8** |

### *5.1.2. Unsuitable Subgrade*

Per ODOT's GB1, the presence of select subgrade conditions (i.e., unsuitable) are prohibited within the subgrade zone for new pavement construction. These unsuitable subgrade conditions generally include the presence of rock and specific soil types. With respect to the proposed reconstruction/rehabilitation project these subgrade conditions are further discussed in the following subsections.

#### *5.1.2.1. Unsuitable Soils*

Unsuitable soil types per the GB1, which include A-4b, A-2-5, A-5, A-7-5, A-8a, A-8b, and soils with liquid limits greater than 65, were encountered within the subgrade of the referenced project roadway segments. Soil Type A-4b (Silt) was encountered within one (1) boring performed along the proposed Ramp 3 alignment. A summary of the prohibited soils encountered and the associated GB1 recommended remediation depths are shown in Table 5 below.

Table 5: Prohibited Soils Location Summary

| Boring ID | Prohibited Soil Type | Depth Below Subgrade (ft) | Remediation Depth (inches) | |
|---|---|---|---|---|
| | | | Excavate and Replace (Item 204 w/ Geotextile) | Chemical Stabilization (Item 206) |
| **Ramp 3** | | | | |
| B-009-0-22 | A-4b | 1.7 - 3.2 | 36 | 14 |

It should be noted that though A-4b type soils were encountered within the proposed subgrade depths of the referenced alignment, based on: 1) the consistent composition of the subgrade soils encountered throughout the project site (including borings adjacent to B-009-0-22); and, 2) the depth below the proposed subgrade at which the A-4b material was encountered, it is our opinion that the presence of this material at the referenced location will not require the GB1 recommended remediation indicated in Table 5, above. It

is our opinion that the proposed Ramp 3 subgrade soils can be stabilized following the recommendations provided in Section 5.1.4. of this report.

### *5.1.3. Unstable Soils*

The GB1 recommends subgrade stabilization for soils considered unstable 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 GB1 recommends a depth of subgrade stabilization for ODOT standard stabilization methods. Additionally, although a soil sample's $N_{60}$ value may meet the criteria to be considered an unstable soil, the depth in which the unstable soil is encountered in relation to the proposed subgrade is considered when each individual subgrade boring is analyzed. For example, if the GB1 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.

Based on $N_{60}$ values encountered within the project borings, our GB1 analysis suggests the need for 12 inches of excavate and replace at select locations. A summary of the boring locations where unstable soils were encountered and determined to have a potential impact on subgrade performance are shown in Table 6 below. Also included is the associated GB1 recommended remediation depth at that location.

Table 6: Unstable Soil Locations Summary

| Boring ID | Average HP (tsf) | $N_{60L}$ (bpf) | Moisture Above Optimum (%) | Depth Below Subgrade (ft) | Remediation Depth (inches) |
|---|---|---|---|---|---|
| | | | | | Excavate and Replace (Item 204 w/ Geotextile) |
| **US-33 Eastbound** | | | | | |
| B-019-0-22 | 2.75 | 12 | 3 | 1.4 - 2.9 | - |
| B-020-0-22 | 4.50 | 7 | 3 | 0.0 - 4.3 | 12 |
| **Ramp 1 & 1A** | | | | | |
| B-005-0-22 | 2.50 | 11 | 3 | 0.0 - 2.4 | 12 |
| B-009-0-22 | - | 10 | 4 | 0.0 - 2.8 | 12 |
| **Ramp 3** | | | | | |
| B-009-0-22 | 2.50 | 10 | 4 | 0.0 - 1.7 | 12 |
| **Winchester Ramp A** | | | | | |
| B-027-0-22 | 2.75 | 11 | 5 | 0.4 - 3.4 | 12 |

It should be noted that *Figure B - Subgrade Stabilization* does not apply to soil types A-1-a, A-1-b, A-3, or A-3a, nor to soils with $N_{60L}$ values of 15 or more. Per GB1 guidance, *these soils should be reworked to stabilize the subgrade*.

#### *5.1.3.1. High Moisture Content Soils*

High moisture content soils are defined by the GB1 as soils that exceed the estimated optimum moisture content (per *Figure A - Optimum Moisture Content* within the GB1) for a given classification by 3 percent or more. Per the GB1, 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 unstable 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. Summaries of the boring locations where high moisture content conditions were

encountered in the top 3 ft of subgrade within the limits of each proposed roadway segment are shown in Table 7 below.

Table 7: High Moisture Content Soils Location Summary

| Boring ID | Moisture Content (%) | Optimum Moisture Content (%) | Depth Below Subgrade (ft) |
|---|---|---|---|
| **US-33 Eastbound & Winchester Ramp A / Turn Around** | | | |
| B-025-0-22 | 14 | 10 | 0.0 - 0.5 |
| **Ramps 1 & 1A** | | | |
| B-005-0-22 | 17 | 14 | 0.0 - 3.4 |
| **Northern Turn Around** | | | |
| B-002-0-22 | 14 | 11 | 0.4 - 2.0 |

### *5.1.4. Subgrade Stabilization Recommendations*

Based on the results of our analysis, subgrade soils designated by ODOT's GB1 as "unstable" were present at various locations throughout the project. Therefore, with respect to stabilization, it is our opinion that areas along the project roadway segments should be stabilized via localized undercut consisting of 12 inches of Excavate and Replace (Item 204) with geotextile. Actual depths and limits of undercuts should be determined in the field by the Project Engineer based on ODOT's Subgrade Compaction and Proof Rolling specifications (Item 204). Our recommended limits for the indicated project subgrade stabilization are provided in Table 10 below.

Table 8: Stabilization Recommendations

| Start Station | End Station | Excavate and Replace w/ Item 204[(1)] (inches) | Unsuitable Subgrade Conditions | Borings Considered |
|---|---|---|---|---|
| **US-33 Eastbound** | | | | |
| 297+50 | 301+00 | 12 | $N_{60}$ | B-020-0-22 |
| **Ramps 1 & 1A** | | | | |
| 571+50 | 575+00 | 12 | $N_{60}$ | B-005-0-22 |
| 587+00 | 591+00 | 12 | $N_{60}$ | B-009-0-22 |
| **Ramp 3** | | | | |
| 648+00 | End | 12 | $N_{60}$ | B-009-0-22 |
| **Winchester Ramp A** | | | | |
| 782+00 | End | 12 | $N_{60}$ | B-027-0-22, B-028-0-22 |

## 5.2. Embankment Stability Analysis and Recommendations

For purposes of evaluating stability of the planned roadway embankments proposed as part of the project, NEAS reviewed cross-sections along the length of the project roadway segments to identify sections that were interpreted to represent conditions that posed the greatest potential for slope instability as a result of the planned construction. In general, cross-sections along each of the proposed roadway alignments were reviewed to identify planned alterations that may present a combination of existing subsurface conditions and planned site grading (i.e., cutting and/or filling) that would potentially be critical to the stability of the existing and/or proposed slopes at the site. Based on our review of the available information along the referenced alignments and the associated soil properties, one cross-section was estimated to be most "critical" along the proposed roadways and was analyzed for global stability. The cross-section selected to be evaluated includes a cross-section along US-33 EB at approximate STA. 289+00.

For the cross-section, NEAS developed a representative cross-sectional model to use as the basis for global stability analyses. The model was developed from NEAS's interpretation of the available information which

included: 1) the project's Stage 2 plans set dated March 31, 2023 provided by GPD; 2) a live load surcharge of 250 pounds per square foot (psf), accounting for traffic induced loads; and, 3) test borings and laboratory data developed as part of this report.

For analysis purposes, borings performed along or adjacent to the indicated proposed embankment section were reviewed and a generalized material profile was developed for analysis to represent worse case conditions at the selected cross-section location. Utilizing the generalized soil profile, engineering properties for each soil strata were estimated based on the field (i.e., SPT $N_{60}$ Values, hand penetrometer values, etc.) and laboratory (i.e., Atterberg Limits, grain size, etc.) test results using correlations provided in published engineering manuals, research reports and guidance documents. The developed soil profile and estimated engineering soil properties for use in analysis (with sited correlation/reference material) is summarized within Table 8 below.

Table 9: Soil Profile and Estimated Engineering Properties – US-33 EB – STA. 289+00

| US-33 Eastbound - STA. 289+00: Embankment Stability Analysis, B-017-0-22 | | | | |
|---|---|---|---|---|
| **Soil Description** | **Unit Weight[1] (pcf)** | **Undrained Shear Strength[2] (psf)** | **Effective Cohesion[3] (psf)** | **Effective Friction Angle[3] (degrees)** |
| Silt and Clay<br>Depth (743.3 ft - 740.3 ft) | 115 | 1000 | 100 | 22 |
| Clay<br>Depth (740.3 ft - 735.3 ft) | 120 | 1400 | 150 | 22 |
| Gravel with Sand, Silt and Clay<br>Depth (735.3 ft - 730.3 ft) | 118 | - | - | 29 |
| Gravel with Sand<br>Depth (730.3 ft - 728.3 ft) | 125 | - | - | 35 |

*Notes:*
1. *Values interpreted from Geotechnical Bulletin 7 Table 1.*
2. *Values calculated from Terzaghi and Peck (1967) if $N1_{60}$ <52, else Stroud and Butler (1975) was used.*
3. *Values interpreted from Geotechnical Bulletin 7 Table 2 for cohesive soils and LRFD BDS Table 10.4.6.2.4-1 and ODOT GDM Table 400-3 for granular soils.*

The above referenced slope stability model was analyzed for long-term (Effective Stress) and short-term (Total Stress) slope stability utilizing the software entitled *Slide2* by Rocscience, Inc. Specifically, the Modified Bishop and Spencer analysis methods were used to calculate a factor of safety (FOS) for circular and block type slope failures, respectively. The FOS is the ratio of the resisting forces and the driving forces, with the desired safety factor being more than about 1.33 which equates to an AASHTO resistance factor less than 0.75 (per AASHTO's LRFD BDS the specified resistance factors are essentially the inverse of the FOS that should be targeted in slope stability programs). For this analysis, a resistance factor of 0.75 or lower is targeted as the slope analyzed does not contain or support a structural element.

Based on our slope stability analyses for the above referenced roadway embankment section, the minimum slope stability safety factor is about 1.39 (0.72 resistance factor) for the section analyzed. The graphical output of the slope stability program (cross-sectional model, calculated safety factor, and critical failure plane) for the analyzed section is presented in Appendix F.

### *5.2.1. Settlement Analysis*

For purposes of evaluating potential for settlement of the planned roadway embankments proposed as part of the project, NEAS reviewed the project's Stage 2 Plans dated March 31, 2023 provided by GPD to identify the embankment grading and soil profile characteristics that represent conditions that could induce the greatest potential for settlement as a result of the planned construction (e.g., presence of compressible soils, large embankment fill depths, etc.). Based on our review of the available information along the project roadway and the associated soil properties, a generalized soil profile was generated along the US-33 EB, Ramp 2 and Ramp 3 alignments where relatively significant amounts of new fill is planned. Specifically, the roadway segments evaluated for settlement included: 1) US-33 EB from approximate STA. 282+00 to STA. 297+00; 2) Ramp 2 from approximate STA. 442+00 to 450+14; and, 3) Ramp 3 from approximate

STA. 642+00 to STA. 648+50. Settlement parameters were estimated and assigned to each soil layer supporting the analyzed roadway segments based on average field and laboratory testing results from borings performed in the area. The generalized soil profile and estimated settlement parameters per identified soil layer underlying the evaluated roadway segments is provided in Table 10 below. Utilizing this information and the software entitled *Settle3* by Rocscience, a settlement model was developed and analyzed for both elastic (short-term) and primary consolidation (long-term) settlement. *Settle3* outputs of our settlement analyses can be found in Appendix G.

Table 10: Soil Profile and Settlement Parameters for Analysis – US-33 EB, Ramp2 and Ramp 3

| US-33 Eastbound, Ramp 2 & 3: Settlement Analysis, B-015-0-22 through B-019-0-22 & B-024-0-22 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Soil Description** | **Unit Weight (pcf)** | **Elastic Modulus[1] (psf)** | **Poissons Ratio[1], v** | **Void Ratio $e_o$** | **Compression Index[2], $C_c$** | **Recompression Index[3], $C_r$** | **OCR[4]** | **Coeff. of Consol.[5], $C_v$** |
| Cohesive Elevation (752.4 ft - 732.3 ft) | 120 | 815000 | 0.40 | 0.695 | 0.228 | 0.046 | 8.50 | 0.25 |
| Non-cohesive Elevation (732.3 ft - 728.3 ft) | 120 | 177000 | 0.20 | - | - | - | - | - |

*Values interpreted from 2017 AASHTO LRFD BDS Table C10.4.6.3-1*
*Values calculated from Kulhawy and Mayne, 1990, Equation 6-6.*
*Values calculated from Kulhawy and Mayne, 1990, Equation 6-9.*
*Values interpreted from Mayne and Kemper, 1988, Figure 7.*
*Values interpreted from FHWA GEC No. 5, Boeckmann, et al., 2016, Figure 6-37.*

Based on our analyses, the estimated maximum total settlement associated with the loads induced by the proposed embankment is about 4.8 inches. The settlement will begin as the embankment load is applied and will dissipate with time. However, the amount of settlement and the time required for the settlement to occur is mostly dependent on the thickness of the underlying compressible soil, the uniformity and properties of these layers (i.e., compaction, material type, compressibility, etc.), and the proposed embankment fill height/surcharge load. Of the total settlement, about 1.3 inches is expected to be elastic (immediate) and take place during construction. The remaining 3.5 inches of settlement is anticipated to be long-term with the majority (i.e., 90 percent) of long-term settlement anticipated to take place in the first 30 days following construction. Therefore, based on: 1) the estimated amount of total settlement anticipated; 2) the gradual grade differences that may be caused by differential settlement; and, 3) the rate that the settlement is anticipated to occur, the estimated settlement magnitude post construction is not anticipated to be a concern for pavements or at-grade structures (i.e., guardrails, signage, etc.). However, these settlement magnitudes may affect existing utilities (i.e., gas, water and electrical lines) if present underlying the areas of newly proposed fills.

### *5.2.2. Embankment Construction Recommendations*

As indicated above, the embankment cross-section analyzed for slope stability was determined to be stable (i.e., FOS greater than about 1.33) as proposed in the Stage 2 Plans dated March 31, 2023. Therefore, the proposed embankment slopes can be constructed in accordance with Item 203 “Roadway Excavation and Embankment” of the ODOT CMS.

In areas where additional embankment material is proposed along existing slopes (i.e., side-hill sliver fills) that are steeper than 8 Horizontal to 1 Vertical (8H:1V) but flatter than 4H:1V, it is recommended that the proposed embankment be benched into the existing slopes in accordance with Item 203.05 “Embankment Construction Methods” of the ODOT CMS. For areas where additional embankment material is proposed along existing slopes that are steeper than 4H:1V, it is recommended that the proposed embankment be designed and constructed in accordance with GB2. For sidehill fills planned on existing slopes steeper than 4H:1V, ODOT’s GB2 recommends that *the embankment slopes be constructed utilizing special benching in order to blend the new embankment with the existing slope to prevent the development of a weak shear plane at the interface between the proposed fill and existing slope material* (ODOT [2], 2017). As the

project embankment fill slopes were determined to be stable as-proposed based on our embankment stability analysis, a special benching scheme similar to that shown in Figures 1, 2 or 3, as appropriate, of the ODOT GB2 can be used in areas where special benching is recommended. The height and width dimensions of the special benching scheme shown in these figures should be arranged to minimize the required cut and fill quantities, though the height of a single bench shall not exceed 20 ft without a stability analysis and design per OSHA requirements. Additionally, it may be appropriate to adjust the bench slope shown from a 1H:1V to a 1.75H:1V slope if the existing slope is made up of primarily granular materials. The benched material should be replaced with compacted engineered fill per Item 203 of the ODOT CMS, while proper lift thicknesses and material density should be maintained in the proposed fill per Item 203.06 of the ODOT CMS. In situations where it is not practical to extend the final bench through the existing roadway due to maintenance of traffic concerns, a benching scheme similar to that shown in Figure 1a of the ODOT GB2 can be used in order to avoid impacting the existing roadway, guardrail or shoulder. This scheme results in the placement of a temporary over-steepened fill that can later be "shaved-off" to bring the slope to the final proposed grade.

## 6. QUALIFICATIONS

This investigation was performed in accordance with accepted geotechnical engineering practice for the purpose of characterizing the subsurface conditions along the referenced portions of roadways. This report has been prepared for GPD, ODOT and their design consultants to be used solely in evaluating the subgrade soils within the project limits and presenting geotechnical engineering recommendations specific to this 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 test 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. In the event that any changes occur in the nature, design or location of the proposed reconstruction, reconfiguration and rehabilitation work, 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 GPD Group in performing this geotechnical exploration for the FRA-33-21.71 project. Please call if there are any questions, or if we can be of further service.

Respectfully Submitted,

Brendan P. Andrews, P.E.
*Project Geotechnical Engineer*

Kevin C. Arens P.E.
*Geotechnical Staff Engineer*

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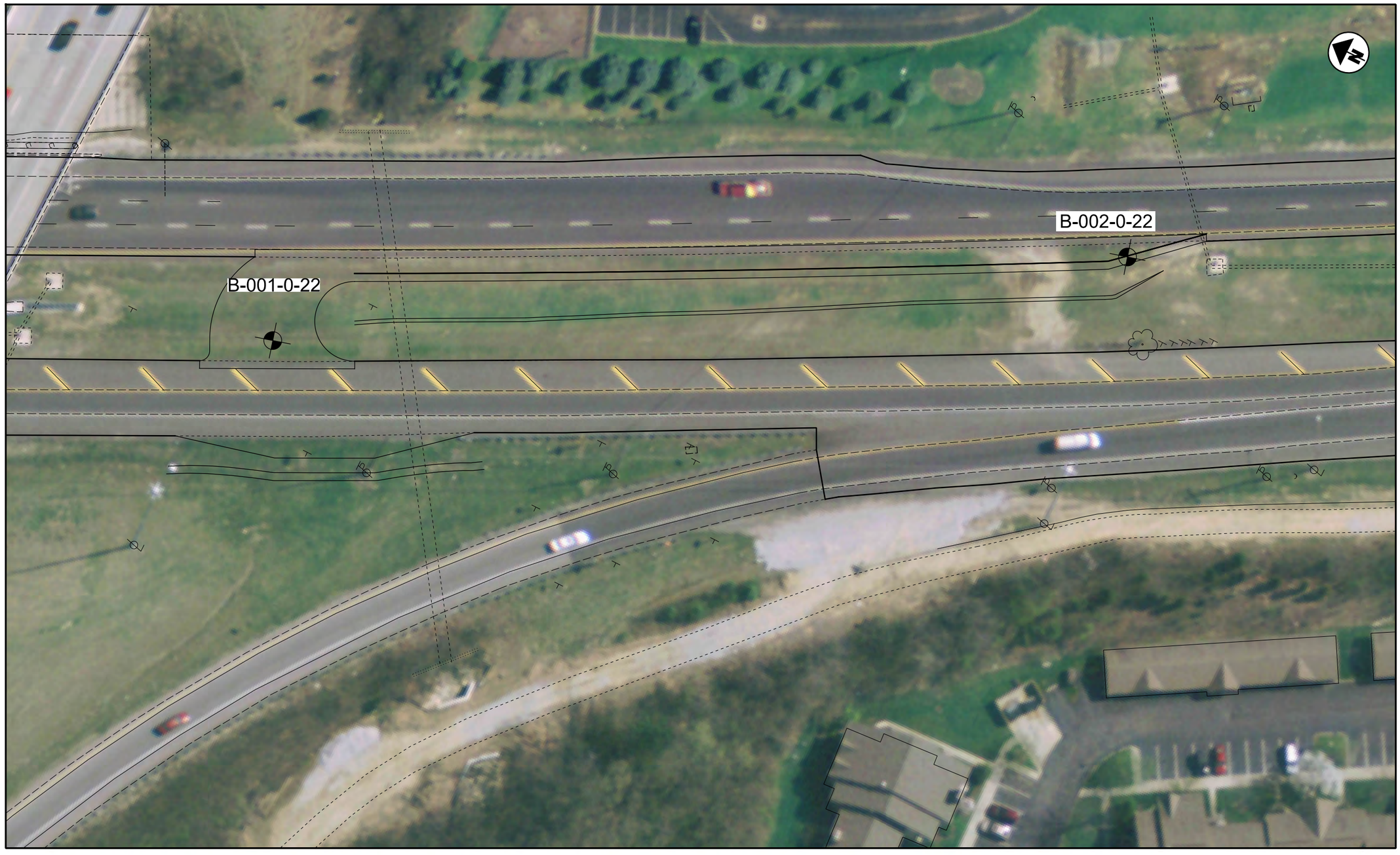
# APPENDIX A

# BORING LOCATION PLAN




TARGET BORING LOCATION

HORIZONTAL SCALE IN FEET
0 12.5 25 50

# BORING LOCATION PLAN

DESIGN AGENCY
KEAS Kleinfelder Engineering & Architectural Services Inc.

| | |
|---|---|
| DESIGNER | KCA |
| REVIEWER | BPA 11-09-2022 |
| PROJECT ID | 113744 |
| SHEET | 1 |
| TOTAL | 4 |

FRA-33-21.71

MODEL: 2D Imperial Sheet PAPERSIZE: 17x11 (in.) DATE: 5/8/2023 TIME: 1:29:06 PM USER: karens
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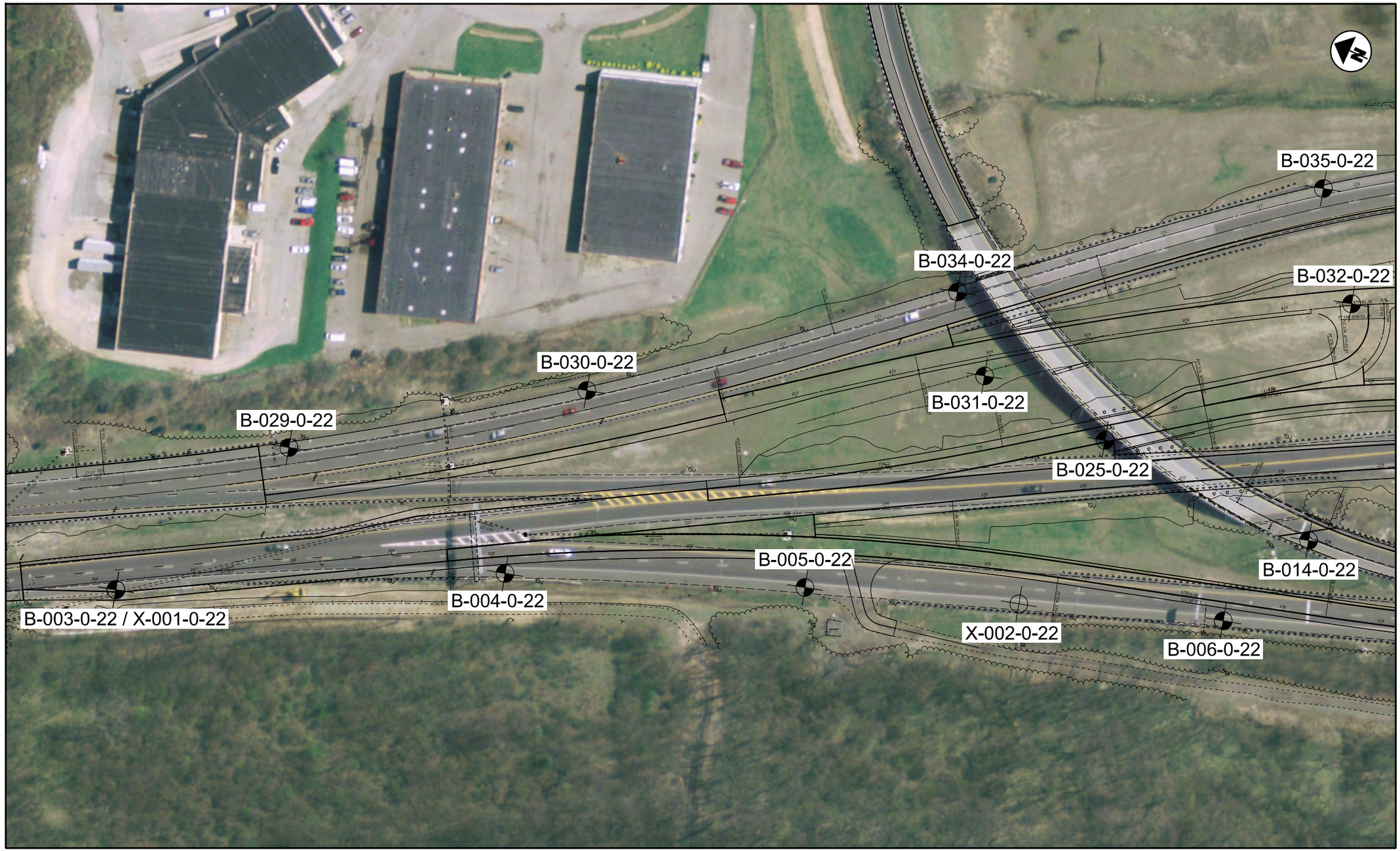


TARGET BORING LOCATION
(B-00X-0-22)

TARGET PAVEMENT CORE LOCATION
(X-00X-0-22)

HORIZONTAL
SCALE IN FEET
0 25 50 100

# BORING LOCATION PLAN

FRA-33-21.71

MODEL: 2D Imperial Sheet PAPERSIZE: 17x11 (in.) DATE: 5/8/2023 TIME: 1:28:20 PM USER: karens
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DESIGN AGENCY
EAS Earthwork Engineering & Architectural Services Inc.

| | |
|---|---|
| DESIGNER | KCA |
| REVIEWER | BPA 11-09-2022 |
| PROJECT ID | 113744 |
| SHEET | 2 |
| TOTAL | 4 |

# BORING LOCATION PLAN

HORIZONTAL SCALE IN FEET
0 25 50 100

B-036-0-22
B-037-0-22
X-008-0-22
B-033-0-22
B-028-0-22
B-026-0-22
B-017-0-22
B-027-0-22
B-024-0-22
B-016-0-22
B-018-0-22
B-023-0-22
B-015-0-22
X-005-0-22
B-008-0-22
B-009-0-22
B-010-0-22
X-004-0-22
X-003-0-22
B-007-0-22

TARGET BORING LOCATION
(B-00X-0-22)

TARGET PAVEMENT CORE LOCATION
(X-00X-0-22)

DESIGN AGENCY
EAS Engineering & Architectural Services Inc.

| | |
|---|---|
| DESIGNER | KCA |
| REVIEWER | BPA 11-09-2022 |
| PROJECT ID | 113744 |
| SHEET | 3 |
| TOTAL | 4 |

FRA-33-21.71

MODEL: 2D Imperial Sheet PAPERSIZE: 17x11 (in.) DATE: 5/8/2023 TIME: 1:40:59 PM USER: karens
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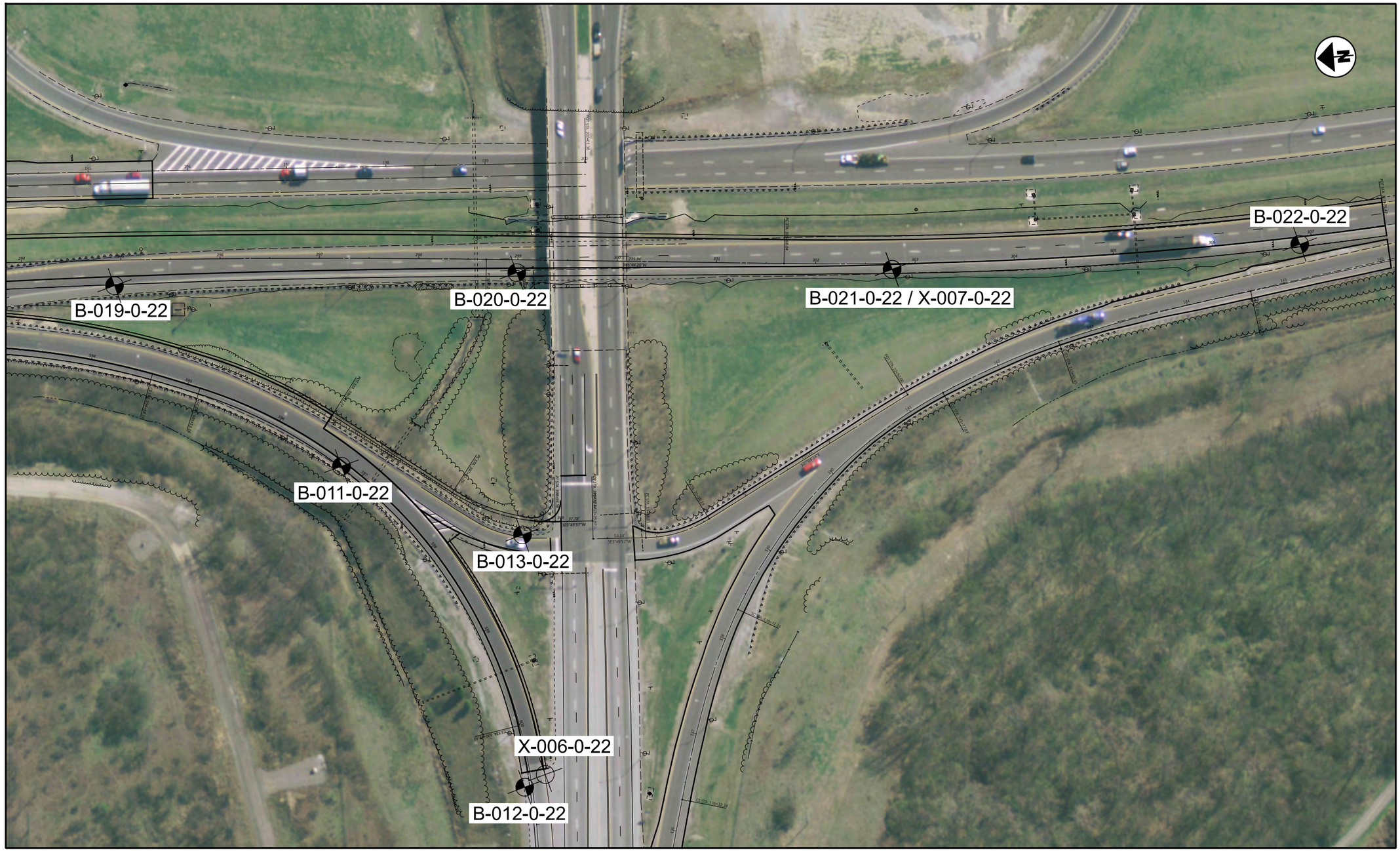


TARGET BORING LOCATION
(B-00X-0-22)

TARGET PAVEMENT CORE LOCATION
(X-00X-0-22)

HORIZONTAL
SCALE IN FEET
0 25 50 100

# BORING LOCATION PLAN

DESIGN AGENCY
KEA Federal Engineering & Architectural Services Inc.

| | |
|---|---|
| DESIGNER | KCA |
| REVIEWER | BPA 11-09-2022 |
| PROJECT ID | 113744 |
| SHEET | 4 |
| TOTAL | 4 |

FRA-33-21.71

MODEL: 2D Imperial Sheet PAPERSIZE: 17x11 (in.) DATE: 5/8/2023 TIME: 1:45:24 PM USER: karens
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# APPENDIX B

# SOIL BORING LOGS & LABORATORY TEST RESULTS

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / J. HODGES | DRILL RIG: CME 55X | STATION / OFFSET: 145+49, 16' RT. | EXPLORATION ID B-001-0-22 |
| TYPE: ROADWAY | SAMPLING FIRM / LOGGER: NEAS / J. HODGES | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 | |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 755.1 (MSL) EOB: 10.0 ft. | PAGE 1 OF 1 |
| START: 3/29/23 END: 3/29/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 79 | LAT / LONG: 39.931275, -82.927257 | |

| MATERIAL DESCRIPTION AND NOTES | ELEV. 755.1 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HARD, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, TRACE IRON STAINING, DAMP | 752.1 | 1 | 6 6 12 | 24 | 100 | SS-1 | 4.50 | 7 | 9 | 16 | 38 | 30 | 30 | 18 | 12 | 14 | A-6a (7) | 93 | |
| VERY STIFF TO HARD, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE TO LITTLE GRAVEL, TRACE IRON STAINING, DAMP | | 2 3 4 5 | 2 5 8 | 17 | 44 | SS-2 | 4.00 | 13 | 10 | 16 | 41 | 20 | 25 | 17 | 8 | 15 | A-4a (5) | - | |
| | | 6 7 8 | 4 7 13 | 26 | 100 | SS-3 | 4.50 | - | - | - | - | - | - | - | - | 14 | A-4a (V) | - | |
| | 745.1 | EOB 9 10 | 6 9 13 | 29 | 22 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 13 | A-4a (V) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / J. HODGES | DRILL RIG: CME 55X | STATION / OFFSET: 149+80, 20' LT. | EXPLORATION ID B-002-0-22 |
| TYPE: ROADWAY | SAMPLING FIRM / LOGGER: NEAS / J. HODGES | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 | |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 758.6 (MSL) EOB: 10.0 ft. | PAGE 1 OF 1 |
| START: 3/29/23 END: 3/29/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 79 | LAT / LONG: 39.930272, -82.926431 | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VERY STIFF TO HARD, BROWN BECOMING GRAYISH BROWN, **SANDY SILT**, SOME CLAY, TRACE TO LITTLE GRAVEL, TRACE IRON STAINING, DAMP | 758.6 | | | | | | | | | | | | | | | | | | |
| | | 1 | 8 10 10 | 26 | 100 | SS-1 | 4.50 | 9 | 12 | 21 | 37 | 21 | 24 | 16 | 8 | 14 | A-4a (5) | 53 | |
| | | 2 | | | | | | | | | | | | | | | | | |
| | | 3 | | | | | | | | | | | | | | | | | |
| | | 4 | 5 6 7 | 17 | 100 | SS-2 | 4.50 | 12 | 10 | 16 | 35 | 27 | 26 | 16 | 10 | 15 | A-4a (5) | - | |
| | | 5 | | | | | | | | | | | | | | | | | |
| | | 6 | | | | | | | | | | | | | | | | | |
| | | 7 | 3 5 4 | 12 | 100 | SS-3 | 4.25 | - | - | - | - | - | - | - | - | 14 | A-4a (V) | - | |
| | | 8 | | | | | | | | | | | | | | | | | |
| | | 9 | 3 5 5 | 13 | 72 | SS-4 | 4.00 | - | - | - | - | - | - | - | - | 13 | A-4a (V) | - | |
| | 748.6 | EOB 10 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 270+13, 30' RT. | EXPLORATION ID B-003-0-22 |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 EB | |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 741.7 (MSL) EOB: 7.5 ft. | PAGE 1 OF 1 |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.926264, -82.923754 | |

| MATERIAL DESCRIPTION AND NOTES | ELEV. 741.7 | 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 AND 10.0" BASE (DRILLERS DESCRIPTION)** | 740.2 | | | | | | | | | | | | | | | | | | |
| LOOSE TO MEDIUM DENSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS**, SOME TO "AND" SAND, TRACE SILT, TRACE CLAY, DAMP TO MOIST | | 1<br>2<br>3<br>4<br>5<br>6<br>7 | 7<br>9<br>8 | 21 | 44 | SS-1 | - | - | - | - | - | - | - | - | - | 6 | A-1-a (V) | 307 | |
| | | | 4<br>6<br>6 | 15 | 56 | SS-2 | - | 65 | 17 | 6 | 8 | 4 | NP | NP | NP | 6 | A-1-a (0) | - | |
| | | W 737.2 | 8<br>3<br>7 | 12 | 11 | SS-3 | - | - | - | - | - | - | - | - | - | 10 | A-1-a (V) | - | |
| | 734.2 | EOB | 3<br>4<br>3 | 8 | 67 | SS-4 | - | 51 | 25 | 11 | 9 | 4 | NP | NP | NP | 13 | A-1-a (0) | - | |

NOTES: GROUNDWATER ENCOUNTERED AT 4.5' DURING DRILLING. HOLE DID NOT CAVE.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 570+12, 17' RT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP 1 |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 750.1 (MSL) EOB: 7.5 ft. |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.925306, -82.923114 |

EXPLORATION ID B-004-0-22



| MATERIAL DESCRIPTION AND NOTES | ELEV. 750.1 | 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 AND 10.0" BASE (DRILLERS DESCRIPTION)** | 748.6 | 1 | | | | | | | | | | | | | | | | | |
| DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, DAMP | 747.1 | 2 | 12 12 16 | 34 | 22 | SS-1 | - | - | - | - | - | - | - | - | - | 7 | A-2-4 (V) | 540 | |
| HARD, BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS NO INTACT SOIL FOR HP READINGS, DAMP | 745.6 | 3 4 | 10 14 20 | 41 | 44 | SS-2 | - | 23 | 18 | 16 | 27 | 16 | 24 | 15 | 9 | 9 | A-4a (2) | - | |
| MEDIUM DENSE TO DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP | 742.6 | 5 | 12 9 15 | 29 | 44 | SS-3 | - | - | - | - | - | - | - | - | - | 7 | A-2-4 (V) | - | |
| | EOB | 6 7 | 8 16 18 | 41 | 50 | SS-4 | - | 35 | 17 | 16 | 21 | 11 | NP | NP | NP | 7 | A-2-4 (0) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; SHOVELED SOIL CUTTINGS

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 573+17, 35' RT. | EXPLORATION ID B-005-0-22 |
| TYPE: ROADWAY | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP 1 | |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 758.5 (MSL) EOB: 10.0 ft. | PAGE 1 OF 1 |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.924538, -82.922707 | |

| MATERIAL DESCRIPTION AND NOTES | ELEV. 758.5 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **7.0" ASPHALT AND 11.0" BASE (DRILLERS DESCRIPTION)** | 757.0 | | | | | | | | | | | | | | | | | | |
| MEDIUM DENSE, BROWN, **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, DAMP | 755.0 | 1 | 4 7 9 | 19 | 61 | SS-1 | - | - | - | - | - | - | - | - | - | 13 | A-2-4 (V) | 293 | |
| VERY STIFF, BROWN AND GRAY WITH BLACK STREAKS, **SILT AND CLAY**, "AND" SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, CONTAINS A SAND SEAM, DAMP | 753.0 | 2 | | | | | | | | | | | | | | | | | |
| VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, IRON STAINING, DAMP | | 3 | 4 5 4 | 11 | 50 | SS-2 | 2.50 | 8 | 19 | 19 | 27 | 27 | 32 | 17 | 15 | 17 | A-6a (6) | - | |
| | | 4 | | | | | | | | | | | | | | | | | |
| | | 5 | 4 5 7 | 15 | 44 | SS-3 | 3.75 | 8 | 9 | 15 | 36 | 32 | 33 | 19 | 14 | 17 | A-6a (8) | - | |
| | | 6 | | | | | | | | | | | | | | | | | |
| | | 7 | | | | | | | | | | | | | | | | | |
| | 748.5 | 8 | 7 9 13 | 27 | 72 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 15 | A-6a (V) | - | |
| | | EOB 9 | | | | | | | | | | | | | | | | | |
| | | 10 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. BORING OFFSET 60' WEST.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 577+43, 19' RT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP 1 |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 766.8 (MSL) EOB: 7.5 ft. |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.923450, -82.922184 |

EXPLORATION ID B-006-0-22

PAGE 1 OF 1

| MATERIAL DESCRIPTION AND NOTES | ELEV. 766.8 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **9.5" ASPHALT AND 11.0" BASE (DRILLERS DESCRIPTION)** | 765.1 | 1 | | | | | | | | | | | | | | | | | |
| MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, DAMP | 763.8 | 2 | 6 9 13 | 27 | 50 | SS-1 | - | - | - | - | - | - | - | - | - | 8 | A-2-4 (V) | 367 | |
| HARD, BROWN, **SANDY SILT**, LITTLE TO SOME GRAVEL, LITTLE CLAY, DAMP | | 3 | 4 7 12 | 23 | 67 | SS-2 | 4.50 | 19 | 15 | 15 | 32 | 19 | 25 | 16 | 9 | 10 | A-4a (3) | - | |
| | | 4 | 8 13 13 | 31 | 67 | SS-3 | 4.50 | 34 | 14 | 15 | 23 | 14 | 26 | 16 | 10 | 8 | A-4a (0) | - | |
| | | 5 | 8 6 10 | 19 | 44 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 10 | A-4a (V) | - | |
| | 759.3 | 6 EOB 7 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. OFFSET TO SHOULDER.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 581+13, 5' RT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP 1 |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 768.9 (MSL) EOB: 7.5 ft. |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.922495, -82.921724 |

EXPLORATION ID B-007-0-22

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| MATERIAL DESCRIPTION AND NOTES | ELEV. 768.9 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **9.5" ASPHALT AND 11.0" BASE (DRILLERS DESCRIPTION)** | 767.2 | 1 | | | | | | | | | | | | | | | | | |
| HARD, BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, DAMP | | 2 | 10 10 11 | 25 | 39 | SS-1 | 4.50 | 25 | 19 | 15 | 24 | 17 | 26 | 16 | 10 | 8 | A-4a (1) | 380 | |
| | | 3 | 5 8 13 | 25 | 56 | SS-2 | 4.50 | 32 | 13 | 14 | 24 | 17 | 26 | 16 | 10 | 10 | A-4a (1) | - | |
| | | 4 | 4 9 33 | 51 | 50 | SS-3 | 4.50 | - | - | - | - | - | - | - | - | 13 | A-4a (V) | - | |
| | 761.4 | 5 6 7 EOB | 6 10 11 | 25 | 50 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 12 | A-4a (V) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. OFFSET TO SHOULDER.

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

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 585+04, 3' RT. | EXPLORATION ID B-008-0-22 |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP 1 | |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 766.1 (MSL) EOB: 7.5 ft. | PAGE 1 OF 1 |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.921490, -82.921236 | |

| MATERIAL DESCRIPTION AND NOTES | ELEV. 766.1 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **7.0" ASPHALT AND 11.0" BASE (DRILLERS DESCRIPTION)** | 764.6 | 1 | | | | | | | | | | | | | | | | | |
| MEDIUM DENSE, GRAY, **STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, MOSTLY FRAGMENTS OF CONCRETE, DAMP **(FILL)** | 763.1 | 2 | 10 13 7 | 24 | 11 | SS-1 | - | - | - | - | - | - | - | - | - | 6 | A-1-a (V) | 947 | |
| VERY STIFF TO HARD, BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP | | 3 4 | 3 3 7 | 12 | 44 | SS-2 | 4.50 | 12 | 12 | 17 | 35 | 24 | 27 | 17 | 10 | 14 | A-4a (5) | - | |
| | | 5 | 3 5 11 | 19 | 56 | SS-3 | 3.00 | 13 | 13 | 17 | 34 | 23 | 27 | 17 | 10 | 13 | A-4a (4) | - | |
| | 758.6 | 6 7 EOB | 2 7 15 | 27 | 39 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 12 | A-4a (V) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 589+05, 12' RT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP 1 |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 756.6 (MSL) EOB: 7.5 ft. |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.920442, -82.920822 |

EXPLORATION ID B-009-0-22

PAGE 1 OF 1

| MATERIAL DESCRIPTION AND NOTES | ELEV. 756.6 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **10.0" ASPHALT AND 8.0" BASE (DRILLERS DESCRIPTION)** | 755.1 | 1 | | | | | | | | | | | | | | | | | |
| LOOSE, BROWN AND BLACK, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP | 753.6 | 2 | 8 3 5 | 10 | 50 | SS-1 | - | - | - | - | - | - | - | - | - | 9 | A-2-4 (V) | 380 | |
| MEDIUM DENSE, BROWN, **GRAVEL**, LITTLE SAND, TRACE SILT, TRACE CLAY, DAMP | 752.1 | 3 | 5 5 5 | 12 | 11 | SS-2 | - | - | - | - | - | - | - | - | - | 10 | A-1-a (V) | - | |
| VERY STIFF, BROWN, **SILT**, LITTLE SAND, LITTLE GRAVEL, LITTLE CLAY, DAMP | 750.6 | 4 5 | 10 9 4 | 16 | 33 | SS-3 | 3.25 | 16 | 8 | 11 | 51 | 14 | 26 | 16 | 10 | 12 | A-4b (6) | - | |
| HARD, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP | 749.1 | 6 | 2 8 12 | 24 | 39 | SS-4 | 4.50 | 18 | 9 | 15 | 34 | 24 | 28 | 17 | 11 | 12 | A-6a (5) | - | |
| | | EOB 7 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. OFFSET TO SHOULDER.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 592+60, 35' LT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP 1 |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 748.7 (MSL) EOB: 7.5 ft. |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.919471, -82.920556 |

EXPLORATION ID B-010-0-22



| MATERIAL DESCRIPTION AND NOTES | ELEV. 748.7 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **4.0" ASPHALT AND 7.0" CONCRETE AND 7.0" BASE (DRILLERS DESCRIPTION)** | 747.2 | 1 | | | | | | | | | | | | | | | | | |
| HARD, BROWN, **SANDY SILT**, LITTLE TO SOME GRAVEL, LITTLE TO SOME CLAY, DAMP | | 2 | 5 6 10 | 19 | 44 | SS-1 | 4.50 | 30 | 17 | 17 | 23 | 13 | 23 | 15 | 8 | 8 | A-4a (0) | 640 | |
| | | 3 | 4 9 9 | 22 | 56 | SS-2 | 4.50 | - | - | - | - | - | - | - | - | 10 | A-4a (V) | - | |
| | 742.7 | 4 | 5 6 8 | 17 | 78 | SS-3 | 4.50 | - | - | - | - | - | - | - | - | 15 | A-4a (V) | - | |
| VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP | 741.2 | 5 | 4 7 11 | 22 | 67 | SS-4 | 3.50 | 16 | 14 | 17 | 31 | 22 | 28 | 17 | 11 | 13 | A-6a (4) | - | |
| | | EOB 6 7 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 596+78, 5' RT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP 1 |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 752.0 (MSL) EOB: 7.5 ft. |
| START: 3/27/23 END: 3/27/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.918437, -82.921224 |

EXPLORATION ID B-011-0-22

PAGE 1 OF 1

| MATERIAL DESCRIPTION AND NOTES | ELEV. 752.0 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **10.0" ASPHALT AND 8.0" BASE (DRILLERS DESCRIPTION)** | 750.5 | 1 | | | | | | | | | | | | | | | | | |
| MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, DAMP | 749.0 | 2 | 6 8 10 | 22 | 33 | SS-1 | - | - | - | - | - | - | - | - | - | 10 | A-2-4 (V) | 240 | |
| HARD, GRAYISH BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP | 747.5 | 3 4 | 6 6 7 | 16 | 39 | SS-2 | 4.50 | 19 | 10 | 14 | 34 | 23 | 29 | 17 | 12 | 14 | A-6a (5) | - | |
| MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, DAMP | 746.0 | 5 | 7 4 5 | 11 | 6 | SS-3 | - | - | - | - | - | - | - | - | - | 9 | A-2-4 (V) | - | |
| STIFF, GRAYISH BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, DAMP | 744.5 | 6 7 EOB | 8 8 9 | 21 | 22 | SS-4 | 1.50 | 21 | 9 | 17 | 33 | 20 | 27 | 17 | 10 | 15 | A-4a (4) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 600+64, 5' RT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP 1 |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 752.8 (MSL) EOB: 7.5 ft. |
| START: 3/27/23 END: 3/27/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.918005, -82.922426 |

EXPLORATION ID B-012-0-22

PAGE 1 OF 1

| MATERIAL DESCRIPTION AND NOTES | ELEV. 752.8 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **4.0" ASPHALT AND 7.0" CONCRETE AND 7.0" BASE (DRILLERS DESCRIPTION)** | 751.3 | | | | | | | | | | | | | | | | | | |
| HARD, BROWN, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, DAMP | 749.8 | 1 | 8 16 14 | 36 | 56 | SS-1 | 4.50 | 31 | 21 | 12 | 23 | 13 | 25 | 16 | 9 | 9 | A-4a (0) | 60 | |
| HARD, BROWN AND GRAY, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP TO MOIST | | 2 | 9 9 10 | 23 | 72 | SS-2 | 4.50 | 18 | 16 | 14 | 29 | 23 | 28 | 17 | 11 | 12 | A-6a (4) | - | |
| | | 3 | 6 8 9 | 21 | 89 | SS-3 | 4.50 | - | - | - | - | - | - | - | - | 10 | A-6a (V) | - | |
| | 745.3 | 4 | 4 10 9 | 23 | 50 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 18 | A-6a (V) | - | |
| | | EOB 5 | | | | | | | | | | | | | | | | | |
| | | 6 | | | | | | | | | | | | | | | | | |
| | | 7 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. OFFSET FROM CORE TO SHOULDER.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 398+64, 15' RT. |
| TYPE: SIDEHILL FILL | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP 1A |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 759.0 (MSL) EOB: 20.0 ft. |
| START: 3/28/23 END: 3/28/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.917954, -82.921523 |

EXPLORATION ID B-013-0-22

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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **4.0" ASPHALT AND 8.0" CONCRETE AND 6.0" BASE (DRILLERS DESCRIPTION)** | 759.0 | | | | | | | | | | | | | | | | | | |
| | 757.5 | | | | | | | | | | | | | | | | | | |
| VERY STIFF TO HARD, BROWN, **SILT AND CLAY**, SOME SAND, TRACE TO LITTLE GRAVEL, DAMP TO MOIST | | 1 | | | | | | | | | | | | | | | | | |
| | | 2 | 4 5 5 | 12 | 44 | SS-1 | 4.50 | 10 | 15 | 18 | 34 | 23 | 27 | 16 | 11 | 13 | A-6a (5) | - | |
| | | 3 | 2 2 3 | 6 | 39 | SS-2 | 3.50 | - | - | - | - | - | - | - | - | 24 | A-6a (V) | - | |
| | | 4 | | | | | | | | | | | | | | | | | |
| | | 5 | 4 6 5 | 13 | 61 | SS-3 | 3.00 | - | - | - | - | - | - | - | - | 14 | A-6a (V) | - | |
| | 753.0 | 6 | | | | | | | | | | | | | | | | | |
| VERY STIFF, BROWN AND BLACK, **CLAY**, "AND" SILT, LITTLE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, MOIST | | 7 | 2 3 2 | 6 | 50 | SS-4 | 2.25 | 4 | 6 | 13 | 41 | 36 | 41 | 19 | 22 | 24 | A-7-6 (13) | - | |
| | 751.0 | 8 | | | | | | | | | | | | | | | | | |
| VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST | | 9 | 3 2 6 | 10 | 56 | SS-5 | 4.00 | 5 | 10 | 18 | 42 | 25 | 29 | 17 | 12 | 18 | A-6a (7) | - | |
| | 748.5 | 10 | | | | | | | | | | | | | | | | | |
| STIFF TO HARD, BROWN AND BROWNISH GRAY, **SILTY CLAY**, SOME SAND, TRACE TO LITTLE GRAVEL, DAMP TO MOIST | | 11 | | | | | | | | | | | | | | | | | |
| | | 12 | 3 4 7 | 13 | 44 | SS-6 | 2.00 | - | - | - | - | - | - | - | - | 24 | A-6b (V) | - | |
| | | 13 | | | | | | | | | | | | | | | | | |
| | | 14 | 3 5 4 | 11 | 50 | SS-7 | 4.25 | 8 | 11 | 16 | 36 | 29 | 33 | 17 | 16 | 17 | A-6b (8) | - | |
| | | 15 | | | | | | | | | | | | | | | | | |
| | | 16 | 5 5 6 | 13 | 61 | SS-8 | 3.50 | - | - | - | - | - | - | - | - | 19 | A-6b (V) | - | |
| | | 17 | | | | | | | | | | | | | | | | | |
| | | 18 | | | | | | | | | | | | | | | | | |
| | | 19 | 4 4 5 | 11 | 72 | SS-9 | 4.50 | - | - | - | - | - | - | - | - | 15 | A-6b (V) | - | |
| | 739.0 | 20 EOB | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; POURED 2 BAGS HOLE PLUG; SHOVELED SOIL CUTTINGS

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 437+82, 3' RT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP 2 |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 774.4 (MSL) EOB: 7.5 ft. |
| START: 3/28/23 END: 3/28/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.923329, -82.921793 |

EXPLORATION ID B-014-0-22



| MATERIAL DESCRIPTION AND NOTES | ELEV. 774.4 | DEPTHS | SPT/ RQD | $N_{60}$ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) GR | CS | FS | SI | CL | ATTERBERG LL | PL | PI | WC | ODOT CLASS (GI) | SO4 ppm | BACK FILL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **8.0" ASPHALT AND 10.0" BASE (DRILLERS DESCRIPTION)** | 772.9 | 1 | | | | | | | | | | | | | | | | | |
| MEDIUM DENSE, BROWN, **GRAVEL WITH SAND AND SILT**, LITTLE CLAY, DAMP | 771.4 | 2 | 2 6 7 | 16 | 67 | SS-1 | 4.50 | 34 | 17 | 14 | 20 | 15 | NP | NP | NP | 9 | A-2-4 (0) | 493 | |
| HARD, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP | | 3 | 5 6 7 | 16 | 78 | SS-2 | 4.50 | 14 | 13 | 18 | 30 | 25 | 31 | 17 | 14 | 14 | A-6a (6) | - | |
| | | 4 | 4 8 8 | 19 | 89 | SS-3 | 4.25 | - | - | - | - | - | - | - | - | 10 | A-6a (V) | - | |
| | 766.9 | 5 6 7 EOB | 9 14 14 | 34 | 67 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 15 | A-6a (V) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; POURED 2 BAGS HOLE PLUG; SHOVELED SOIL CUTTINGS

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / J. HODGES | DRILL RIG: CME 55X | STATION / OFFSET: 441+85, 24' LT. |
| TYPE: EMBANKMENT FOUNDATION | SAMPLING FIRM / LOGGER: NEAS / J. HODGES | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP 2 |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 752.4 (MSL) EOB: 15.0 ft. |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 79 | LAT / LONG: 39.922321, -82.921283 |

EXPLORATION ID B-015-0-22

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| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HARD, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP | 752.4 | | 6 9 11 | 26 | 100 | SS-1 | 4.25 | 19 | 11 | 17 | 32 | 21 | 30 | 18 | 12 | 16 | A-6a (4) | - | |
| | 749.4 | | | | | | | | | | | | | | | | | | |
| MEDIUM STIFF TO VERY STIFF, BROWN AND DARK BROWN, **SILT AND CLAY**, LITTLE TO SOME SAND, TRACE TO LITTLE GRAVEL AND STONE FRAGMENTS, IRON STAINING, MOIST TO WET | | | 2 2 5 | 9 | 44 | SS-2 | 1.00 | - | - | - | - | - | - | - | - | 23 | A-6a (V) | - | |
| | | | 3 6 8 | 18 | 33 | SS-3 | 2.25 | - | - | - | - | - | - | - | - | 32 | A-6a (V) | - | |
| | | | 4 5 5 | 13 | 100 | SS-4 | 2.25 | 8 | 7 | 18 | 38 | 29 | 33 | 18 | 15 | 18 | A-6a (8) | - | |
| | 741.9 | | | | | | | | | | | | | | | | | | |
| STIFF TO VERY STIFF, BROWN AND DARK BROWN, **SILT AND CLAY**, "AND" SAND, TRACE GRAVEL, IRON STAINING, MOIST | | | 3 5 7 | 16 | 100 | SS-5 | 2.25 | - | - | - | - | - | - | - | - | 21 | A-6a (V) | - | |
| | | | 2 3 3 | 8 | 100 | SS-6 | 1.25 | - | - | - | - | - | - | - | - | 26 | A-6a (V) | - | |
| | 737.4 | EOB | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / J. HODGES | DRILL RIG: CME 55X | STATION / OFFSET: 445+58, 7' LT. |
| TYPE: EMBANKMENT FOUNDATION | SAMPLING FIRM / LOGGER: NEAS / J. HODGES | HAMMER: CME AUTOMATIC | ALIGNMENT: RAMP 2 |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 746.4 (MSL) EOB: 15.0 ft. |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 79 | LAT / LONG: 39.921409, -82.920669 |

EXPLORATION ID B-016-0-22

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| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MEDIUM DENSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND, SILT, AND CLAY**, DAMP | 746.4 | 1 | 8 5 4 | 12 | 100 | SS-1 | - | - | - | - | - | - | - | - | - | 20 | A-2-6 (V) | - | |
| STIFF TO VERY STIFF, DARK GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MODERATELY ORGANIC, MOIST | 743.4 | 4 | 3 3 4 | 9 | 100 | SS-2 | 2.00 | 3 | 5 | 17 | 46 | 29 | 39 | 26 | 13 | 28 | A-6a (9) | - | |
| VERY STIFF, DARK GRAY AND BLACK, **CLAY**, "AND" SILT, SOME SAND, TRACE GRAVEL, MODERATELY ORGANIC, MOIST | 740.9 | 6 | 2 4 5 | 12 | 50 | SS-3 | 2.50 | 1 | 5 | 19 | 40 | 35 | 43 | 25 | 18 | 28 | A-7-6 (12) | - | |
| STIFF TO VERY STIFF, BROWN MOTTLED WITH GRAY AND YELLOWISH BROWN, **CLAY**, SOME SILT, LITTLE TO SOME SAND, TRACE GRAVEL, IRON STAINING, MOIST | 738.4 | 9 | 3 4 5 | 12 | 100 | SS-4 | 3.00 | 1 | 3 | 20 | 34 | 42 | 47 | 21 | 26 | 24 | A-7-6 (16) | - | |
| VERY LOOSE, DARK GRAY, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, MOIST | 733.4 | 11 | 2 3 3 | 8 | 100 | SS-5 | 1.25 | - | - | - | - | - | - | - | - | 27 | A-7-6 (V) | - | |
| | 731.4 EOB | 14 | 2 1 2 | 4 | 100 | SS-6 | - | - | - | - | - | - | - | - | - | 14 | A-1-b (V) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / J. HODGES | DRILL RIG: CME 55X | STATION / OFFSET: 287+95, 5' RT. |
| TYPE: EMBANKMENT FOUNDATION | SAMPLING FIRM / LOGGER: NEAS / J. HODGES | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 EB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 743.3 (MSL) EOB: 15.0 ft. |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 79 | LAT / LONG: 39.920929, -82.920413 |

EXPLORATION ID B-017-0-22

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| MATERIAL DESCRIPTION AND NOTES | ELEV. 743.3 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| STIFF, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, MOIST | 740.3 | 1 | 3 3 3 | 8 | 100 | SS-1 | 1.50 | 1 | 5 | 20 | 48 | 26 | 31 | 20 | 11 | 22 | A-6a (8) | - | |
| STIFF TO VERY STIFF, DARK BROWN, **CLAY**, "AND" SILT, LITTLE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, SS-3 CONTAINS HEAVY IRON STAINING, MOIST | 735.3 | 4 | 2 4 5 | 12 | 33 | SS-2 | 2.25 | 1 | 6 | 13 | 37 | 43 | 55 | 28 | 27 | 31 | A-7-6 (18) | - | |
| | | 7 | 2 3 5 | 11 | 100 | SS-3 | 1.50 | - | - | - | - | - | - | - | - | 29 | A-7-6 (V) | - | |
| LOOSE, BROWN, **GRAVEL WITH SAND, SILT, AND CLAY**, MOIST | 732.8 | 9 | 4 2 2 | 5 | 39 | SS-4 | - | - | - | - | - | - | - | - | - | 21 | A-2-6 (V) | - | |
| VERY LOOSE TO MEDIUM DENSE, DARK GRAY, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, WET | 728.3 | W 732.3 11 | 2 1 1 | 3 | 44 | SS-5 | - | - | - | - | - | - | - | - | - | 26 | A-1-b (V) | - | |
| | | 14 | 6 6 7 | 17 | 100 | SS-6 | - | - | - | - | - | - | - | - | - | 15 | A-1-b (V) | - | |
| | | EOB 15 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER ENCOUNTERED AT 11.0' DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / J. HODGES | DRILL RIG: CME 55X | STATION / OFFSET: 291+92, 6' LT. |
| TYPE: EMBANKMENT FOUNDATION | SAMPLING FIRM / LOGGER: NEAS / J. HODGES | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 EB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 741.0 (MSL) EOB: 10.0 ft. |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 79 | LAT / LONG: 39.919844, -82.920345 |

EXPLORATION ID B-018-0-22

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| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| VERY STIFF, DARK BROWN, **CLAY**, SOME SILT, SOME SAND, LITTLE GRAVEL, SLIGHTLY ORGANIC, DAMP | 741.0 | | | | | | | | | | | | | | | | | | |
| | | 1 | 5 6 8 | 18 | 100 | SS-1 | 3.50 | 18 | 7 | 15 | 30 | 30 | 41 | 21 | 20 | 20 | A-7-6 (9) | - | |
| | 738.0 | 2 | | | | | | | | | | | | | | | | | |
| VERY STIFF, BROWN AND ORANGISH BROWN, **CLAY**, "AND" SILT, SOME SAND, TRACE GRAVEL, IRON STAINING, MOIST | | 3 | 2 4 6 | 13 | 56 | SS-2 | 3.00 | 1 | 6 | 20 | 36 | 37 | 45 | 20 | 25 | 22 | A-7-6 (15) | - | |
| | | 4 | | | | | | | | | | | | | | | | | |
| | | 5 | | | | | | | | | | | | | | | | | |
| | | 6 | 3 3 3 | 8 | 44 | SS-3 | 3.00 | - | - | - | - | - | - | - | - | 23 | A-7-6 (V) | - | |
| | 732.4 | 7 | | | | | | | | | | | | | | | | | |
| MEDIUM DENSE, BROWN AND ORANGISH BROWN, **GRAVEL WITH SAND, SILT, AND CLAY**, IRON STAINING, MOIST | 731.0 | 8 | | | | | | | | | | | | | | | | | |
| | EOB | 9 | 1 3 5 | 11 | 39 | SS-4 | - | - | - | - | - | - | - | - | - | 20 | A-2-6 (V) | - | |
| | | 10 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 294+93, 26' RT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 EB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 745.8 (MSL) EOB: 7.5 ft. |
| START: 3/27/23 END: 3/27/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.919022, -82.920511 |

EXPLORATION ID B-019-0-22



| MATERIAL DESCRIPTION AND NOTES | ELEV. 745.8 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **4.0" ASPHALT AND 7.0" CONCRETE AND 7.0" BASE (DRILLERS DESCRIPTION)** | 744.3 | | | | | | | | | | | | | | | | | | |
| VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, DAMP | 742.8 | 1 | 6 5 5 | 12 | 44 | SS-1 | 2.75 | - | - | - | - | - | - | - | - | 17 | A-6a (V) | 667 | |
| VERY STIFF TO HARD, BROWN, **SANDY SILT**, LITTLE TO SOME CLAY, LITTLE TO SOME GRAVEL, DAMP | | 2 | 5 6 9 | 18 | 56 | SS-2 | 4.50 | 14 | 15 | 17 | 33 | 21 | 25 | 15 | 10 | 11 | A-4a (4) | - | |
| | | 3 | 4 7 4 | 13 | 61 | SS-3 | 3.75 | 19 | 16 | 19 | 30 | 16 | 24 | 17 | 7 | 12 | A-4a (2) | - | |
| | 738.3 | 4 5 6 7 EOB | 9 9 13 | 27 | 72 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 13 | A-4a (V) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. OFFSET TO SHOULDER.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 298+99, 13' RT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 EB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 743.8 (MSL) EOB: 7.5 ft. |
| START: 3/28/23 END: 3/28/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.917911, -82.920583 |

EXPLORATION ID B-020-0-22



| MATERIAL DESCRIPTION AND NOTES | ELEV. 743.8 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **3.5" ASPHALT AND 6.0" CONCRETE AND 9.5" BASE (DRILLERS DESCRIPTION)** | 742.2 | | | | | | | | | | | | | | | | | | |
| VERY STIFF TO HARD, BROWN AND BROWNISH GRAY, **SILT AND CLAY**, SOME SAND, LITTLE TO SOME GRAVEL, DAMP TO MOIST | | 1 | 3 4 4 | 10 | 50 | SS-1 | 4.50 | 21 | 12 | 15 | 29 | 23 | 31 | 16 | 15 | 14 | A-6a (5) | 167 | |
| | | 2 | 2 3 7 | 12 | 67 | SS-2 | 4.50 | - | - | - | - | - | - | - | - | 17 | A-6a (V) | - | |
| | | 3 | 2 2 4 | 7 | 56 | SS-3 | 4.25 | 19 | 14 | 18 | 28 | 21 | 27 | 16 | 11 | 14 | A-6a (3) | - | |
| | | 4 | 4 4 13 | 21 | 44 | SS-4 | 2.50 | - | - | - | - | - | - | - | - | 18 | A-6a (V) | - | |
| | 736.3 | 5 EOB | | | | | | | | | | | | | | | | | |
| | | 6 | | | | | | | | | | | | | | | | | |
| | | 7 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. OFFSET TO SHOULDER.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 302+77, 6' RT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 EB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 743.3 (MSL) EOB: 7.5 ft. |
| START: 3/28/23 END: 3/28/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.916875, -82.920681 |

EXPLORATION ID B-021-0-22

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| MATERIAL DESCRIPTION AND NOTES | ELEV. 743.3 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **9.5" ASPHALT AND 11.0" BASE (DRILLERS DESCRIPTION)** | 741.6 | | | | | | | | | | | | | | | | | | |
| MEDIUM DENSE, BROWN AND GRAY, **GRAVEL**, LITTLE SAND, TRACE SILT, TRACE CLAY, MOIST **(FILL)** | 738.8 | | 3 4 8 | 15 | 44 | SS-1 | - | - | - | - | - | - | - | - | - | 9 | A-1-a (V) | 100 | |
| | | | 6 5 4 | 11 | 39 | SS-2 | - | 85 | 8 | 3 | 3 | 1 | NP | NP | NP | 5 | A-1-a (0) | - | |
| HARD, BROWN AND DARK BROWN, **SILT AND CLAY**, SOME SAND, LITTLE TO SOME GRAVEL, CONTAINS BRICK FRAGMENTS, DAMP **(FILL)** | 735.8 | | 4 4 7 | 13 | 67 | SS-3 | 4.50 | 20 | 13 | 16 | 27 | 24 | 32 | 20 | 12 | 17 | A-6a (4) | - | |
| | | EOB | 8 8 8 | 19 | 78 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 16 | A-6a (V) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 306+88, 7' RT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 EB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 743.9 (MSL) EOB: 7.5 ft. |
| START: 3/28/23 END: 3/28/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.915747, -82.920712 |

EXPLORATION ID B-022-0-22

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| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **9.5" ASPHALT AND 8.5" BASE (DRILLERS DESCRIPTION)** | 743.9 | | | | | | | | | | | | | | | | | | |
| | 742.4 | | | | | | | | | | | | | | | | | | |
| MEDIUM DENSE, BROWN AND GRAY, **GRAVEL WITH SAND**, TRACE SILT, TRACE CLAY, DAMP TO MOIST **(FILL)** | | 1 | 5 4 8 | 15 | 44 | SS-1 | - | - | - | - | - | - | - | - | - | 8 | A-1-a (V) | 100 | |
| | 739.4 | 2 3 4 | 6 6 4 | 12 | 44 | SS-2 | - | 80 | 11 | 4 | 4 | 1 | NP | NP | NP | 5 | A-1-a (0) | - | |
| VERY STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL, CONTAINS BRICK FRAGMENTS, DAMP **(FILL)** | 737.9 | W 737.9 5 6 | 3 7 11 | 22 | 50 | SS-3 | 3.50 | 20 | 11 | 15 | 32 | 22 | 27 | 16 | 11 | 13 | A-6a (4) | - | |
| MEDIUM DENSE, BROWN, **GRAVEL WITH SAND**, SOME SILT, LITTLE CLAY, WET | 736.4 | EOB 7 | 6 9 10 | 23 | 39 | SS-4 | - | - | - | - | - | - | - | - | - | 10 | A-1-b (V) | - | |

NOTES: GROUNDWATER ENCOUNTERED AT 6.0' DURING DRILLING. HOLE DID NOT CAVE.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 280+28, 7' LT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 EB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 751.4 (MSL) EOB: 7.5 ft. |
| START: 3/28/23 END: 3/28/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.922929, -82.921215 |

EXPLORATION ID B-023-0-22

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| MATERIAL DESCRIPTION AND NOTES | ELEV. 751.4 | DEPTHS | SPT/ RQD | $N_{60}$ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) GR | CS | FS | SI | CL | ATTERBERG LL | PL | PI | WC | ODOT CLASS (GI) | SO4 ppm | BACK FILL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2.5" ASPHALT AND 9.5" CONCRETE AND 6.0" BASE (DRILLERS DESCRIPTION)** | 749.9 | | | | | | | | | | | | | | | | | | |
| LOOSE TO MEDIUM DENSE, BROWN, **GRAVEL**, SOME SAND, LITTLE SILT, TRACE CLAY, DAMP | 746.7 | | 4 7 6 | 16 | 50 | SS-1 | - | - | - | - | - | - | - | - | - | 9 | A-1-a (V) | 160 | |
| | | | 3 3 2 | 6 | 44 | SS-2 | - | 58 | 18 | 10 | 11 | 3 | NP | NP | NP | 9 | A-1-a (0) | - | |
| VERY STIFF, GRAY, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, DAMP TO MOIST | | W 745.4 | 2 4 4 | 10 | 67 | SS-3 | 3.00 | 23 | 12 | 16 | 31 | 18 | 21 | 14 | 7 | 12 | A-4a (3) | - | |
| | 743.9 | | 2 2 4 | 7 | 39 | SS-4 | 2.25 | - | - | - | - | - | - | - | - | 15 | A-4a (V) | - | |
| | | EOB | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER ENCOUNTERED AT 6.0' DURING DRILLING. HOLE DID NOT CAVE.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / J. HODGES | DRILL RIG: CME 55X | STATION / OFFSET: 284+07, 8' LT. |
| TYPE: EMBANKMENT FOUNDATION | SAMPLING FIRM / LOGGER: NEAS / J. HODGES | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 EB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 749.1 (MSL) EOB: 15.0 ft. |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 79 | LAT / LONG: 39.921978, -82.920668 |

EXPLORATION ID B-024-0-22

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| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| HARD, BROWN WITH TRACE GRAY MOTTLES, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP | 749.1 | | | | | | | | | | | | | | | | | | |
| | | 1 | 5 13 19 | 42 | 78 | SS-1 | 4.50 | 10 | 10 | 13 | 40 | 27 | 30 | 19 | 11 | 11 | A-6a (7) | - | |
| | 746.1 | 2 | | | | | | | | | | | | | | | | | |
| HARD, BROWN AND BROWNISH GRAY, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, DAMP | | 3 | | | | | | | | | | | | | | | | | |
| | | 4 | 8 12 12 | 32 | 61 | SS-2 | 4.50 | 19 | 12 | 16 | 33 | 20 | 26 | 16 | 10 | 16 | A-4a (4) | - | |
| | | 5 | | | | | | | | | | | | | | | | | |
| | | 6 | 5 6 7 | 17 | 100 | SS-3 | 4.50 | - | - | - | - | - | - | - | - | 11 | A-4a (V) | - | |
| | 741.1 | 7 | | | | | | | | | | | | | | | | | |
| VERY DENSE, GRAY, **STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE GRAVEL, DAMP | | 8 | | | | | | | | | | | | | | | | | |
| | | 9 | 19 26 32 | 76 | 100 | SS-4 | - | - | - | - | - | - | - | - | - | 5 | A-1-b (V) | - | |
| | | 10 | | | | | | | | | | | | | | | | | |
| | | 11 | 20 31 32 | 83 | 100 | SS-5 | - | - | - | - | - | - | - | - | - | 5 | A-1-b (V) | - | |
| | | 12 | | | | | | | | | | | | | | | | | |
| | | 13 | | | | | | | | | | | | | | | | | |
| | | 14 | 16 25 29 | 71 | 100 | SS-6 | - | - | - | - | - | - | - | - | - | 9 | A-1-b (V) | - | |
| | 734.1 | 15 | | | | | | | | | | | | | | | | | |
| | | EOB | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

| | | | | | |
|---|---|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / J. HODGES | DRILL RIG: CME 55X | STATION / OFFSET: 776+26, 14' RT. | EXPLORATION ID B-025-0-22 |
| TYPE: ROADWAY | SAMPLING FIRM / LOGGER: NEAS / L. ROSENBECK | HAMMER: CME AUTOMATIC | ALIGNMENT: WINCHESTER RAMP A | |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 755.4 (MSL) EOB: 10.0 ft. | PAGE 1 OF 1 |
| START: 3/29/23 END: 3/29/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 79 | LAT / LONG: 39.923956, -82.921774 | |

| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **4.0" TOPSOIL (DRILLERS DESCRIPTION)** | 755.4 / 755.1 | | | | | | | | | | | | | | | | | | |
| MEDIUM DENSE, BROWN, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP | | 1 | 7 6 7 | 17 | 89 | SS-1 | 4.50 | 11 | 12 | 20 | 36 | 21 | 23 | 15 | 8 | 14 | A-4a (4) | 13 | |
| | | 2 | | | | | | | | | | | | | | | | | |
| | | 3 | | | | | | | | | | | | | | | | | |
| @3.5'; SS-2 NO RECOVERY. ENCOUNTERED 3.0" ROCK WEDGED IN SPOON | | 4 | 3 7 9 | 21 | 0 | SS-2 | - | - | - | - | - | - | - | - | - | - | | - | |
| | | 5 | | | | | | | | | | | | | | | | | |
| | | 6 | | | | | | | | | | | | | | | | | |
| | | 7 | 3 4 4 | 11 | 72 | SS-3 | 4.50 | 11 | 12 | 17 | 37 | 23 | 26 | 16 | 10 | 15 | A-4a (5) | - | |
| | | 8 | | | | | | | | | | | | | | | | | |
| @9.0'; BECOMES GRAY | 745.4 | 9 | 6 6 7 | 17 | 89 | SS-4 | 3.75 | - | - | - | - | - | - | - | - | 12 | A-4a (V) | - | |
| | | EOB 10 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / J. HODGES | DRILL RIG: CME 55X | STATION / OFFSET: 780+12, 6' RT. |
| TYPE: ROADWAY | SAMPLING FIRM / LOGGER: NEAS / L. ROSENBECK | HAMMER: CME AUTOMATIC | ALIGNMENT: WINCHESTER RAMP A |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 748.6 (MSL) EOB: 10.0 ft. |
| START: 3/29/23 END: 3/29/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 79 | LAT / LONG: 39.923068, -82.921043 |

EXPLORATION ID B-026-0-22

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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 748.6 | | | | | | | | | | | | | | | | | | |
| **2.0" TOPSOIL (DRILLERS DESCRIPTION)** | 748.4 | | | | | | | | | | | | | | | | | | |
| VERY STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, DAMP | | 1 | 5 6 9 | 20 | 83 | SS-1 | 3.25 | 16 | 14 | 20 | 33 | 17 | 26 | 18 | 8 | 14 | A-4a (3) | 2767 | |
| | 744.6 | 2 | | | | | | | | | | | | | | | | | |
| DENSE TO VERY DENSE, BROWN AND GRAY, **GRAVEL WITH SAND**, SOME SILT, TRACE CLAY, DAMP | | 3 | 7 21 30 | 67 | 72 | SS-2 | - | - | - | - | - | - | - | - | - | 9 | A-1-b (V) | - | |
| | | 4 | | | | | | | | | | | | | | | | | |
| | | 5 | 18 26 29 | 72 | 67 | SS-3 | - | - | - | - | - | - | - | - | - | 8 | A-1-b (V) | - | |
| | | 6 | | | | | | | | | | | | | | | | | |
| | | 7 | 12 16 17 | 43 | 78 | SS-4 | - | - | - | - | - | - | - | - | - | 7 | A-1-b (V) | - | |
| | 738.6 | 8 | | | | | | | | | | | | | | | | | |
| | EOB | 9 | | | | | | | | | | | | | | | | | |
| | | 10 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 783+04, 25' RT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: WINCHESTER RAMP A |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 757.4 (MSL) EOB: 7.5 ft. |
| START: 3/28/23 END: 3/29/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.922304, -82.920727 |

EXPLORATION ID B-027-0-22

PAGE 1 OF 1

| MATERIAL DESCRIPTION AND NOTES | ELEV. 757.4 | DEPTHS | SPT/ RQD | $N_{60}$ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) GR | CS | FS | SI | CL | ATTERBERG LL | PL | PI | WC | ODOT CLASS (GI) | SO4 ppm | BACK FILL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2.5" ASPHALT AND 11.0" CONCRETE AND 4.5" BASE (DRILLERS DESCRIPTION)** | 755.9 | | | | | | | | | | | | | | | | | | |
| VERY STIFF, BROWN, **SILTY CLAY**, SOME SAND, TRACE TO LITTLE GRAVEL, MOIST TO DAMP | | 1–2–3–4–5–6–7 | 3 4 5 | 11 | 89 | SS-1 | 2.75 | 5 | 9 | 19 | 30 | 37 | 40 | 20 | 20 | 21 | A-6b (10) | 233 | |
| | | | 3 4 7 | 13 | 100 | SS-2 | 3.00 | - | - | - | - | - | - | - | - | 21 | A-6b (V) | - | |
| | 751.4 | | 4 7 12 | 23 | 94 | SS-3 | 2.25 | - | - | - | - | - | - | - | - | 20 | A-6b (V) | - | |
| HARD, BROWN AND GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, IRON STAINING, DAMP | 749.9 | EOB | 4 5 17 | 27 | 100 | SS-4 | 4.50 | 9 | 11 | 17 | 36 | 27 | 27 | 16 | 11 | 14 | A-6a (6) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. OFFSET TO SHOULDER.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 884+33, 10' RT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: WINCHESTER RAMP B |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 764.1 (MSL) EOB: 7.5 ft. |
| START: 3/29/23 END: 3/29/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.921748, -82.920301 |

EXPLORATION ID B-028-0-22

PAGE 1 OF 1

| MATERIAL DESCRIPTION AND NOTES | ELEV. 764.1 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2.5" ASPHALT AND 11.0" CONCRETE AND 4.5" BASE (DRILLERS DESCRIPTION)** | 762.6 | | | | | | | | | | | | | | | | | | |
| VERY STIFF TO HARD, BROWN AND GRAY, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, DAMP | | 1 | 6 5 5 | 12 | 50 | SS-1 | 4.50 | 8 | 11 | 18 | 36 | 27 | 28 | 17 | 11 | 15 | A-6a (6) | 120 | |
| | | 2 | 4 5 4 | 11 | 56 | SS-2 | 4.50 | - | - | - | - | - | - | - | - | 15 | A-6a (V) | - | |
| | | 3 | 2 3 5 | 10 | 83 | SS-3 | 2.75 | 9 | 10 | 17 | 34 | 30 | 30 | 17 | 13 | 16 | A-6a (7) | - | |
| | | 4 | 4 5 7 | 15 | 67 | SS-4 | 4.25 | - | - | - | - | - | - | - | - | 16 | A-6a (V) | - | |
| | 756.6 | 5 EOB | | | | | | | | | | | | | | | | | |
| | | 6 | | | | | | | | | | | | | | | | | |
| | | 7 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. OFFSET TO SHOULDER.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 166+91, 4' LT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 WB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 744.2 (MSL) EOB: 7.5 ft. |
| START: 3/22/23 END: 3/22/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.925995, -82.923030 |

EXPLORATION ID B-029-0-22

PAGE 1 OF 1

| MATERIAL DESCRIPTION AND NOTES | ELEV. 744.2 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **4.0" ASPHALT AND 8.0" CONCRETE AND 6.0" BASE (DRILLERS DESCRIPTION)** | 742.7 | | | | | | | | | | | | | | | | | | |
| DENSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, SS-1 CONTAINS CONCRETE FRAGMENTS, DAMP | 741.2 | | 13 16 20 | 44 | 50 | SS-1 | - | 42 | 14 | 12 | 22 | 10 | NP | NP | NP | 7 | A-2-4 (0) | 587 | |
| DENSE TO VERY DENSE, BROWN AND GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP TO MOIST | | | 17 16 15 | 38 | 56 | SS-2 | - | 47 | 22 | 11 | 15 | 5 | NP | NP | NP | 5 | A-1-b (0) | - | |
| | | | 13 25 20 | 54 | 22 | SS-3 | - | - | - | - | - | - | - | - | - | 10 | A-1-b (V) | - | |
| BECOMES WET | | W 737.2 | 5 13 24 | 45 | 33 | SS-4 | - | - | - | - | - | - | - | - | - | 11 | A-1-b (V) | - | |
| | 736.7 | EOB | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER ENCOUNTERED AT 7.0' DURING DRILLING. HOLE DID NOT CAVE. OFFSET 30' FROM CORE TO SHOULDER.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 169+97, 7' LT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 WB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 749.3 (MSL) EOB: 7.5 ft. |
| START: 3/21/23 END: 3/21/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.925314, -82.922394 |

EXPLORATION ID B-030-0-22



| MATERIAL DESCRIPTION AND NOTES | ELEV. 749.3 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **4.0" ASPHALT AND 7.0" CONCRETE AND 7.0" BASE (DRILLERS DESCRIPTION)** | 747.8 | 1 | | | | | | | | | | | | | | | | | |
| VERY STIFF TO HARD, GRAY, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, SS-1 CONTAINS NO INTACT SOIL FOR HP READINGS, DAMP | 744.7 | 2 3 4 | 5 10 15 | 30 | 56 | SS-1 | - | 27 | 14 | 15 | 27 | 17 | 24 | 16 | 8 | 9 | A-4a (2) | 913 | |
| | | | 7 12 14 | 31 | 78 | SS-2 | 4.50 | 32 | 16 | 15 | 24 | 13 | 22 | 16 | 6 | 8 | A-4a (0) | - | |
| DENSE TO VERY DENSE, BROWN AND GRAY, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP | 741.8 | 5 6 7 EOB | 7 18 22 | 48 | 56 | SS-3 | - | - | - | - | - | - | - | - | - | 8 | A-1-b (V) | - | |
| | | | 13 27 30 | 69 | 44 | SS-4 | - | - | - | - | - | - | - | - | - | 5 | A-1-b (V) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / J. HODGES | DRILL RIG: CME 55X | STATION / OFFSET: 873+91, 19' RT. |
| TYPE: ROADWAY | SAMPLING FIRM / LOGGER: NEAS / L. ROSENBECK | HAMMER: CME AUTOMATIC | ALIGNMENT: WINCHESTER RAMP B |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 752.4 (MSL) EOB: 10.0 ft. |
| START: 3/29/23 END: 3/29/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 79 | LAT / LONG: 39.924333, -82.921746 |

EXPLORATION ID B-031-0-22

PAGE 1 OF 1

| MATERIAL DESCRIPTION AND NOTES | ELEV. 752.4 | DEPTHS | SPT/ RQD | $N_{60}$ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) GR | CS | FS | SI | CL | ATTERBERG LL | PL | PI | WC | ODOT CLASS (GI) | SO4 ppm | BACK FILL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **5.0" TOPSOIL (DRILLERS DESCRIPTION)** | 752.0 | | | | | | | | | | | | | | | | | | |
| VERY STIFF TO HARD, BROWN, **SANDY SILT**, LITTLE TO SOME CLAY, TRACE TO LITTLE GRAVEL, DAMP | | 1 | 3 6 7 | 17 | 100 | SS-1 | 3.75 | 13 | 12 | 17 | 36 | 22 | 26 | 16 | 10 | 13 | A-4a (5) | - | |
| | | 2 | | | | | | | | | | | | | | | | | |
| | | 3 | | | | | | | | | | | | | | | | | |
| | | 4 | 4 8 9 | 22 | 67 | SS-2 | 4.50 | 16 | 17 | 17 | 31 | 19 | 24 | 15 | 9 | 10 | A-4a (3) | - | |
| | | 5 | | | | | | | | | | | | | | | | | |
| | | 6 | 7 9 11 | 26 | 89 | SS-3 | 4.50 | - | - | - | - | - | - | - | - | 11 | A-4a (V) | - | |
| | | 7 | | | | | | | | | | | | | | | | | |
| | | 8 | | | | | | | | | | | | | | | | | |
| | | 9 | 4 5 9 | 18 | 72 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 12 | A-4a (V) | - | |
| | 742.4 | EOB 10 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. OFFSET 4.0' WEST DUE TO TEMPORARY SNOW FENCE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / J. HODGES | DRILL RIG: CME 55X | STATION / OFFSET: 877+68, 2' LT. |
| TYPE: ROADWAY | SAMPLING FIRM / LOGGER: NEAS / L. ROSENBECK | HAMMER: CME AUTOMATIC | ALIGNMENT: WINCHESTER RAMP B |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 751.5 (MSL) EOB: 10.0 ft. |
| START: 3/29/23 END: 3/29/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 79 | LAT / LONG: 39.923496, -82.920958 |

EXPLORATION ID B-032-0-22

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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **2.0" TOPSOIL (DRILLERS DESCRIPTION)** | 751.5 | | | | | | | | | | | | | | | | | | |
| SOFT TO MEDIUM STIFF, BROWN, **SANDY SILT**, LITTLE CLAY, TRACE TO LITTLE GRAVEL, DAMP | 751.3 | 1 | 10 9 12 | 28 | 22 | SS-1 | 0.50 | - | - | - | - | - | - | - | - | 8 | A-4a (V) | 0 | |
| HARD, BROWN AND GRAY, **SANDY SILT**, SOME GRAVEL, LITTLE CLAY, CONTAINS NO INTACT SOIL FOR HP READINGS, DAMP @3.5'; SS-2 NO RECOVERY | 748.5 | 2 3 4 5 | 10 10 12 | 29 | 0 | SS-2 | - | - | - | - | - | - | - | - | - | - | | - | |
| VERY DENSE, BROWN AND GRAY, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP @7.5'; RIG CHATTER | 744.0 | 6 7 8 | 5 15 20 | 46 | 89 | SS-3 | - | 31 | 18 | 15 | 24 | 12 | 22 | 15 | 7 | 9 | A-4a (0) | - | |
| | 741.5 EOB | 9 10 | 14 30 32 | 82 | 72 | SS-4 | - | - | - | - | - | - | - | - | - | 7 | A-1-b (V) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

STANDARD ODOT LOG W/ SULFATES (8.5 X 11) - OH DOT.GDT - 5/10/23 13:04 - X:\ACTIVE PROJECTS\ACTIVE SOIL PROJECTS\FRA-33-21.71\GINT FILES\FRA-33-21.71.GPJ

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / J. HODGES | DRILL RIG: CME 55X | STATION / OFFSET: 881+79, 21' LT. |
| TYPE: ROADWAY | SAMPLING FIRM / LOGGER: NEAS / L. ROSENBECK | HAMMER: CME AUTOMATIC | ALIGNMENT: WINCHESTER RAMP B |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 747.3 (MSL) EOB: 10.0 ft. |
| START: 3/29/23 END: 3/29/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 79 | LAT / LONG: 39.922423, -82.920511 |

EXPLORATION ID B-033-0-22

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| 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 747.3 | | | | | | | | | | | | | | | | | | |
| **2.0" TOPSOIL (DRILLERS DESCRIPTION)** | 747.1 | | | | | | | | | | | | | | | | | | |
| HARD, BROWN, **SANDY SILT**, LITTLE GRAVEL, LITTLE CLAY, DAMP | 744.3 | 1 | 5 7 12 | 25 | 100 | SS-1 | 4.25 | 17 | 17 | 23 | 28 | 15 | 22 | 16 | 6 | 11 | A-4a (2) | 0 | |
| VERY DENSE, BROWN AND GRAY, **GRAVEL WITH SAND**, LITTLE TO SOME SILT, TRACE CLAY, DAMP | | 2 | | | | | | | | | | | | | | | | | |
| | | 3 | | | | | | | | | | | | | | | | | |
| | | 4 | 8 18 28 | 61 | 78 | SS-2 | - | - | - | - | - | - | - | - | - | 6 | A-1-b (V) | - | |
| | | 5 | | | | | | | | | | | | | | | | | |
| | | 6 | | | | | | | | | | | | | | | | | |
| | | 7 | 13 31 41 | 95 | 89 | SS-3 | - | 48 | 21 | 12 | 14 | 5 | NP | NP | NP | 5 | A-1-b (0) | - | |
| | | 8 | | | | | | | | | | | | | | | | | |
| | | 9 | | | | | | | | | | | | | | | | | |
| | 737.3 | EOB 10 | 5 29 37 | 87 | 83 | SS-4 | - | - | - | - | - | - | - | - | - | 8 | A-1-b (V) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: SHOVELED SOIL CUTTINGS

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 173+84, 5' LT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 WB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 751.6 (MSL) EOB: 7.5 ft. |
| START: 3/21/23 END: 3/21/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.924498, -82.921514 |

EXPLORATION ID B-034-0-22

PAGE 1 OF 1

| MATERIAL DESCRIPTION AND NOTES | ELEV. 751.6 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **4.0" ASPHALT AND 7.0" CONCRETE AND 7.0" BASE (DRILLERS DESCRIPTION)** | 750.1 | 1 | | | | | | | | | | | | | | | | | |
| DENSE, GRAY, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, CONTAINS CONCRETE FRAGMENTS, DAMP **(FILL)** | 747.1 | 2 | 10 16 16 | 39 | 89 | SS-1 | - | - | - | - | - | - | - | - | - | 10 | A-1-b (V) | 1920 | |
| | | 3 | 7 15 13 | 34 | 78 | SS-2 | - | 39 | 24 | 12 | 16 | 9 | NP | NP | NP | 8 | A-1-b (0) | - | |
| HARD, GRAY, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, DAMP | | 4 | 4 3 3 | 7 | 44 | SS-3 | 4.25 | 15 | 15 | 17 | 32 | 21 | 22 | 16 | 6 | 12 | A-4a (4) | - | |
| | 744.1 | 5 | 5 9 10 | 23 | 44 | SS-4 | 4.50 | - | - | - | - | - | - | - | - | 10 | A-4a (V) | - | |
| | | EOB 6 7 | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE. OFFSET 5.0' WEST.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 177+67, 6' LT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 WB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 751.9 (MSL) EOB: 7.5 ft. |
| START: 3/21/23 END: 3/21/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.923701, -82.920625 |

EXPLORATION ID B-035-0-22

PAGE 1 OF 1

| MATERIAL DESCRIPTION AND NOTES | ELEV. 751.9 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **4.0" ASPHALT AND 7.0" CONCRETE AND 7.0" BASE (DRILLERS DESCRIPTION)** | 750.4 | | | | | | | | | | | | | | | | | | |
| HARD, BROWNISH GRAY, **SANDY SILT**, LITTLE CLAY, LITTLE GRAVEL, DAMP | 747.1 | 1 | 13 20 16 | 44 | 67 | SS-1 | 4.50 | 20 | 12 | 18 | 33 | 17 | 23 | 16 | 7 | 9 | A-4a (3) | 260 | |
| | | 2 | 9 9 9 | 22 | 56 | SS-2 | 4.50 | 12 | 14 | 19 | 35 | 20 | 24 | 16 | 8 | 9 | A-4a (4) | - | |
| VERY DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP | 744.4 | 3 | 14 23 26 | 59 | 67 | SS-3 | - | - | - | - | - | - | - | - | - | 8 | A-1-b (V) | - | |
| | | 4 | 6 22 24 | 56 | 44 | SS-4 | - | - | - | - | - | - | - | - | - | 6 | A-1-b (V) | - | |
| | | 5 | | | | | | | | | | | | | | | | | |
| | | 6 | | | | | | | | | | | | | | | | | |
| | | 7 EOB | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 180+81, 5' LT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 WB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 751.7 (MSL) EOB: 7.5 ft. |
| START: 3/21/23 END: 3/21/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.922946, -82.920081 |

EXPLORATION ID B-036-0-22

PAGE 1 OF 1

| MATERIAL DESCRIPTION AND NOTES | ELEV. 751.7 | 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **3.0" ASPHALT AND 10.0" CONCRETE AND 5.0" BASE (DRILLERS DESCRIPTION)** | 750.2 | | | | | | | | | | | | | | | | | | |
| HARD, GRAY, **SANDY SILT**, LITTLE TO SOME GRAVEL, LITTLE CLAY, DAMP | 747.2 | 1 | 14 14 12 | 31 | 28 | SS-1 | 4.50 | - | - | - | - | - | - | - | - | 9 | A-4a (V) | 1007 | |
| | | 2 | 8 9 12 | 25 | 56 | SS-2 | 4.50 | 24 | 11 | 15 | 31 | 19 | 23 | 15 | 8 | 9 | A-4a (3) | - | |
| VERY DENSE, BROWN AND GRAY, **GRAVEL WITH SAND**, LITTLE SILT, TRACE CLAY, DAMP<br>SS-3 CONTAINS NO RECOVERY | 744.2 | 3 | 21 30 36 | 80 | 0 | SS-3 | - | - | - | - | - | - | - | - | - | - | | - | |
| | | 4 | 27 23 25 | 58 | 33 | SS-4 | - | 42 | 24 | 11 | 16 | 7 | NP | NP | NP | 6 | A-1-b (0) | - | |
| | | 5 | | | | | | | | | | | | | | | | | |
| | | 6 | | | | | | | | | | | | | | | | | |
| | | 7 | | | | | | | | | | | | | | | | | |
| | | EOB | | | | | | | | | | | | | | | | | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

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

| | | | |
|---|---|---|---|
| PROJECT: FRA-33-21.71 | DRILLING FIRM / OPERATOR: NEAS / JL | DRILL RIG: CME 45B | STATION / OFFSET: 183+77, 7' LT. |
| TYPE: SUBGRADE | SAMPLING FIRM / LOGGER: NEAS / JL | HAMMER: CME AUTOMATIC | ALIGNMENT: US-33 WB |
| PID: 113744 SFN: | DRILLING METHOD: 3.25" HSA | CALIBRATION DATE: 1/24/22 | ELEVATION: 750.4 (MSL) EOB: 7.5 ft. |
| START: 3/21/23 END: 3/21/23 | SAMPLING METHOD: SPT | ENERGY RATIO (%): 72.6 | LAT / LONG: 39.922149, -82.919865 |

EXPLORATION ID B-037-0-22



| MATERIAL DESCRIPTION AND NOTES | ELEV. 750.4 | DEPTHS | SPT/ RQD | $N_{60}$ | REC (%) | SAMPLE ID | HP (tsf) | GRADATION (%) GR | CS | FS | SI | CL | ATTERBERG LL | PL | PI | WC | ODOT CLASS (GI) | SO4 ppm | BACK FILL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **4.0" ASPHALT AND 8.0" CONCRETE AND 6.0" BASE (DRILLERS DESCRIPTION)** | 748.9 | 1 | | | | | | | | | | | | | | | | | |
| HARD, BROWN, **SANDY SILT**, LITTLE TO SOME CLAY, LITTLE TO SOME GRAVEL, DAMP | | 2 | 6 6 8 | 17 | 56 | SS-1 | 4.50 | 16 | 12 | 17 | 34 | 21 | 26 | 17 | 9 | 11 | A-4a (4) | 80 | |
| | | 3 | 5 8 7 | 18 | 22 | SS-2 | 4.50 | 23 | 12 | 15 | 30 | 20 | 27 | 17 | 10 | 10 | A-4a (3) | - | |
| SS-3 CONTAINED A 2.5" STONE FRAGMENT LODGED IN SPOON, NO INTACT SOIL FOR HP READINGS | 744.4 | 4 5 6 | 6 7 5 | 15 | 11 | SS-3 | - | - | - | - | - | - | - | - | - | 11 | A-4a (V) | - | |
| VERY DENSE, GRAY, **STONE FRAGMENTS**, LITTLE SAND, TRACE SILT, TRACE CLAY, DAMP | 742.9 | 7 EOB | 22 21 25 | 56 | 11 | SS-4 | - | - | - | - | - | - | - | - | - | 7 | A-1-a (V) | - | |

NOTES: GROUNDWATER NOT ENCOUNTERED DURING DRILLING. HOLE DID NOT CAVE.

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

# APPENDIX C

# PAVEMENT CORING LOGS

## Core Photo: X-001-0-22

| Core Information | | | | |
|---|---|---|---|---|
| **Core Diameter (in):** | | | **3.75** | |
| **Core Total Length (in):** | | | **10.5** | |
| Layers | Core Composition & Thickness (in) | | | Remarks/ Condition |
| | Asphalt | Concrete | Brick | |
| 1 | 4 | | | Good |
| 2 | 3 | | | Good |
| 3 | 3.5 | | | Good |
| 4 | | | | |
| Rebar Encountered | N/A | | | |

## Pavement & Core Photo Log

National Engineering & Architectural Services Inc.

**Roadway Project**

**FRA-33-21.71 (PID# 113744)**

| | |
|---|---|
| NEAS Project No.: | 22-0008 |
| Date: | 4/4/2023 |
| Taken By: | MK |
| Scale: | N/A |

# Core Photo: X-002-0-22

| Core Information | | | | |
|---|---|---|---|---|
| **Core Diameter (in):** | | | **3.75** | |
| **Core Total Length (in):** | | | **10.25** | |
| Layers | Core Composition & Thickness (in) | | | Remarks/ Condition |
| | Asphalt | Concrete | Brick | |
| 1 | 2.25 | | | Good |
| 2 | 1.75 | | | Good |
| 3 | 2.25 | | | Good |
| 4 | 4 | | | Good |
| Rebar Encountered | N/A | | | |

## Pavement & Core Photo Log

National Engineering & Architectural Services Inc.

**Roadway Project**

**FRA-33-21.71 (PID# 113744)**

| | |
|---|---|
| NEAS Project No.: | 22-0008 |
| Date: | 4/4/2023 |
| Taken By: | MK |
| Scale: | N/A |

## Core Photo: X-003-0-22

| Core Information | | | | |
|---|---|---|---|---|
| **Core Diameter (in):** | | | **3.75** | |
| **Core Total Length (in):** | | | **9** | |
| Layers | Core Composition & Thickness (in) | | | Remarks/ Condition |
| | Asphalt | Concrete | Brick | |
| 1 | 1.25 | | | Good |
| 2 | 4.25 | | | Good |
| 3 | 3.5 | | | Poor |
| 4 | | | | |
| Rebar Encountered | N/A | | | |

## Pavement & Core Photo Log

National Engineering & Architectural Services Inc.

**Roadway Project**

**FRA-33-21.71 (PID# 113744)**

| | |
|---|---|
| NEAS Project No.: | 22-0008 |
| Date: | 4/4/2023 |
| Taken By: | MK |
| Scale: | N/A |

## Core Photo: X-004-0-22

| Core Information | | | | |
|---|---|---|---|---|
| **Core Diameter (in):** | | | **3.75** | |
| **Core Total Length (in):** | | | **11.25** | |
| Layers | Core Composition & Thickness (in) | | | Remarks/ Condition |
| | Asphalt | Concrete | Brick | |
| 1 | 1.5 | | | Good |
| 2 | 3.75 | | | Good |
| 3 | 6 | | | Good |
| 4 | | | | |
| Rebar Encountered | N/A | | | |

## Pavement & Core Photo Log

National Engineering & Architectural Services Inc.

**Roadway Project**

**FRA-33-21.71 (PID# 113744)**

| | |
|---|---|
| NEAS Project No.: | 22-0008 |
| Date: | 4/4/2023 |
| Taken By: | MK |
| Scale: | N/A |

## Core Photo: X-005-0-22

| Core Information | | | | |
|---|---|---|---|---|
| **Core Diameter (in):** | | | **3.75** | |
| **Core Total Length (in):** | | | **12** | |
| Layers | Core Composition & Thickness (in) | | | Remarks/ Condition |
| | Asphalt | Concrete | Brick | |
| 1 | 2.5 | | | Good |
| 2 | 2 | | | Good |
| 3 | 3 | | | Good |
| 4 | 4.5 | | | Good |
| Rebar Encountered | N/A | | | |

## Pavement & Core Photo Log

National Engineering & Architectural Services Inc.

**Roadway Project**

**FRA-33-21.71 (PID# 113744)**

| | |
|---|---|
| NEAS Project No.: | 22-0008 |
| Date: | 4/4/2023 |
| Taken By: | MK |
| Scale: | N/A |

## Core Photo: X-006-0-22

| Core Information | | | | |
|---|---|---|---|---|
| **Core Diameter (in):** | | | **3.75** | |
| **Core Total Length (in):** | | | **13.25** | |
| Layers | Core Composition & Thickness (in) | | | Remarks/ Condition |
| | Asphalt | Concrete | Brick | |
| 1 | 1.5 | | | Good |
| 2 | 2.5 | | | Good |
| 3 | | 9.5 | | Good |
| 4 | | | | |
| Rebar Encountered | N/E | | | |

## Pavement & Core Photo Log

National Engineering & Architectural Services Inc.

**Roadway Project**

**FRA-33-21.71 (PID# 113744)**

| | |
|---|---|
| NEAS Project No.: | 22-0008 |
| Date: | 4/4/2023 |
| Taken By: | MK |
| Scale: | N/A |

## Core Photo: X-007-0-22

| Core Information | | | | |
|---|---|---|---|---|
| **Core Diameter (in):** | | | **3.75** | |
| **Core Total Length (in):** | | | **14** | |
| Layers | Core Composition & Thickness (in) | | | Remarks/ Condition |
| | Asphalt | Concrete | Brick | |
| 1 | 4.75 | | | Good |
| 2 | | 9.25 | | Good |
| 3 | | | | |
| 4 | | | | |
| Rebar Encountered | N/E | | | |

## Pavement & Core Photo Log

National Engineering & Architectural Services Inc.

**Roadway Project**

**FRA-33-21.71 (PID# 113744)**

| | |
|---|---|
| NEAS Project No.: | 22-0008 |
| Date: | 4/4/2023 |
| Taken By: | MK |
| Scale: | N/A |

## Core Photo: X-008-0-22

| Core Information | | | | |
|---|---|---|---|---|
| **Core Diameter (in):** | | | **3.75** | |
| **Core Total Length (in):** | | | **11.25** | |
| Layers | Core Composition & Thickness (in) | | | Remarks/ Condition |
| | Asphalt | Concrete | Brick | |
| 1 | 2.25 | | | Good |
| 2 | 4.75 | | | Good |
| 3 | 4.25 | | | Good |
| 4 | | | | |
| Rebar Encountered | N/A | | | |

## Pavement & Core Photo Log

National Engineering & Architectural Services Inc.

**Roadway Project**

**FRA-33-21.71 (PID# 113744)**

| | |
|---|---|
| NEAS Project No.: | 22-0008 |
| Date: | 4/4/2023 |
| Taken By: | MK |
| Scale: | N/A |

# APPENDIX D

# SULFATE CONTENT DATA

# OHIO DEPARTMENT OF TRANSPORTATION

## DETERMINING SULFATE CONTENT IN SOILS

## SUPPLEMENT 1122

| | |
|---|---|
| Project C-R-S: | FRA-33-21.71 |
| PID No: | 113744 |
| Report Date: | 5/10/2023 |
| Consultant: | NEAS Inc. |
| Technician: | L. Rosenbeck |

| Boring ID & Sample # | Station | Offset | Latitude & Longitude or State Plane Coordinates | | Elevation | Soaking Time (hr) | Replicate Sample Readings | | | | | | Sulfate Content (ppm) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 | | 2 | | 3 | | |
| | | | | | | | Dilution | Reading | Dilution | Reading | Dilution | Reading | |
| B-001-0-22 SS-1 | 14548.8 | 15.808RT | 39.931275 | -82.927257 | 755.09 | 22.3 | 20 | 5 | 20 | 4 | 20 | 5 | **93** |
| B-002-0-22 SS-1 | 14979.9 | 19.828LT | 39.930272 | -82.926431 | 758.55 | 22.3 | 20 | 2 | 20 | 2 | 20 | 4 | **53** |
| B-003-0-22 SS-1 | 27012.7 | 30.235RT | 39.926264 | -82.923754 | 741.68 | 22.3 | 20 | 17 | 20 | 14 | 20 | 15 | **307** |
| B-004-0-22 SS-1 | 57012.3 | 17.106RT | 39.925306 | -82.923114 | 750.09 | 21.6 | 20 | 25 | 20 | 28 | 20 | 28 | **540** |
| B-005-0-22 SS-1 | 57317.4 | 35.002RT | 39.924538 | -82.922707 | 758.46 | 21.6 | 20 | 16 | 20 | 12 | 20 | 16 | **293** |
| B-006-0-22 SS-1 | 57743.0 | 18.82RT | 39.923450 | -82.922184 | 766.81 | 18.5 | 20 | 18 | 20 | 19 | 20 | 18 | **367** |
| B-007-0-22 SS-1 | 58113.1 | 4.962RT | 39.922495 | -82.921724 | 768.94 | 18.4 | 20 | 19 | 20 | 19 | 20 | 19 | **380** |
| B-008-0-22 SS-1 | 58504.1 | 3.405RT | 39.921490 | -82.921236 | 766.10 | 18.5 | 40 | 25 | 40 | 24 | 40 | 22 | **947** |
| B-009-0-22 SS-1 | 58904.8 | 11.706RT | 39.920442 | -82.920822 | 756.57 | 18.5 | 20 | 20 | 20 | 19 | 20 | 18 | **380** |
| B-010-0-22 SS-1 | 59260.3 | 34.9LT | 39.919471 | -82.920556 | 748.69 | 18.5 | 20 | 32 | 20 | 32 | 20 | 32 | **640** |
| B-011-0-22 SS-1 | 59677.5 | 4.823RT | 39.918437 | -82.921224 | 751.96 | 18.5 | 20 | 12 | 20 | 12 | 20 | 12 | **240** |
| B-012-0-22 SS-1 | 60063.7 | 5.152RT | 39.918005 | -82.922426 | 752.78 | 18.5 | 20 | 3 | 20 | 3 | 20 | 3 | **60** |
| B-014-0-22 SS-1 | 43781.5 | 2.721RT | 39.923329 | -82.921793 | 774.40 | 18.4 | 20 | 25 | 20 | 25 | 20 | 24 | **493** |
| B-019-0-22 SS-1 | 29493.2 | 25.648RT | 39.919022 | -82.920511 | 745.83 | 18.4 | 20 | 33 | 20 | 34 | 20 | 33 | **667** |
| B-020-0-22 SS-1 | 29898.9 | 13.039RT | 39.917911 | -82.920583 | 743.80 | 22.2 | 20 | 8 | 20 | 9 | 20 | 8 | **167** |
| B-021-0-22 SS-1 | 30277.0 | 5.585RT | 39.916875 | -82.920681 | 743.34 | 20.1 | 20 | 5 | 20 | 5 | 20 | 5 | **100** |
| B-022-0-22 SS-1 | 30687.6 | 7.44RT | 39.915747 | -82.920712 | 743.93 | 20.1 | 20 | 5 | 20 | 5 | 20 | 5 | **100** |
| B-023-0-22 SS-1 | 28028.0 | 6.923LT | 39.922929 | -82.921215 | 751.37 | 20.1 | 20 | 8 | 20 | 8 | 20 | 8 | **160** |
| B-025-0-22 SS-1 | 77625.7 | 14.175RT | 39.923956 | -82.921774 | 755.39 | 17.0 | 20 | 2 | 20 | 0 | 20 | 0 | **13** |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B-026-0-22 SS-1 | 78012.3 | 6.271RT | 39.923068 | -82.921043 | 748.60 | 17.0 | 100 | 29 | 100 | 24 | 100 | 30 | **2767** |
| B-027-0-22 SS-1 | 78303.6 | 24.79RT | 39.922304 | -82.920727 | 757.42 | 20.1 | 20 | 13 | 20 | 13 | 20 | 9 | **233** |
| B-028-0-22 SS-1 | 88432.9 | 10.403RT | 39.921748 | -82.920301 | 764.12 | 21.9 | 20 | 6 | 20 | 6 | 20 | 6 | **120** |
| B-029-0-22 SS-1 | 16690.7 | 4.011LT | 39.925995 | -82.923030 | 744.15 | 22.0 | 20 | 31 | 20 | 28 | 20 | 29 | **587** |
| B-030-0-22 SS-1 | 16997.4 | 6.758LT | 39.925314 | -82.922394 | 749.28 | 21.9 | 20 | 46 | 20 | 48 | 20 | 43 | **913** |
| B-031-0-22 SS-1 | 87390.5 | 18.793RT | 39.924333 | -82.921746 | 752.35 | 17.0 | 100 | 73 | 100 | >80 | 100 | >80 | **>8000** |
| B-032-0-22 SS-1 | 87767.6 | 1.779LT | 39.923496 | -82.920958 | 751.49 | 17.0 | 20 | 0 | 20 | 0 | 20 | 0 | **0** |
| B-033-0-22 SS-1 | 88179.0 | 20.776LT | 39.922423 | -82.920511 | 747.31 | 17.0 | 20 | 0 | 20 | 0 | 20 | 0 | **0** |
| B-034-0-22 SS-1 | 17384.2 | 4.801LT | 39.924498 | -82.921514 | 751.56 | 22.1 | 40 | 52 | 40 | 46 | 40 | 46 | **1920** |
| B-035-0-22 SS-1 | 17766.7 | 6.332LT | 39.923701 | -82.920625 | 751.87 | 22.1 | 20 | 13 | 20 | 13 | 20 | 13 | **260** |
| B-036-0-22 SS-1 | 18080.8 | 5.097LT | 39.922946 | -82.920081 | 751.72 | 22.1 | 20 | 50 | 20 | 51 | 20 | 50 | **1007** |
| B-037-0-22 SS-1 | 18376.5 | 7.208LT | 39.922149 | -82.919865 | 750.44 | 22.1 | 20 | 4 | 20 | 4 | 20 | 4 | **80** |

# APPENDIX E

# GEOTECHNICAL BULLETIN 1 (GB1) ANALYSIS SPREADSHEETS

# 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-33-21.71**
**113744**

**Reconstruction & reconfiguration of US-33 interchange with James Rd & Winchester Pike w/ construction of R-cut intersection at Petzinger Rd & U-turns at each end**

**NEAS Inc.**

**Prepared By:** KCA
**Date prepared:** Monday, April 24, 2023

Brendan P. Andrews
2800 Corporate Exchange Drive, Suite 240
Columbus, OH 43231

(513) 337-9823
brendan.andrews@neasinc.com

**NO. OF BORINGS:** 32

| # | Boring ID | Alignment | Station | Offset | Dir | Drill Rig | ER | Boring EL. | Proposed Subgrade EL | Cut Fill |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | B-001-0-22 | US-33 | 145+49 | 16 | RT | CME 55X | 79 | 755.1 | 755.1 | 0.0 F |
| 2 | B-002-0-22 | US-33 | 149+80 | 20 | LT | CME 55X | 79 | 758.6 | 758.0 | 0.6 C |
| 3 | B-003-0-22 | US-33 EB | 270+13 | 30 | RT | CME 45B | 73 | 741.7 | 740.2 | 1.5 C |
| 4 | B-004-0-22 | Ramp 1 | 570+12 | 17 | RT | CME 45B | 73 | 750.1 | 748.6 | 1.5 C |
| 5 | B-005-0-22 | Ramp 1 | 573+17 | 35 | RT | CME 45B | 73 | 758.5 | 757.0 | 1.5 C |
| 6 | B-006-0-22 | Ramp 1 | 577+43 | 19 | RT | CME 45B | 73 | 766.8 | 765.3 | 1.5 C |
| 7 | B-007-0-22 | Ramp 1 | 581+13 | 5 | RT | CME 45B | 73 | 768.9 | 767.4 | 1.5 C |
| 8 | B-008-0-22 | Ramp 1 | 585+04 | 3 | RT | CME 45B | 73 | 766.1 | 764.6 | 1.5 C |
| 9 | B-009-0-22 | Ramp 1 | 589+05 | 12 | RT | CME 45B | 73 | 756.6 | 755.1 | 1.5 C |
| 10 | B-010-0-22 | Ramp 1 | 592+60 | 35 | LT | CME 45B | 73 | 748.7 | 747.2 | 1.5 C |
| 11 | B-011-0-22 | Ramp 1 | 596+77 | 5 | RT | CME 45B | 73 | 752.0 | 750.5 | 1.5 C |
| 12 | B-012-0-22 | Ramp 1 | 600+64 | 5 | RT | CME 45B | 73 | 752.8 | 751.3 | 1.5 C |
| 13 | B-013-0-22 | Ramp 1A | 398+64 | 15 | RT | CME 45B | 73 | 759.0 | 757.5 | 1.5 C |
| 14 | B-014-0-22 | Ramp 2 | 437+82 | 3 | RT | CME 45B | 73 | 774.4 | 772.9 | 1.5 C |
| 15 | B-019-0-22 | US-33 EB | 294+93 | 26 | RT | CME 45B | 73 | 745.8 | 744.3 | 1.5 C |
| 16 | B-020-0-22 | US-33 EB | 298+99 | 13 | RT | CME 45B | 73 | 743.8 | 742.3 | 1.5 C |
| 17 | B-021-0-22 | US-33 EB | 302+77 | 6 | RT | CME 45B | 73 | 743.3 | 741.8 | 1.5 C |
| 18 | B-022-0-22 | US-33 EB | 306+88 | 7 | RT | CME 45B | 73 | 743.9 | 742.4 | 1.5 C |
| 19 | B-023-0-22 | US-33 EB | 280+28 | 7 | LT | CME 45B | 73 | 751.4 | 749.9 | 1.5 C |
| 20 | B-025-0-22 | Winchester Ramp A | 776+26 | 14 | RT | CME 55X | 79 | 755.4 | 753.9 | 1.5 C |
| 21 | B-026-0-22 | Winchester Ramp A | 780+12 | 6 | RT | CME 55X | 79 | 748.6 | 747.1 | 1.5 C |
| 22 | B-027-0-22 | Winchester Ramp A | 783+04 | 25 | RT | CME 45B | 73 | 757.4 | 755.9 | 1.5 C |
| 23 | B-028-0-22 | Winchester Ramp B | 884+33 | 10 | RT | CME 45B | 73 | 764.1 | 762.6 | 1.5 C |
| 24 | B-029-0-22 | US-33 WB | 166+91 | 4 | LT | CME 45B | 73 | 744.2 | 742.7 | 1.5 C |
| 25 | B-030-0-22 | US-33 WB | 169+97 | 7 | LT | CME 45B | 73 | 749.3 | 747.8 | 1.5 C |
| 26 | B-031-0-22 | Winchester Ramp B | 873+90 | 19 | RT | CME 55X | 79 | 752.3 | 750.8 | 1.5 C |
| 27 | B-032-0-22 | Winchester Ramp B | 877+68 | 2 | LT | CME 55X | 79 | 751.5 | 750.0 | 1.5 C |
| 28 | B-033-0-22 | Winchester Ramp B | 881+79 | 21 | LT | CME 55X | 79 | 747.3 | 745.8 | 1.5 C |
| 29 | B-034-0-22 | US-33 WB | 173+84 | 5 | LT | CME 45B | 73 | 751.6 | 750.1 | 1.5 C |
| 30 | B-035-0-22 | US-33 WB | 177+67 | 6 | LT | CME 45B | 73 | 751.9 | 750.4 | 1.5 C |
| 31 | B-036-0-22 | US-33 WB | 180+81 | 5 | LT | CME 45B | 73 | 751.7 | 750.2 | 1.5 C |
| 32 | B-037-0-22 | US-33 WB | 183+76 | 7 | LT | CME 45B | 73 | 750.4 | 748.9 | 1.5 C |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 | 1.0 | 2.5 | 24 | | 4.5 | 30 | 18 | 12 | 38 | 30 | 68 | 14 | 14 | A-6a | 7 | 93 | | | | | |
| | 001-0 | SS-2 | 3.5 | 5.0 | 3.5 | 5.0 | 17 | | 4 | 25 | 17 | 8 | 41 | 20 | 61 | 15 | 12 | A-4a | 5 | | | | | | |
| | 22 | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | 17 | | | | | | | | | | | | | | | | | |
| 2 | B | SS-1 | 1.0 | 2.5 | 0.4 | 2.0 | 26 | | 4.5 | 24 | 16 | 8 | 37 | 21 | 58 | 14 | 11 | A-4a | 5 | 53 | | Mc | | | |
| | 002-0 | SS-2 | 3.5 | 5.0 | 3.0 | 4.5 | 17 | | 4.5 | 26 | 16 | 10 | 35 | 27 | 62 | 15 | 11 | A-4a | 5 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 5.5 | 7.0 | 12 | | 4.25 | | | | | | | 14 | 10 | A-4a | | | | | | | |
| | | SS-4 | | | | | | 12 | | | | | | | | | | | | | | | | | |
| 3 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 21 | | | | | | | | | 6 | 6 | A-1-a | 0 | 307 | | | | | |
| | 003-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 15 | | | NP | NP | NP | 8 | 4 | 12 | 6 | 6 | A-1-a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 12 | | | | | | | | | 10 | 6 | A-1-a | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 8 | 8 | | NP | NP | NP | 9 | 4 | 13 | 13 | 6 | A-1-a | 0 | | | | | | |
| 4 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 34 | | | | | | | | | 7 | 10 | A-2-4 | 0 | 540 | | | | | |
| | 004-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 41 | | | 24 | 15 | 9 | 27 | 16 | 43 | 9 | 10 | A-2-4 | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 29 | | | | | | | | | 7 | 10 | A-2-4 | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 41 | 29 | | NP | NP | NP | 21 | 11 | 32 | 7 | 10 | A-2-4 | 0 | | | | | | |
| 5 | B | SS-1 | 1.0 | 2.5 | -0.5 | 1.0 | 19 | | | | | | | | | 13 | 10 | A-2-4 | 0 | 293 | | Mc | | | |
| | 005-0 | SS-2 | 3.5 | 5.0 | 2.0 | 3.5 | 11 | | 2.5 | 32 | 17 | 15 | 27 | 27 | 54 | 17 | 14 | A-6a | 6 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 4.5 | 6.0 | 15 | | 3.75 | 33 | 19 | 14 | 36 | 32 | 68 | 17 | 14 | A-6a | 8 | | | | | | |
| | | | | | | | | 11 | | | | | | | | | | | | | | | | | |
| 6 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 27 | | | | | | | | | 8 | 10 | A-2-4 | 0 | 367 | | | | | |
| | 006-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 23 | | 4.5 | 25 | 16 | 9 | 32 | 19 | 51 | 10 | 11 | A-4a | 3 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 31 | | 4.5 | 26 | 16 | 10 | 23 | 14 | 37 | 8 | 11 | A-4a | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 19 | 19 | 4.5 | | | | | | | 10 | 10 | A-4a | 8 | | | | | | |
| 7 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 25 | | 4.5 | 26 | 16 | 10 | 24 | 17 | 41 | 8 | 11 | A-4a | 1 | 380 | | | | | |
| | 007-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 25 | | 4.5 | 26 | 16 | 10 | 24 | 17 | 41 | 10 | 11 | A-4a | 1 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 51 | | 4.5 | | | | | | | 13 | 10 | A-4a | 8 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 25 | 25 | 4.5 | | | | | | | 12 | 10 | A-4a | 8 | | | | | | |
| 8 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 24 | | | | | | | | | 6 | 6 | A-1-a | 0 | 947 | | | | | |
| | 008-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 12 | | 4.5 | 27 | 17 | 10 | 35 | 24 | 59 | 14 | 12 | A-4a | 5 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 19 | | 3 | 27 | 17 | 10 | 34 | 23 | 57 | 13 | 12 | A-4a | 4 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 27 | 12 | 4.5 | | | | | | | 12 | 10 | A-4a | 8 | | | | | | |
| 9 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 10 | | | | | | | | | 9 | 10 | A-2-4 | 0 | 380 | | $N_{60}$ | | 12" | |
| | 009-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 12 | | | | | | | | | 10 | 6 | A-1-a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 16 | | 3.25 | 26 | 16 | 10 | 51 | 14 | 65 | 12 | 11 | A-4b | 6 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 24 | 10 | 4.5 | 28 | 17 | 11 | 34 | 24 | 58 | 12 | 14 | A-6a | 5 | | | | | | |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 | |
| 10 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 19 | | 4.5 | 23 | 15 | 8 | 23 | 13 | 36 | 8 | 10 | A-4a | 0 | 640 | | | | | |
| | 010-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 22 | | 4.5 | | | | | | | 10 | 10 | A-4a | 8 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 17 | | 4.5 | | | | | | | 15 | 10 | A-4a | 8 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 22 | 17 | 3.5 | 28 | 17 | 11 | 31 | 22 | 53 | 13 | 12 | A-4a | 4 | | | | | | |
| 11 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 22 | | | | | | | | | 10 | 10 | A-2-4 | 0 | 240 | | | | | |
| | 011-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 16 | | 4.5 | 29 | 17 | 12 | 34 | 23 | 57 | 14 | 14 | A-6a | 5 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 11 | | | | | | | | | 9 | 10 | A-2-4 | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 21 | 11 | 1.5 | 27 | 17 | 10 | 33 | 20 | 53 | 15 | 12 | A-4a | 4 | | | | | | |
| 12 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 36 | | 4.5 | 25 | 16 | 9 | 23 | 13 | 36 | 9 | 11 | A-4a | 0 | 60 | | | | | |
| | 012-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 23 | | 4.5 | 28 | 17 | 11 | 29 | 23 | 52 | 12 | 14 | A-6a | 4 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 21 | | 4.5 | | | | | | | 10 | 14 | A-6a | 10 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 23 | 21 | 4.5 | | | | | | | 18 | 14 | A-6a | 10 | | | | | | |
| 13 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 12 | | 4.5 | 27 | 16 | 11 | 34 | 23 | 57 | 13 | 14 | A-6a | 5 | | | | | | |
| | 013-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 6 | | 3.5 | | | | | | | 24 | 14 | A-6a | 10 | | | $N_{60}$ & Mc | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 13 | | 3 | | | | | | | 14 | 14 | A-6a | 10 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 6 | 6 | 2.25 | 41 | 19 | 22 | 41 | 36 | 77 | 24 | 18 | A-7-6 | 13 | | | | | | |
| 14 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 16 | | 4.5 | NP | NP | NP | 20 | 15 | 35 | 9 | 10 | A-2-4 | 0 | 493 | | | | | |
| | 014-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 16 | | 4.5 | 31 | 17 | 14 | 30 | 25 | 55 | 14 | 14 | A-6a | 6 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 19 | | 4.25 | | | | | | | 10 | 14 | A-6a | 10 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 34 | 16 | 4.5 | | | | | | | 15 | 14 | A-6a | 10 | | | | | | |
| 15 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 12 | | 2.75 | | | | | | | 17 | 14 | A-6a | 10 | 667 | | $N_{60}$ & Mc | | **12"** | |
| | 019-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 18 | | 4.5 | 25 | 15 | 10 | 33 | 21 | 54 | 11 | 10 | A-4a | 4 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 13 | | 3.75 | 24 | 17 | 7 | 30 | 16 | 46 | 12 | 12 | A-4a | 2 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 27 | 12 | 4.5 | | | | | | | 13 | 10 | A-4a | 8 | | | | | | |
| 16 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 10 | | 4.5 | 31 | 16 | 15 | 29 | 23 | 52 | 14 | 14 | A-6a | 5 | 167 | | $N_{60}$ | | **12"** | |
| | 020-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 12 | | 4.5 | | | | | | | 17 | 14 | A-6a | 10 | | | $N_{60}$ & Mc | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 7 | | 4.25 | 27 | 16 | 11 | 28 | 21 | 49 | 14 | 14 | A-6a | 3 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 21 | 7 | 2.5 | | | | | | | 18 | 14 | A-6a | 10 | | | | | | |
| 17 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 15 | | | | | | | | | 9 | 6 | A-1-a | 0 | 100 | | | | | |
| | 021-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 11 | | | NP | NP | NP | 3 | 1 | 4 | 5 | 6 | A-1-a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 13 | | 4.5 | 32 | 20 | 12 | 27 | 24 | 51 | 17 | 15 | A-6a | 4 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 19 | 11 | 4.5 | | | | | | | 16 | 14 | A-6a | 10 | | | | | | |
| 18 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 15 | | | | | | | | | 8 | 6 | A-1-a | 0 | 100 | | | | | |
| | 022-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 12 | | | NP | NP | NP | 4 | 1 | 5 | 5 | 6 | A-1-a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 22 | | 3.5 | 27 | 16 | 11 | 32 | 22 | 54 | 13 | 14 | A-6a | 4 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 23 | 12 | | | | | | | | 10 | 6 | A-1-b | 0 | | | | | | |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 | |
| 19 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 16 | | | | | | | | | 9 | 6 | A-1-a | 0 | 160 | | | | | |
| | 023-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 6 | | | NP | NP | NP | 11 | 3 | 14 | 9 | 6 | A-1-a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 10 | | 3 | 21 | 14 | 7 | 31 | 18 | 49 | 12 | 10 | A-4a | 3 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 7 | 6 | 2.25 | | | | | | | 15 | 10 | A-4a | 8 | | | | | | |
| 20 | B | SS-1 | 1.0 | 2.5 | -0.5 | 1.0 | 17 | | 4.5 | 23 | 15 | 8 | 36 | 21 | 57 | 14 | 10 | A-4a | 4 | 13 | | Mc | | | |
| | 025-0 | SS-2 | 3.5 | 5.0 | 2.0 | 3.5 | 21 | | | | | | | | | | 10 | A-4a | 8 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 4.5 | 6.0 | 11 | | 4.5 | 26 | 16 | 10 | 37 | 23 | 60 | 15 | 11 | A-4a | 5 | | | | | | |
| | | | | | | | | 11 | | | | | | | | | | | | | | | | | |
| 21 | B | SS-1 | 1.0 | 2.5 | -0.5 | 1.0 | 20 | | 3.25 | 26 | 18 | 8 | 33 | 17 | 50 | 14 | 13 | A-4a | 3 | 2767 | | | | | |
| | 026-0 | SS-2 | 3.5 | 5.0 | 2.0 | 3.5 | 67 | | | | | | | | | 9 | 6 | A-1-b | 0 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 4.5 | 6.0 | 72 | | | | | | | | | 8 | 6 | A-1-b | 0 | | | | | | |
| | | | | | | | | 20 | | | | | | | | 7 | 6 | A-1-b | | | | | | | |
| 22 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 11 | | 2.75 | 40 | 20 | 20 | 30 | 37 | 67 | 21 | 16 | A-6b | 10 | 233 | | $N_{60}$ & Mc | | **12"** | |
| | 027-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 13 | | 3 | | | | | | | 21 | 16 | A-6b | 16 | | | $N_{60}$ & Mc | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 23 | | 2.25 | | | | | | | 20 | 16 | A-6b | 16 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 27 | 11 | 4.5 | 27 | 16 | 11 | 36 | 27 | 63 | 14 | 14 | A-6a | 6 | | | | | | |
| 23 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 12 | | 4.5 | 28 | 17 | 11 | 36 | 27 | 63 | 15 | 14 | A-6a | 6 | 120 | | | | | |
| | 028-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 11 | | 4.5 | | | | | | | 15 | 14 | A-6a | 10 | | | $N_{60}$ | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 10 | | 2.75 | 30 | 17 | 13 | 34 | 30 | 64 | 16 | 14 | A-6a | 7 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 15 | 10 | 4.25 | | | | | | | 16 | 14 | A-6a | 10 | | | | | | |
| 24 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.6 | 44 | | | NP | NP | NP | 22 | 10 | 32 | 7 | 10 | A-2-4 | 0 | 587 | | | | | |
| | 029-0 | SS-2 | 3.0 | 4.5 | 1.6 | 3.1 | 38 | | | NP | NP | NP | 15 | 5 | 20 | 5 | 6 | A-1-b | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.1 | 4.6 | 54 | | | | | | | | | 10 | 6 | A-1-b | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.6 | 6.1 | 45 | 30 | | | | | | | | 11 | 6 | A-1-b | 0 | | | | | | |
| 25 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 30 | | | 24 | 16 | 8 | 27 | 17 | 44 | 9 | 11 | A-4a | 2 | 913 | | | | | |
| | 030-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 31 | | 4.5 | 22 | 16 | 6 | 24 | 13 | 37 | 8 | 11 | A-4a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 48 | | | | | | | | | 8 | 6 | A-1-b | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 69 | 30 | | | | | | | | 5 | 6 | A-1-b | 0 | | | | | | |
| 26 | B | SS-1 | 1.0 | 2.5 | -0.5 | 1.0 | 17 | | 3.75 | 26 | 16 | 10 | 36 | 22 | 58 | 13 | 11 | A-4a | 5 | | | | | | |
| | 031-0 | SS-2 | 3.5 | 5.0 | 2.0 | 3.5 | 22 | | 4.5 | 24 | 15 | 9 | 31 | 19 | 50 | 10 | 10 | A-4a | 3 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 4.5 | 6.0 | 26 | | 4.5 | | | | | | | 11 | 10 | A-4a | 8 | | | | | | |
| | | | | | | | | 17 | | | | | | | | | | | | | | | | | |
| 27 | B | SS-1 | 1.0 | 2.5 | -0.5 | 1.0 | 28 | | | | | | | | | 8 | 10 | A-4a | 8 | 0 | | | | | |
| | 032-0 | SS-2 | 3.5 | 5.0 | 2.0 | 3.5 | 29 | | | | | | | | | | 10 | A-4a | 8 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 4.5 | 6.0 | 46 | | | 22 | 15 | 7 | 24 | 12 | 36 | 9 | 10 | A-4a | 0 | | | | | | |
| | | | | | | | | 28 | | | | | | | | | | | | | | | | | |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 | |
| 28 | B | SS-1 | 1.0 | 2.5 | -0.5 | 1.0 | 25 | | 4.25 | 22 | 16 | 6 | 28 | 15 | 43 | 11 | 11 | A-4a | 2 | 0 | | | | | |
| | 033-0 | SS-2 | 3.5 | 5.0 | 2.0 | 3.5 | 61 | | | | | | | | | 6 | 6 | A-1-b | 0 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 4.5 | 6.0 | 95 | | | NP | NP | NP | 14 | 5 | 19 | 5 | 6 | A-1-b | 0 | | | | | | |
| | | | | | | | | 25 | | | | | | | | | | | | | | | | | |
| 29 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 39 | | | | | | | | | 10 | 6 | A-1-b | 0 | 1920 | | | | | |
| | 034-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 34 | | | NP | NP | NP | 16 | 9 | 25 | 8 | 6 | A-1-b | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 7 | | 4.25 | 22 | 16 | 6 | 32 | 21 | 53 | 12 | 11 | A-4a | 4 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 23 | 7 | 4.5 | | | | | | | 10 | 10 | A-4a | 8 | | | | | | |
| 30 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 44 | | 4.5 | 23 | 16 | 7 | 33 | 17 | 50 | 9 | 11 | A-4a | 3 | 260 | | | | | |
| | 035-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 22 | | 4.5 | 24 | 16 | 8 | 35 | 20 | 55 | 9 | 11 | A-4a | 4 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 59 | | | | | | | | | 8 | 6 | A-1-b | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 56 | 22 | | | | | | | | 6 | 6 | A-1-b | 0 | | | | | | |
| 31 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 31 | | 4.5 | | | | | | | 9 | 10 | A-4a | 8 | 1007 | | | | | |
| | 036-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 25 | | 4.5 | 23 | 15 | 8 | 31 | 19 | 50 | 9 | 10 | A-4a | 3 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 80 | | | | | | | | | | | | | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 58 | 25 | | NP | NP | NP | 16 | 7 | 23 | 6 | 6 | A-1-b | 0 | | | | | | |
| 32 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 17 | | 4.5 | 26 | 17 | 9 | 34 | 21 | 55 | 11 | 12 | A-4a | 4 | 80 | | | | | |
| | 037-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 18 | | 4.5 | 27 | 17 | 10 | 30 | 20 | 50 | 10 | 12 | A-4a | 3 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 15 | | | | | | | | | 11 | 10 | A-4a | 8 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 56 | 15 | | | | | | | | 7 | 6 | A-1-a | 0 | | | | | | |

**PID:** 113744

**County-Route-Section:** FRA-33-21.71

**No. of Borings:** 32

**Geotechnical Consultant:** NEAS Inc.

**Prepared By:** KCA

**Date prepared:** 4/24/2023

| Chemical Stabilization Options | | |
|---|---|---|
| 320 | Rubblize & Roll | Option |
| 206 | Cement Stabilization | Option |
| | Lime Stabilization | No |
| 206 | Depth | NA |

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

| Design CBR | 8 |
|---|---|

| % Samples within 6 feet of subgrade | | | |
|---|---|---|---|
| $N_{60} \leq 5$ | 0% | HP ≤ 0.5 | 0% |
| $N_{60} < 12$ | 14% | 0.5 < HP ≤ 1 | 0% |
| $12 \leq N_{60} < 15$ | 11% | 1 < HP ≤ 2 | 1% |
| $N_{60} \geq 20$ | 54% | HP > 2 | 61% |
| M+ | 7% | | |
| Rock | 0% | | |
| Unsuitable | 1% | | |

| Excavate and Replace at Surface | |
|---|---|
| Average | 0" |
| Maximum | 0" |
| Minimum | 0" |

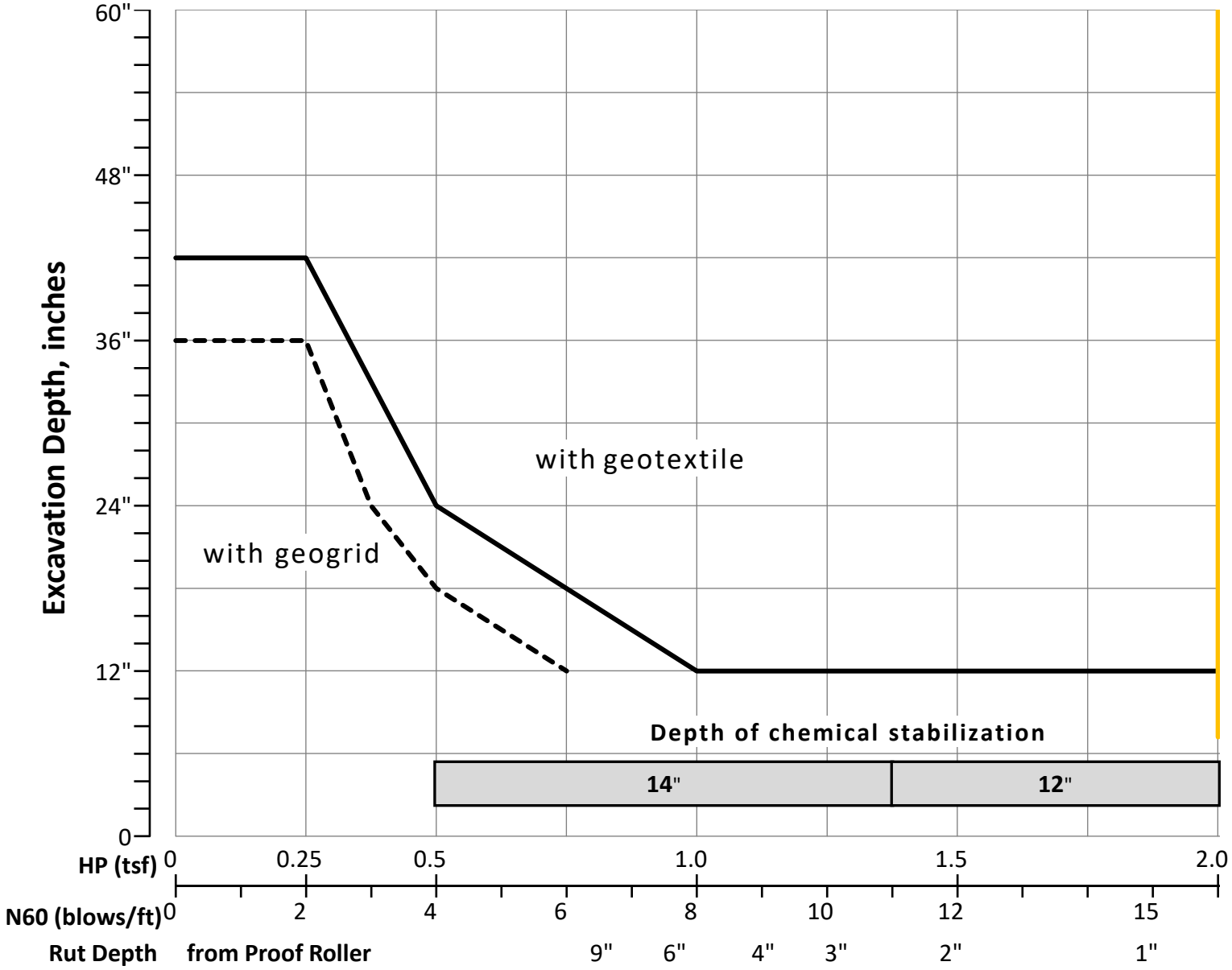
| % Proposed Subgrade Surface | |
|---|---|
| Unstable & Unsuitable | 18% |
| Unstable | 18% |
| Unsuitable | 0% |

| | $N_{60}$ | $N_{60L}$ | HP | LL | PL | PI | Silt | Clay | P 200 | $M_C$ | $M_{OPT}$ | GI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 25 | 16 | 4.03 | 27 | 16 | 10 | 28 | 18 | 47 | 11 | 10 | 4 |
| Maximum | 95 | 30 | 4.50 | 41 | 20 | 22 | 51 | 37 | 77 | 24 | 18 | 16 |
| Minimum | 6 | 6 | 1.50 | 21 | 14 | 6 | 3 | 1 | 4 | 5 | 6 | 0 |

**Classification Counts by Sample**

| ODOT Class | 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 | 13 | 15 | 11 | 0 | 0 | 0 | 0 | 0 | 47 | 1 | 0 | 27 | 3 | 0 | 1 | 0 | 0 | 118 |
| Percent | 0% | 11% | 13% | 9% | 0% | 0% | 0% | 0% | 0% | 40% | 1% | 0% | 23% | 3% | 0% | 1% | 0% | 0% | 100% |
| % Rock\|Granular\|Cohesive | 0% | 73% | | | | | | | | | 27% | | | | | | | | 100% |
| Surface Class Count | 0 | 10 | 5 | 8 | 0 | 0 | 0 | 0 | 0 | 25 | 0 | 0 | 12 | 2 | 0 | 0 | 0 | 0 | 62 |
| Surface Class Percent | 0% | 16% | 8% | 13% | 0% | 0% | 0% | 0% | 0% | 40% | 0% | 0% | 19% | 3% | 0% | 0% | 0% | 0% | 100% |

**Fig. 600-1 – Subgrade Stabilization**




OVERRIDE TABLE

| Calculated Average | New Values | Check to Override |
|---|---|---|
| 4.03 | 0.50 | ☐ HP |
| 16.03 | 6.00 | ☐ N60L |

Average HP
Average $N_{60L}$

The subgrade analysis workbook consists of five worksheets. Each worksheet functions independently. In all of the worksheets the fields are color coded as follows:

- Every yellow highlighted field indicates a field to be entered by the user.
- Every salmon field is to indicate a problem/issue.
- Every gray or green field is a heading/informational field.

**IMPORTANT:** The sequence of filling out the data needs to be followed as outlined below:

1. Cover Sheet: this worksheet is designed for the purpose of entering the project information. Enter all the following fields:

| | |
|---|---|
| County-Route-Section | This includes the county, route, section number assigned to the project. |
| PID | the Project Identification Number |
| Project Description | See Cover Sheet for list of example details |
| Geotechnical Consultant | The Geotechnical Consultant performing the analysis. |
| Prepared By | The preparer of the subgrade analysis |
| Date prepared | The date the analysis is performed. |
| Contact Information | Name, address, telephone #, and email address |
| No. of Borings | Enter the total number of borings within the alignment that is being analyzed. |

2. Boring Logs Entry Worksheet: this worksheet has a programming code that will run in the background every time the sheet is activated and will make the sheet unresponsive for less than a minute. The code is designed to read the total number of borings from the cover sheet and generate the needed number of fields.
    a. All yellow highlighted fields are user's entry.
    b. ODOT has developed a text table export from gINT *(GB 1 Borings Log Entry Tab)* that will allow for copy and paste of all highlighted fields with the exception of proposed subgrade elevation. The designer must provide a proposed subgrade elevation in order for the spreadsheet to function properly.
    c. The Cut/Fill field is a calculated field that, based on the difference between the boring elevation and the proposed subgrade elevation, will highlight the cell either gray and adds the letter "C" to the end in a cut situation or highlights the cell in light purple and adds the letter "F" to the end in a fill situation.
    d. Every duplicate boring ID will be highlighted in salmon background and red text.
    e. **IMPORTANT**: <u>After</u> entering all the borings' information, the user must click "Add Subgrade Analysis Entry Fields" button. This will generate all the required fields in the "Subgrade Analysis" Worksheet.

3. Subgrade Analysis Worksheet:
    a. The boring number and boring ID is read from the "Boring Logs Entry Worksheet" excluding every boring that has six feet or more of fill.
    b. All yellow highlighted fields are to be entered by the user and salmon highlighted fields indicates a problem or issue.
    c. Every sample that has a Sulfate Content greater than or equal to 3000 will be highlighted in light salmon background. Every sample that has a Sulfate Content greater than or equal to 8000 will be highlighted in darker salmon background. Refer to Section 605 of the Geotechnical Design Manual for the latest guidance regarding high sulfate soils.

d. Unsuitable/Unstable:

i. Unsuitable samples that are within 3 feet of the top of subgrade will be highlighted with salmon background and the class will be showing in this field.

ii. Unstable Samples that are within 3 feet of top of subgrade will be highlighted with salmon background and text to indicate the problem as follows:

| Criterion | Stabilization Need Check | Text displayed in the field |
|---|---|---|
| A-1-a, A-1-b, A-3, or A-3a Soil Class | No Stabilization is needed | |
| HP ≥ 1.875 | No Stabilization is needed | |
| $N_{60}$ ≥ 15 | No Stabilization is needed | |
| 1.875 ≥ HP ≥ 1.5 and $M_c$≥ Opt. $M_c$+3 | Unstable Subgrade | HP & Mc |
| 15 ≥ $N_{60}$ ≥ 12 and $M_c$≥ Opt. $M_c$+3 | Unstable Subgrade | $N_{60}$ & Mc |
| HP ≤ 1.5 | Unstable Subgrade | HP |
| $N_{60}$ ≤ 12 | Unstable Subgrade | $N_{60}$ |

iii. The field is formulated to check for HP first and check for $N_{60}$ second.

e. Excavate and Replace (Item 204) is going to be calculated based on the subgrade depth for each sample indicating an unsuitable or unstable problem.

f. Recommendation:

i. Geotextile Option is calculated and rounded to a multiple of 3 inches based on the subgrade depth for every sample indicating an unsuitable or unstable problem.

ii. GEOGRID Option is only offered in case of unstable subgrade problem and if the geotextile option indicates the need to excavate greater than 12 inches.

**PLEASE NOTE: The Problem, Excavate & Replace, and Recommendation Fields are the responsibility of the Designer. These fields are being enhanced to attempt to capture the ODOT philosophy regarding the subgrade stabilization chart, but are considered still under development. If there are discrepancies between the spreadsheet output and the stabilization chart - the chart governs in conjunction with engineering judgement. Please contact Steve Taliaferro at stephen.taliaferro@dot.ohio.gov if you have any questions.**

**PLEASE NOTE: It is the Designer's responsibility to identify the most representative data when samples have been separated into multiple specimen (say 1.5 to 2.3 feet and 2.3 to 3.0 feet). The spreadsheet is not capable at this time of addressing this issue within a direct data export from gINT.**

4. Results Summary:
All fields in this sheet are password protected and are either calculated or read from the other worksheets.

5. Graph Worksheet:
This worksheet is designed to read the average $N_{60L}$ and the average HP from the Cover Sheet and plot a blue line for Average HP and orange line for Average $N_{60L}$ on GDM Figure 600-1 – Subgrade Stabilization. The Override Table can be used to enter HP and/or $N_{60L}$ values that are different than the calculated averages. The Override values will change the global undercut recommendation in the Results Summary.

# US-33 WESTBOUND

# 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-33-21.71**
**113744**

**Reconstruction & reconfiguration of US-33 interchange with James Rd & Winchester Pike w/ construction of R-cut intersection at Petzinger Rd & U-turns at each end**

**NEAS Inc.**

**Prepared By:** KCA
**Date prepared:** Monday, April 24, 2023

Brendan P. Andrews
2800 Corporate Exchange Drive, Suite 240
Columbus, OH 43231

(513) 337-9823
brendan.andrews@neasinc.com

**NO. OF BORINGS:** 6

| # | Boring ID | Alignment | Station | Offset | Dir | Drill Rig | ER | Boring EL. | Proposed Subgrade EL | Cut Fill |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | B-029-0-22 | US-33 WB | 166+91 | 4 | LT | CME 45B | 73 | 744.2 | 742.8 | 1.4 C |
| 2 | B-030-0-22 | US-33 WB | 169+97 | 7 | LT | CME 45B | 73 | 749.3 | 748.0 | 1.3 C |
| 3 | B-034-0-22 | US-33 WB | 173+84 | 5 | LT | CME 45B | 73 | 751.6 | 750.7 | 0.9 C |
| 4 | B-035-0-22 | US-33 WB | 177+67 | 6 | LT | CME 45B | 73 | 751.9 | 750.0 | 1.9 C |
| 5 | B-036-0-22 | US-33 WB | 180+81 | 5 | LT | CME 45B | 73 | 751.7 | 750.2 | 1.5 C |
| 6 | B-037-0-22 | US-33 WB | 183+76 | 7 | LT | CME 45B | 73 | 750.4 | 748.9 | 1.5 C |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 | 44 | | | NP | NP | NP | 22 | 10 | 32 | 7 | 10 | A-2-4 | 0 | 587 | | | | | |
| | 029-0 | SS-2 | 3.0 | 4.5 | 1.6 | 3.1 | 38 | | | NP | NP | NP | 15 | 5 | 20 | 5 | 6 | A-1-b | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.1 | 4.6 | 54 | | | | | | | | | 10 | 6 | A-1-b | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.6 | 6.1 | 45 | 30 | | | | | | | | 11 | 6 | A-1-b | 0 | | | | | | |
| 2 | B | SS-1 | 1.5 | 3.0 | 0.2 | 1.7 | 30 | | | 24 | 16 | 8 | 27 | 17 | 44 | 9 | 11 | A-4a | 2 | 913 | | | | | |
| | 030-0 | SS-2 | 3.0 | 4.5 | 1.7 | 3.2 | 31 | | 4.5 | 22 | 16 | 6 | 24 | 13 | 37 | 8 | 11 | A-4a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.2 | 4.7 | 48 | | | | | | | | | 8 | 6 | A-1-b | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.7 | 6.2 | 69 | 30 | | | | | | | | 5 | 6 | A-1-b | 0 | | | | | | |
| 3 | B | SS-1 | 1.5 | 3.0 | 0.6 | 2.1 | 39 | | | | | | | | | 10 | 6 | A-1-b | 0 | 1920 | | | | | |
| | 034-0 | SS-2 | 3.0 | 4.5 | 2.1 | 3.6 | 34 | | | NP | NP | NP | 16 | 9 | 25 | 8 | 6 | A-1-b | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.6 | 5.1 | 7 | | 4.25 | 22 | 16 | 6 | 32 | 21 | 53 | 12 | 11 | A-4a | 4 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 5.1 | 6.6 | 23 | 7 | 4.5 | | | | | | | 10 | 10 | A-4a | | | | | | | |
| 4 | B | SS-1 | 1.5 | 3.0 | -0.4 | 1.1 | 44 | | 4.5 | 23 | 16 | 7 | 33 | 17 | 50 | 9 | 11 | A-4a | 3 | 260 | | | | | |
| | 035-0 | SS-2 | 3.0 | 4.5 | 1.1 | 2.6 | 22 | | 4.5 | 24 | 16 | 8 | 35 | 20 | 55 | 9 | 11 | A-4a | 4 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 2.6 | 4.1 | 59 | | | | | | | | | 8 | 6 | A-1-b | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.1 | 5.6 | 56 | 22 | | | | | | | | 6 | 6 | A-1-b | 0 | | | | | | |
| 5 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 31 | | 4.5 | | | | | | | 9 | 10 | A-4a | 8 | 1007 | | | | | |
| | 036-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 25 | | 4.5 | 23 | 15 | 8 | 31 | 19 | 50 | 9 | 10 | A-4a | 3 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 80 | | | | | | | | | | | | | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 58 | 25 | | NP | NP | NP | 16 | 7 | 23 | 6 | 6 | A-1-b | 0 | | | | | | |
| 6 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 17 | | 4.5 | 26 | 17 | 9 | 34 | 21 | 55 | 11 | 12 | A-4a | 4 | 80 | | | | | |
| | 037-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 18 | | 4.5 | 27 | 17 | 10 | 30 | 20 | 50 | 10 | 12 | A-4a | 3 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 15 | | | | | | | | | 11 | 10 | A-4a | 8 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 56 | 15 | | | | | | | | 7 | 6 | A-1-a | 0 | | | | | | |

**PID:** 113744

**County-Route-Section:** FRA-33-21.71

**No. of Borings:** 6

**Geotechnical Consultant:** NEAS Inc.

**Prepared By:** KCA

**Date prepared:** 4/24/2023

| Chemical Stabilization Options | | |
|---|---|---|
| 320 | Rubblize & Roll | Option |
| 206 | Cement Stabilization | Option |
| | Lime Stabilization | No |
| 206 | Depth | NA |

| Excavate and Replace Stabilization Options | |
|---|---|
| Global Geotextile Average(N60L): | 0" |
| Average(HP): | 0" |
| Global Geogrid Average(N60L): | 0" |
| Average(HP): | 0" |

| Design CBR | 11 |
|---|---|

| % Samples within 6 feet of subgrade | | | |
|---|---|---|---|
| $N_{60} \leq 5$ | 0% | HP ≤ 0.5 | 0% |
| $N_{60} < 12$ | 4% | 0.5 < HP ≤ 1 | 0% |
| $12 \leq N_{60} < 15$ | 0% | 1 < HP ≤ 2 | 0% |
| $N_{60} \geq 20$ | 83% | HP > 2 | 38% |
| M+ | 0% | | |
| Rock | 0% | | |
| Unsuitable | 0% | | |

| Excavate and Replace at Surface | |
|---|---|
| Average | 0" |
| Maximum | 0" |
| Minimum | 0" |

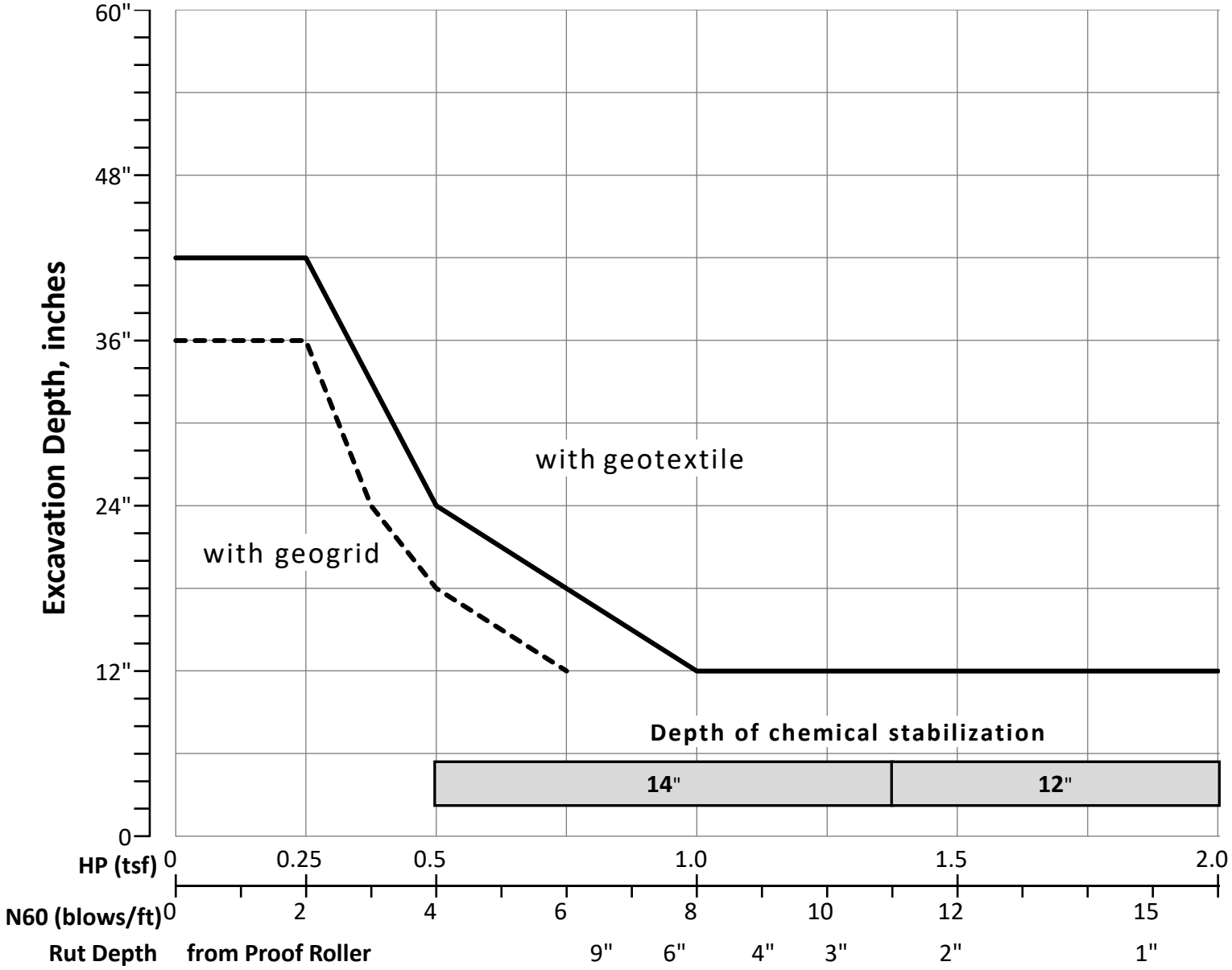
| % Proposed Subgrade Surface | |
|---|---|
| Unstable & Unsuitable | 0% |
| Unstable | 0% |
| Unsuitable | 0% |

| | $N_{60}$ | $N_{60L}$ | HP | LL | PL | PI | Silt | Clay | P 200 | $M_C$ | $M_{OPT}$ | GI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 39 | 22 | 4.47 | 24 | 16 | 8 | 26 | 15 | 41 | 9 | 8 | 2 |
| Maximum | 80 | 30 | 4.50 | 27 | 17 | 10 | 35 | 21 | 55 | 12 | 12 | 8 |
| Minimum | 7 | 7 | 4.25 | 22 | 15 | 6 | 15 | 5 | 20 | 5 | 6 | 0 |

**Classification Counts by Sample**

| ODOT Class | 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 | 1 | 10 | 1 | 0 | 0 | 0 | 0 | 0 | 11 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 23 |
| Percent | 0% | 4% | 43% | 4% | 0% | 0% | 0% | 0% | 0% | 48% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| % Rock\|Granular\|Cohesive | 0% | 100% | | | | | | | | | 0% | | | | | | | | 100% |
| Surface Class Count | 0 | 0 | 4 | 1 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 13 |
| Surface Class Percent | 0% | 0% | 31% | 8% | 0% | 0% | 0% | 0% | 0% | 62% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |

**Fig. 600-1 – Subgrade Stabilization**




OVERRIDE TABLE

| Calculated Average | New Values | Check to Override |
|---|---|---|
| 4.47 | 0.50 | ☐ HP |
| 21.50 | 6.00 | ☐ N60L |

Average HP
Average $N_{60L}$

# US-33 EASTBOUND

# 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-33-21.71**
**113744**

**Reconstruction & reconfiguration of US-33 interchange with James Rd & Winchester Pike w/ construction of R-cut intersection at Petzinger Rd & U-turns at each end**

**NEAS Inc.**

**Prepared By:** KCA
**Date prepared:** Monday, April 24, 2023

Brendan P. Andrews
2800 Corporate Exchange Drive, Suite 240
Columbus, OH 43231

(513) 337-9823
brendan.andrews@neasinc.com

**NO. OF BORINGS:** 8

| # | Boring ID | Alignment | Station | Offset | Dir | Drill Rig | ER | Boring EL. | Proposed Subgrade EL | Cut Fill |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | B-003-0-22 | US-33 EB | 270+13 | 30 | RT | CME 45B | 73 | 741.7 | 740.2 | 1.5 C |
| 2 | B-004-0-22 | Ramp 1 | 570+12 | 17 | RT | CME 45B | 73 | 750.1 | 748.6 | 1.5 C |
| 3 | B-025-0-22 | Winchester Ramp A | 776+26 | 14 | RT | CME 55X | 79 | 755.4 | 753.4 | 2.0 C |
| 4 | B-023-0-22 | US-33 EB | 280+28 | 7 | LT | CME 45B | 73 | 751.4 | 750.3 | 1.1 C |
| 5 | B-019-0-22 | US-33 EB | 294+93 | 26 | RT | CME 45B | 73 | 745.8 | 745.7 | 0.1 C |
| 6 | B-020-0-22 | US-33 EB | 298+99 | 13 | RT | CME 45B | 73 | 743.8 | 742.1 | 1.7 C |
| 7 | B-021-0-22 | US-33 EB | 302+77 | 6 | RT | CME 45B | 73 | 743.3 | 741.8 | 1.5 C |
| 8 | B-022-0-22 | US-33 EB | 306+88 | 7 | RT | CME 45B | 73 | 743.9 | 742.4 | 1.5 C |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 | 0.0 | 1.5 | 21 | | | | | | | | | 6 | 6 | A-1-a | 0 | 307 | | | | | |
| | 003-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 15 | | | NP | NP | NP | 8 | 4 | 12 | 6 | 6 | A-1-a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 12 | | | | | | | | | 10 | 6 | A-1-a | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 8 | 8 | | NP | NP | NP | 9 | 4 | 13 | 13 | 6 | A-1-a | 0 | | | | | | |
| 2 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 34 | | | | | | | | | 7 | 10 | A-2-4 | 0 | 540 | | | | | |
| | 004-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 41 | | | 24 | 15 | 9 | 27 | 16 | 43 | 9 | 10 | A-2-4 | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 29 | | | | | | | | | 7 | 10 | A-2-4 | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 41 | 29 | | NP | NP | NP | 21 | 11 | 32 | 7 | 10 | A-2-4 | 0 | | | | | | |
| 3 | B | SS-1 | 1.0 | 2.5 | -1.0 | 0.5 | 17 | | 4.5 | 23 | 15 | 8 | 36 | 21 | 57 | 14 | 10 | A-4a | 4 | 13 | | Mc | | | |
| | 025-0 | SS-2 | 3.5 | 5.0 | 1.5 | 3.0 | 21 | | | | | | | | | | 10 | A-4a | 8 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 4.0 | 5.5 | 11 | | 4.5 | 26 | 16 | 10 | 37 | 23 | 60 | 15 | 11 | A-4a | 5 | | | | | | |
| | | | | | | | | 11 | | | | | | | | | | | | | | | | | |
| 4 | B | SS-1 | 1.5 | 3.0 | 0.4 | 1.9 | 16 | | | | | | | | | 9 | 6 | A-1-a | 0 | 160 | | | | | |
| | 023-0 | SS-2 | 3.0 | 4.5 | 1.9 | 3.4 | 6 | | | NP | NP | NP | 11 | 3 | 14 | 9 | 6 | A-1-a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.4 | 4.9 | 10 | | 3 | 21 | 14 | 7 | 31 | 18 | 49 | 12 | 10 | A-4a | 3 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.9 | 6.4 | 7 | 6 | 2.25 | | | | | | | 15 | 10 | A-4a | 8 | | | | | | |
| 5 | B | SS-1 | 1.5 | 3.0 | 1.4 | 2.9 | 12 | | 2.75 | | | | | | | 17 | 14 | A-6a | 10 | 667 | | $N_{60}$ & Mc | | | |
| | 019-0 | SS-2 | 3.0 | 4.5 | 2.9 | 4.4 | 18 | | 4.5 | 25 | 15 | 10 | 33 | 21 | 54 | 11 | 10 | A-4a | 4 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 4.4 | 5.9 | 13 | | 3.75 | 24 | 17 | 7 | 30 | 16 | 46 | 12 | 12 | A-4a | 2 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 5.9 | 7.4 | 27 | 12 | 4.5 | | | | | | | 13 | 10 | A-4a | | | | | | | |
| 6 | B | SS-1 | 1.5 | 3.0 | -0.2 | 1.3 | 10 | | 4.5 | 31 | 16 | 15 | 29 | 23 | 52 | 14 | 14 | A-6a | 5 | 167 | | $N_{60}$ | | **12"** | |
| | 020-0 | SS-2 | 3.0 | 4.5 | 1.3 | 2.8 | 12 | | 4.5 | | | | | | | 17 | 14 | A-6a | 10 | | | $N_{60}$ & Mc | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 2.8 | 4.3 | 7 | | 4.25 | 27 | 16 | 11 | 28 | 21 | 49 | 14 | 14 | A-6a | 3 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.3 | 5.8 | 21 | 7 | 2.5 | | | | | | | 18 | 14 | A-6a | 10 | | | | | | |
| 7 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 15 | | | | | | | | | 9 | 6 | A-1-a | 0 | 100 | | | | | |
| | 021-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 11 | | | NP | NP | NP | 3 | 1 | 4 | 5 | 6 | A-1-a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 13 | | 4.5 | 32 | 20 | 12 | 27 | 24 | 51 | 17 | 15 | A-6a | 4 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 19 | 11 | 4.5 | | | | | | | 16 | 14 | A-6a | 10 | | | | | | |
| 8 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 15 | | | | | | | | | 8 | 6 | A-1-a | 0 | 100 | | | | | |
| | 022-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 12 | | | NP | NP | NP | 4 | 1 | 5 | 5 | 6 | A-1-a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 22 | | 3.5 | 27 | 16 | 11 | 32 | 22 | 54 | 13 | 14 | A-6a | 4 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 23 | 12 | | | | | | | | 10 | 6 | A-1-b | 0 | | | | | | |

**PID:** 113744

**County-Route-Section:** FRA-33-21.71
**No. of Borings:** 8

**Geotechnical Consultant:** NEAS Inc.
**Prepared By:** KCA
**Date prepared:** 4/24/2023

| 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 | 9 |
|---|---|

| % Samples within 6 feet of subgrade | | | |
|---|---|---|---|
| $N_{60} \leq 5$ | 0% | HP ≤ 0.5 | 0% |
| $N_{60} < 12$ | 26% | 0.5 < HP ≤ 1 | 0% |
| $12 \leq N_{60} < 15$ | 19% | 1 < HP ≤ 2 | 0% |
| $N_{60} \geq 20$ | 32% | HP > 2 | 48% |
| M+ | 10% | | |
| Rock | 0% | | |
| Unsuitable | 0% | | |

| Excavate and Replace at Surface | |
|---|---|
| Average | 0" |
| Maximum | 0" |
| Minimum | 0" |

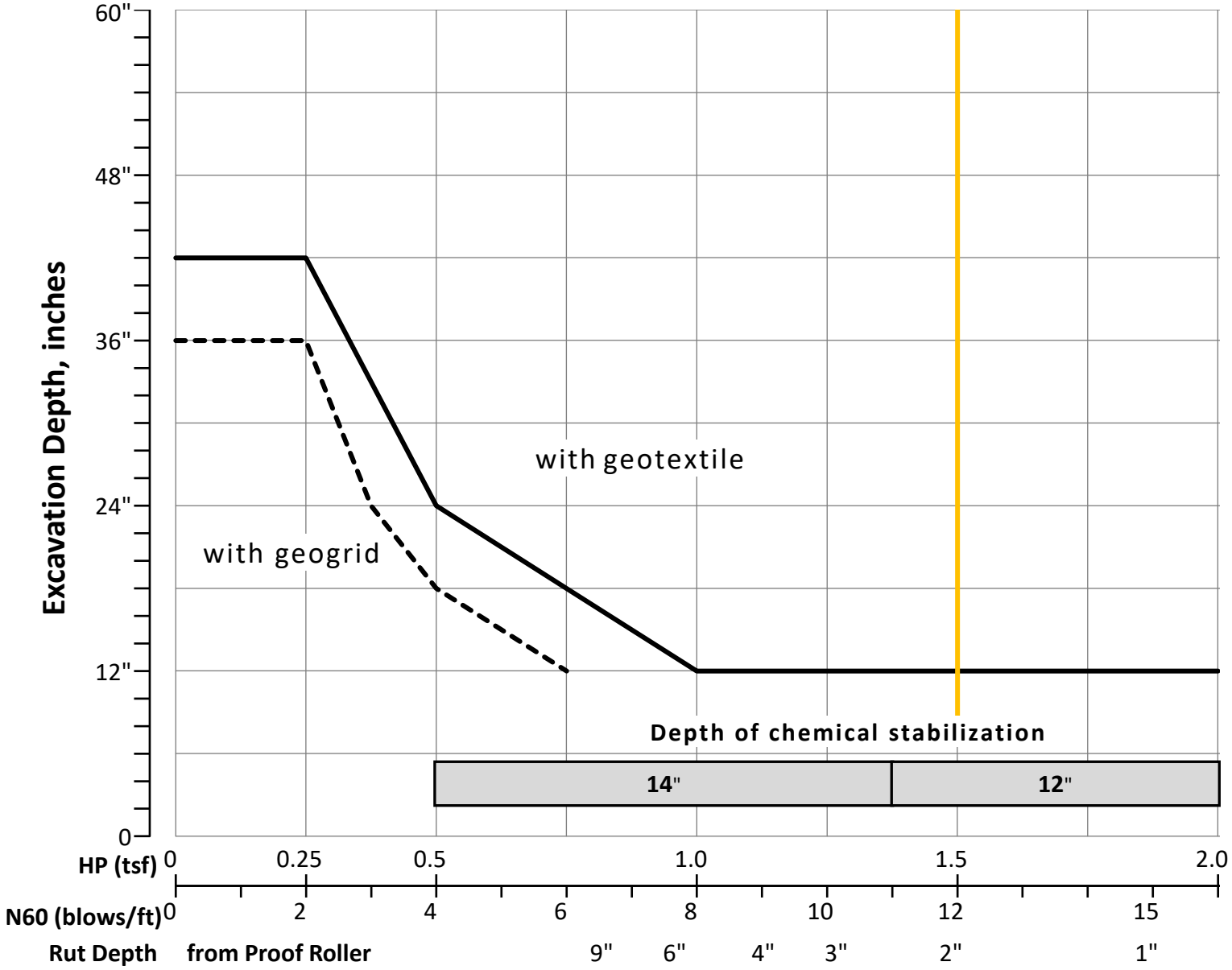
| % Proposed Subgrade Surface | |
|---|---|
| Unstable & Unsuitable | 27% |
| Unstable | 27% |
| Unsuitable | 0% |

| | $N_{60}$ | $N_{60L}$ | HP | LL | PL | PI | Silt | Clay | P 200 | $M_C$ | $M_{OPT}$ | GI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 17 | 12 | 3.87 | 26 | 16 | 10 | 23 | 14 | 37 | 11 | 10 | 3 |
| Maximum | 41 | 29 | 4.50 | 32 | 20 | 15 | 37 | 24 | 60 | 18 | 15 | 10 |
| Minimum | 6 | 6 | 2.25 | 21 | 14 | 7 | 3 | 1 | 4 | 5 | 6 | 0 |

**Classification Counts by Sample**

| ODOT Class | 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 | 10 | 1 | 4 | 0 | 0 | 0 | 0 | 0 | 8 | 0 | 0 | 8 | 0 | 0 | 0 | 0 | 0 | 31 |
| Percent | 0% | 32% | 3% | 13% | 0% | 0% | 0% | 0% | 0% | 26% | 0% | 0% | 26% | 0% | 0% | 0% | 0% | 0% | 100% |
| % Rock\|Granular\|Cohesive | 0% | 74% | | | | | | | | | 26% | | | | | | | | 100% |
| Surface Class Count | 0 | 8 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 15 |
| Surface Class Percent | 0% | 53% | 0% | 13% | 0% | 0% | 0% | 0% | 0% | 13% | 0% | 0% | 20% | 0% | 0% | 0% | 0% | 0% | 100% |

**Fig. 600-1 – Subgrade Stabilization**




OVERRIDE TABLE

| Calculated Average | New Values | Check to Override |
|---|---|---|
| 3.87 | 0.50 | ☐ HP |
| 12.00 | 6.00 | ☐ N60L |

Average HP
Average $N_{60L}$

# RAMP 1 AND 1A

# 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-33-21.71**
**113744**

**Reconstruction & reconfiguration of US-33 interchange with James Rd & Winchester Pike w/ construction of R-cut intersection at Petzinger Rd & U-turns at each end**

**NEAS Inc.**

**Prepared By:** KCA
**Date prepared:** Monday, April 24, 2023

Brendan P. Andrews
2800 Corporate Exchange Drive, Suite 240
Columbus, OH 43231

(513) 337-9823
brendan.andrews@neasinc.com

**NO. OF BORINGS:** 11

| # | Boring ID | Alignment | Station | Offset | Dir | Drill Rig | ER | Boring EL. | Proposed Subgrade EL | Cut Fill |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | B-003-0-22 | US-33 EB | 270+13 | 30 | RT | CME 45B | 73 | 741.7 | 740.2 | 1.5 C |
| 2 | B-004-0-22 | Ramp 1 | 570+12 | 17 | RT | CME 45B | 73 | 750.1 | 748.5 | 1.6 C |
| 3 | B-005-0-22 | Ramp 1 | 573+17 | 35 | RT | CME 45B | 73 | 758.5 | 754.4 | 4.1 C |
| 4 | B-006-0-22 | Ramp 1 | 577+43 | 19 | RT | CME 45B | 73 | 766.8 | 763.2 | 3.6 C |
| 5 | B-007-0-22 | Ramp 1 | 581+13 | 5 | RT | CME 45B | 73 | 768.9 | 766.8 | 2.1 C |
| 6 | B-008-0-22 | Ramp 1 | 585+04 | 3 | RT | CME 45B | 73 | 766.1 | 764.6 | 1.5 C |
| 7 | B-009-0-22 | Ramp 1 | 589+05 | 12 | RT | CME 45B | 73 | 756.6 | 754.9 | 1.7 C |
| 8 | B-010-0-22 | Ramp 1 | 592+60 | 35 | LT | CME 45B | 73 | 748.7 | 747.2 | 1.5 C |
| 9 | B-011-0-22 | Ramp 1 | 596+77 | 5 | RT | CME 45B | 73 | 752.0 | 750.4 | 1.6 C |
| 10 | B-012-0-22 | Ramp 1 | 600+64 | 5 | RT | CME 45B | 73 | 752.8 | 751.3 | 1.5 C |
| 11 | B-013-0-22 | Ramp 1A | 398+64 | 15 | RT | CME 45B | 73 | 759.0 | 757.8 | 1.2 C |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 | 0.0 | 1.5 | 21 | | | | | | | | | 6 | 6 | A-1-a | 0 | 307 | | | | | |
| | 003-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 15 | | | NP | NP | NP | 8 | 4 | 12 | 6 | 6 | A-1-a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 12 | | | | | | | | | 10 | 6 | A-1-a | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 8 | 8 | | NP | NP | NP | 9 | 4 | 13 | 13 | 6 | A-1-a | 0 | | | | | | |
| 2 | B | SS-1 | 1.5 | 3.0 | -0.1 | 1.4 | 34 | | | | | | | | | 7 | 10 | A-2-4 | 0 | 540 | | | | | |
| | 004-0 | SS-2 | 3.0 | 4.5 | 1.4 | 2.9 | 41 | | | 24 | 15 | 9 | 27 | 16 | 43 | 9 | 10 | A-2-4 | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 2.9 | 4.4 | 29 | | | | | | | | | 7 | 10 | A-2-4 | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.4 | 5.9 | 41 | 29 | | NP | NP | NP | 21 | 11 | 32 | 7 | 10 | A-2-4 | 0 | | | | | | |
| 3 | B | SS-2 | 3.5 | 5.0 | -0.6 | 0.9 | 11 | | 2.5 | 32 | 17 | 15 | 27 | 27 | 54 | 17 | 14 | A-6a | 6 | 293 | | $N_{60}$ & Mc | | 12" | |
| | 005-0 | SS-3 | 6.0 | 7.5 | 1.9 | 3.4 | 15 | | 3.75 | 33 | 19 | 14 | 36 | 32 | 68 | 17 | 14 | A-6a | 8 | | | Mc | | | |
| | 22 | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | 11 | | | | | | | | | | | | | | | | | |
| 4 | B | SS-2 | 3.0 | 4.5 | -0.6 | 0.9 | 23 | | 4.5 | 25 | 16 | 9 | 32 | 19 | 51 | 10 | 11 | A-4a | 3 | 367 | | | | | |
| | 006-0 | SS-3 | 4.5 | 6.0 | 0.9 | 2.4 | 31 | | 4.5 | 26 | 16 | 10 | 23 | 14 | 37 | 8 | 11 | A-4a | 0 | | | | | | |
| | 22 | SS-4 | 6.0 | 7.5 | 2.4 | 3.9 | 19 | | 4.5 | | | | | | | 10 | 10 | A-4a | 8 | | | | | | |
| | | | | | | | | 19 | | | | | | | | | | | | | | | | | |
| 5 | B | SS-1 | 1.5 | 3.0 | -0.6 | 0.9 | 25 | | 4.5 | 26 | 16 | 10 | 24 | 17 | 41 | 8 | 11 | A-4a | 1 | 380 | | | | | |
| | 007-0 | SS-2 | 3.0 | 4.5 | 0.9 | 2.4 | 25 | | 4.5 | 26 | 16 | 10 | 24 | 17 | 41 | 10 | 11 | A-4a | 1 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 2.4 | 3.9 | 51 | | 4.5 | | | | | | | 13 | 10 | A-4a | 8 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 3.9 | 5.4 | 25 | 25 | 4.5 | | | | | | | 12 | 10 | A-4a | 8 | | | | | | |
| 6 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 24 | | | | | | | | | 6 | 6 | A-1-a | 0 | 947 | | | | | |
| | 008-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 12 | | 4.5 | 27 | 17 | 10 | 35 | 24 | 59 | 14 | 12 | A-4a | 5 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 19 | | 3 | 27 | 17 | 10 | 34 | 23 | 57 | 13 | 12 | A-4a | 4 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 27 | 12 | 4.5 | | | | | | | 12 | 10 | A-4a | 8 | | | | | | |
| 7 | B | SS-1 | 1.5 | 3.0 | -0.2 | 1.3 | 10 | | | | | | | | | 9 | 10 | A-2-4 | 0 | 380 | | $N_{60}$ | | 12" | |
| | 009-0 | SS-2 | 3.0 | 4.5 | 1.3 | 2.8 | 12 | | | | | | | | | 10 | 6 | A-1-a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 2.8 | 4.3 | 16 | | 3.25 | 26 | 16 | 10 | 51 | 14 | 65 | 12 | 11 | A-4b | 6 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.3 | 5.8 | 24 | 10 | 4.5 | 28 | 17 | 11 | 34 | 24 | 58 | 12 | 14 | A-6a | 5 | | | | | | |
| 8 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 19 | | 4.5 | 23 | 15 | 8 | 23 | 13 | 36 | 8 | 10 | A-4a | 0 | 640 | | | | | |
| | 010-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 22 | | 4.5 | | | | | | | 10 | 10 | A-4a | 8 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 17 | | 4.5 | | | | | | | 15 | 10 | A-4a | 8 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 22 | 17 | 3.5 | 28 | 17 | 11 | 31 | 22 | 53 | 13 | 12 | A-4a | 4 | | | | | | |
| 9 | B | SS-1 | 1.5 | 3.0 | -0.1 | 1.4 | 22 | | | | | | | | | 10 | 10 | A-2-4 | 0 | 240 | | | | | |
| | 011-0 | SS-2 | 3.0 | 4.5 | 1.4 | 2.9 | 16 | | 4.5 | 29 | 17 | 12 | 34 | 23 | 57 | 14 | 14 | A-6a | 5 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 2.9 | 4.4 | 11 | | | | | | | | | 9 | 10 | A-2-4 | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.4 | 5.9 | 21 | 11 | 1.5 | 27 | 17 | 10 | 33 | 20 | 53 | 15 | 12 | A-4a | 4 | | | | | | |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 | |
| 10 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 36 | | 4.5 | 25 | 16 | 9 | 23 | 13 | 36 | 9 | 11 | A-4a | 0 | 60 | | | | | |
| | 012-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 23 | | 4.5 | 28 | 17 | 11 | 29 | 23 | 52 | 12 | 14 | A-6a | 4 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 21 | | 4.5 | | | | | | | 10 | 14 | A-6a | 10 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 23 | 21 | 4.5 | | | | | | | 18 | 14 | A-6a | 10 | | | | | | |
| 11 | B | SS-1 | 1.5 | 3.0 | 0.3 | 1.8 | 12 | | 4.5 | 27 | 16 | 11 | 34 | 23 | 57 | 13 | 14 | A-6a | 5 | | | | | | |
| | 013-0 | SS-2 | 3.0 | 4.5 | 1.8 | 3.3 | 6 | | 3.5 | | | | | | | 24 | 14 | A-6a | 10 | | | $N_{60}$ & Mc | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.3 | 4.8 | 13 | | 3 | | | | | | | 14 | 14 | A-6a | 10 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.8 | 6.3 | 6 | 6 | 2.25 | 41 | 19 | 22 | 41 | 36 | 77 | 24 | 18 | A-7-6 | 13 | | | | | | |

OHIO DEPARTMENT OF TRANSPORTATION

**Subgrade Analysis**

V. 14.6 2/11/2022

**PID:** 113744

**County-Route-Section:** FRA-33-21.71

**No. of Borings:** 11

**Geotechnical Consultant:** NEAS Inc.

**Prepared By:** KCA

**Date prepared:** 4/24/2023

| 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 | 8 |
|---|---|

| % Samples within 6 feet of subgrade | | | |
|---|---|---|---|
| $N_{60} \leq 5$ | 0% | HP ≤ 0.5 | 0% |
| $N_{60} < 12$ | 15% | 0.5 < HP ≤ 1 | 0% |
| $12 \leq N_{60} < 15$ | 12% | 1 < HP ≤ 2 | 2% |
| $N_{60} \geq 20$ | 54% | HP > 2 | 66% |
| M+ | 7% | | |
| Rock | 0% | | |
| Unsuitable | 2% | | |

| Excavate and Replace at Surface | |
|---|---|
| Average | 0" |
| Maximum | 0" |
| Minimum | 0" |

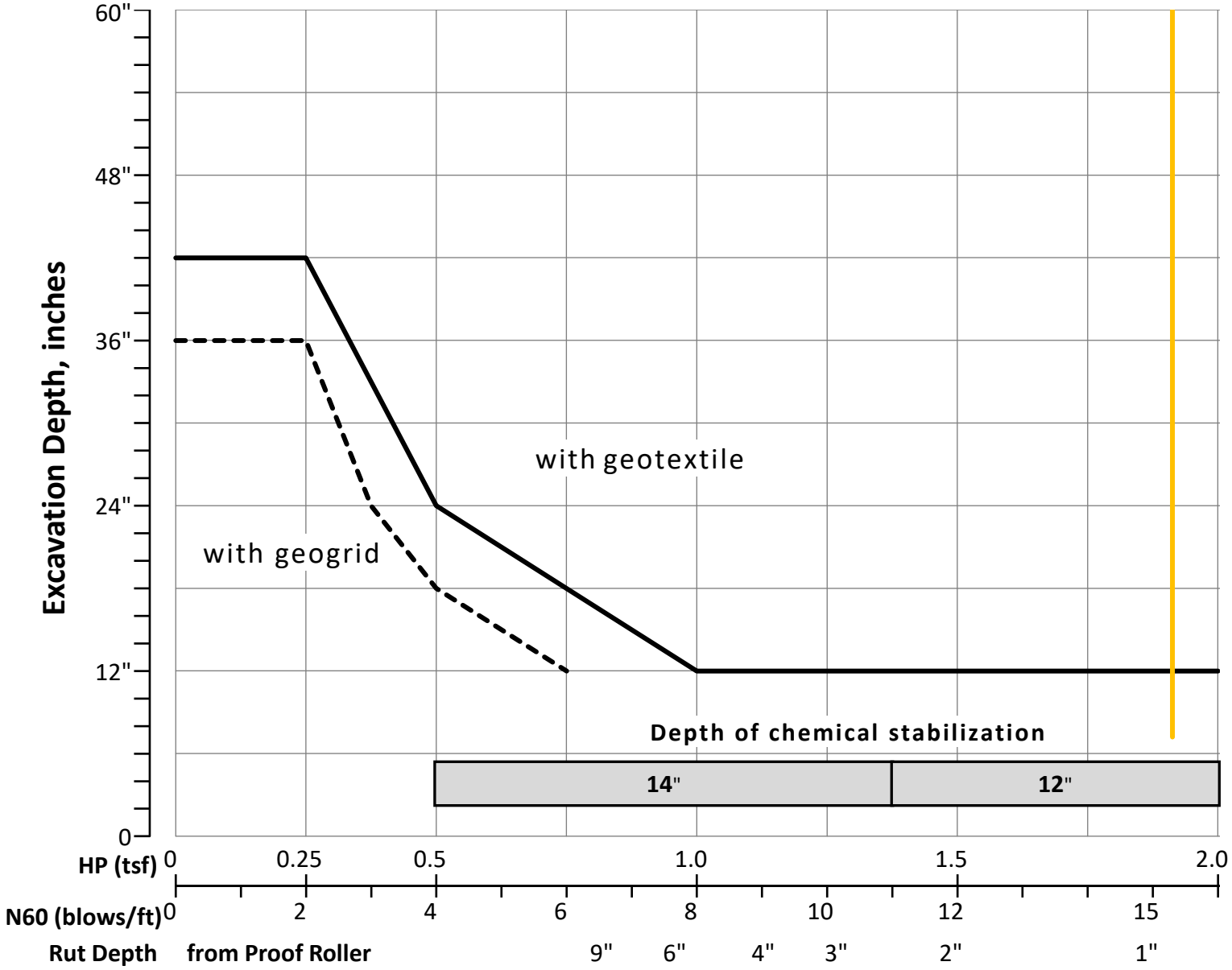
| % Proposed Subgrade Surface | |
|---|---|
| Unstable & Unsuitable | 17% |
| Unstable | 17% |
| Unsuitable | 0% |

| | $N_{60}$ | $N_{60L}$ | HP | LL | PL | PI | Silt | Clay | P 200 | $M_C$ | $M_{OPT}$ | GI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 21 | 15 | 3.99 | 28 | 17 | 11 | 29 | 19 | 48 | 12 | 11 | 4 |
| Maximum | 51 | 29 | 4.50 | 41 | 19 | 22 | 51 | 36 | 77 | 24 | 18 | 13 |
| Minimum | 6 | 6 | 1.50 | 23 | 15 | 8 | 8 | 4 | 12 | 6 | 6 | 0 |

**Classification Counts by Sample**

| ODOT Class | 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 | 6 | 0 | 7 | 0 | 0 | 0 | 0 | 0 | 16 | 1 | 0 | 10 | 0 | 0 | 1 | 0 | 0 | 41 |
| Percent | 0% | 15% | 0% | 17% | 0% | 0% | 0% | 0% | 0% | 39% | 2% | 0% | 24% | 0% | 0% | 2% | 0% | 0% | 100% |
| % Rock\|Granular\|Cohesive | 0% | 71% | | | | | | | | | 29% | | | | | | | | 100% |
| Surface Class Count | 0 | 4 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 10 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 24 |
| Surface Class Percent | 0% | 17% | 0% | 17% | 0% | 0% | 0% | 0% | 0% | 42% | 0% | 0% | 25% | 0% | 0% | 0% | 0% | 0% | 100% |

**Fig. 600-1 – Subgrade Stabilization**




OVERRIDE TABLE

| Calculated Average | New Values | Check to Override |
|---|---|---|
| 3.99 | 0.50 | ☐ HP |
| 15.36 | 6.00 | ☐ N60L |

Average HP
Average $N_{60L}$

# RAMP 2

# OHIO DEPARTMENT OF TRANSPORTATION

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**FRA-33-21.71**
**113744**

**Reconstruction & reconfiguration of US-33 interchange with James Rd & Winchester Pike w/ construction of R-cut intersection at Petzinger Rd & U-turns at each end**

**NEAS Inc.**

**Prepared By:** KCA
**Date prepared:** Monday, April 24, 2023

Brendan P. Andrews
2800 Corporate Exchange Drive, Suite 240
Columbus, OH 43231

(513) 337-9823
brendan.andrews@neasinc.com

**NO. OF BORINGS:** 2

| # | Boring ID | Alignment | Station | Offset | Dir | Drill Rig | ER | Boring EL. | Proposed Subgrade EL | Cut Fill |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | B-014-0-22 | Ramp 2 | 437+82 | 3 | RT | CME 45B | 73 | 774.4 | 772.9 | 1.5 C |
| 2 | B-007-0-22 | Ramp 1 | 581+13 | 5 | RT | CME 45B | 73 | 768.9 | 767.4 | 1.5 C |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 014-0 22 | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 16 | | 4.5 | NP | NP | NP | 20 | 15 | 35 | 9 | 10 | A-2-4 | 0 | 493 | | | | | |
| | | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 16 | | 4.5 | 31 | 17 | 14 | 30 | 25 | 55 | 14 | 14 | A-6a | 6 | | | | | | |
| | | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 19 | | 4.25 | | | | | | | 10 | 14 | A-6a | 10 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 34 | 16 | 4.5 | | | | | | | 15 | 14 | A-6a | 10 | | | | | | |
| 2 | B 007-0 22 | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 25 | | 4.5 | 26 | 16 | 10 | 24 | 17 | 41 | 8 | 11 | A-4a | 1 | 380 | | | | | |
| | | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 25 | | 4.5 | 26 | 16 | 10 | 24 | 17 | 41 | 10 | 11 | A-4a | 1 | | | | | | |
| | | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 51 | | 4.5 | | | | | | | 13 | 10 | A-4a | 8 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 25 | 25 | 4.5 | | | | | | | 12 | 10 | A-4a | 8 | | | | | | |

**PID:** 113744

**County-Route-Section:** FRA-33-21.71

**No. of Borings:** 2

**Geotechnical Consultant:** NEAS Inc.

**Prepared By:** KCA

**Date prepared:** 4/24/2023

| Chemical Stabilization Options | | |
|---|---|---|
| 320 | Rubblize & Roll | Option |
| 206 | Cement Stabilization | Option |
| | Lime Stabilization | No |
| 206 | Depth | NA |

| Excavate and Replace Stabilization Options | |
|---|---|
| Global Geotextile Average(N60L): | 0" |
| Average(HP): | 0" |
| Global Geogrid Average(N60L): | 0" |
| Average(HP): | 0" |

| Design CBR | 8 |
|---|---|

| % Samples within 6 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% |
| $N_{60} \geq 20$ | 63% | HP > 2 | 100% |
| M+ | 0% | | |
| Rock | 0% | | |
| Unsuitable | 0% | | |

| Excavate and Replace at Surface | |
|---|---|
| Average | 0" |
| Maximum | 0" |
| Minimum | 0" |

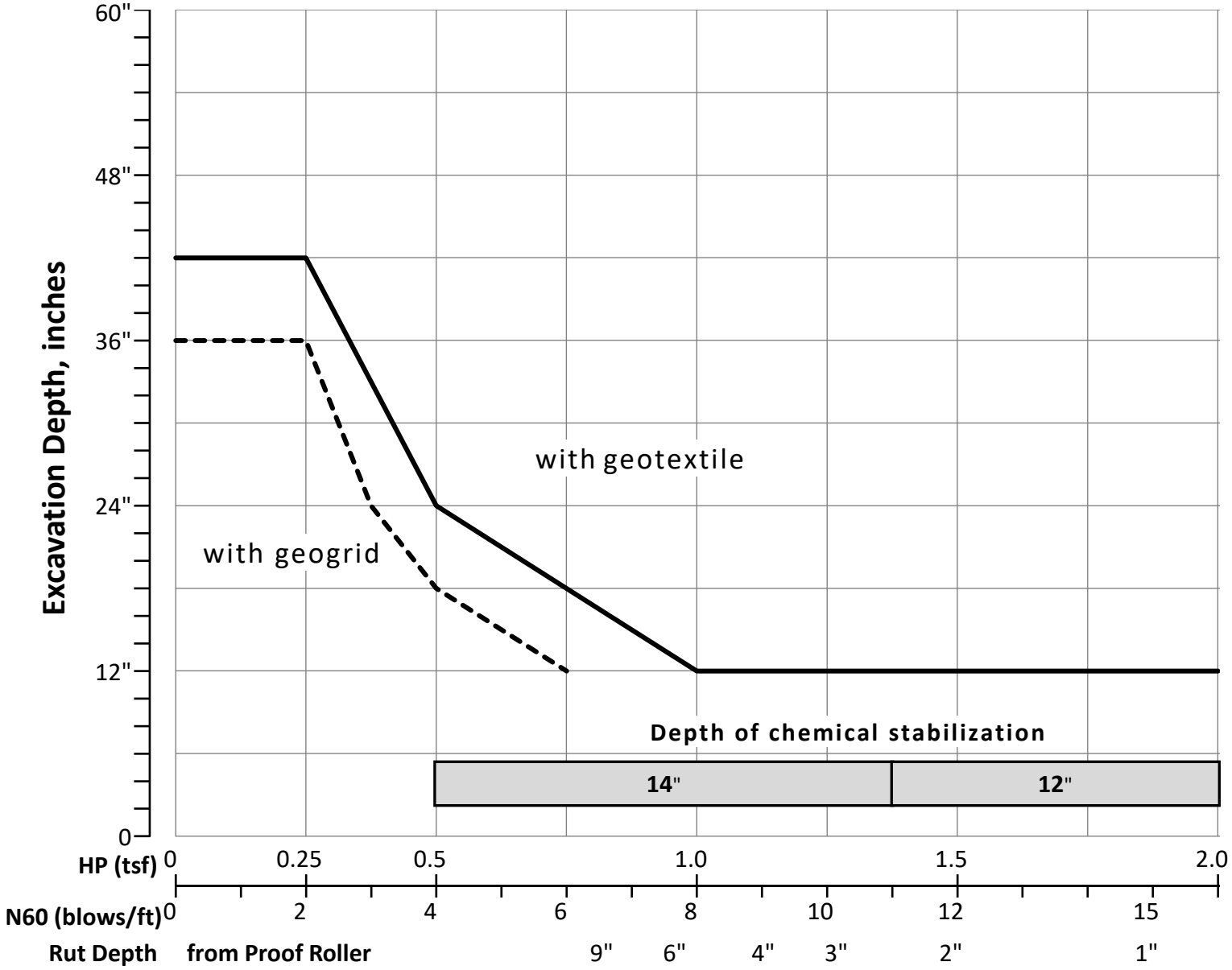
| % Proposed Subgrade Surface | |
|---|---|
| Unstable & Unsuitable | 0% |
| Unstable | 0% |
| Unsuitable | 0% |

| | $N_{60}$ | $N_{60L}$ | HP | LL | PL | PI | Silt | Clay | P 200 | $M_C$ | $M_{OPT}$ | GI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 26 | 21 | 4.47 | 28 | 16 | 11 | 25 | 19 | 43 | 11 | 12 | 6 |
| Maximum | 51 | 25 | 4.50 | 31 | 17 | 14 | 30 | 25 | 55 | 15 | 14 | 10 |
| Minimum | 16 | 16 | 4.25 | 26 | 16 | 10 | 20 | 15 | 35 | 8 | 10 | 0 |

**Classification Counts by Sample**

| ODOT Class | 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 | 1 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 3 | 0 | 0 | 0 | 0 | 0 | 8 |
| Percent | 0% | 0% | 0% | 13% | 0% | 0% | 0% | 0% | 0% | 50% | 0% | 0% | 38% | 0% | 0% | 0% | 0% | 0% | 100% |
| % Rock\|Granular\|Cohesive | 0% | 63% | | | | | | | | | 38% | | | | | | | | 100% |
| Surface Class Count | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 4 |
| Surface Class Percent | 0% | 0% | 0% | 25% | 0% | 0% | 0% | 0% | 0% | 50% | 0% | 0% | 25% | 0% | 0% | 0% | 0% | 0% | 100% |

**Fig. 600-1 – Subgrade Stabilization**




OVERRIDE TABLE

| Calculated Average | New Values | Check to Override |
|---|---|---|
| 4.47 | 0.50 | ☐ HP |
| 20.50 | 6.00 | ☐ N60L |

Average HP
Average $N_{60L}$

# RAMP 3

# OHIO DEPARTMENT OF TRANSPORTATION

## OFFICE OF GEOTECHNICAL ENGINEERING

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## Geotechnical Design Manual Section 600

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**FRA-33-21.71**
**113744**

**Reconstruction & reconfiguration of US-33 interchange with James Rd & Winchester Pike w/ construction of R-cut intersection at Petzinger Rd & U-turns at each end**

**NEAS Inc.**

**Prepared By:** KCA
**Date prepared:** Monday, April 24, 2023

Brendan P. Andrews
2800 Corporate Exchange Drive, Suite 240
Columbus, OH 43231

(513) 337-9823
brendan.andrews@neasinc.com

**NO. OF BORINGS:** 1

| # | Boring ID | Alignment | Station | Offset | Dir | Drill Rig | ER | Boring EL. | Proposed Subgrade EL | Cut Fill |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | B-009-0-22 | Ramp 1 | 589+05 | 12 | RT | CME 45B | 73 | 756.6 | 753.8 | 2.8 C |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 009-0 22 | SS-1 | 1.5 | 3.0 | -1.3 | 0.2 | 10 | | | | | | | | | 9 | 10 | A-2-4 | 0 | 380 | | $N_{60}$ | | **12"** | |
| | | SS-2 | 3.0 | 4.5 | 0.2 | 1.7 | 12 | | | | | | | | | 10 | 6 | A-1-a | 0 | | | | | | |
| | | SS-3 | 4.5 | 6.0 | 1.7 | 3.2 | 16 | | 3.25 | 26 | 16 | 10 | 51 | 14 | 65 | 12 | 11 | A-4b | 6 | | A-4b | | **38"** | | |
| | | SS-4 | 6.0 | 7.5 | 3.2 | 4.7 | 24 | 10 | 4.5 | 28 | 17 | 11 | 34 | 24 | 58 | 12 | 14 | A-6a | 5 | | | | | | |

**PID:** 113744

**County-Route-Section:** FRA-33-21.71

**No. of Borings:** 1

**Geotechnical Consultant:** NEAS Inc.

**Prepared By:** KCA

**Date prepared:** 4/24/2023

| Chemical Stabilization Options | | |
|---|---|---|
| 320 | Rubblize & Roll | No |
| 206 | Cement Stabilization | Option |
| | Lime Stabilization | No |
| 206 | Depth | 14'' |

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

| Design CBR | 9 |
|---|---|

| % Samples within 6 feet of subgrade | | | |
|---|---|---|---|
| $N_{60} \leq 5$ | 0% | HP ≤ 0.5 | 0% |
| $N_{60} < 12$ | 25% | 0.5 < HP ≤ 1 | 0% |
| $12 \leq N_{60} < 15$ | 25% | 1 < HP ≤ 2 | 0% |
| $N_{60} \geq 20$ | 25% | HP > 2 | 50% |
| M+ | 0% | | |
| Rock | 0% | | |
| Unsuitable | 25% | | |

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

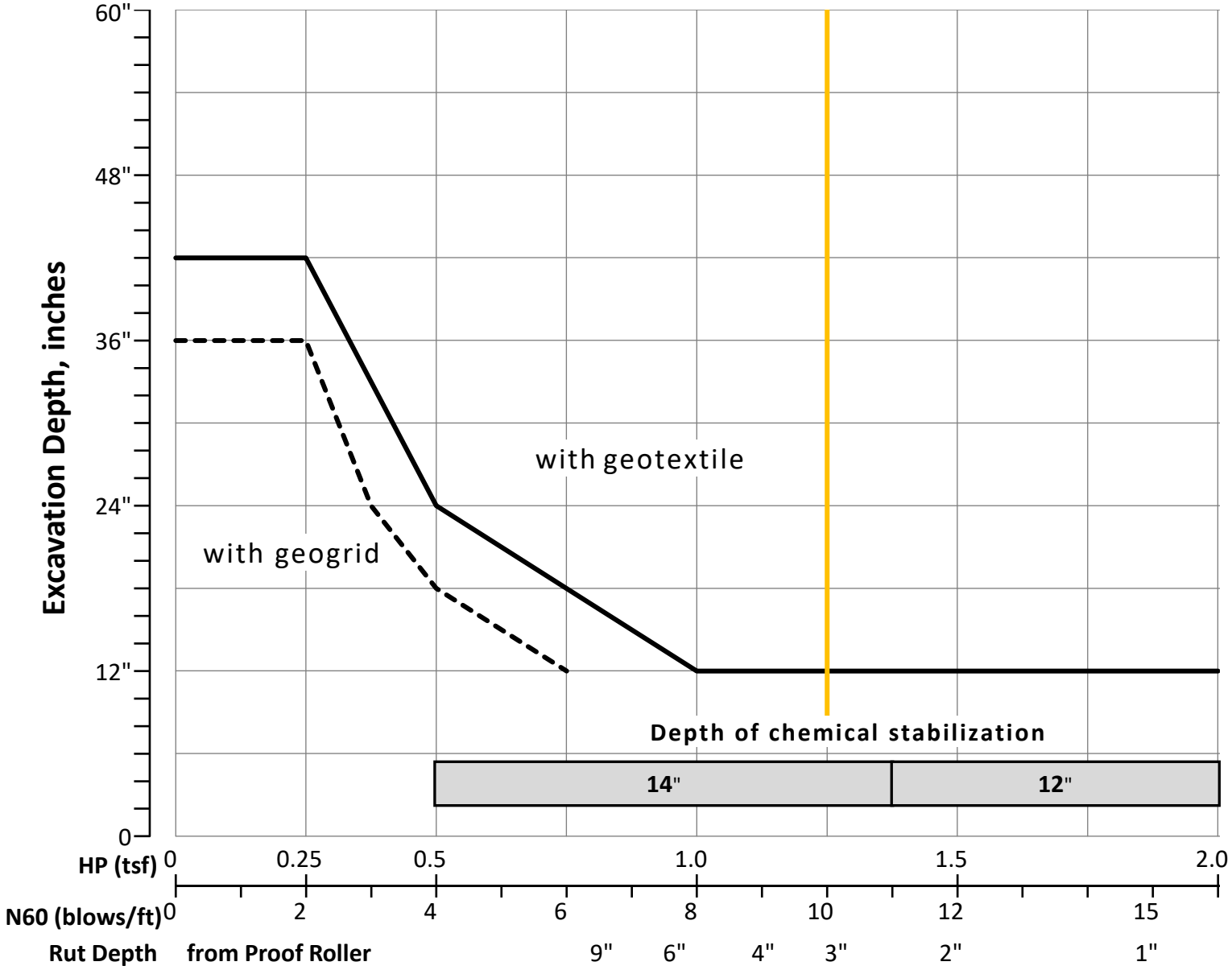
| % Proposed Subgrade Surface | |
|---|---|
| Unstable & Unsuitable | 67% |
| Unstable | 33% |
| Unsuitable | 33% |

| | $N_{60}$ | $N_{60L}$ | HP | LL | PL | PI | Silt | Clay | P 200 | $M_C$ | $M_{OPT}$ | GI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 16 | 10 | 3.88 | 27 | 17 | 11 | 43 | 19 | 62 | 11 | 10 | 3 |
| Maximum | 24 | 10 | 4.50 | 28 | 17 | 11 | 51 | 24 | 65 | 12 | 14 | 6 |
| Minimum | 10 | 10 | 3.25 | 26 | 16 | 10 | 34 | 14 | 58 | 9 | 6 | 0 |

**Classification Counts by Sample**

| ODOT Class | 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 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 4 |
| Percent | 0% | 25% | 0% | 25% | 0% | 0% | 0% | 0% | 0% | 0% | 25% | 0% | 25% | 0% | 0% | 0% | 0% | 0% | 100% |
| % Rock\|Granular\|Cohesive | 0% | 50% | | | | | | | | | 50% | | | | | | | | 100% |
| Surface Class Count | 0 | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 3 |
| Surface Class Percent | 0% | 33% | 0% | 33% | 0% | 0% | 0% | 0% | 0% | 0% | 33% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |

**Fig. 600-1 – Subgrade Stabilization**




OVERRIDE TABLE

| Calculated Average | New Values | Check to Override |
|---|---|---|
| 3.88 | 3.30 | ☐ HP |
| 10.00 | 10.00 | ☐ N60L |

Average HP
Average $N_{60L}$

# WINCHESTER RAMP A

# OHIO DEPARTMENT OF TRANSPORTATION

## OFFICE OF GEOTECHNICAL ENGINEERING

## PLAN SUBGRADES
## Geotechnical Design Manual Section 600

Instructions: Enter data in the shaded cells only.
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**FRA-33-21.71**
**113744**

**Reconstruction & reconfiguration of US-33 interchange with James Rd & Winchester Pike w/ construction of R-cut intersection at Petzinger Rd & U-turns at each end**

**NEAS Inc.**

**Prepared By:** KCA
**Date prepared:** Monday, April 24, 2023

Brendan P. Andrews
2800 Corporate Exchange Drive, Suite 240
Columbus, OH 43231

(513) 337-9823
brendan.andrews@neasinc.com

**NO. OF BORINGS:** 4

| # | Boring ID | Alignment | Station | Offset | Dir | Drill Rig | ER | Boring EL. | Proposed Subgrade EL | Cut Fill |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | B-025-0-22 | Winchester Ramp A | 776+26 | 14 | RT | CME 55X | 79 | 755.4 | 754.0 | 1.4 C |
| 2 | B-026-0-22 | Winchester Ramp A | 780+12 | 6 | RT | CME 55X | 79 | 748.6 | 747.8 | 0.8 C |
| 3 | B-027-0-22 | Winchester Ramp A | 783+04 | 25 | RT | CME 45B | 73 | 757.4 | 756.3 | 1.1 C |
| 4 | B-028-0-22 | Winchester Ramp B | 884+33 | 10 | RT | CME 45B | 73 | 764.1 | 762.9 | 1.2 C |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 | -0.4 | 1.1 | 17 | | 4.5 | 23 | 15 | 8 | 36 | 21 | 57 | 14 | 10 | A-4a | 4 | 13 | | Mc | | | |
| | 025-0 | SS-2 | 3.5 | 5.0 | 2.1 | 3.6 | 21 | | | | | | | | | | 10 | A-4a | 8 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 4.6 | 6.1 | 11 | | 4.5 | 26 | 16 | 10 | 37 | 23 | 60 | 15 | 11 | A-4a | 5 | | | | | | |
| | | | | | | | | 11 | | | | | | | | | | | | | | | | | |
| 2 | B | SS-1 | 1.0 | 2.5 | 0.2 | 1.7 | 20 | | 3.25 | 26 | 18 | 8 | 33 | 17 | 50 | 14 | 13 | A-4a | 3 | 2767 | | | | | |
| | 026-0 | SS-2 | 3.5 | 5.0 | 2.7 | 4.2 | 67 | | | | | | | | | 9 | 6 | A-1-b | 0 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 5.2 | 6.7 | 72 | | | | | | | | | 8 | 6 | A-1-b | | | | | | | |
| | | | | | | | | 20 | | | | | | | | | | | | | | | | | |
| 3 | B | SS-1 | 1.5 | 3.0 | 0.4 | 1.9 | 11 | | 2.75 | 40 | 20 | 20 | 30 | 37 | 67 | 21 | 16 | A-6b | 10 | 233 | | $N_{60}$ & Mc | | 12" | |
| | 027-0 | SS-2 | 3.0 | 4.5 | 1.9 | 3.4 | 13 | | 3 | | | | | | | 21 | 16 | A-6b | 16 | | | $N_{60}$ & Mc | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.4 | 4.9 | 23 | | 2.25 | | | | | | | 20 | 16 | A-6b | 16 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.9 | 6.4 | 27 | 11 | 4.5 | 27 | 16 | 11 | 36 | 27 | 63 | 14 | 14 | A-6a | 6 | | | | | | |
| 4 | B | SS-1 | 1.5 | 3.0 | 0.3 | 1.8 | 12 | | 4.5 | 28 | 17 | 11 | 36 | 27 | 63 | 15 | 14 | A-6a | 6 | 120 | | | | | |
| | 028-0 | SS-2 | 3.0 | 4.5 | 1.8 | 3.3 | 11 | | 4.5 | | | | | | | 15 | 14 | A-6a | 10 | | | $N_{60}$ | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.3 | 4.8 | 10 | | 2.75 | 30 | 17 | 13 | 34 | 30 | 64 | 16 | 14 | A-6a | 7 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.8 | 6.3 | 15 | 10 | 4.25 | | | | | | | 16 | 14 | A-6a | 10 | | | | | | |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

**PID:** 113744

**County-Route-Section:** FRA-33-21.71
**No. of Borings:** 4

**Geotechnical Consultant:** NEAS Inc.
**Prepared By:** KCA
**Date prepared:** 4/24/2023

| 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 | 7 |
|---|---|

| % Samples within 6 feet of subgrade | | | |
|---|---|---|---|
| $N_{60} \leq 5$ | 0% | HP ≤ 0.5 | 0% |
| $N_{60} < 12$ | 29% | 0.5 < HP ≤ 1 | 0% |
| $12 \leq N_{60} < 15$ | 14% | 1 < HP ≤ 2 | 0% |
| $N_{60} \geq 20$ | 43% | HP > 2 | 79% |
| M+ | 21% | | |
| Rock | 0% | | |
| Unsuitable | 0% | | |

| Excavate and Replace at Surface | |
|---|---|
| Average | 0" |
| Maximum | 0" |
| Minimum | 0" |

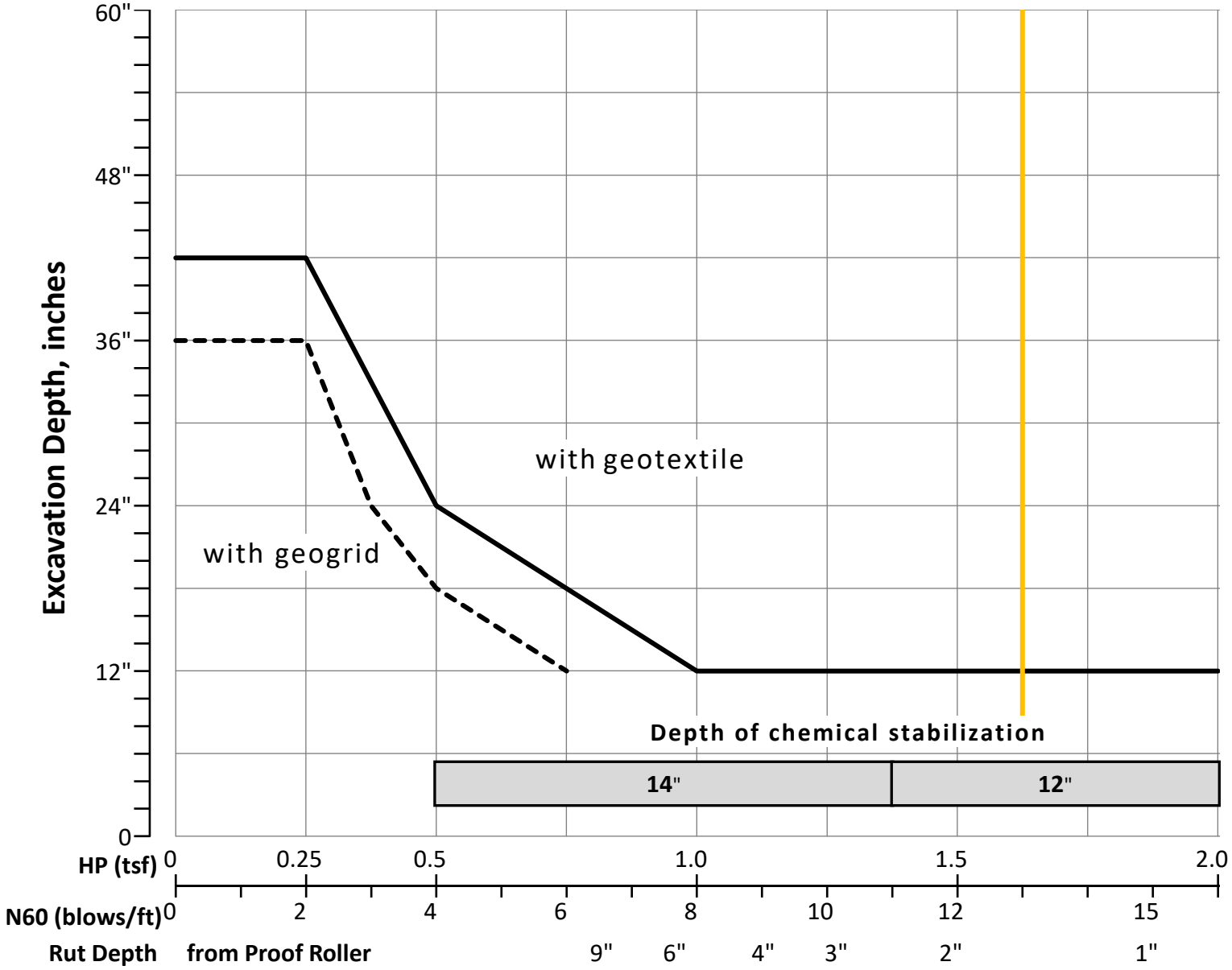
| % Proposed Subgrade Surface | |
|---|---|
| Unstable & Unsuitable | 50% |
| Unstable | 50% |
| Unsuitable | 0% |

| | $N_{60}$ | $N_{60L}$ | HP | LL | PL | PI | Silt | Clay | P 200 | $M_C$ | $M_{OPT}$ | GI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 24 | 13 | 3.70 | 29 | 17 | 12 | 35 | 26 | 61 | 15 | 12 | 8 |
| Maximum | 72 | 20 | 4.50 | 40 | 20 | 20 | 37 | 37 | 67 | 21 | 16 | 16 |
| Minimum | 10 | 10 | 2.25 | 23 | 15 | 8 | 30 | 17 | 50 | 8 | 6 | 0 |

**Classification Counts by Sample**

| ODOT Class | 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 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 5 | 3 | 0 | 0 | 0 | 0 | 14 |
| Percent | 0% | 0% | 14% | 0% | 0% | 0% | 0% | 0% | 0% | 29% | 0% | 0% | 36% | 21% | 0% | 0% | 0% | 0% | 100% |
| % Rock\|Granular\|Cohesive | 0% | 43% | | | | | | | | | 57% | | | | | | | | 100% |
| Surface Class Count | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 0 | 0 | 2 | 2 | 0 | 0 | 0 | 0 | 8 |
| Surface Class Percent | 0% | 0% | 13% | 0% | 0% | 0% | 0% | 0% | 0% | 38% | 0% | 0% | 25% | 25% | 0% | 0% | 0% | 0% | 100% |

**Fig. 600-1 – Subgrade Stabilization**




OVERRIDE TABLE

| Calculated Average | New Values | Check to Override |
|---|---|---|
| 3.70 | 0.50 | ☐ HP |
| 13.00 | 6.00 | ☐ N60L |

Average HP
Average $N_{60L}$

# WINCHESTER RAMP B

# 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-33-21.71**
**113744**

**Reconstruction & reconfiguration of US-33 interchange with James Rd & Winchester Pike w/ construction of R-cut intersection at Petzinger Rd & U-turns at each end**

**NEAS Inc.**

**Prepared By:** KCA
**Date prepared:** Monday, April 24, 2023

Brendan P. Andrews
2800 Corporate Exchange Drive, Suite 240
Columbus, OH 43231

(513) 337-9823
brendan.andrews@neasinc.com

**NO. OF BORINGS:** 5

| # | Boring ID | Alignment | Station | Offset | Dir | Drill Rig | ER | Boring EL. | Proposed Subgrade EL | Cut Fill |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | B-030-0-22 | US-33 WB | 169+97 | 7 | LT | CME 45B | 73 | 749.3 | 747.8 | 1.5 C |
| 2 | B-031-0-22 | Winchester Ramp B | 873+90 | 19 | RT | CME 55X | 79 | 752.4 | 750.9 | 1.5 C |
| 3 | B-032-0-22 | Winchester Ramp B | 877+68 | 2 | LT | CME 55X | 79 | 751.5 | 749.3 | 2.2 C |
| 4 | B-033-0-22 | Winchester Ramp B | 881+79 | 21 | LT | CME 55X | 79 | 747.3 | 745.8 | 1.5 C |
| 5 | B-028-0-22 | Winchester Ramp B | 884+33 | 10 | RT | CME 45B | 73 | 764.1 | 762.6 | 1.5 C |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 | 0.0 | 1.5 | 30 | | | 24 | 16 | 8 | 27 | 17 | 44 | 9 | 11 | A-4a | 2 | 913 | | | | | |
| | 030-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 31 | | 4.5 | 22 | 16 | 6 | 24 | 13 | 37 | 8 | 11 | A-4a | 0 | | | | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 48 | | | | | | | | | 8 | 6 | A-1-b | 0 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 69 | 30 | | | | | | | | 5 | 6 | A-1-b | 0 | | | | | | |
| 2 | B | SS-1 | 1.0 | 2.5 | -0.5 | 1.0 | 17 | | 3.75 | 26 | 16 | 10 | 36 | 22 | 58 | 13 | 11 | A-4a | 5 | | | | | | |
| | 031-0 | SS-2 | 3.5 | 5.0 | 2.0 | 3.5 | 22 | | 4.5 | 24 | 15 | 9 | 31 | 19 | 50 | 10 | 10 | A-4a | 3 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 4.5 | 6.0 | 26 | | 4.5 | | | | | | | 11 | 10 | A-4a | 8 | | | | | | |
| | | | | | | | | 17 | | | | | | | | | | | | | | | | | |
| 3 | B | SS-1 | 1.0 | 2.5 | -1.2 | 0.3 | 28 | | | | | | | | | 8 | 10 | A-4a | 8 | 0 | | | | | |
| | 032-0 | SS-2 | 3.5 | 5.0 | 1.3 | 2.8 | 29 | | | | | | | | | | 10 | A-4a | 8 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 3.8 | 5.3 | 46 | | | 22 | 15 | 7 | 24 | 12 | 36 | 9 | 10 | A-4a | 0 | | | | | | |
| | | | | | | | | 28 | | | | | | | | | | | | | | | | | |
| 4 | B | SS-1 | 1.0 | 2.5 | -0.5 | 1.0 | 25 | | 4.25 | 22 | 16 | 6 | 28 | 15 | 43 | 11 | 11 | A-4a | 2 | 0 | | | | | |
| | 033-0 | SS-2 | 3.5 | 5.0 | 2.0 | 3.5 | 61 | | | | | | | | | 6 | 6 | A-1-b | 0 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 4.5 | 6.0 | 95 | | | NP | NP | NP | 14 | 5 | 19 | 5 | 6 | A-1-b | 0 | | | | | | |
| | | | | | | | | 25 | | | | | | | | | | | | | | | | | |
| 5 | B | SS-1 | 1.5 | 3.0 | 0.0 | 1.5 | 12 | | 4.5 | 28 | 17 | 11 | 36 | 27 | 63 | 15 | 14 | A-6a | 6 | 120 | | | | | |
| | 028-0 | SS-2 | 3.0 | 4.5 | 1.5 | 3.0 | 11 | | 4.5 | | | | | | | 15 | 14 | A-6a | 10 | | | $N_{60}$ | | | |
| | 22 | SS-3 | 4.5 | 6.0 | 3.0 | 4.5 | 10 | | 2.75 | 30 | 17 | 13 | 34 | 30 | 64 | 16 | 14 | A-6a | 7 | | | | | | |
| | | SS-4 | 6.0 | 7.5 | 4.5 | 6.0 | 15 | 10 | 4.25 | | | | | | | 16 | 14 | A-6a | 10 | | | | | | |

**PID:** 113744

**County-Route-Section:** FRA-33-21.71

**No. of Borings:** 5

**Geotechnical Consultant:** NEAS Inc.

**Prepared By:** KCA

**Date prepared:** 4/24/2023

| Chemical Stabilization Options | | |
|---|---|---|
| 320 | Rubblize & Roll | Option |
| 206 | Cement Stabilization | Option |
| | Lime Stabilization | No |
| 206 | Depth | NA |

| Excavate and Replace Stabilization Options | |
|---|---|
| Global Geotextile Average(N60L): | 0" |
| Average(HP): | 0" |
| Global Geogrid Average(N60L): | 0" |
| Average(HP): | 0" |

| Design CBR | 8 |
|---|---|

| % Samples within 6 feet of subgrade | | | |
|---|---|---|---|
| $N_{60} \leq 5$ | 0% | HP ≤ 0.5 | 0% |
| $N_{60} < 12$ | 12% | 0.5 < HP ≤ 1 | 0% |
| $12 \leq N_{60} < 15$ | 6% | 1 < HP ≤ 2 | 0% |
| $N_{60} \geq 20$ | 71% | HP > 2 | 53% |
| M+ | 0% | | |
| Rock | 0% | | |
| Unsuitable | 0% | | |

| Excavate and Replace at Surface | |
|---|---|
| Average | 0" |
| Maximum | 0" |
| Minimum | 0" |

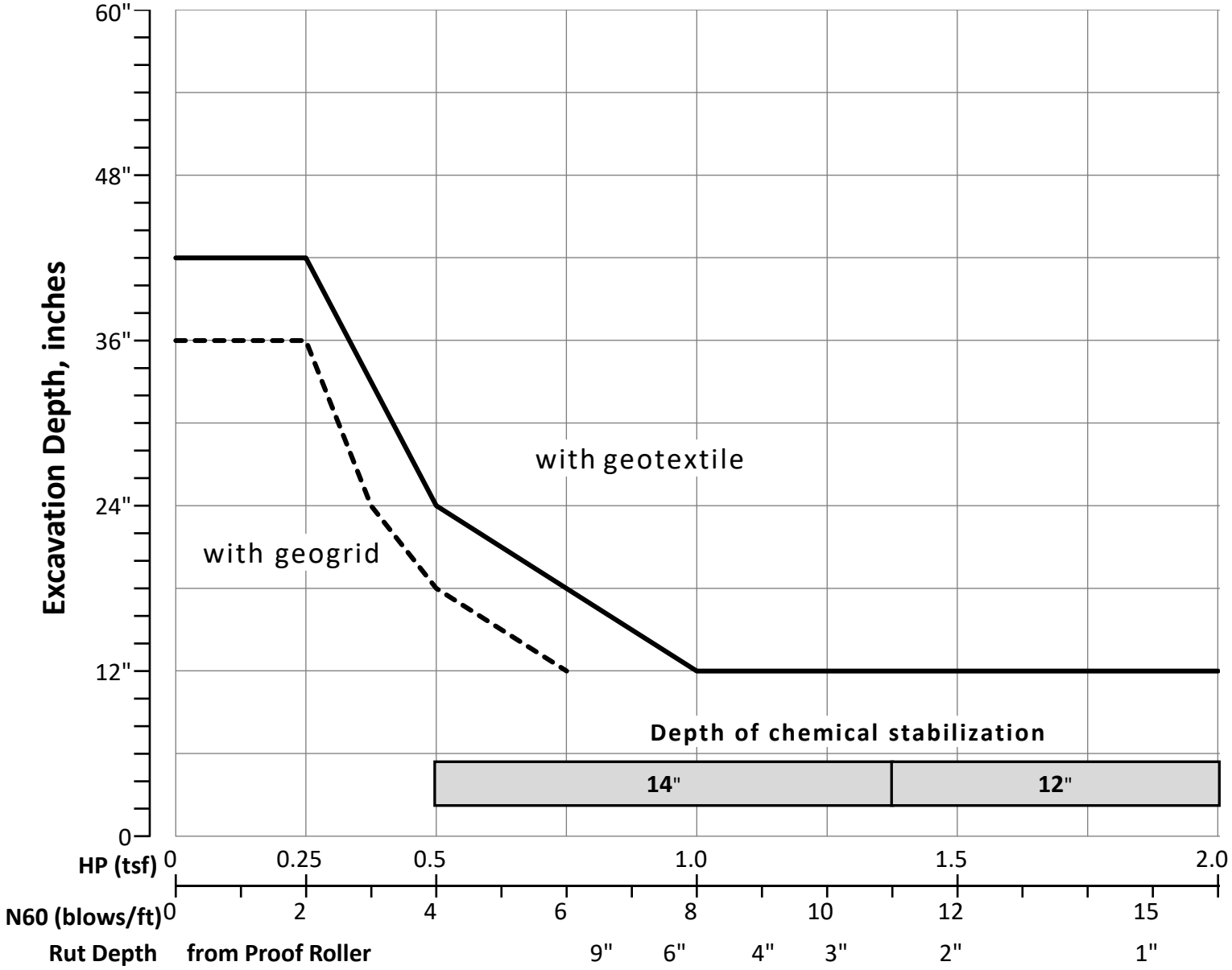
| % Proposed Subgrade Surface | |
|---|---|
| Unstable & Unsuitable | 10% |
| Unstable | 10% |
| Unsuitable | 0% |

| | $N_{60}$ | $N_{60L}$ | HP | LL | PL | PI | Silt | Clay | P 200 | $M_C$ | $M_{OPT}$ | GI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 34 | 22 | 4.17 | 25 | 16 | 9 | 28 | 18 | 46 | 10 | 10 | 4 |
| Maximum | 95 | 30 | 4.50 | 30 | 17 | 13 | 36 | 30 | 64 | 16 | 14 | 10 |
| Minimum | 10 | 10 | 2.75 | 22 | 15 | 6 | 14 | 5 | 19 | 5 | 6 | 0 |

**Classification Counts by Sample**

| ODOT Class | 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 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 17 |
| Percent | 0% | 0% | 24% | 0% | 0% | 0% | 0% | 0% | 0% | 53% | 0% | 0% | 24% | 0% | 0% | 0% | 0% | 0% | 100% |
| % Rock\|Granular\|Cohesive | 0% | 76% | | | | | | | | | 24% | | | | | | | | 100% |
| Surface Class Count | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 7 | 0 | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 10 |
| Surface Class Percent | 0% | 0% | 10% | 0% | 0% | 0% | 0% | 0% | 0% | 70% | 0% | 0% | 20% | 0% | 0% | 0% | 0% | 0% | 100% |

**Fig. 600-1 – Subgrade Stabilization**




OVERRIDE TABLE

| Calculated Average | New Values | Check to Override |
|---|---|---|
| 4.17 | 0.50 | ☐ HP |
| 22.00 | 6.00 | ☐ N60L |

Average HP
Average $N_{60L}$

# WINCHESTER TURN AROUND

# 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-33-21.71**
**113744**

**Reconstruction & reconfiguration of US-33 interchange with James Rd & Winchester Pike w/ construction of R-cut intersection at Petzinger Rd & U-turns at each end**

**NEAS Inc.**

**Prepared By:** KCA
**Date prepared:** Monday, April 24, 2023

Brendan P. Andrews
2800 Corporate Exchange Drive, Suite 240
Columbus, OH 43231

(513) 337-9823
brendan.andrews@neasinc.com

**NO. OF BORINGS:** 2

| # | Boring ID | Alignment | Station | Offset | Dir | Drill Rig | ER | Boring EL. | Proposed Subgrade EL | Cut Fill |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | B-025-0-22 | Winchester Ramp A | 776+26 | 14 | RT | CME 55X | 79 | 755.4 | 753.4 | 2.0 C |
| 2 | B-032-0-22 | Winchester Ramp B | 877+68 | 2 | LT | CME 55X | 79 | 751.5 | 749.5 | 2.0 C |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 | -1.0 | 0.5 | 17 | | 4.5 | 23 | 15 | 8 | 36 | 21 | 57 | 14 | 10 | A-4a | 4 | 13 | | Mc | | | |
| | 025-0 | SS-2 | 3.5 | 5.0 | 1.5 | 3.0 | 21 | | | | | | | | | | 10 | A-4a | 8 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 4.0 | 5.5 | 11 | | 4.5 | 26 | 16 | 10 | 37 | 23 | 60 | 15 | 11 | A-4a | 5 | | | | | | |
| | | | | | | | | 11 | | | | | | | | | | | | | | | | | |
| 2 | B | SS-1 | 1.0 | 2.5 | -1.0 | 0.5 | 28 | | | | | | | | | 8 | 10 | A-4a | 8 | 0 | | | | | |
| | 032-0 | SS-2 | 3.5 | 5.0 | 1.5 | 3.0 | 29 | | | | | | | | | | 10 | A-4a | 8 | | | | | | |
| | 22 | SS-3 | 6.0 | 7.5 | 4.0 | 5.5 | 46 | | | 22 | 15 | 7 | 24 | 12 | 36 | 9 | 10 | A-4a | 0 | | | | | | |
| | | | | | | | | 28 | | | | | | | | | | | | | | | | | |

**PID:** 113744

**County-Route-Section:** FRA-33-21.71

**No. of Borings:** 2

**Geotechnical Consultant:** NEAS Inc.

**Prepared By:** KCA

**Date prepared:** 4/24/2023

| Chemical Stabilization Options | | |
|---|---|---|
| 320 | Rubblize & Roll | Option |
| 206 | Cement Stabilization | Option |
| | Lime Stabilization | No |
| 206 | Depth | NA |

| Excavate and Replace Stabilization Options | |
|---|---|
| Global Geotextile Average(N60L): | 0" |
| Average(HP): | 0" |
| Global Geogrid Average(N60L): | 0" |
| Average(HP): | 0" |

| Design CBR | 8 |
|---|---|

| % Samples within 6 feet of subgrade | | | |
|---|---|---|---|
| $N_{60} \leq 5$ | 0% | HP ≤ 0.5 | 0% |
| $N_{60} < 12$ | 17% | 0.5 < HP ≤ 1 | 0% |
| $12 \leq N_{60} < 15$ | 0% | 1 < HP ≤ 2 | 0% |
| $N_{60} \geq 20$ | 67% | HP > 2 | 33% |
| M+ | 17% | | |
| Rock | 0% | | |
| Unsuitable | 0% | | |

| Excavate and Replace at Surface | |
|---|---|
| Average | 0" |
| Maximum | 0" |
| Minimum | 0" |

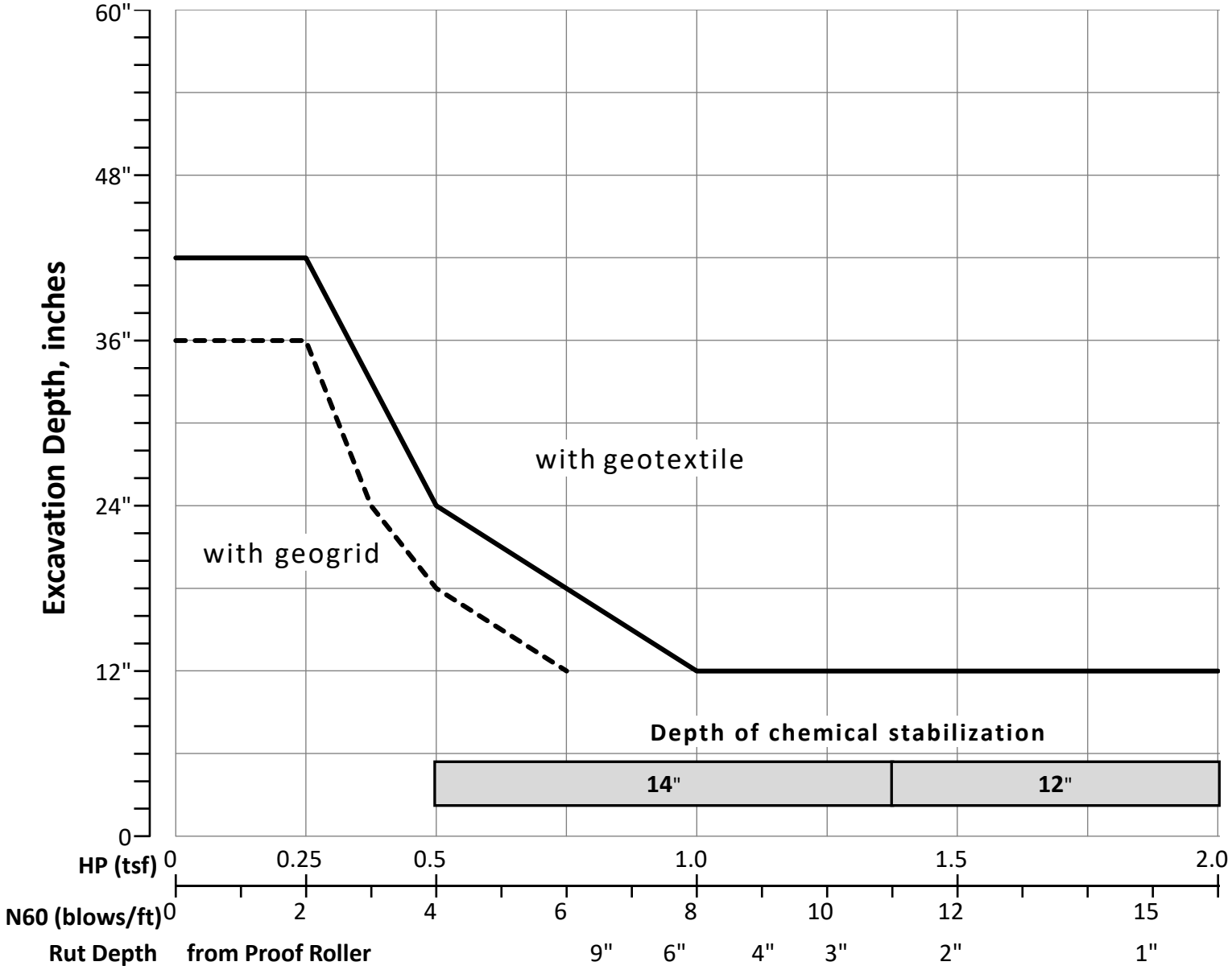
| % Proposed Subgrade Surface | |
|---|---|
| Unstable & Unsuitable | 25% |
| Unstable | 25% |
| Unsuitable | 0% |

| | $N_{60}$ | $N_{60L}$ | HP | LL | PL | PI | Silt | Clay | P 200 | $M_C$ | $M_{OPT}$ | GI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 25 | 20 | 4.50 | 24 | 15 | 8 | 32 | 19 | 51 | 12 | 10 | 6 |
| Maximum | 46 | 28 | 4.50 | 26 | 16 | 10 | 37 | 23 | 60 | 15 | 11 | 8 |
| Minimum | 11 | 11 | 4.50 | 22 | 15 | 7 | 24 | 12 | 36 | 8 | 10 | 0 |

**Classification Counts by Sample**

| ODOT Class | 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 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 |
| Percent | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |
| % Rock\|Granular\|Cohesive | 0% | 100% | | | | | | | | | 0% | | | | | | | | 100% |
| Surface Class Count | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 4 |
| Surface Class Percent | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 100% |

**Fig. 600-1 – Subgrade Stabilization**




OVERRIDE TABLE

| Calculated Average | New Values | Check to Override |
|---|---|---|
| 4.50 | 0.50 | ☐ HP |
| 19.50 | 6.00 | ☐ N60L |

Average HP
Average $N_{60L}$

# NORTHERN TURN AROUND

# 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-33-21.71**
**113744**

**Reconstruction & reconfiguration of US-33 interchange with James Rd & Winchester Pike w/ construction of R-cut intersection at Petzinger Rd & U-turns at each end**

**NEAS Inc.**

**Prepared By:** KCA
**Date prepared:** Monday, April 24, 2023

Brendan P. Andrews
2800 Corporate Exchange Drive, Suite 240
Columbus, OH 43231

(513) 337-9823
brendan.andrews@neasinc.com

**NO. OF BORINGS:** 2

| # | Boring ID | Alignment | Station | Offset | Dir | Drill Rig | ER | Boring EL. | Proposed Subgrade EL | Cut Fill |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | B-001-0-22 | US-33 | 145+49 | 16 | RT | CME 55X | 79 | 755.1 | 755.1 | 0.0 F |
| 2 | B-002-0-22 | US-33 | 149+80 | 20 | LT | CME 55X | 79 | 758.6 | 758.0 | 0.6 C |

OHIO DEPARTMENT OF TRANSPORTATION

# Subgrade Analysis

V. 14.6 2/11/2022

| # | 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 001-0 22 | SS-1 | 1.0 | 2.5 | 1.0 | 2.5 | 24 | | 4.5 | 30 | 18 | 12 | 38 | 30 | 68 | 14 | 14 | A-6a | 7 | 93 | | | | | |
| | | SS-2 | 3.5 | 5.0 | 3.5 | 5.0 | 17 | | 4 | 25 | 17 | 8 | 41 | 20 | 61 | 15 | 12 | A-4a | 5 | | | | | | |
| | | | | | | | | | | | | | | | | | | | | | | | | | |
| | | | | | | | | 17 | | | | | | | | | | | | | | | | | |
| 2 | B 002-0 22 | SS-1 | 1.0 | 2.5 | 0.4 | 2.0 | 26 | | 4.5 | 24 | 16 | 8 | 37 | 21 | 58 | 14 | 11 | A-4a | 5 | 53 | | Mc | | | |
| | | SS-2 | 3.5 | 5.0 | 3.0 | 4.5 | 17 | | 4.5 | 26 | 16 | 10 | 35 | 27 | 62 | 15 | 11 | A-4a | 5 | | | | | | |
| | | SS-3 | 6.0 | 7.5 | 5.5 | 7.0 | 12 | | 4.25 | | | | | | | 14 | 10 | A-4a | | | | | | | |
| | | SS-4 | | | | | | 12 | | | | | | | | | | | | | | | | | |

**PID:** 113744

**County-Route-Section:** FRA-33-21.71

**No. of Borings:** 2

**Geotechnical Consultant:** NEAS Inc.

**Prepared By:** KCA

**Date prepared:** 4/24/2023

| 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 | 8 |
|---|---|

| % Samples within 6 feet of subgrade | | | |
|---|---|---|---|
| $N_{60} \leq 5$ | 0% | HP ≤ 0.5 | 0% |
| $N_{60} < 12$ | 0% | 0.5 < HP ≤ 1 | 0% |
| $12 \leq N_{60} < 15$ | 20% | 1 < HP ≤ 2 | 0% |
| $N_{60} \geq 20$ | 40% | HP > 2 | 100% |
| M+ | 20% | | |
| Rock | 0% | | |
| Unsuitable | 0% | | |

| Excavate and Replace at Surface | |
|---|---|
| Average | 0" |
| Maximum | 0" |
| Minimum | 0" |

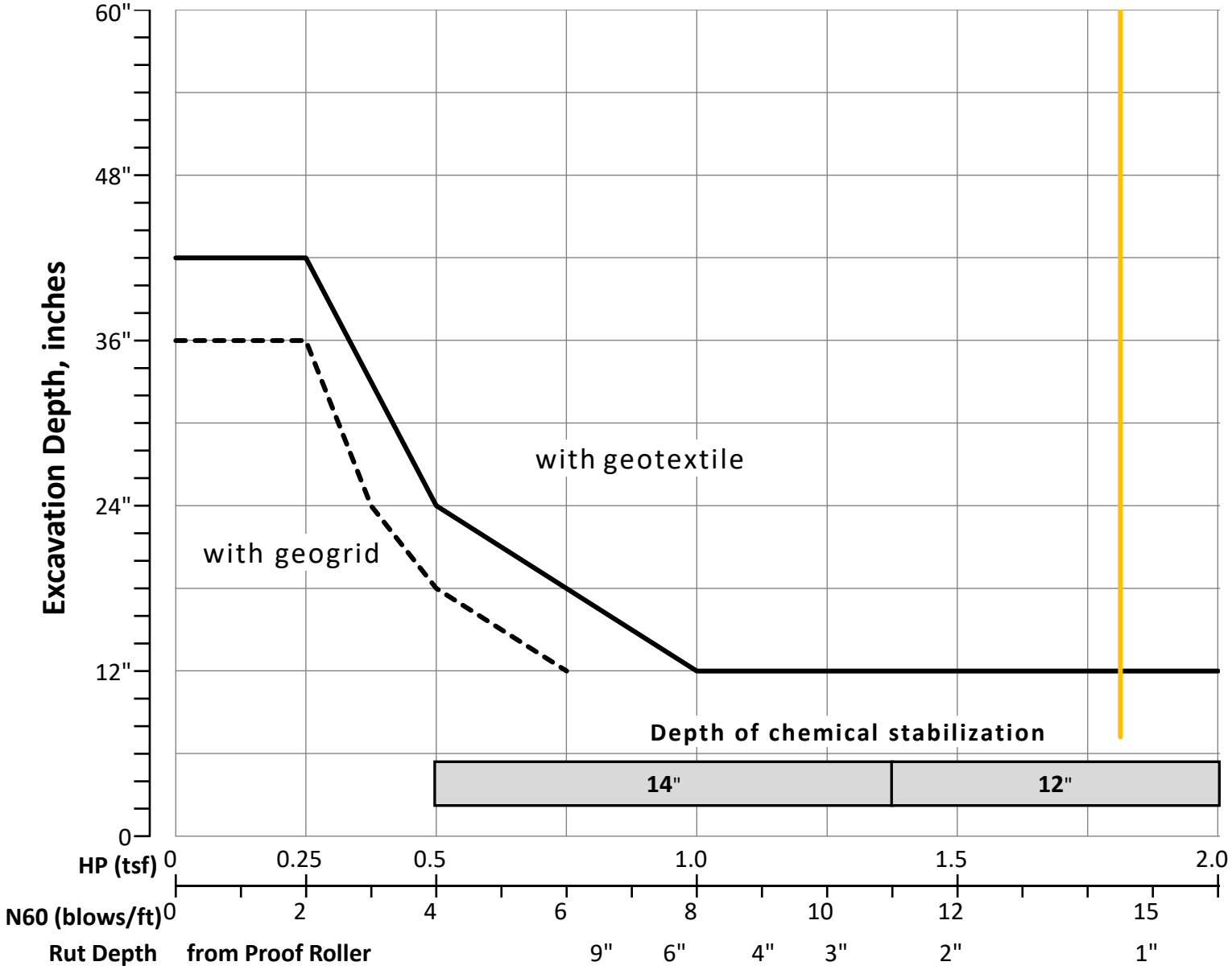
| % Proposed Subgrade Surface | |
|---|---|
| Unstable & Unsuitable | 50% |
| Unstable | 50% |
| Unsuitable | 0% |

| | $N_{60}$ | $N_{60L}$ | HP | LL | PL | PI | Silt | Clay | P 200 | $M_C$ | $M_{OPT}$ | GI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average | 19 | 15 | 4.35 | 26 | 17 | 10 | 38 | 25 | 62 | 14 | 12 | 6 |
| Maximum | 26 | 17 | 4.50 | 30 | 18 | 12 | 41 | 30 | 68 | 15 | 14 | 7 |
| Minimum | 12 | 12 | 4.00 | 24 | 16 | 8 | 35 | 20 | 58 | 14 | 10 | 5 |

**Classification Counts by Sample**

| ODOT Class | 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 | 4 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 5 |
| Percent | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 80% | 0% | 0% | 20% | 0% | 0% | 0% | 0% | 0% | 100% |
| % Rock\|Granular\|Cohesive | 0% | 80% | | | | | | | | | 20% | | | | | | | | 100% |
| Surface Class Count | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 2 |
| Surface Class Percent | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 0% | 50% | 0% | 0% | 50% | 0% | 0% | 0% | 0% | 0% | 100% |

**Fig. 600-1 – Subgrade Stabilization**




OVERRIDE TABLE

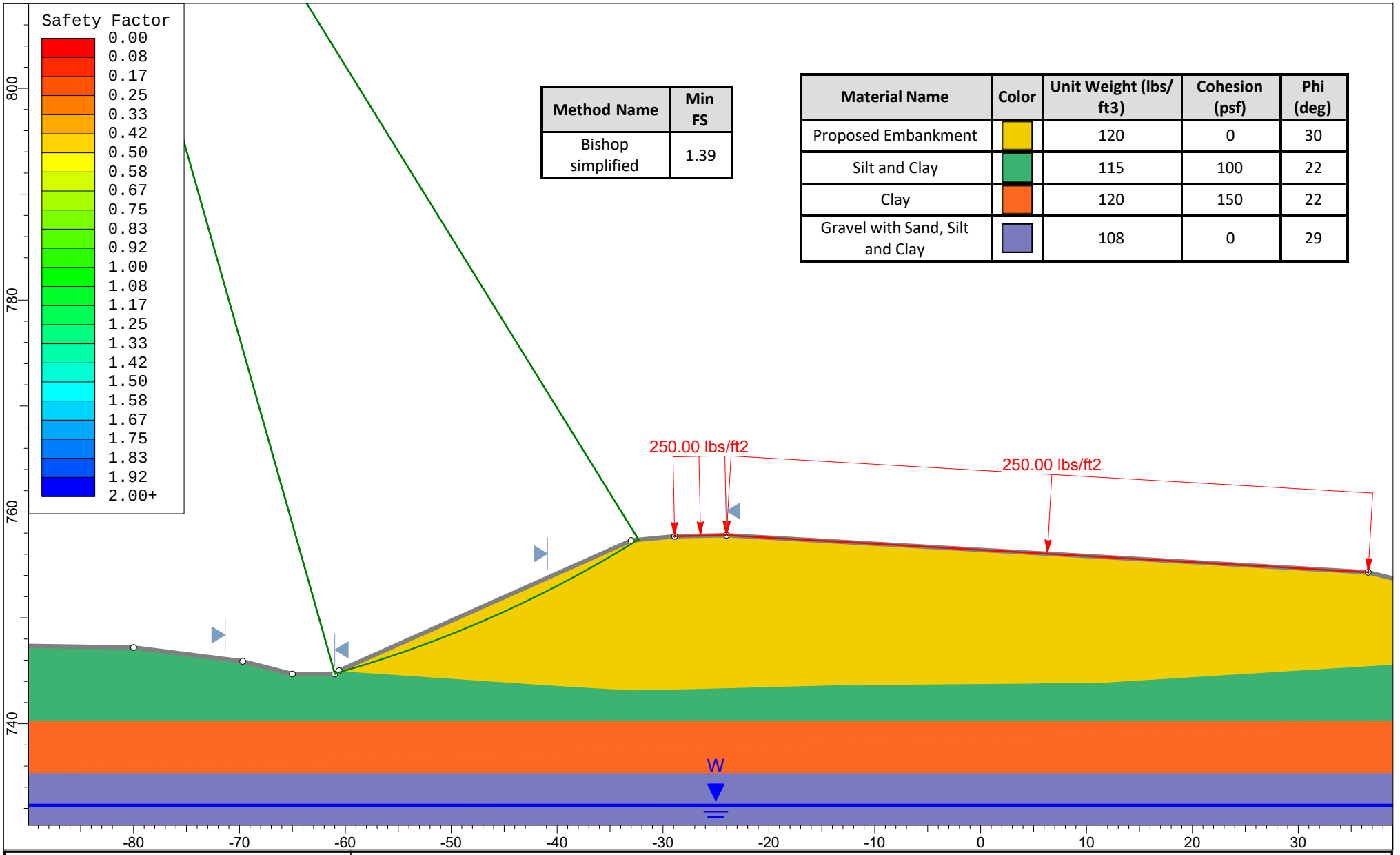
| Calculated Average | New Values | Check to Override |
|---|---|---|
| 4.35 | 0.50 | ☐ HP |
| 14.50 | 6.00 | ☐ N60L |

Average HP
Average $N_{60L}$

# APPENDIX F

# EMBANKMENT GLOBAL STABILITY ANALYSIS

**STA. 289+00**



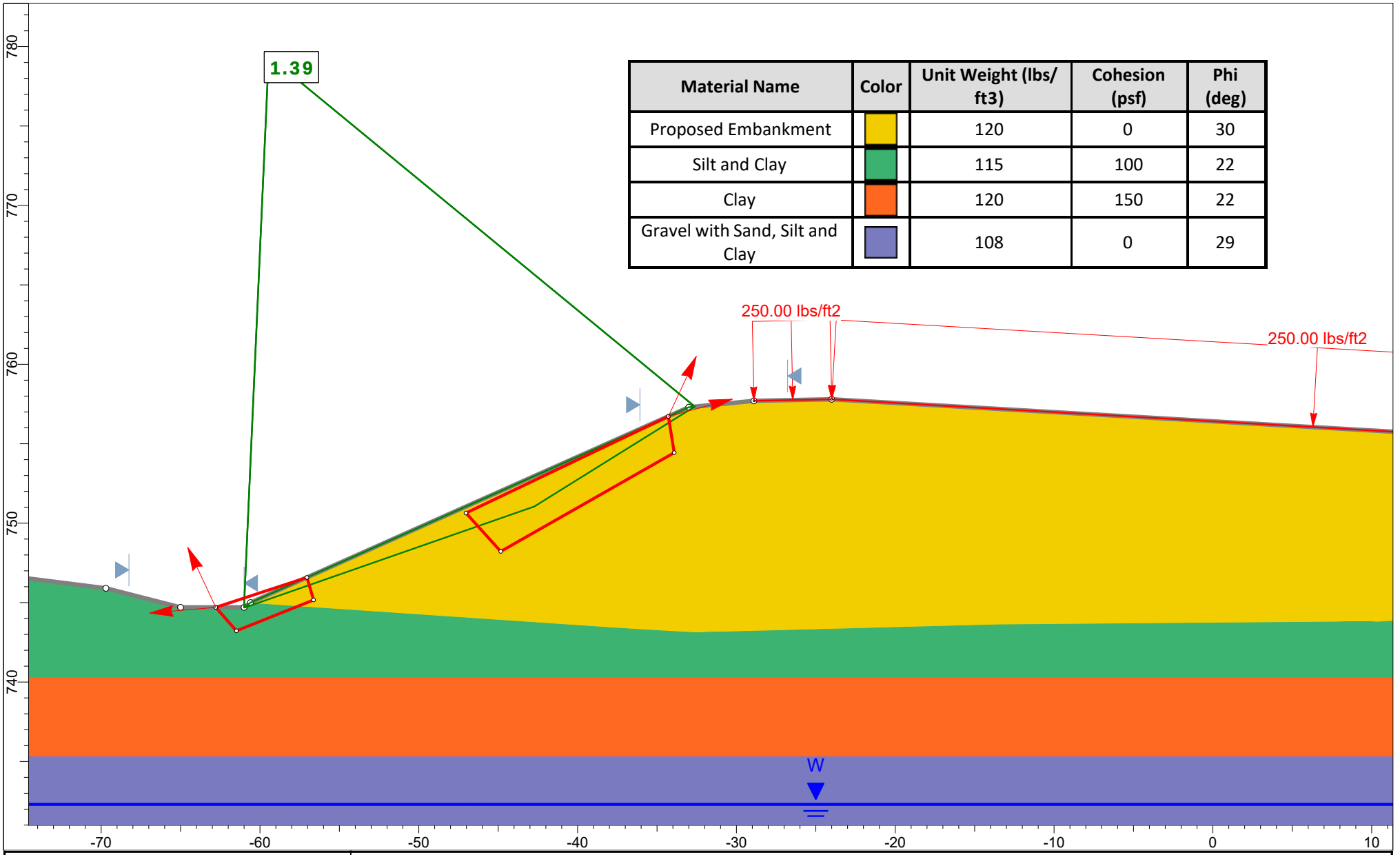

| Method Name | Min FS |
|---|---|
| Bishop simplified | 1.39 |

| Material Name | Color | Unit Weight (lbs/ ft3) | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|
| Proposed Embankment | | 120 | 0 | 30 |
| Silt and Clay | | 115 | 100 | 22 |
| Clay | | 120 | 150 | 22 |
| Gravel with Sand, Silt and Clay | | 108 | 0 | 29 |

rocscience

SLIDEINTERPRET 9.025

| | | | |
|---|---|---|---|
| *Project* | FRA-33-21.71 - PID 113744 | | |
| *Analysis Description* | Embankment Stability Analysis - US-33 EB STA. 289+00 - Effective Stress - Circular Failure | | |
| *Drawn By* | KCA | *Company* | NEAS Inc. |
| *Date* | 5/4/2023, 9:25:34 AM | *File Name* | Slide_STA289+00_EffCircular050423.slmd |

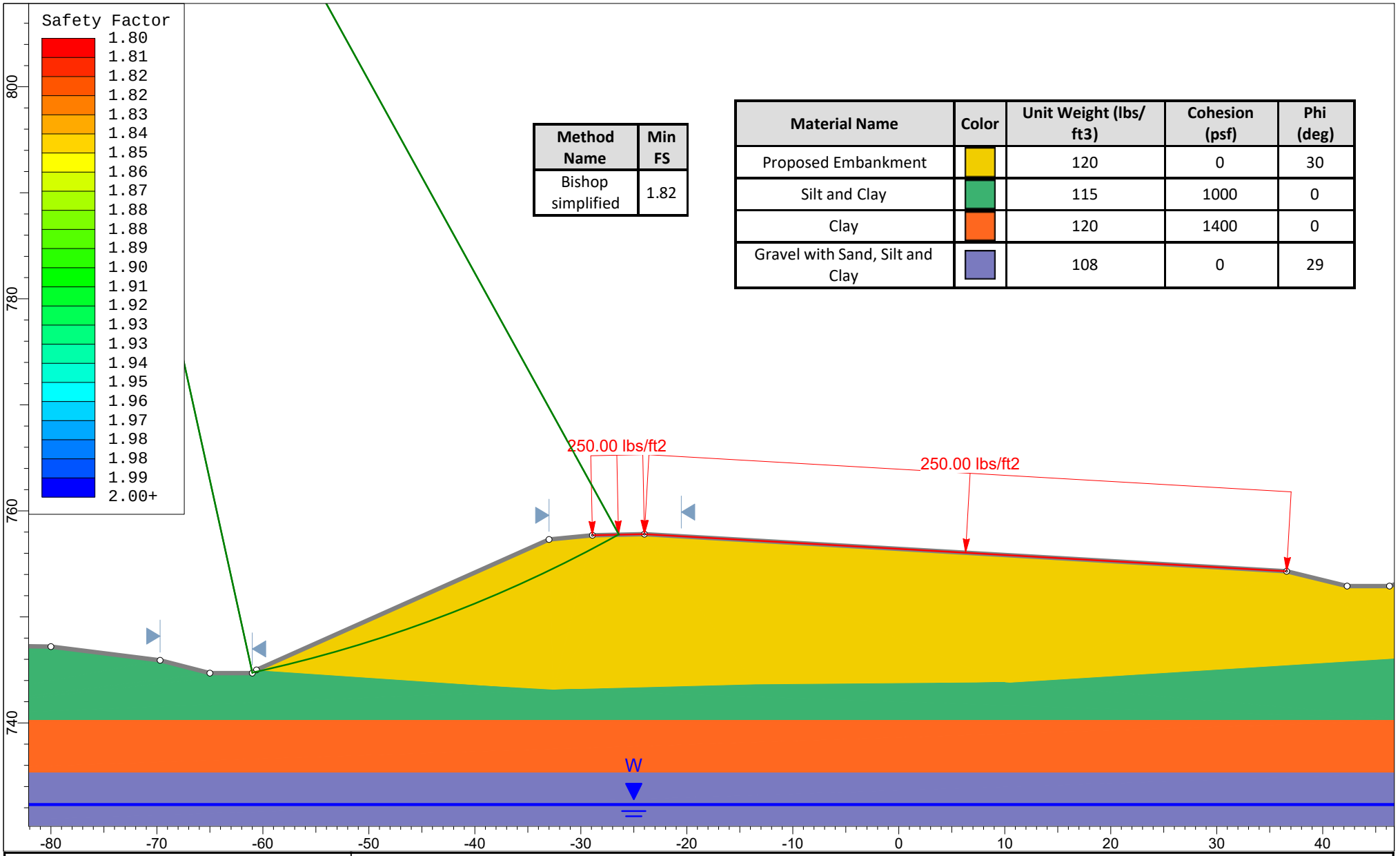



| Material Name | Color | Unit Weight (lbs/ ft3) | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|
| Proposed Embankment | | 120 | 0 | 30 |
| Silt and Clay | | 115 | 100 | 22 |
| Clay | | 120 | 150 | 22 |
| Gravel with Sand, Silt and Clay | | 108 | 0 | 29 |

rocscience

SLIDEINTERPRET 9.025

| | | | |
|---|---|---|---|
| *Project* | FRA-33-21.71 - PID 113744 | | |
| *Analysis Description* | Embankment Stability Analysis - US-33 EB STA. 289+00 - Effective Stress - Block Failure | | |
| *Drawn By* | KCA | *Company* | NEAS Inc. |
| *Date* | 5/4/2023, 9:25:34 AM | *File Name* | Slide_STA289+00_EffBlock050423.slmd |




| Method Name | Min FS |
|---|---|
| Bishop simplified | 1.82 |

| Material Name | Color | Unit Weight (lbs/ft3) | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|
| Proposed Embankment | | 120 | 0 | 30 |
| Silt and Clay | | 115 | 1000 | 0 |
| Clay | | 120 | 1400 | 0 |
| Gravel with Sand, Silt and Clay | | 108 | 0 | 29 |

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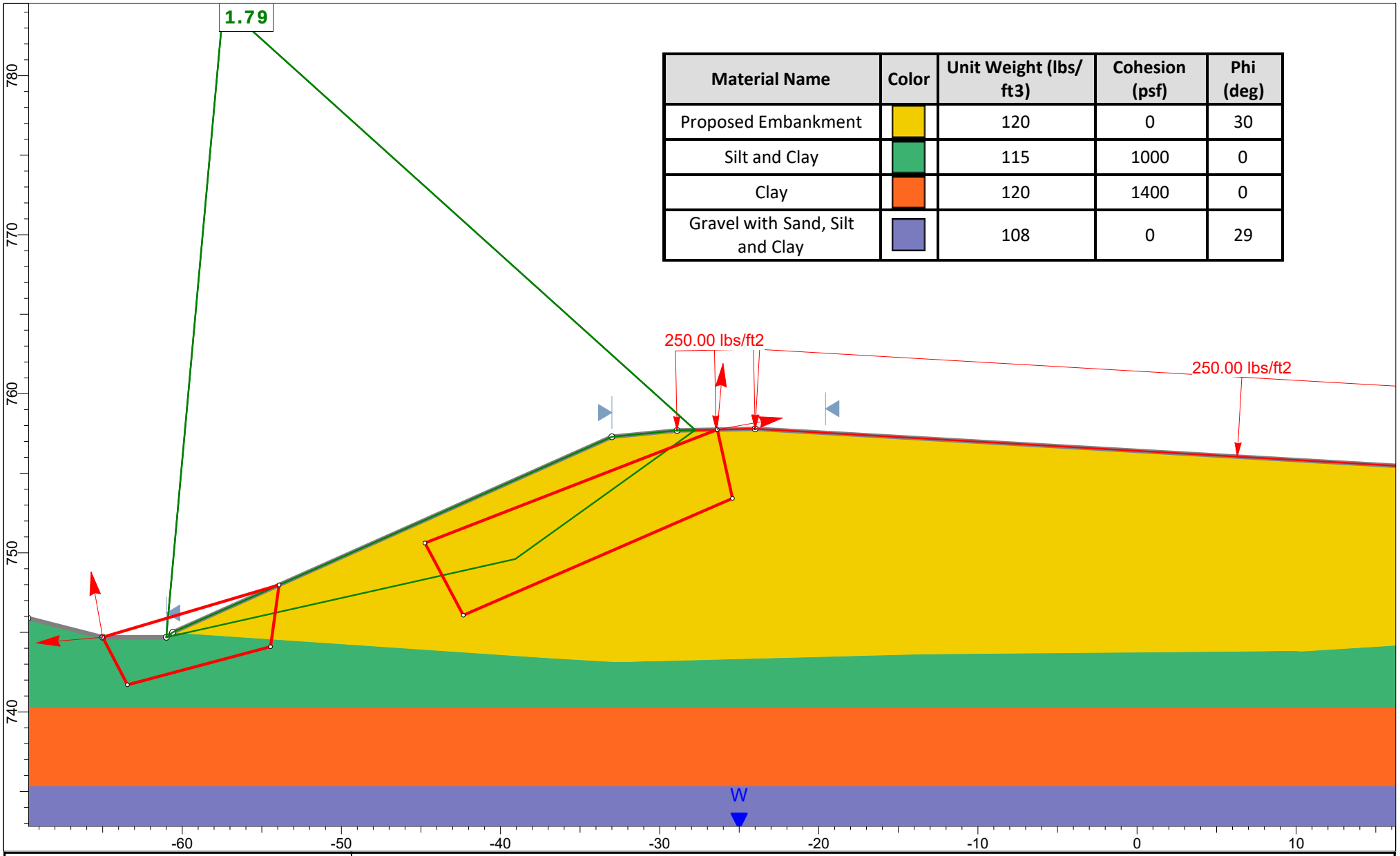
SLIDEINTERPRET 9.025

| | |
|---|---|
| Project | FRA-33-21.71 - PID 113744 |
| Analysis Description | Embankment Stability Analysis - US-33 EB STA. 289+00 - Total Stress - Circular Failure |
| Drawn By | KCA |
| Company | NEAS Inc. |
| Date | 5/4/2023, 9:25:34 AM |
| File Name | Slide_STA289+00_TotalCircular050423.slmd |




| Material Name | Color | Unit Weight (lbs/ ft3) | Cohesion (psf) | Phi (deg) |
|---|---|---|---|---|
| Proposed Embankment | | 120 | 0 | 30 |
| Silt and Clay | | 115 | 1000 | 0 |
| Clay | | 120 | 1400 | 0 |
| Gravel with Sand, Silt and Clay | | 108 | 0 | 29 |

rocscience

SLIDEINTERPRET 9.025

| | | | |
|---|---|---|---|
| *Project* | FRA-33-21.71 - PID 113744 | | |
| *Analysis Description* | Embankment Stability Analysis - US-33 EB STA. 289+00 - Total Stress - Block Failure | | |
| *Drawn By* | KCA | *Company* | NEAS Inc. |
| *Date* | 5/4/2023, 9:25:34 AM | *File Name* | Slide_STA289+00_TotalBlock050423.slmd |

# APPENDIX G

# SETTLEMENT ANALYSIS

National Engineering & Architectural Services Inc.

US-33EB_Settlement050223
Report Creation Date: 2023/05/08, 10:14:59

# Table of Contents

# Settle3 Analysis Information

# US-33EB_Settlement050223

## Project Settings

| | |
|---|---|
| Document Name | US-33EB_Settlement050223.s3z |
| Date Created | 4/21/2023, 1:04:24 PM |
| Last saved with Settle3 version | 5.017 |
| Stress Computation Method | Boussinesq |
| Stress Units | Imperial, stress as ksf |
| Settlement Units | inches |
| Time-dependent Consolidation Analysis | |
| Time Units | days |
| Permeability Units | feet/day |

### Advanced Settings

| | |
|---|---|
| Start of secondary consolidation (% of primary) | 95 |
| Min. stress for secondary consolidation (% of initial) | 1 |
| Reset time when load changes for secondary consolidation | No |
| Minimum settlement ratio for subgrade modulus | 0.9 |
| Use average poisson's ratio to calculate layered stresses | |
| Update Cv in each time step (improves consolidation accuracy) | |
| Ignore negative effective stresses in settlement calculations | |
| Add field points to load edges | |

### Soil Profile

| | |
|---|---|
| Layer Option | Horizontal Soil Layers |
| Vertical Axis | Depth below ground surface |

# Stage Settings

| Stage # | Name | Time [days] |
|---|---|---|
| 1 | Stage 1 - Load | 0 |
| 2 | Stage 2 | 1 |
| 3 | Stage 3 | 30 |
| 4 | Stage 4 | 60 |

# Results (relative to Stage: Stage 1 - Load = 0 d)

Time taken to compute: 3.49888 seconds

## Stage: Stage 1 - Load = 0 d

| Data Type | Minimum | Maximum |
|---|---|---|
| Total Settlement [in] | 0 | 0 |
| Total Consolidation Settlement [in] | 0 | 0 |
| Virgin Consolidation Settlement [in] | 0 | 0 |
| Recompression Consolidation Settlement [in] | 0 | 0 |
| Immediate Settlement [in] | 0 | 0 |
| Secondary Settlement [in] | 0 | 0 |
| Loading Stress ZZ [ksf] | 0 | 0 |
| Loading Stress XX [ksf] | 0 | 0 |
| Loading Stress YY [ksf] | 0 | 0 |
| Effective Stress ZZ [ksf] | 0 | 0 |
| Effective Stress XX [ksf] | 0 | 0 |
| Effective Stress YY [ksf] | 0 | 0 |
| Total Stress ZZ [ksf] | 0 | 0 |
| Total Stress XX [ksf] | 0 | 0 |
| Total Stress YY [ksf] | 0 | 0 |
| Modulus of Subgrade Reaction (Total) [ksf/ft] | 0 | 0 |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft] | 0 | 0 |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0 | 0 |
| Total Strain | 0 | 0 |
| Pore Water Pressure [ksf] | 0 | 0 |
| Excess Pore Water Pressure [ksf] | 0 | 0 |
| Degree of Consolidation [%] | 0 | 0 |
| Pre-consolidation Stress [ksf] | 0 | 0 |
| Over-consolidation Ratio | 0 | 0 |
| Void Ratio | 0 | 0 |
| Permeability [ft/d] | 0 | 0 |
| Coefficient of Consolidation [ft^2/d] | 0 | 0 |
| Hydroconsolidation Settlement [in] | 0 | 0 |
| Average Degree of Consolidation [%] | 0 | 0 |
| Undrained Shear Strength | 0 | 0 |

## Stage: Stage 2 = 1 d

| Data Type | Minimum | Maximum |
|---|---|---|
| Total Settlement [in] | 0 | 1.26825 |
| Total Consolidation Settlement [in] | 0 | 0 |
| Virgin Consolidation Settlement [in] | 0 | 0 |
| Recompression Consolidation Settlement [in] | 0 | 0 |
| Immediate Settlement [in] | 0 | 1.26825 |
| Secondary Settlement [in] | 0 | 0 |
| Loading Stress ZZ [ksf] | -0.00163817 | 1.824 |
| Loading Stress XX [ksf] | -0.435022 | 1.72786 |
| Loading Stress YY [ksf] | -0.527286 | 2.51761 |
| Effective Stress ZZ [ksf] | -2.22045e-16 | 2.22045e-16 |
| Effective Stress XX [ksf] | -0.435022 | 1.72786 |
| Effective Stress YY [ksf] | -0.527286 | 2.51761 |
| Total Stress ZZ [ksf] | -0.00163817 | 1.824 |
| Total Stress XX [ksf] | -0.26666 | 3.23377 |
| Total Stress YY [ksf] | -0.417517 | 4.10033 |
| Modulus of Subgrade Reaction (Total) [ksf/ft] | -0.502431 | 27.5752 |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft] | -0.502431 | 27.5752 |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | 0 | 0 |
| Total Strain | -1.93869e-06 | 0.0096964 |
| Pore Water Pressure [ksf] | -0.00163817 | 1.824 |
| Excess Pore Water Pressure [ksf] | -0.00163817 | 1.824 |
| Degree of Consolidation [%] | 0 | 0 |
| Pre-consolidation Stress [ksf] | 0 | 0 |
| Over-consolidation Ratio | -7.4607e-14 | 5.32907e-14 |
| Void Ratio | -0.00379306 | 3.28608e-06 |
| Permeability [ft/d] | 0 | 0 |
| Coefficient of Consolidation [ft^2/d] | 0 | 0 |
| Hydroconsolidation Settlement [in] | 0 | 0 |
| Average Degree of Consolidation [%] | -100 | 0 |
| Undrained Shear Strength | 0 | 0 |

## Stage: Stage 3 = 30 d

| Data Type | Minimum | Maximum |
|---|---|---|
| Total Settlement [in] | 0 | 4.40332 |
| Total Consolidation Settlement [in] | 0 | 3.15769 |
| Virgin Consolidation Settlement [in] | 0 | 1.24773 |
| Recompression Consolidation Settlement [in] | 0 | 1.91717 |
| Immediate Settlement [in] | 0 | 1.26825 |
| Secondary Settlement [in] | 0 | 0 |
| Loading Stress ZZ [ksf] | -0.00163817 | 1.824 |
| Loading Stress XX [ksf] | -0.435022 | 1.72786 |
| Loading Stress YY [ksf] | -0.527286 | 2.51761 |
| Effective Stress ZZ [ksf] | -0.00152252 | 1.824 |
| Effective Stress XX [ksf] | -0.283756 | 3.23377 |
| Effective Stress YY [ksf] | -0.430049 | 4.10033 |
| Total Stress ZZ [ksf] | -0.00152189 | 1.824 |
| Total Stress XX [ksf] | -0.26666 | 3.23377 |
| Total Stress YY [ksf] | -0.417517 | 4.10033 |
| Modulus of Subgrade Reaction (Total) [ksf/ft] | -0.257042 | 7.20604 |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft] | -0.502431 | 27.5752 |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | -1.32717 | 20.2135 |
| Total Strain | -0.00985123 | 0.326457 |
| Pore Water Pressure [ksf] | 0 | 0.776052 |
| Excess Pore Water Pressure [ksf] | 0 | 0.776052 |
| Degree of Consolidation [%] | 0 | 99.9641 |
| Pre-consolidation Stress [ksf] | 0 | 1.8137 |
| Over-consolidation Ratio | -7.5 | 11.104 |
| Void Ratio | -0.553345 | 0.0166978 |
| Permeability [ft/d] | -0.0273915 | 0 |
| Coefficient of Consolidation [ft^2/d] | -0.33 | 0 |
| Hydroconsolidation Settlement [in] | 0 | 0 |
| Average Degree of Consolidation [%] | -42.7331 | 0 |
| Undrained Shear Strength | 0 | 0.123655 |

## Stage: Stage 4 = 60 d

| Data Type | Minimum | Maximum |
|---|---|---|
| Total Settlement [in] | 0 | 4.68444 |
| Total Consolidation Settlement [in] | 0 | 3.44177 |
| Virgin Consolidation Settlement [in] | 0 | 1.28219 |
| Recompression Consolidation Settlement [in] | 0 | 2.16402 |
| Immediate Settlement [in] | 0 | 1.26825 |
| Secondary Settlement [in] | 0 | 0 |
| Loading Stress ZZ [ksf] | -0.00163817 | 1.824 |
| Loading Stress XX [ksf] | -0.435022 | 1.72786 |
| Loading Stress YY [ksf] | -0.527286 | 2.51761 |
| Effective Stress ZZ [ksf] | -0.00152206 | 1.824 |
| Effective Stress XX [ksf] | -0.271167 | 3.23377 |
| Effective Stress YY [ksf] | -0.41926 | 4.10033 |
| Total Stress ZZ [ksf] | -0.00152189 | 1.824 |
| Total Stress XX [ksf] | -0.26666 | 3.23377 |
| Total Stress YY [ksf] | -0.417517 | 4.10033 |
| Modulus of Subgrade Reaction (Total) [ksf/ft] | -0.237261 | 5.09134 |
| Modulus of Subgrade Reaction (Immediate) [ksf/ft] | -0.502431 | 27.5752 |
| Modulus of Subgrade Reaction (Consolidation) [ksf/ft] | -0.927782 | 7.05575 |
| Total Strain | -0.0098466 | 0.326458 |
| Pore Water Pressure [ksf] | 0 | 0.24165 |
| Excess Pore Water Pressure [ksf] | 0 | 0.24165 |
| Degree of Consolidation [%] | 0 | 99.991 |
| Pre-consolidation Stress [ksf] | 0 | 1.81372 |
| Over-consolidation Ratio | -7.5 | 11.0963 |
| Void Ratio | -0.553346 | 0.01669 |
| Permeability [ft/d] | -0.0273915 | 0 |
| Coefficient of Consolidation [ft^2/d] | -0.33 | 0 |
| Hydroconsolidation Settlement [in] | 0 | 0 |
| Average Degree of Consolidation [%] | -12.3878 | 0 |
| Undrained Shear Strength | 0 | 0.128826 |

# Loads

## 1. Polygonal Load: "Polygonal Load 1"

| | |
|---|---|
| Label | Polygonal Load 1 |
| Load Type | Flexible |
| Area of Load | 30920 ft2 |
| Depth | 0 ft |
| Installation Stage | Stage 2 = 1 d |

### Coordinates and Load

| X [ft] | Y [ft] | Load Magnitude [ksf] |
|---|---|---|
| 0 | -10 | 0 |
| 200 | -32.8 | 0 |
| 200 | -24 | 0.456 |
| 200 | 10 | 0.78 |
| 200 | 75 | 1.404 |
| 200 | 113.7 | 1.188 |
| 200 | 120.4 | 0.84 |
| 200 | 130.4 | 0 |
| 0 | 136 | 0 |

## 2. Polygonal Load: "Polygonal Load 2"

| | |
|---|---|
| Label | Polygonal Load 2 |
| Load Type | Flexible |
| Area of Load | 33770 ft2 |
| Depth | 0 ft |
| Installation Stage | Stage 2 = 1 d |

### Coordinates and Load

| X [ft] | Y [ft] | Load Magnitude [ksf] |
|---|---|---|
| 200 | -32.8 | 0 |
| 400 | -61 | 0 |
| 400 | -33 | 1.392 |
| 400 | 10 | 1.56 |
| 400 | 91 | 0.924 |
| 400 | 113.5 | 0 |
| 200 | 130.4 | 0 |
| 200 | 120.4 | 0.84 |
| 200 | 113.7 | 1.188 |
| 200 | 75 | 1.404 |
| 200 | 10 | 0.78 |
| 200 | -24 | 0.456 |

## 3. Polygonal Load: "Polygonal Load 3"

| | |
|---|---|
| Label | Polygonal Load 3 |
| Load Type | Flexible |
| Area of Load | 34380 ft2 |
| Depth | 0 ft |
| Installation Stage | Stage 2 = 1 d |

### Coordinates and Load

| X [ft] | Y [ft] | Load Magnitude [ksf] |
|---|---|---|
| 400 | 91 | 0.924 |
| 400 | 10 | 1.56 |
| 400 | -33 | 1.392 |
| 400 | -61 | 0 |
| 600 | -73.3 | 0 |
| 600 | -33 | 1.824 |
| 600 | 71.7 | 1.236 |
| 600 | 82.5 | 0.996 |
| 600 | 96 | 0 |
| 400 | 113.5 | 0 |

## 4. Polygonal Load: "Polygonal Load 4"

| | |
|---|---|
| Label | Polygonal Load 4 |
| Load Type | Flexible |
| Area of Load | 15700 ft2 |
| Depth | 0 ft |
| Installation Stage | Stage 2 = 1 d |

### Coordinates and Load

| X [ft] | Y [ft] | Load Magnitude [ksf] |
|---|---|---|
| 600 | -73.3 | 0 |
| 700 | -60.7 | 0 |
| 700 | -33 | 1.68 |
| 700 | 65.2 | 1.212 |
| 700 | 74.6 | 0.672 |
| 700 | 84 | 0 |
| 600 | 96 | 0 |
| 600 | 82.5 | 0.996 |
| 600 | 71.7 | 1.236 |
| 600 | -33 | 1.824 |

## 5. Polygonal Load: "Polygonal Load 5"

| | |
|---|---|
| Label | Polygonal Load 5 |
| Load Type | Flexible |
| Area of Load | 12245 ft2 |
| Depth | 0 ft |
| Installation Stage | Stage 2 = 1 d |

### Coordinates and Load

| X [ft] | Y [ft] | Load Magnitude [ksf] |
|---|---|---|
| 700 | 74.6 | 0.672 |
| 700 | 65.2 | 1.212 |
| 700 | -33 | 1.68 |
| 700 | -60.7 | 0 |
| 800 | -54.2 | 0 |
| 800 | -33 | 1.5 |
| 800 | 36.5 | 1.008 |
| 800 | 46 | 0 |
| 700 | 84 | 0 |

## 6. Polygonal Load: "Polygonal Load 6"

| | |
|---|---|
| Label | Polygonal Load 6 |
| Load Type | Flexible |
| Area of Load | 29600 ft2 |
| Depth | 0 ft |
| Installation Stage | Stage 2 = 1 d |

### Coordinates and Load

| X [ft] | Y [ft] | Load Magnitude [ksf] |
|---|---|---|
| 800 | -54.2 | 0 |
| 1200 | -44.8 | 0 |
| 1200 | -33 | 0.888 |
| 1200 | -27.7 | 0.924 |
| 1200 | -14.6 | 0.672 |
| 1200 | 3 | 0 |
| 800 | 46 | 0 |
| 800 | 36.5 | 1.008 |
| 800 | -33 | 1.5 |

## 7. Polygonal Load: "Polygonal Load 7"

| | |
|---|---|
| Label | Polygonal Load 7 |
| Load Type | Flexible |
| Area of Load | 14340 ft2 |
| Depth | 0 ft |
| Installation Stage | Stage 2 = 1 d |

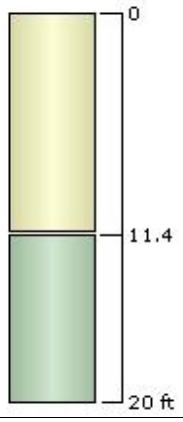
### Coordinates and Load

| X [ft] | Y [ft] | Load Magnitude [ksf] |
|---|---|---|
| 1200 | -14.6 | 0.672 |
| 1200 | -27.7 | 0.924 |
| 1200 | -33 | 0.888 |
| 1200 | -44.8 | 0 |
| 1500 | -44.8 | 0 |
| 1500 | 3 | 0 |
| 1200 | 3 | 0 |

# Soil Layers

Ground Surface Drained: Yes

| Layer # | Type | Thickness [ft] | Depth [ft] | Drained at Bottom |
|---|---|---|---|---|
| 1 | Cohesive Soil | 11.4 | 0 | Yes |
| 2 | Non-cohesive Soil | 8.6 | 11.4 | No |



# Soil Properties

| Property | Cohesive Soil | Non-cohesive Soil |
|---|---|---|
| Color | | |
| Unit Weight [kips/ft3] | 0.12 | 0.12 |
| Saturated Unit Weight [kips/ft3] | 0.12 | 0.12 |
| K0 | 1 | 1 |
| Immediate Settlement | Enabled | Enabled |
| Es [ksf] | 815 | 177 |
| Esur [ksf] | 815 | 177 |
| Primary Consolidation | Enabled | Disabled |
| Material Type | Non-Linear | |
| Cc | 0.23 | - |
| Cr | 0.046 | - |
| e0 | 0.695 | - |
| OCR | 8.5 | - |
| Cv [ft2/d] | 0.07 | - |
| Cvr [ft2/d] | 0.4 | - |
| B-bar | 1 | - |
| Undrained Su A [kips/ft2] | 0 | 0 |
| Undrained Su S | 0.2 | 0.2 |
| Undrained Su m | 0.8 | 0.8 |
| Piezo Line ID | 1 | 1 |

# Groundwater

| | |
|---|---|
| Groundwater method | Piezometric Lines |
| Water Unit Weight | 0.0624 kips/ft3 |
| Generating excess pore pressure above water table | |

## Piezometric Line Entities

| ID | Depth (ft) |
|---|---|
| 1 | 11.2 ft |

# Query

## Query Lines

| Line # | Query Line Name | Start Location | End Location | Horizontal Divisions | Vertical Divisions |
|---|---|---|---|---|---|
| 1 | Query Line 1 | 0, 0 | 1500, 0 | 60 | Auto: 43 |
| 2 | Query Line 2 | 0, 135 | 200, 100 | 8 | Auto: 43 |
| 3 | Query Line 3 | 200, 100 | 400, 55 | 8 | Auto: 43 |
| 4 | Query Line 4 | 400, 55 | 600, 30 | 8 | Auto: 43 |
| 5 | Query Line 5 | 600, 30 | 800, 26 | 8 | Auto: 43 |
| 6 | Query Line 6 | 600, 96 | 600, -73.3 | 20 | Auto: 43 |
| 7 | Query Line 7 | 200, 130.4 | 200, -32.8 | 20 | Auto: 43 |

## Field Point Grid

| | |
|---|---|
| Number of points | 389 |
| Expansion Factor | 2 |

### Grid Coordinates

| X [ft] | Y [ft] |
|---|---|
| 1650 | 286 |
| 1650 | -223.3 |
| -150 | -223.3 |
| -150 | 286 |

# Time Points

| Point # | (X,Y) Location | Depth | Goal Type | Goal | Time Until Goal |
|---|---|---|---|---|---|
| 1 | 600, -33 | 0 ft | Degree of Consolidation | 90% | 30.9894 d |