GPD GROUP
Cleveland, Ohio

Geotechnical Subsurface Investigation
OTIC 71-20-01 Bridge Deck Rehabilitation
Beam Strengthening – TR 22 Bridge over
Mainline MP 27.3
Fulton County, Ohio

June 2021

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June 18, 2021 **TTL Project No. 1982501**

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Geotechnical Subsurface Investigation
OTIC 71-20-01 Bridge Deck Rehabilitation
Beam Strengthening - TR 22 Bridge over Mainline MP 27.3
Fulton County, Ohio

Dear Mr. Washko:

Following is the report of the geotechnical subsurface investigation performed by TTL Associates, Inc. (TTL) at the site of the referenced project. This investigation was performed in general accordance with TTL Proposal No. 1982501-rev1, dated August 5, 2020 and authorized via a Subconsultant Agreement for Professional Services dated October 26, 2020. TTL previously submitted a report and results for the desktop study portion of this project (TTL Project No. 1982501).

This final report addresses the bridge at mile post (MP) 27.3 and contains the results of our study and provides our construction recommendations addressing slope stability concerns. . Reports addressing the bridges at MP 32.2, MP 37.1, and MP 46.4 will be part of separate reports.

Soil samples collected during this investigation will be stored at our laboratory for 90 days from the date of this report. The samples will be discarded after this time unless you request that they be saved or delivered to you.

Should you have any questions regarding this report or require additional information, please contact our office.

Sincerely,

TTL Associates, Inc.

Imad El Hajjar, EI
Geotechnical Project Manager

Curtis E. Roupe, P.E.
Vice President

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GEOTECHNICAL SUBSURFACE INVESTIGATION
OTIC 71-20-01 BRIDGE DECK REHABILITATION
BEAM STRENGTHENING - TR 22 BRIDGE OVER MAINLINE MP 27.3
FULTON COUNTY, OHIO

FOR

GPD GROUP INC
5595 TRANSPORTATION BOULEVARD, SUITE 100
CLEVELAND, OHIO 44125

SUBMITTED

JUNE 18, 2021
TTL PROJECT NO. 1982501

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1.0 INTRODUCTION

This geotechnical subsurface investigation report has been prepared as part of the OTIC 71-20-01 Bridge Deck Rehabilitation for the beam strengthening of TR 22 (aka CR 22) Bridge over mainline mile post 27.3 (MP 27.3) in Fulton County, Ohio. The general project area is shown on the attached Site Location Map (Plate 1.0).

This final report addresses the bridge at MP 27.3 and contains the results of our study and provides our construction recommendations addressing slope stability concerns. Foundation support evaluation and pile design are not included in this report because the new expanded wingwalls/parapet will cantilever from the existing structure and new piles will not be added as part of this project. Reports addressing the bridges at MP 32.2, MP 37.1, and MP 46.4 are part of separate reports.

This investigation was performed in general accordance with TTL Proposal No. 1982501-rev1, dated August 5, 2020 and authorized via a Subconsultant Agreement for Professional Services dated October 26, 2020. TTL previously submitted a report and results for the desktop study portion of this project (TTL Project No. 1982501).

The purpose of this investigation was to evaluate the subsurface conditions relative to the design and construction of replacement pavements, underground utilities, and a replacement culvert. To accomplish this, TTL performed 2 soil test borings, field and laboratory soil testing, and a geotechnical engineering evaluation of the test results.

This report includes:

- A description of the pavement, subsurface soil, and groundwater conditions encountered in the borings;
- Recommendations for slope remediation; and
- Recommendations concerning soil and groundwater related construction procedures such as site preparation, earthwork, benching, toe key construction, and related field testing.

The scope of this study did not include an environmental assessment of the subsurface materials at this site.

2.0 PROJECT DESCIPTION

We understand that it is proposed to raise the profile at the TR-22 overpass bridge on the James W. Shocknessy Ohio Turnpike (Interstate Route 90 [IR-90]) in Fulton County Ohio. This bridge currently has roughly 14.5 feet of vertical clearance with grades along the bridge on the order of 743.5 feet. Based on information provided by GPD and as shown in Figure 1 below, we understand that it is proposed to raise the bridge roughly 1½ feet such that the final grades along the bridge are on the order of 745 feet. To accommodate the vertical change in grade sliver fill placement on the existing embankment and special benching for landslide stabilization will be required. The proposed embankment will measure approximately 25 feet in thickness having a roughly 2:1 slope.

We understand that the new bridge deck will be supported on the same wing wall and that a structural analysis has been performed to confirm that the existing wing wall and associated foundation subsystem are capable of supporting the new raised and/or widened structure.

As stated in our desktop study prepared for this project and dated December 15, 2021, the following should be noted:

- The pavements appeared in generally good condition. Minor longitudinal cracking down the center of the pavement areas were apparent. It appeared that the bridge has been recently rehabilitated.

- Notable evidences of slope instability were observed and are listed below:
  - Leaning telephone Pole - Tilting downslope roughly 10-to-15 degrees out of plumb.
  - Longitudinal Cracks up to 1-inch-wide observed along shoulders and curbs.

- Excavating through and filling over landslide-susceptible materials can exacerbate landslide-prone soil conditions to the point of causing failure.

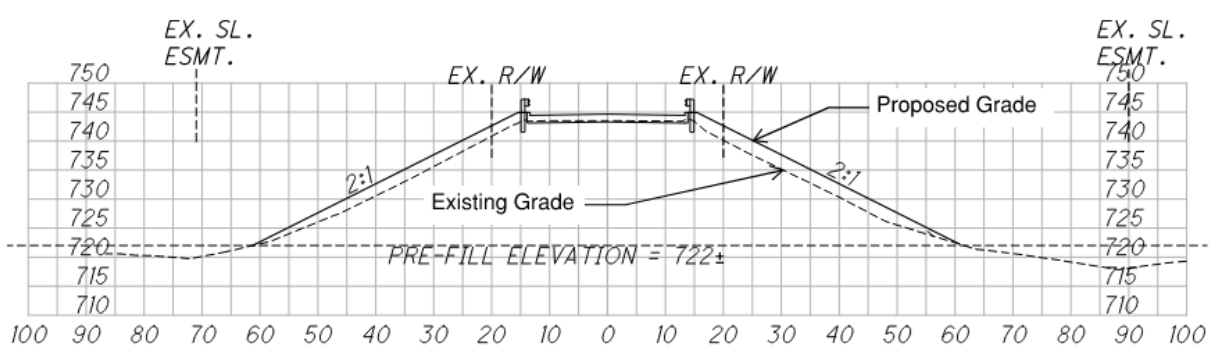


Figure 1: Slope Repair Most Critical Cross-Sections

3.0 GENERAL SITE AND SUBSURFACE CONDITIONS

3.1 Field Sampling and Testing

Two test boring, designated as Borings B-1 and B-2, were drilled by TTL on March 17 and 19, 2021. The test borings were performed at the top of the embankment through the roadway pavement in the southbound lane north of the bridge and the northbound lane south of the bridge. The boring locations were established in the field by TTL based on the provided information by pacing and taping methods. Ground surface elevations at the boring locations were approximated from Google Earth. The approximate location of the test borings are shown on the attached Test Boring Location Plan (Plate 2.0).

The test borings were performed in general accordance with geotechnical investigative procedures outlined in ASTM Standard D 6151. The test boring performed during this investigation were drilled with a truck-mounted rotary drilling rig utilizing 3¼-inch inside diameter hollow-stem augers. Borings were terminated at the target depth of 80 feet below existing grade (approximate Elev. 663 feet).

During auger advancement, soil samples were collected at 2½-foot intervals and at 5-foot intervals thereafter to boring termination. Split-spoon (SS) samples were obtained by the Standard Penetration Test (SPT) Method (ASTM D 1586), which consists of driving a 2-inch outside diameter split-spoon sampler into the soil with a 140-pound weight falling freely through a distance of 30 inches. The sum of the number of blows required to advance the sampler the second and third 6-inch increments is termed the Standard Penetration Resistance, or N_m-value, and is typically reported in blows per foot (bpf). The N_m-values were corrected to an equivalent rod energy ratio of 60 percent, N_{60}. The hammer/rod energy ratio for the CME 75 Truck 844 was 66 percent, and was last calibrated on March 15, 2021. The N_{60}-values are presented on the attached Logs of Test Borings and Summary of Soil Test Data sheets. The split-spoon samples were sealed in jars and transported to our laboratory for further classification and testing.

Soil conditions encountered in the test borings are presented in the Logs of Test Borings, along with information related to sample data, SPT results, water conditions observed in the borings, and laboratory test data. It should be noted that these logs have been prepared on the basis of laboratory classification and testing as well as field logs of the encountered soils.

Experience indicates that the actual subsoil conditions at a site could vary from those generalized on the basis of test borings made at specific locations. Therefore, it is essential that

a geotechnical engineer be retained to provide soil engineering services during the site preparation, excavation, and construction phases of the proposed project. This is to observe compliance with the design concepts, specifications, and recommendations, and to allow design changes in the event subsurface conditions differ from those anticipated prior to the start of construction.

3.2 Laboratory Testing

All of the recovered samples of the subsoils were visually or manually classified in accordance with the Unified Soil Classification System (USCS) (ASTM D 2487 and D 2488). All samples were tested in our laboratory for moisture content (ASTM D 2216). Dry density determinations and unconfined compressive strength tests by the constant rate of strain method (ASTM D 2166) were performed for selected intact cohesive samples. Unconfined compressive strength estimates were performed for the remaining intact cohesive samples using a calibrated hand penetrometer. Atterberg limits tests (ASTM D 4318) and particle size analyses (ASTM D 422) were performed on four selected samples from each boring. The results of these tests are presented on the Logs of Test Borings, and Summary of Soil Test Data sheets attached to this report.

4.0 GENERAL SITE AND SUBSURFACE CONDITIONS

4.1 General Surface Conditions

The surface materials encountered in Borings B-1 and B-2 consisted of asphalt approximately 10½ inches and 10 inches in thickness, respectively. Aggregate base was encountered underlying the asphalt in each boring on the order of 3½ inches and 5 inches in thickness, respectively.

4.2 Site Geology

As stated in the desktop study, published geologic maps from the Ohio Department of Natural Resources (ODNR) indicate that this project site is located within the glaciated portion of Ohio Quaternary soil deposits consist of Lacustrine Clays (LC), deposited in calm water of glacial lakes; mostly laminated; covered in places with thin organic deposits.

Based upon the available ODNR references, the surface soils above the bedrock are part of the Lake Maumee Lacustrine Aquifer which more than 100 feet thick and yields 25 to 100 gallons of groundwater per minute

Bedrock at the site consist of Lower Mississippian and Upper Devonian aged Shale of the undivided Sunbury and Bedford Shale formations. Top of rock elevation was reported between Elevs. 580 and 600 feet above mean seal level, which is anticipated around 140 to 160 feet below existing grades (along the bridge).

4.3 General Soil Conditions

Based on the results of our field and laboratory tests, the subsoils encountered underlying the crushed stone can generally be characterized by a layer of fill material overlying native cohesive soils.

Stratum I consisted of cohesive fill material and was encountered underlying the pavement materials to depths of 22 feet below existing grades and 24 feet in Borings B-1 and B-2, respectively (approximate Elev. 721 to 719, respectively). The cohesive fill contained silt and clay (A-6a) as well as silty clay (A-6b). SPT N_{60}-values for the cohesive fill materials generally ranged from 9 to 18 blows per foot (bpf), indicating stiff to very stiff consistency. However, one SPT N_{60}-value of 8 bpf was encountered in Boring B-1 (SS-2), indicative of a medium stiff consistency. Unconfined compressive strengths determined by the rate of strain method were approximately 2,900 pounds per square foot (psf) and 3,200 psf. Unconfined compressive

strengths determined by a calibrated hand penetrometer ranged from 5,500 pounds per square foot (psf) to greater than 9,000 psf (highest obtainable reading using a calibrated hand penetrometer). Moisture contents generally ranged from 19 to 26 percent.

Stratum II consisted of predominantly stiff to very stiff native cohesive soils encountered underlying Stratum I (Fill) to boring termination at a depth of 80 feet in both borings (approximate Elev. 663 feet). Stratum II consisted of silt (A-4a), silt and clay (A-6a), silty clay (A-6b), and clay (A-7-6). SPT N_{60}-values for the Stratum II soils generally ranged from 9 to 22 bpf. However, one SPT N_{60}-value of 8 bpf was encountered in Boring B-1 (SS-8), indicative of a medium stiff consistency. Unconfined compressive strengths determined by the rate of strain method generally ranged from approximately 2,000 to 4,500 psf. Unconfined compressive strengths determined by a calibrated hand penetrometer ranged from 3,000 psf to greater than 9,000 psf. Moisture contents generally ranged from 18 to 25 percent. However, a higher moisture content of 31 percent existed in Borings B-1 (SS-9) and B-2 (SS-8).

Additional descriptions of the soil stratigraphy encountered in the borings are presented on the Logs of Test Borings attached to the report.

4.4 Groundwater Conditions

Groundwater was not observed during drilling operations in either of the borings. Groundwater was only observed in Boring B-2 upon completion of drilling at a depth of 37 feet. It should be noted that the boring was drilled and backfilled within the same day. As such, stabilized water levels may not have occurred over this limited time period. Instrumentation was not installed to observe long-term groundwater levels.

Based on the soil characteristics and groundwater conditions encountered in the borings, it is our opinion that the “normal” long-term groundwater table will be generally encountered at depths of approximately 32 feet or lower, corresponding to approximate Elev. 711 or deeper. However, groundwater elevations can fluctuate with seasonal and climatic influences. In particular, “perched” water may be encountered in fill materials underlain by relatively impermeable cohesive soils. Therefore, the groundwater conditions may vary at different times of the year from those encountered during this investigation.

5.0 DESIGN RECOMMENDATIONS

The following conclusions and recommendations are based on our understanding of the proposed construction and the data obtained during our field investigation. If the project information or location as outlined is incorrect or should change significantly, a review of these recommendations should be made by TTL. These recommendations are subject to satisfactory completion of the recommended site and subgrade preparation and fill placement operations described in Section 6.0, "Construction Recommendations."

5.1 New Embankment Fill

Fill will be placed for the new embankment in order to accommodate the vertical change in grades along the bridge overpass. In order to achieve this, the re-construction of an embankment, roughly 25 feet in height and having a roughly 2:1 slope will be required. In addition, signs of landslide instability were observed along the existing slopes and sliver fill placement on the existing embankment and special benching for landslide stabilization will be required.

5.1.1 Special Benching and Sidehill Embankment Fills

Where fill will be placed along slight slopes, this new fill should be placed in horizontal lifts in accordance with ODOT Construction and Materials Specifications (CMS) Item 203.05, which describes "standard specification" benching. In areas where the existing slope is steeper (approaching 3:1) and due to the above noted slope instability, fill placement would fall under the specifications of ODOT Geotechnical Bulletin GB-2, "Special Benching and Sidehill Embankment Fills," dated January 17, 2021. Specifically, in accordance with Figure 4 in Section E. Special Benching for Landslide Stabilization with the following:

- Minimum 8 feet wide benches;
- Minimum 3.5 feet deep and 9 feet wide Toe Key (i.e., Shear Key); and
- Bench and/or toe drains are not be required.

The contractor should plan to excavate a toe key having the above noted dimensions at the toe of the proposed slope. A conceptual figure showing the proposed dimension of the toe key, its location and dimensions associated with dimension of the benches is provided in appendix E. The edge of the proposed toe should coincide with the toe of the proposed slope. The location of the toe key could be adjusted inward to fit all the excavation within the easement limits, all

the corresponding benches should be shifted along with the toe key. The toe key subgrade should consist of stiff to very stiff native cohesive soils consistent with the soil encountered in the test borings. The toe key should be backfilled ODOT Item 703 No. 1 and No. 2 stone. The side slopes of the key should be graded no steeper than 1H:1V, and the bottom of the toe key should be 9.0 feet wide. A filter (geotextile) fabric (ODOT Item 712.09, Type B) should be placed along surface of the shear key excavation prior to placement of the No. 1 and No. 2 stone, and the surface of the No. 1 and No. 2 stone should be covered with filter fabric prior to construction of the embankment to prevent the migration of fines into the void space of the aggregate. The toe key should extend along the whole length of the reconstructed slope. It would be preferable to "drain" this granular key, but we understand that this might not be feasible due to the surrounding site grades. Hence, a 2-foot thick cohesive cap could be installed above the filter fabric /stone to seal the key area to prevent saturation. In lieu of open graded stone, ODOT Item 304 could be used to reduce the possible saturation at the toe of the slope, but it would likely be less cost efficient.

The soils in the project area where the excavation will be performed consist of predominantly existing fill material. For these soils, GB-2 indicates that a 1H:1V backslope should be planned. Based on the conditions encountered in the borings and on the slope stability analysis for the temporary conditions during construction conditions, a 1H:1V backslope should be generally achievable for short-term excavations. Based on the different grades on the 4 sides of the bridge abutments, the height of the upper bench(es) should be adjusted such that it intercept the existing pavement.

In general, and as shown on the stability analysis outputs presented in Appendix E, three (3) benches are prescribed for the existing slope and the prescribed toe key shall be excavated at the back of the bench. The approximate location of the bench and toe key along with their dimensions is shown on the slope stability outputs provided in Appendix E. The backslope associated with this bench will intercept existing roadway approximately 8 feet inside the pavement, special measures for maintenance of traffic (MOT) may be required.

5.1.2 Global Stability

We performed global slope stability analyses using the 2-D Limit Equilibrium Slope Stability Program Slide 6.0 by Rocscience to evaluate proposed 2H:1V embankment slope throughout the Site, and to ensure permanent embankment slope designs having factors of safety greater than 1.3 for static conditions. The slope stability analysis of the existing slope was performed

for was perform on the most critical section within slope repair area of the respective site. Schematic cross sections of the existing slopes were provided by GPD.

We performed this analysis simulating a 25 foot thick embankment having 2:1 slope. We also analyzed a long term scenario simulating a possible flood event of the surrounding agricultural fields. Using this program, a myriad of potential failure surfaces can be generated theoretically, from which the factor of safety can be determined as to whether sufficient resisting soil strength can be mobilized to counteract the driving forces (weight of soil, seepage, and surcharge loads) that would cause the slope to move downward. The factor of safety is the ratio of the resisting forces to the driving forces.

Global instability typically is manifested by pronounced movements of a large arc or wedge of soil that result in bulging at the toe of the slope as well as observable displacement of soil at or near the crest of the slope. This crest displacement may be exhibited by a near-vertical tension crack at the back edge of the displaced soil mass, or may be significant enough to exhibit a downward movement of soil that creates a “scarp” such that a sharp drop occurs in an otherwise level ground surface. Global instability of the embankment at this site could create a significant impact due to the potential for such movement to encompass a portion of the roadway.

We analyzed one typical embankment section located along the center of the proposed new embankment. The short term conditions where simulated using total stress soil parameters (TSSP) and the long term conditions using effective stress soil parameters (ESSP). Based on the site topography and our field observations, the groundwater table was modeled along the ground surface of the adjacent agricultural fields.

Shear strength parameters for the new embankment fill were determined using ODOT GB-2 as a general guideline. Remaining soil strengths were evaluated based on unconfined compressive strength test results, hand penetrometer readings as well as SPT N-values, moisture content, unit weight (density), and soil plasticity data of the encountered soils. Correlations with published data were also utilized to estimate soil properties.

It should be noted that the properties of the soil strata vary somewhat with layer and depth; the layers and assigned soil properties used in the analyses are detailed in the attached slope stability outputs that illustrate the toe key, potential critical failure surfaces associated with the global stability of the embankment, as well as slope geometry and potential critical failure surfaces associated with the slope. The soil parameters utilized for analysis of the wall are also

presented on the wall slope stability outputs attached to this report. The results are summarized in the following table.

Summary of Slope Stability Calculations

Model	Method	Factor of Safety
1	Total Stress Soil Parameters (TSSP) *3.5 foot deep 9 foot-wide Toe Key + 8 foot-wide Benches*	2.80
2	Effective Stress Soil Parameters (ESSP) *3.5 foot deep 9 foot-wide Toe Key + 8 foot-wide Benches*	1.32
4	Total Stress Soil Parameters (TSSP) *Temporary Conditions during Construction*	2.73

As stated above and shown on the attached slope stability outputs, a 3.5 feet-deep and 9 feet-wide Toe Key will be required at the toe of the existing slope in order to achieve adequate factors of safety. The factor of safety for the short-term (end-of-construction) case using TSSP was greater than the required minimum factor of safety of 1.1. The factor of safety for the long-term (post-construction) case using ESSP meets the required minimum factor of safety of 1.3, since the bridge structure is supported on a deep foundation system.

We also analyzed the conditions of the back slopes during construction using Total Stress Soil Parameters resulted in a factor of safety greater than 1.5 as shown on the attached slope stability outputs.

5.2 Subgrades

5.2.1 Pavement Subgrade

The subgrade along the pavement area is anticipated to consist of newly placed engineered fill material (ODOT item 203) used to re-construct the existing embankment. These soils are considered adequate to support the proposed pavement. If loose or soft soils are encountered during the subgrade proofroll, we recommend over-excavating this material and backfilling with ODOT Construction and Materials Specifications (CMS) Item 203 material.

5.2.2 Modified Subgrade

If soils wet of optimum are encountered, lowering the moisture content by scarification and aeration (discing and exposure to sun and wind) may be required. Very moist to wet soils will "pump" under the operation of heavy equipment, resulting in deep rutting and perhaps rendering the operation of grading and paving equipment difficult or impossible. The granular subgrade soils should be generally conducive for drying using scarification and aeration.

If the schedule does not allow for scarification and aeration, other methods of subgrade modification may be required in areas of high moisture content. Modification may be achieved by undercutting and replacement with granular subbase (possibly in combination with a geotextile separation layer or geogrid reinforcement), mixing stone into the subgrade, or treating the subgrade with cement. The method of subgrade modification should be determined at the time of construction (See Section 6.1, "Construction Recommendations - Site and Subgrade Preparation").

5.3 Flexible (Asphalt) Pavement Design

We understand the subgrade of the pavement shoulder will consist of properly compacted engineered fill. Based on our experience with similar soils, and on the results of the plasticity and gradation testing for the upper profile cohesive subgrade soil samples, we recommend a subgrade CBR value of 6 percent. This CBR value is based on subgrade soils that are placed and compacted in accordance with ODOT Item #203.

It should be noted that we are not privy to the design traffic loads or intended design life. The subgrade support recommendations indicated herein should be reviewed by the site engineer in conjunction with the design traffic criteria to determine the required pavement sections.

All paving operations should conform to the Ohio Turnpike Commission and the Ohio Department of Transportation (ODOT) specifications. The pavement and subgrade preparation procedures outlined in this report should result in a reasonably workable and satisfactory pavement. It should be recognized, however, that all flexible pavements need repairs or overlays from time to time as a result of progressive yielding under repeated traffic loads for a prolonged period of time, as well as exposure to freeze-thaw conditions.

5.4 Groundwater Control and Pavement Drainage

As stated previously, groundwater was generally not observed during drilling operations or upon completion of drilling of the test boring. Based on the soil characteristics and groundwater conditions encountered in the borings, it is our opinion that the "normal" long-term groundwater table will be generally encountered will be generally encountered at depths of approximately 32 feet or lower, corresponding to approximate Elev. 711 or deeper. However, groundwater elevations can fluctuate with seasonal and climatic influences. In particular, "perched" water may be encountered in fill materials underlain by relatively impermeable cohesive soils. Therefore, the groundwater conditions may vary at different times of the year from those encountered during this investigation.

Construction planning should include potential remedial measures to be implemented where excessive groundwater seepage or unstable subgrades are encountered in the proposed excavations. Dewatering methods may include multiple sumps or a system of well points. The type of dewatering system utilized will depend on construction practices, soil conditions encountered in the toe key excavations, seasonal conditions, and the depth of excavation. Additionally, the contractor will need to exercise diligence to control seepage and runoff to maintain a stable subgrade. Installation of utilities early in the site development may also alleviate unstable subgrade conditions.

Based on the poorly-drained nature of the clayey soils present at the site and anticipated cohesive fill material, it is anticipated that surface water infiltration may collect in the aggregate base course. Without adequate drainage, water will remain in the base for extended periods of time, creating localized wet, soft pockets. The presence of these pockets will increase the likelihood that pavement distress (cracking, potholes, etc.) will develop. Drainage features may include grading the subgrade surface to slope downward to the outside edge of pavements and/or providing longitudinal edge drains connected to storm sewers or other outlets.

6.0 CONSTRUCTION RECOMMENDATIONS

6.1 Site and Subgrade Preparation

Site and subgrade preparation activities should conform to ODOT Construction and Materials Specifications (CMS) Item 204 specifications. Prior to proceeding with construction operations, all pavements, vegetation, topsoil, root systems, debris, and other deleterious non-soil materials should be stripped from the proposed construction area. Suitable topsoil may be stockpiled for later use in landscaped areas. The actual amount of required stripping should be determined in the field by a geotechnical engineer or qualified representative. The Pavement thickness presented in the borings are not intended as a basis for project quantity estimates or bid purposes.

It should be noted that the topsoil thickness may vary across the site. Dark soils having the appearance of topsoil, but exhibiting only root "hairs" or trace organics less than approximately three percent, may not require stripping for the full depth of the darkly colored zone, provided the subgrade can be satisfactorily proof rolled as described below. Conversely, the site may contain areas where additional excavation will be required beyond the darkly colored zone due to organics in order to provide a stable subgrade for construction.

The approximate location of the toe key is shown on the slope stability outputs provided in Appendix E. The toe key subgrade should consist of stiff to very stiff native cohesive soils consistent with the soil encountered in the test borings.

Upon completion of the stripping and clearing, the areas intended to support new fill, and pavements should be carefully inspected by a geotechnical engineer. Pavement subgrades should be proof rolled in general accordance with ODOT CMS 204.06. At the time of inspection, the engineer may require proof rolling of the cohesive subgrades utilizing a 20- to 30-ton loaded truck or other pneumatic-tired vehicle of similar size and weight. If granular subgrade soils are present at the proposed subgrade elevation, proof rolling/compaction should be performed using a vibratory smooth-drum roller. The vehicle should make a sufficient number of passes, in two perpendicular directions, covering the proposed development area, to locate any soft, weak, or excessively wet soils that may be present at the time of construction.

The purpose of proof rolling the clayey subgrades is to locate any weak, soft, or excessively wet soils that may be present at the time of construction. Any unsuitable materials observed

during the inspection and proof-rolling operations should be undercut and replaced with compacted fill or stabilized in place utilizing conventional remedial measures such as discing, aeration, and re-compaction. Once the site has been proof rolled, inspected, and stabilized, the proof-rolled or inspected subgrades should not be exposed to wet conditions. It should be recognized that during periods of wet weather, the clayey soils that will be exposed at design subgrades will tend to pond water for short periods of time, with the potential to deteriorate the prepared subgrade. Additionally, we recommend that the fill areas be constantly sloped for positive gravity drainage to avoid ponded water on fills, and that fill areas be sealed at the end of each day by smooth-drum rolling when there is a threat of precipitation.

The results of the proof-rolling and inspection operations will be partially dependent on construction operations, the moisture content of the soil, and the weather conditions prevalent at the time. If pumping or rutting is encountered and difficulty is experienced in the operation of construction equipment, TTL should be notified to determine which method of subgrade modification may be best suited for the conditions encountered. At that time, we may recommend that a small test area be used to determine the necessary depth of undercutting and stone replacement to achieve a stable subgrade condition.

Due to the presence of the predominantly clay subgrade soils and the potential for seasonal high water table conditions (perched or ponded), it is our opinion that completion of the excavation and site work activities will require care and diligence by the contractor to avoid loss of subgrade strength and to reduce undercut areas.

If wet soils are encountered during excavation of the prescribed bench, slope drains should be installed at the back of the excavation in accordance with specifications of ODOT Geotechnical Bulletin GB-2, “Special Benching and Sidehill Embankment Fills,” dated January 17, 2021. A typical slope drain detail is also shown in Figure 2 below.

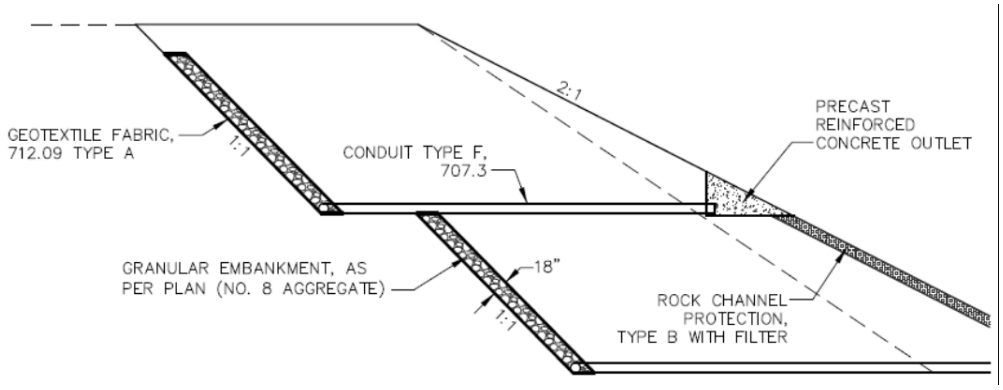


Figure 2: Slope Drain Typical Detail

These drains should consist of ODOT Item 203 granular embankment (No. 8 aggregate), ODOT Item 204 geotextile fabric, 712.09 Type A, and ODOT Item 611 conduit, 707.31 Type CP (perforated). The granular embankment should be placed in lifts as the benching backfill is constructed. Transverse outlet drains consisting of ODOT Item 611 conduit, 707.33 Type F, should outlet from the aggregate drain at the low end of the benches. The transverse outlet should be installed at a minimum 1.0 percent slope and outlet through the face of the slope. It is recommended that ODOT Item 601 rock channel protection with filter fabric lining or other erosion protection be provided below the outlets, extending to the toe of the slope, to prevent erosion.

6.2 Fill

Material for engineered fill or backfill required to achieve design grades should meet ODOT Item 203 "Embankment Fill" placement and compaction requirements. New embankment fill shall be placed in accordance with ODOT Item 203 and shall consist of natural soils classified as A-4a, A-6a or A-6b with a maximum dry density of 110 pcf or greater as determined by ODOT Supplement 1015. In general, the majority of the existing embankment soils on site would meet the above-noted requirements, provided that the soils are moisture conditioned and/or blended as required to meet ODOT Item 203 compaction requirements. On-site soils may be used as engineered fill materials provided that they are free of organic matter, debris, excessive moisture, and rock or stone fragments larger than 3 inches in diameter. Depending on seasonal conditions, the on-site soils may be wet of optimum and may require scarification and aeration to achieve satisfactory compaction.

Fill placement shall be performed as symmetrical as possible across the entire site to prevent lateral stresses from developing on the existing bridge piers and their foundation components. Compaction of the new fill placement around existing structures shall be accomplished through the use of portable compaction equipment (hand operated tampers or other equipment approved by the engineer).

The on-site soils consist of fill and native cohesive soils. For the cohesive soils, a sheepsfoot roller should provide the most effective soil compaction. If new granular engineered fill is placed, a vibratory smooth-drum roller would be required to provide effective compaction.

Scarified subgrade soils and all fill material should be within 3 percent of the optimum moisture content to facilitate compaction. Furthermore, fill material should not be frozen or placed on a frozen base. It is recommended that all earthwork and site preparation activities be conducted under adequate specifications and properly monitored in the field by a qualified geotechnical testing firm.

7.0 QUALIFICATIONS OF RECOMMENDATIONS

Our evaluation of construction conditions for embankment fill placement and pavement construction has been based on our understanding of the site and project information and the data obtained during our field investigation. The general subsurface conditions were based on interpretation of the subsurface data at specific boring locations. Regardless of the thoroughness of a subsurface investigation, there is the possibility that conditions between borings will differ from those at the boring locations, that conditions are not as anticipated by the designers, or that the construction process has altered the soil conditions. Therefore, experienced geotechnical engineers should observe earthwork and foundation construction to confirm that the conditions anticipated in design are noted. Otherwise, TTL assumes no responsibility for construction compliance with the design concepts, specifications, or recommendations.

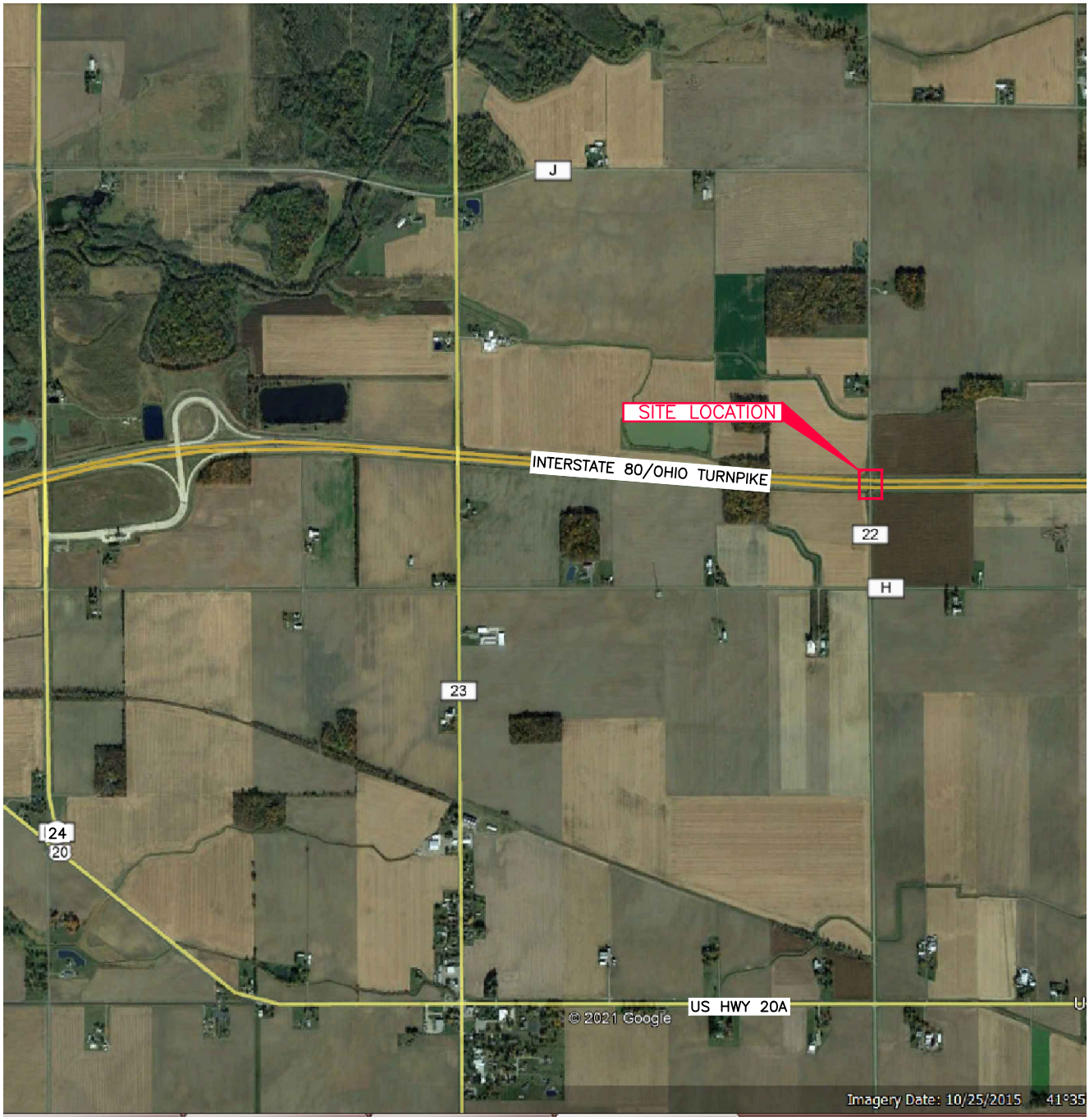
The evaluations and recommendations presented in this report have been formulated on the basis of reported or assumed data relating to the location and finished grades for the proposed structure. Any significant change in this data in the final design plans should be brought to our attention for review and evaluation with respect to the prevailing subsoil conditions.

The nature and extent of variations between the borings may not become evident until the course of construction. If such variations are encountered, it will be necessary to reevaluate the recommendations of this report after on-site observations of the conditions.

Our professional services have been performed and our findings have been derived in accordance with generally accepted geotechnical engineering principles and practices. This warranty is in lieu of all other warranties either expressed or implied. TTL is not responsible for the conclusions, opinions, or recommendations of others based on this data.

Plates

Plate 1.0 Site Location Map
Plate 2.0 Test Boring Location Plan



LEGEND

APPROXIMATE SITE LOCATION

N

APPROXIMATE SCALE – FEET

0 2,000 4,000

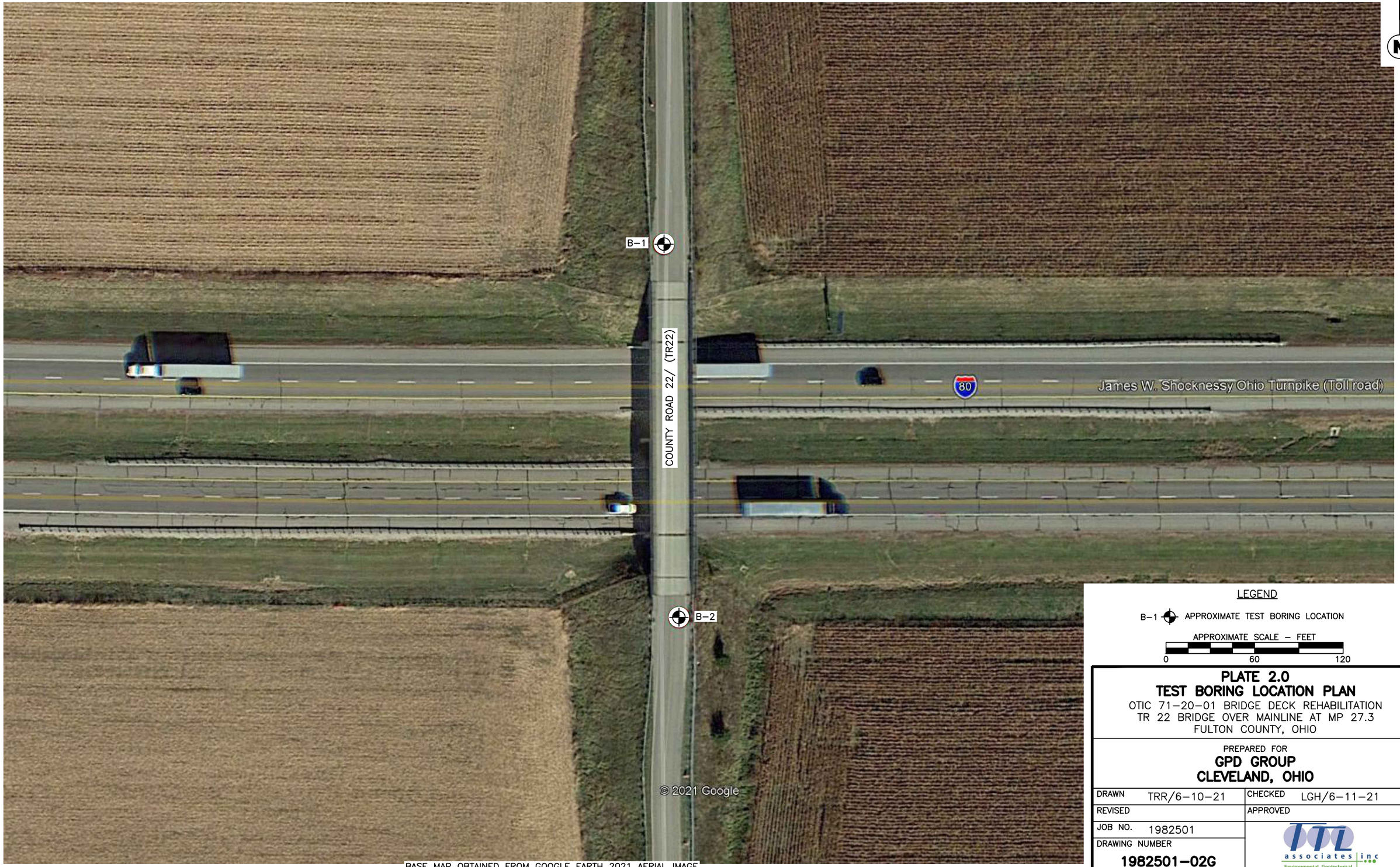
PLATE 1.0
SITE LOCATION MAP

OTIC 71–20–01 BRIDGE DECK REHABILITATION
TR 22 BRIDGE OVER MAINLINE AT MP 27.3
FULTON COUNTY, OHIO

PREPARED FOR
GPD GROUP
CLEVELAND, OHIO

DRAWN	TRR/6–10–21	CHECKED	LGH/6–11–21
REVISED		APPROVED	
JOB NO.	1982501		
DRAWING NUMBER	**1982501–01G**		

TTL associates inc
Environmental, Geotechnical Engineering & Testing



BASE MAP OBTAINED FROM GOOGLE EARTH 2021 AERIAL IMAGE

LEGEND

B–1 APPROXIMATE TEST BORING LOCATION

APPROXIMATE SCALE – FEET

0 60 120

PLATE 2.0
TEST BORING LOCATION PLAN
OTIC 71–20–01 BRIDGE DECK REHABILITATION
TR 22 BRIDGE OVER MAINLINE AT MP 27.3
FULTON COUNTY, OHIO

PREPARED FOR
GPD GROUP
CLEVELAND, OHIO

DRAWN	TRR/6–10–21	CHECKED	LGH/6–11–21
REVISED		APPROVED	
JOB NO.	1982501		
DRAWING NUMBER	**1982501–02G**		

ITL associates inc
Environmental, Geotechnical Engineering & Testing

APPENDIX A

Log of Test Boring

LEGEND KEY

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)

- A-1-A: Ohio DOT: A-1-a, gravel and/or stone fragments
- A-1-B: Ohio DOT: A-1-b, gravel and/or stone fragments with sand
- A-2-6: Ohio DOT: A-2-6, gravel and/or stone fragments with sand, silt and clay
- A-3: Ohio DOT: A-3, fine sand
- A-3A: Ohio DOT: A-3a, coarse and fine sand
- A-4A: Ohio DOT: A-4a, sandy silt
- A-4B: Ohio DOT: A-4b, silt
- A-6A: Ohio DOT: A-6a, silt and clay
- A-6B: Ohio DOT: A-6b, silty clay
- A-7-6: Ohio DOT: A-7-6, clay
- PAVEMENT OR BASE: Ohio DOT: Pavement or Aggregate base

SAMPLER SYMBOLS

WELL CONSTRUCTION SYMBOLS

- Soil Cuttings Backfill mixed with Bentonite Pellets or Chips
- Asphalt or Concrete Pavement Patch

Notes:

1. Exploratory borings were drilled by TTL on March 17 and 19, 2021, using 3¼-inch diameter hollow-stem augers.

2. These logs are subject to the limitations, conclusions, and recommendations in the report and should not be interpreted separate from the report.

3. The test borings were located in the field by TTL Associates, Inc. in accordance with a proposed boring location plan provided by GPD Group.

APPENDIX B

Legend Key

PROJECT: BRIDGE DECK REHAB	DRILLING FIRM / OPERATOR: TTL / TB	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET:
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT:
PID: SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 743.0 (NAVD88) EOB: 80.0 ft.
START: 3/19/21 END: 3/19/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: Not Recorded

EXPLORATION ID TR22 B-1

MATERIAL DESCRIPTION AND NOTES	ELEV. 743.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 10.5 INCHES	742.1																	
AGGREGATE BASE - 3.5 INCHES	741.8																	
MEDIUM STIFF TO STIFF, BROWN, **SILTY CLAY**, TRACE SAND, TRACE CRUSHED STONE, TRACE BRICK FRAGMENTS, DAMP FILL @3': LITTLE SAND		1 2	9 3 5	9	78	SS-1	4.50	3	4	5	22	66	40	23	17	19	A-6b (11)	
		3 4 5	3 3 4	8	89	SS-2	4.00	-	-	-	-	-	-	-	-	22	A-6b (V)	
STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, MOIST FILL	737.0	6 7	4 5 6	12	89	SS-3	3.75	-	-	-	-	-	-	-	-	24	A-6b (V)	
		8 9 10	5 6 9	17	100	SS-4	3.75	-	-	-	-	-	-	-	-	20	A-6b (V)	
@13.5': TRACE GRAVEL	729.5	11 12 13																
MEDIUM STIFF, BROWN/GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST FILL, Qu = 3198 PSF	724.3	14 15 16 17 18	3 3 5	9	100	SS-5	2.75	0	1	4	22	73	35	22	13	25	A-6a (9)	
STIFF, BROWN/GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST FILL	721.0	19 20 21	3 4 11	17	100	SS-6	3.25	-	-	-	-	-	-	-	-	26	A-6b (V)	
VERY STIFF, GRAY/BROWN, **CLAY**, LITTLE SILT, TRACE SAND, TRACE GRAVEL, DAMP @23': Qu = 8346 PSF		22 23 24 25	5 7 12	21	100	SS-7	4.50	1	1	5	17	76	44	24	20	21	A-7-6 (13)	
@27': STIFF, BROWN		26 27 28 29	3 5 8	14	100	SS-8	4.25	-	-	-	-	-	-	-	-	22	A-7-6 (V)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/14/21 12:46 - S:\PROJECTS\1982501.GPJ

PID:	SFN:	PROJECT: BRIDGE DECK REHAB	STATION / OFFSET:	START: 3/19/21	END: 3/19/21	PG 2 OF 3	TR22 B-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)	BACK FILL
VERY STIFF, GRAY/BROWN, **CLAY**, LITTLE SILT, TRACE SAND, TRACE GRAVEL, DAMP *(continued)*	713.0	31																
MEDIUM STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, MOIST	711.0	32																
		33																
@33.5': Qu = 2372 PSF		34	3 3 4	8	100	SS-9	2.25	-	-	-	-	-	-	-	-	23	A-6b (V)	
		35																
		36																
		37																
		38																
		39	3 3 5	9	100	SS-10	2.25	-	-	-	-	-	-	-	-	31	A-6b (V)	
		40																
		41																
		42																
@42': TRACE GRAVEL		43																
@43.5': Qu = 2054 PSF		44	3 3 5	9	100	SS-11	2.00	-	-	-	-	-	-	-	-	20	A-6b (V)	
		45																
		46																
	696.0	47																
STIFF, GRAY, **SILT AND CLAY**, LITTLE SAND, LITTLE GRAVEL, MOIST		48																
		49	4 4 6	11	100	SS-12	2.50	-	-	-	-	-	-	-	-	18	A-6a (V)	
		50																
		51																
		52																
		53																
@53.5': TRACE GRAVEL, Qu = 3746 PSF		54	3 5 8	14	100	SS-13	3.00	-	-	-	-	-	-	-	-	18	A-6a (V)	
		55																
		56																
		57																
		58																
		59	3 5 7	13	100	SS-14	2.75	-	-	-	-	-	-	-	-	18	A-6a (V)	
		60																
		61																

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/14/21 12:46 - S:\PROJECTS\1982501.GPJ

PID:	SFN:	PROJECT: BRIDGE DECK REHAB	STATION / OFFSET:	START: 3/19/21	END: 3/19/21	PG 3 OF 3	TR22 B-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)	BACK FILL
STIFF, GRAY, **SILT AND CLAY**, LITTLE SAND, LITTLE GRAVEL, MOIST *(continued)*	680.9	63																
		64	4 5 8	14	100	SS-15	2.25	-	-	-	-	-	-	-	-	19	A-6a (V)	
		65																
		66																
		67																
		68																
		69	3 4 6	11	100	SS-16	1.75	-	-	-	-	-	-	-	-	20	A-6a (V)	
		70																
		71																
		72																
		73																
		74	4 5 7	13	100	SS-17	1.50	5	4	10	25	56	31	20	11	20	A-6a (8)	
		75																
		76																
		77																
		78																
@78.5': VERY STIFF		79	5 8 12	22	11	SS-18	1.75	-	-	-	-	-	-	-	-	18	A-6a (V)	
	663.0	EOB 80																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; AUGER CUTTINGS MIXED WITH 4 BAGS BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/14/21 12:46 - S:\PROJECTS\1982501.GPJ

PROJECT: BRIDGE DECK REHAB	DRILLING FIRM / OPERATOR: TTL / TB	DRILL RIG: CME 75 TRUCK 844	STATION / OFFSET:
TYPE: BRIDGE	SAMPLING FIRM / LOGGER: TTL / KKC	HAMMER: CME AUTOMATIC	ALIGNMENT:
PID: SFN:	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 3/15/21	ELEVATION: 743.0 (NAVD88) EOB: 80.0 ft.
START: 3/17/21 END: 3/18/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 66	COORD: Not Recorded

EXPLORATION ID TR22 B-2

MATERIAL DESCRIPTION AND NOTES	ELEV. 743.0	DEPTHS	SPT/ RQD	N_{60}	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%) GR	CS	FS	SI	CL	ATTERBERG LL	PL	PI	WC	ODOT CLASS (GI)	BACK FILL
ASPHALT - 10 INCHES	742.2																	
AGGREGATE BASE - 5 INCHES	741.7																	
STIFF, BROWN, **SILTY CLAY**, LITTLE SAND, LITTLE CRUSHED STONE, MOIST FILL	740.0	1 2	4 5 6	12	78	SS-1	4.25	-	-	-	-	-	-	-	-	14	A-6b (V)	
STIFF, BROWN, **CLAY**, LITTLE SILT, TRACE SAND, TRACE GRAVEL, MOIST FILL		3 4 5	3 5 7	13	78	SS-2	3.50	1	2	3	18	76	48	24	24	25	A-7-6 (15)	
@6': VERY STIFF	735.0	6 7	4 7 9	18	100	SS-3	4.25	-	-	-	-	-	-	-	-	19	A-7-6 (V)	
STIFF, BROWN/GRAY, **SILTY CLAY**, TRACE SAND, TRACE GRAVEL, MOIST Qu = 2914 PSF, FILL		8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23	3 4 7	12	100	SS-4	4.50	2	1	2	24	71	40	22	18	24	A-6b (11)	
			4 5 9	15	100	SS-5	2.75	-	-	-	-	-	-	-	-	20	A-6b (V)	
			4 4 8	13	100	SS-6	4.50	-	-	-	-	-	-	-	-	24	A-6b (V)	
VERY STIFF, BROWN/GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST Qu = 4537 PSF	719.2	24 25 26 27 28	4 7 11	20	100	SS-7	4.00	-	-	-	-	-	-	-	-	21	A-6b (V)	
STIFF, BROWN, **SILT**, LITTLE CLAY, LITTLE SAND, MOIST	714.0	29	3 5 7	13	100	SS-8	1.50	-	-	-	-	-	-	-	-	25	A-4b (V)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/14/21 12:46 - S:\PROJECTS\1982501.GPJ

PID:	SFN:	PROJECT: BRIDGE DECK REHAB	STATION / OFFSET:	START: 3/17/21	END: 3/18/21	PG 2 OF 3	TR22 B-2

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)	BACK FILL
STIFF, BROWN, **SILT**, LITTLE CLAY, LITTLE SAND, MOIST *(continued)*	713.0																	
STIFF, GRAY, **CLAY**, SOME SILT, MOIST	711.0																	
@33.5': Qu = 2537 PSF		34	3 3 6	10	100	SS-9	1.75	0	0	0	23	77	47	25	22	31	A-7-6 (14)	
@37': LITTLE SAND, TRACE GRAVEL		39	3 4 6	11	100	SS-10	2.00	-	-	-	-	-	-	-	-	24	A-7-6 (V)	
		44	4 4 6	11	100	SS-11	3.00	-	-	-	-	-	-	-	-	18	A-7-6 (V)	
@48': VERY STIFF		49	4 6 9	17	100	SS-12	2.25	-	-	-	-	-	-	-	-	19	A-7-6 (V)	
		54	5 7 9	18	100	SS-13	2.25	-	-	-	-	-	-	-	-	18	A-7-6 (V)	
VERY STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST Qu = 1988 PSF	684.5	59	3 6 9	17	100	SS-14	2.00	3	5	7	22	63	32	15	17	19	A-6b (11)	

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/14/21 12:46 - S:\PROJECTS\1982501.GPJ

PID:	SFN:	PROJECT: BRIDGE DECK REHAB	STATION / OFFSET:	START: 3/17/21	END: 3/18/21	PG 3 OF 3	TR22 B-2

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)	BACK FILL
VERY STIFF, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST Qu = 1988 PSF *(continued)*	680.9	63																
		64	3 5 8	14	100	SS-15	2.25	-	-	-	-	-	-	-	-	19	A-6b (V)	
		65																
		66																
		67																
		68																
		69	4 7 7	15	100	SS-16	3.25	-	-	-	-	-	-	-	-	18	A-6b (V)	
		70																
		71																
	671.0	72																
VERY STIFF TO HARD, GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, MOIST		73																
		74	9 13 17	33	11	SS-17	3.25	-	-	-	-	-	-	-	-	17	A-6b (V)	
		75																
		76																
		77																
		78																
		79	5 8 8	18	100	SS-18	4.25	-	-	-	-	-	-	-	-	16	A-6b (V)	
	663.0	EOB 80																

NOTES: NONE

ABANDONMENT METHODS, MATERIALS, QUANTITIES: PLACED 0.5 BAG ASPHALT PATCH; AUGER CUTTINGS MIXED WITH 4 BAGS BENTONITE CHIPS

STANDARD ODOT SOIL BORING LOG (8.5 X 11) - OH DOT.GDT - 6/14/21 12:46 - S:\PROJECTS\1982501.GPJ

APPENDIX C

Tabulation of Test Data

TTL Associates, Inc.
1915 N 12th Street
Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

SUMMARY OF LABORATORY RESULTS

CLIENT _____ **PROJECT NAME** _____

PROJECT NUMBER _____ **PROJECT LOCATION** N/A

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
TR12-1 B-1	1.0							10.0			
TR12-1 B-1	3.5	NP	NP	NP	2	15	SM	10.9			
TR12-1 B-1	6.0							17.5			
TR12-1 B-1	8.5							15.3			
TR12-1 B-1	13.5							7.7			
TR12-1 B-1	18.5							13.0			
TR12-1 B-1	23.5							11.5			
TR12-1 B-1	28.5	29	18	11	12.5	71	CL	13.8	116.8	86	0.427
TR12-1 B-1	33.5							14.6			
TR12-1 B-1	38.5	31	18	13	12.5	74	CL	15.7	110.2	82	0.513
TR12-1 B-1	43.5							16.2			
TR12-1 B-1	48.5							17.7			
TR12-1 B-1	53.5							16.3	103.8	72	0.606
TR12-1 B-1	58.5							17.1			
TR12-1 B-1	63.5							15.2			
TR12-1 B-1	68.5							16.8	107.4	81	0.552
TR12-1 B-1	73.5	28	17	11	25	67	CL	13.5			
TR12-1 B-1	78.5							13.9			
TR12-1 B-2	1.0							7.7			
TR12-1 B-2	3.5							13.5	106.1	63	0.571
TR12-1 B-2	6.0	19	14	5	9.5	43	SC-SM	12.4			
TR12-1 B-2	8.5							12.6			
TR12-1 B-2	13.5							10.9			
TR12-1 B-2	18.5							9.9			
TR12-1 B-2	23.5							18.9			
TR12-1 B-2	28.5	29	16	13	12.5	69	CL	16.6	104.3	74	0.598
TR12-1 B-2	33.5							17.8			
TR12-1 B-2	38.5							17.3			
TR12-1 B-2	43.5							17.4			
TR12-1 B-2	48.5	29	17	12	19	68	CL	16.1	106.9	77	0.559
TR12-1 B-2	53.5							17.8			
TR12-1 B-2	58.5							17.3			
TR12-1 B-2	63.5	29	18	11	19	73	CL	16.3	111.8	89	0.491
TR12-1 B-2	68.5							17.0			
TR12-1 B-2	73.5							16.0			
TR12-1 B-2	78.5							18.7			
TR17 B-1	1.0							6.8			
TR17 B-1	3.5	NP	NP	NP	2	20	SM	9.0			
TR17 B-1	6.0							7.6			
TR17 B-1	8.5							11.8			
TR17 B-1	13.5							10.4			
TR17 B-1	18.5							14.4			
TR17 B-1	23.5							14.5			

TTL Associates, Inc.
1915 N 12th Street
Toledo, Ohio 43624
Telephone: 419-324-2222
Fax: 419-241-1808

SUMMARY OF LABORATORY RESULTS

CLIENT _____ **PROJECT NAME** _____

PROJECT NUMBER _____ **PROJECT LOCATION** N/A

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
TR17 B-1	28.5	29	22	7	4.75	95	CL-ML	23.6	103.3	103	0.613
TR17 B-1	33.5							17.4			
TR17 B-1	38.5							22.5	100.3	91	0.662
TR17 B-1	43.5							29.0			
TR17 B-1	48.5							28.3			
TR17 B-1	53.5	33	20	13	19	83	CL	22.5	107.4	109	0.552
TR17 B-1	58.5							26.2			
TR17 B-1	63.5							41.8			
TR17 B-1	68.5							22.3	106.0	104	0.572
TR17 B-1	73.5							21.9			
TR17 B-1	78.5	32	19	13	9.5	89	CL	22.6			
TR17 B-2	1.0	NP	NP	NP	2	18	SM	10.6			
TR17 B-2	3.5							11.6			
TR17 B-2	6.0							9.8			
TR17 B-2	8.5							11.2			
TR17 B-2	13.5							14.3			
TR17 B-2	18.5	NP	NP	NP	4.75	28	SM	18.1			
TR17 B-2	23.5							6.9			
TR17 B-2	28.5							17.3	111.5	93	0.496
TR17 B-2	33.5							15.9			
TR17 B-2	38.5	34	19	15	9.5	86	CL	18.1	110.4	95	0.510
TR17 B-2	43.5							19.6			
TR17 B-2	48.5							22.8			
TR17 B-2	53.5							20.5	109.0	103	0.529
TR17 B-2	58.5							22.3			
TR17 B-2	63.5							21.9			
TR17 B-2	68.5	32	19	13	9.5	89	CL	21.5	108.3	107	0.539
TR17 B-2	73.5							23.1			
TR17 B-2	78.5							21.1			
TR22 B-1	1.0	40	23	17	9.5	88	CL	19.1			
TR22 B-1	3.5							21.8			
TR22 B-1	6.0							24.4			
TR22 B-1	8.5							20.3			
TR22 B-1	13.5	35	22	13	2	95	CL	24.8	100.1	99	0.666
TR22 B-1	18.5							25.7			
TR22 B-1	23.5	44	24	20	4.75	93	CL	20.8	106.9	99	0.560
TR22 B-1	28.5							22.1			
TR22 B-1	33.5							23.1	105.7	107	0.577
TR22 B-1	38.5							30.5			
TR22 B-1	43.5							20.4	105.4	94	0.582
TR22 B-1	48.5							18.4			
TR22 B-1	53.5							18.0	114.1	104	0.461
TR22 B-1	58.5							18.4			

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SUMMARY OF LABORATORY RESULTS

CLIENT _____ **PROJECT NAME** _____

PROJECT NUMBER _____ **PROJECT LOCATION** N/A

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
TR22 B-1	63.5							19.2			
TR22 B-1	68.5							19.5			
TR22 B-1	73.5	31	20	11	9.5	81	CL	20.2			
TR22 B-1	78.5							17.8			
TR22 B-2	1.0							13.5			
TR22 B-2	3.5	48	24	24	9.5	94	CL	25.3			
TR22 B-2	6.0							18.9			
TR22 B-2	8.5	40	22	18	4.75	95	CL	23.8	99.6	94	0.674
TR22 B-2	13.5							20.2			
TR22 B-2	18.5							24.4			
TR22 B-2	23.5							21.3	105.3	98	0.582
TR22 B-2	28.5							25.3			
TR22 B-2	33.5	47	25	22	2	100	CL	31.1	99.3	123	0.678
TR22 B-2	38.5							24.2			
TR22 B-2	43.5							18.1			
TR22 B-2	48.5							18.5			
TR22 B-2	53.5							18.0			
TR22 B-2	58.5	32	15	17	9.5	85	CL	19.4	109.0	98	0.530
TR22 B-2	63.5							18.7			
TR22 B-2	68.5							17.8			
TR22 B-2	73.5							16.6			
TR22 B-2	78.5							16.0			
TR3 B-1	1.0	NP	NP	NP	9.5	10	SW-SM	4.2			
TR3 B-1	3.5							16.4			
TR3 B-1	6.0							16.1			
TR3 B-1	8.5	32	18	14	9.5	74	CL	19.0	104.5	85	0.596
TR3 B-1	13.5							17.2			
TR3 B-1	18.5							16.9			
TR3 B-1	23.5							21.6			
TR3 B-1	28.5							13.7	117.1	86	0.423
TR3 B-1	33.5							12.5			
TR3 B-1	38.5							13.7			
TR3 B-1	43.5							15.6			
TR3 B-1	48.5	32	19	13	9.5	79	CL	18.3	112.3	101	0.484
TR3 B-1	53.5							20.1			
TR3 B-1	58.5							12.1	118.7	80	0.405
TR3 B-1	63.5							12.4			
TR3 B-1	68.5							20.5			
TR3 B-1	73.5							19.2			
TR3 B-1	78.5	31	19	12	2	62	CL	19.2			
TR3 B-2	1.0							6.9			
TR3 B-2	3.5	33	19	14	12.5	75	CL	16.7			
TR3 B-2	6.0							16.8			

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SUMMARY OF LABORATORY RESULTS

CLIENT _____ **PROJECT NAME** _____

PROJECT NUMBER _____ **PROJECT LOCATION** N/A

Borehole	Depth	Liquid Limit	Plastic Limit	Plasticity Index	Maximum Size (mm)	%<#200 Sieve	Class-ification	Water Content (%)	Dry Density (pcf)	Satur-ation (%)	Void Ratio
TR3 B-2	8.5							20.2	109.1	102	0.527
TR3 B-2	13.5							24.1			
TR3 B-2	18.5							19.1			
TR3 B-2	23.5	32	19	13	12.5	82	CL	20.7	107.4	100	0.551
TR3 B-2	28.5							13.6			
TR3 B-2	33.5							12.4			
TR3 B-2	38.5	29	15	14	9.5	78	CL	12.1	122.9	91	0.357
TR3 B-2	43.5							13.5			
TR3 B-2	48.5							17.8			
TR3 B-2	53.5							21.0			
TR3 B-2	58.5	28	17	11	25	76	CL	17.0	111.4	92	0.496
TR3 B-2	63.5							17.7			
TR3 B-2	68.5							13.2			
TR3 B-2	73.5							11.4			
TR3 B-2	78.5							20.2			

APPENDIX D

Laboratory Test Results

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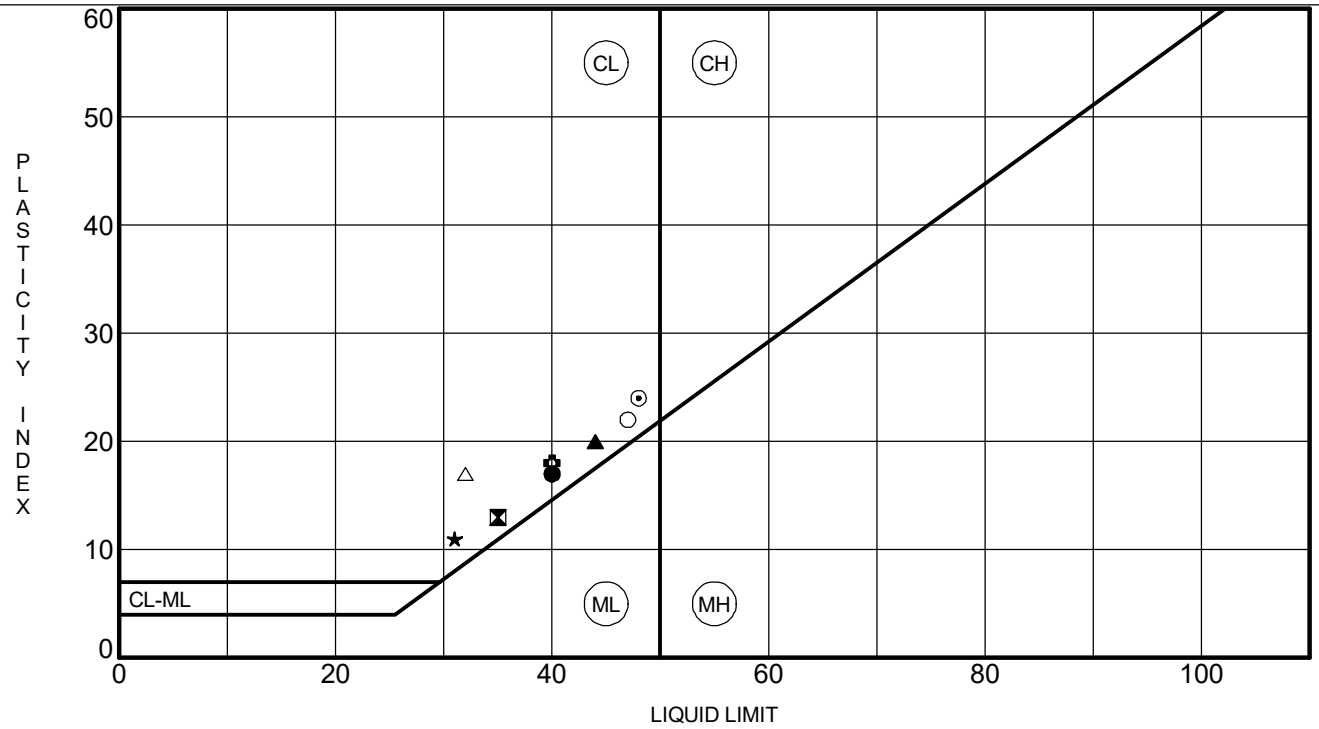
ATTERBERG LIMITS' RESULTS

CLIENT _____ **PROJECT NAME** _____

PROJECT NUMBER _____ **PROJECT LOCATION** N/A



	Specimen Identification		LL	PL	PI	Fines	Classification
●	**TR22 B-1**	**1.0**	**40**	**23**	**17**	**88**	**LEAN CLAY (CL)**
⊠	**TR22 B-1**	**13.5**	**35**	**22**	**13**	**95**	**LEAN CLAY (CL)**
▲	**TR22 B-1**	**23.5**	**44**	**24**	**20**	**93**	**LEAN CLAY (CL)**
★	**TR22 B-1**	**73.5**	**31**	**20**	**11**	**81**	**LEAN CLAY with SAND (CL)**
⊙	**TR22 B-2**	**3.5**	**48**	**24**	**24**	**94**	**LEAN CLAY (CL)**
✿	**TR22 B-2**	**8.5**	**40**	**22**	**18**	**95**	**LEAN CLAY (CL)**
○	**TR22 B-2**	**33.5**	**47**	**25**	**22**	**100**	**LEAN CLAY (CL)**
△	**TR22 B-2**	**58.5**	**32**	**15**	**17**	**85**	**LEAN CLAY with SAND (CL)**

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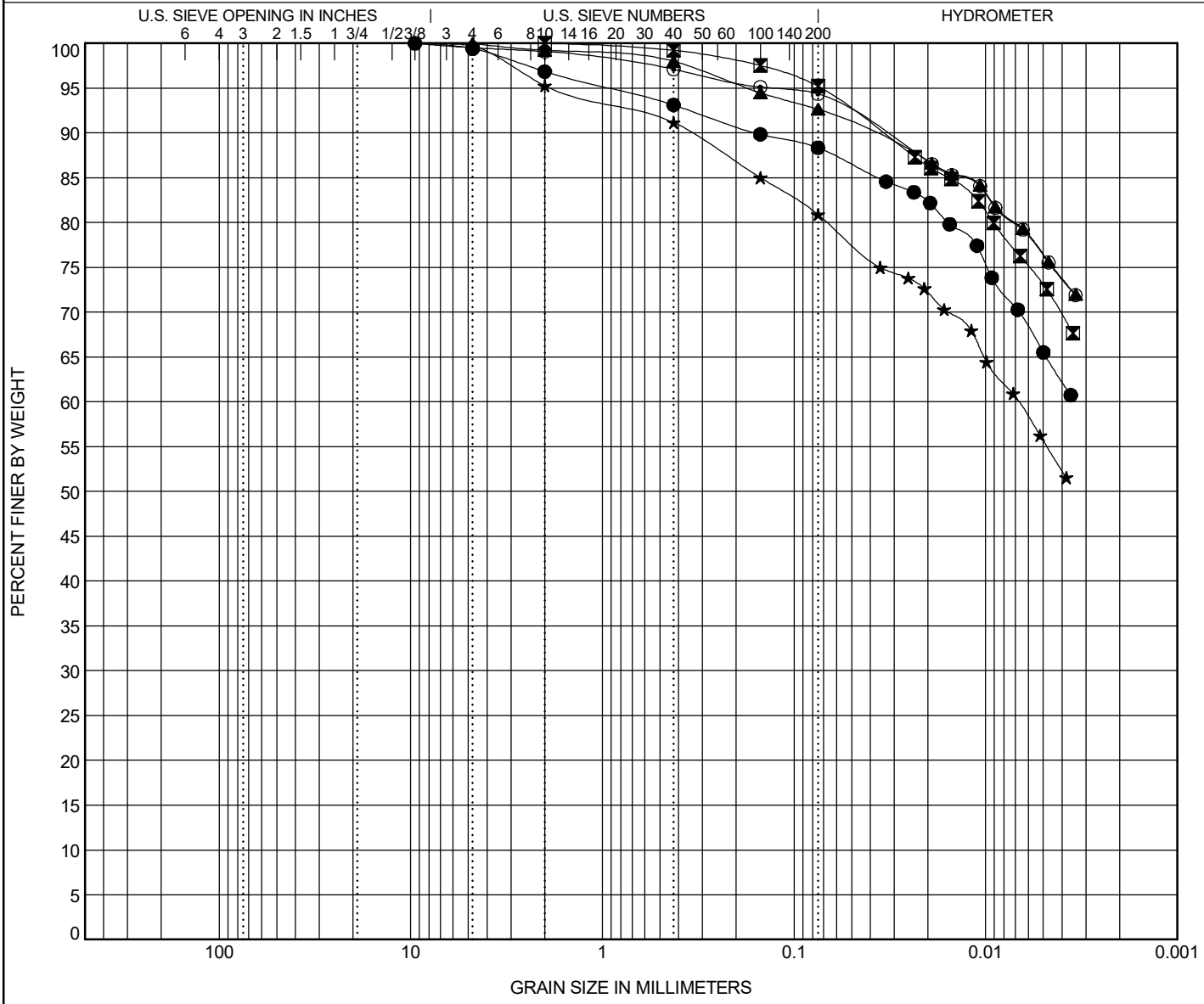
GRAIN SIZE DISTRIBUTION

CLIENT _____ **PROJECT NAME** _____

PROJECT NUMBER _____ **PROJECT LOCATION** N/A



COBBLES	GRAVEL		SAND		SILT	CLAY
	coarse	fine	coarse	fine		

	Specimen Identification		OHDOT Classification	LL	PL	PI	Cc	Cu
●	**TR22 B-1**	**1.0**	**A-4a (11)**	**40**	**23**	**17**		
⊠	**TR22 B-1**	**13.5**	**A-4a (9)**	**35**	**22**	**13**		
▲	**TR22 B-1**	**23.5**	**A-4a (13)**	**44**	**24**	**20**		
★	**TR22 B-1**	**73.5**	**A-4a (8)**	**31**	**20**	**11**		
⊙	**TR22 B-2**	**3.5**	**A-4a (15)**	**48**	**24**	**24**		

	Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TR22 B-1**	**1.0**	**9.5**				**3.1**	**8.5**	**22.8**	**65.5**
⊠	**TR22 B-1**	**13.5**	**2**				**0.0**	**4.8**	**22.2**	**73.0**
▲	**TR22 B-1**	**23.5**	**4.75**				**0.8**	**6.6**	**16.3**	**76.4**
★	**TR22 B-1**	**73.5**	**9.5**				**4.7**	**14.4**	**25.3**	**55.7**
⊙	**TR22 B-2**	**3.5**	**9.5**				**0.9**	**4.7**	**18.1**	**76.3**

SILT-CLAY BOUNDARY = 0.005 MILLIMETERS

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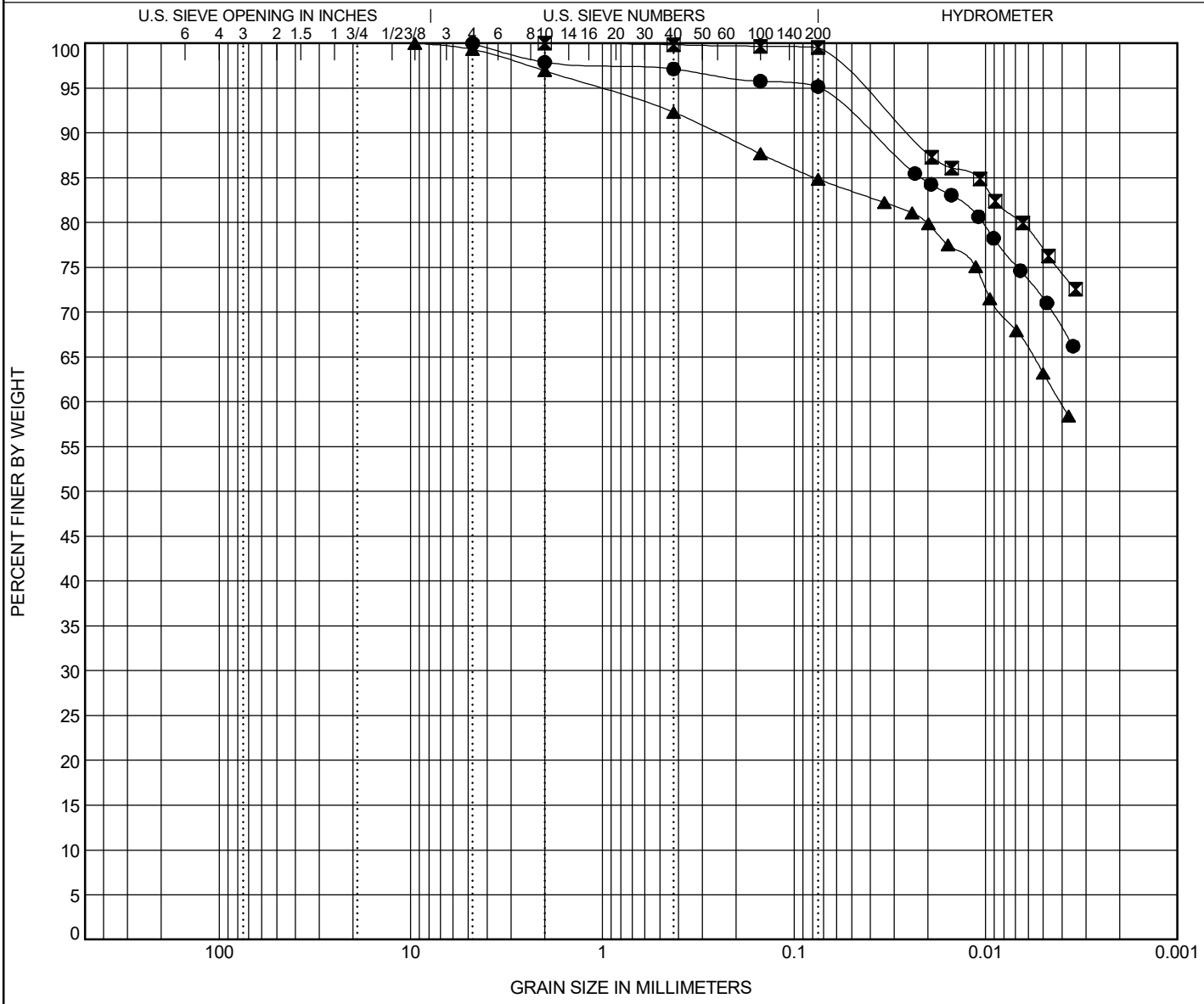
GRAIN SIZE DISTRIBUTION

CLIENT _____ **PROJECT NAME** _____

PROJECT NUMBER _____ **PROJECT LOCATION** N/A



COBBLES	GRAVEL		SAND		SILT	CLAY
	coarse	fine	coarse	fine		

	Specimen Identification		OHDOT Classification	LL	PL	PI	Cc	Cu
●	**TR22 B-2**	**8.5**	**A-4a (11)**	**40**	**22**	**18**		
⊠	**TR22 B-2**	**33.5**	**A-4a (14)**	**47**	**25**	**22**		
▲	**TR22 B-2**	**58.5**	**A-4a (11)**	**32**	**15**	**17**		

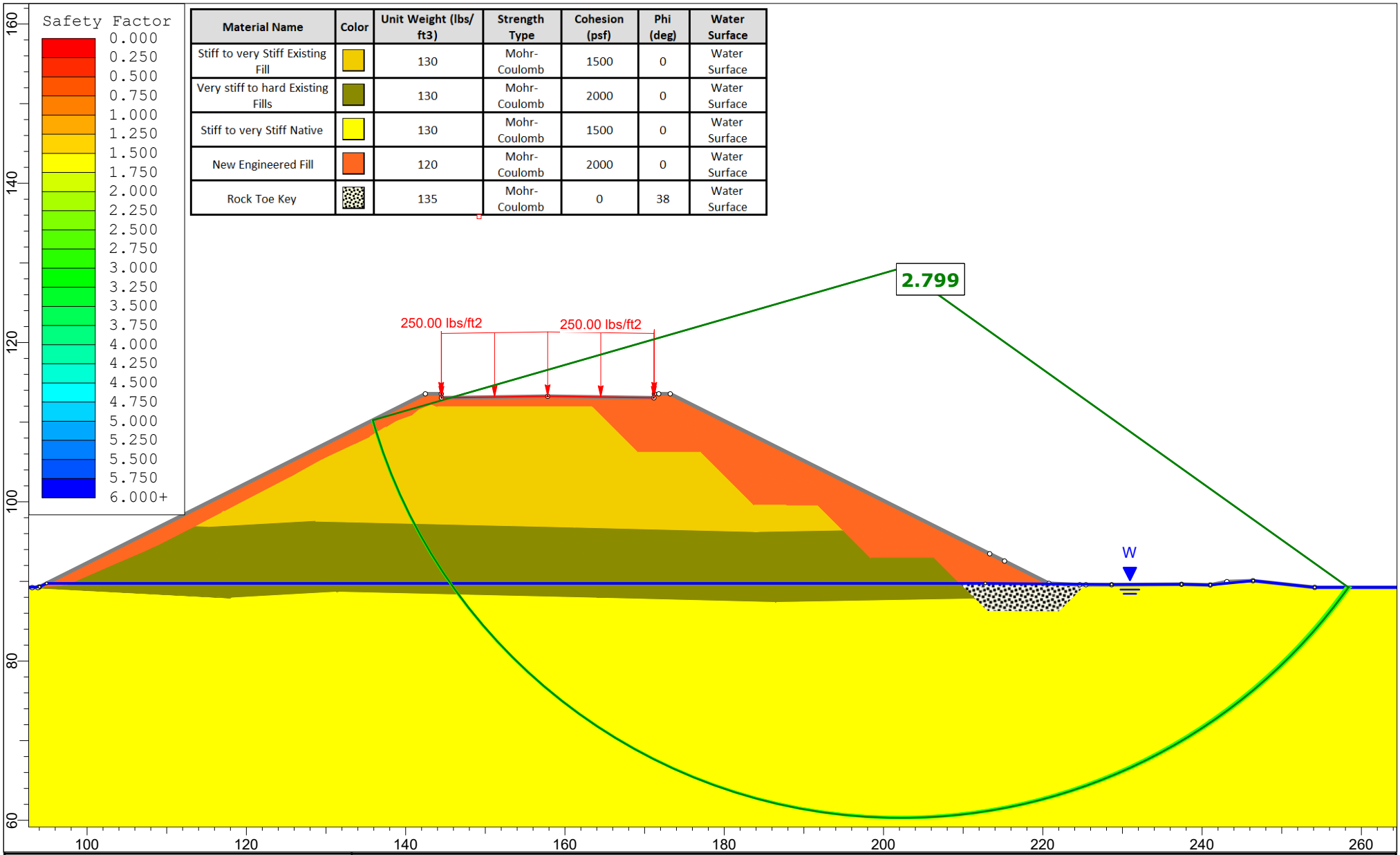
	Specimen Identification		D100	D50	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TR22 B-2**	**8.5**	**4.75**				**2.1**	**2.7**	**23.7**	**71.5**
⊠	**TR22 B-2**	**33.5**	**2**				**0.0**	**0.5**	**22.5**	**77.0**
▲	**TR22 B-2**	**58.5**	**9.5**				**3.1**	**12.1**	**21.7**	**63.2**

SILT-CLAY BOUNDARY = 0.005 MILLIMETERS

APPENDIX E

Slope Stability Analysis Outputs

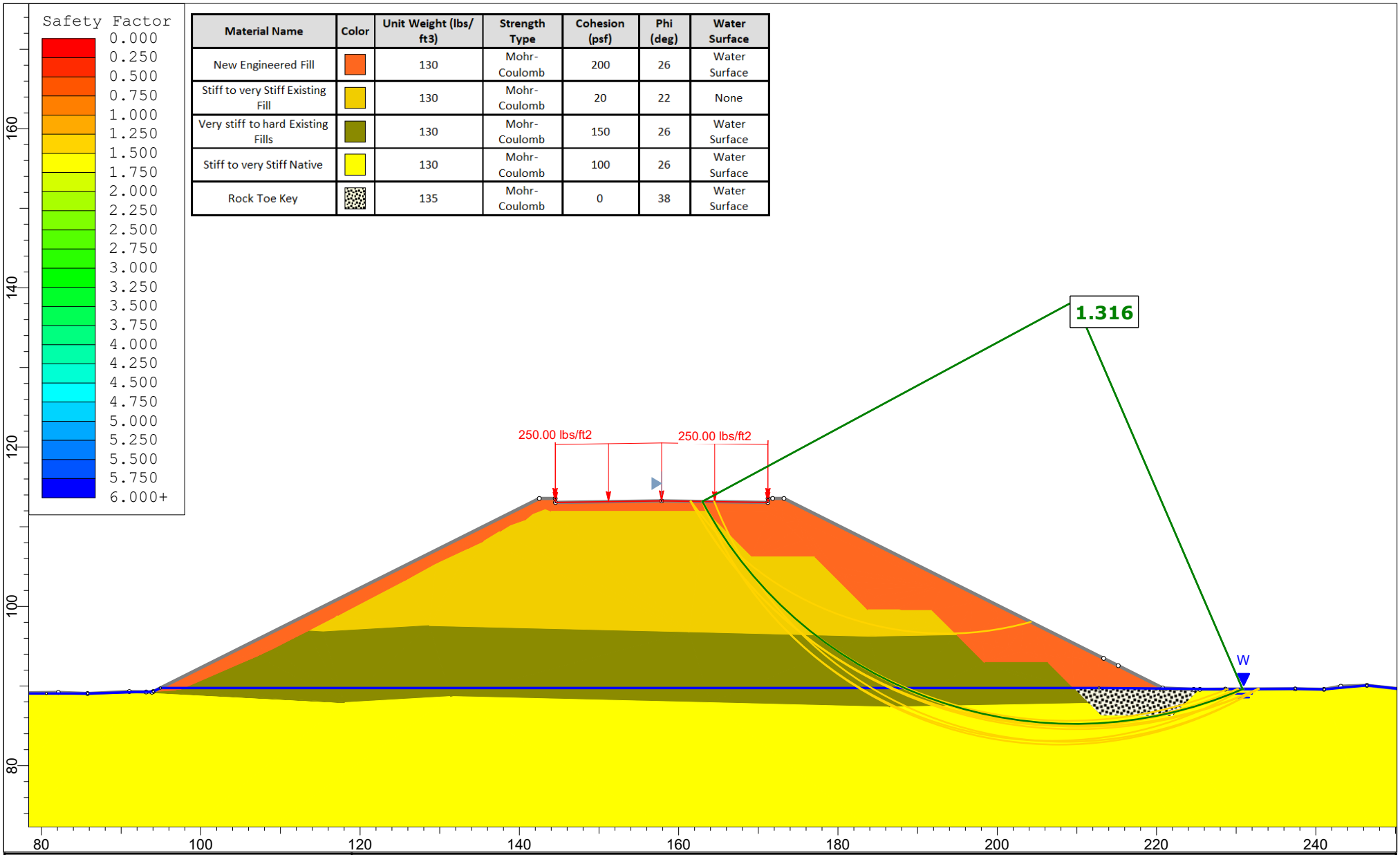
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Stiff to very Stiff Existing Fill		130	Mohr-Coulomb	1500	0	Water Surface
Very stiff to hard Existing Fills		130	Mohr-Coulomb	2000	0	Water Surface
Stiff to very Stiff Native		130	Mohr-Coulomb	1500	0	Water Surface
New Engineered Fill		120	Mohr-Coulomb	2000	0	Water Surface
Rock Toe Key		135	Mohr-Coulomb	0	38	Water Surface



TTL associates inc
Environmental, Geotechnical Engineering & Testing

Project	**OTIC 71-20-01 Bridge Deck Rehabilitation**		
Group		*Scenario*	TSSP
Drawn By	IJH	*Company*	TTL Associates, Inc
Date	6/11/21	*File Name*	TSSP - 9 ft toe + 8 ft bench + water.slim

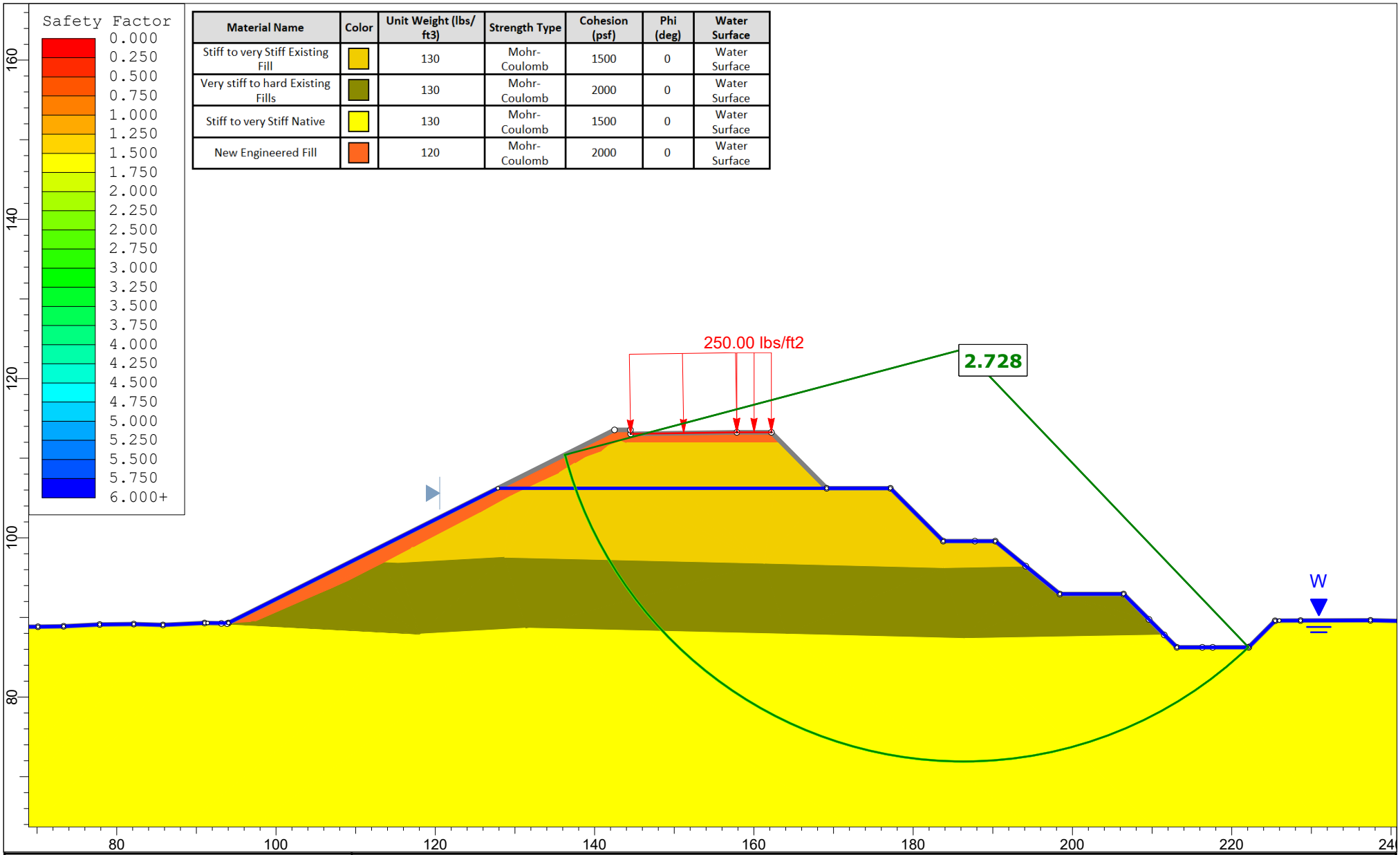
Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
New Engineered Fill		130	Mohr-Coulomb	200	26	Water Surface
Stiff to very Stiff Existing Fill		130	Mohr-Coulomb	20	22	None
Very stiff to hard Existing Fills		130	Mohr-Coulomb	150	26	Water Surface
Stiff to very Stiff Native		130	Mohr-Coulomb	100	26	Water Surface
Rock Toe Key		135	Mohr-Coulomb	0	38	Water Surface



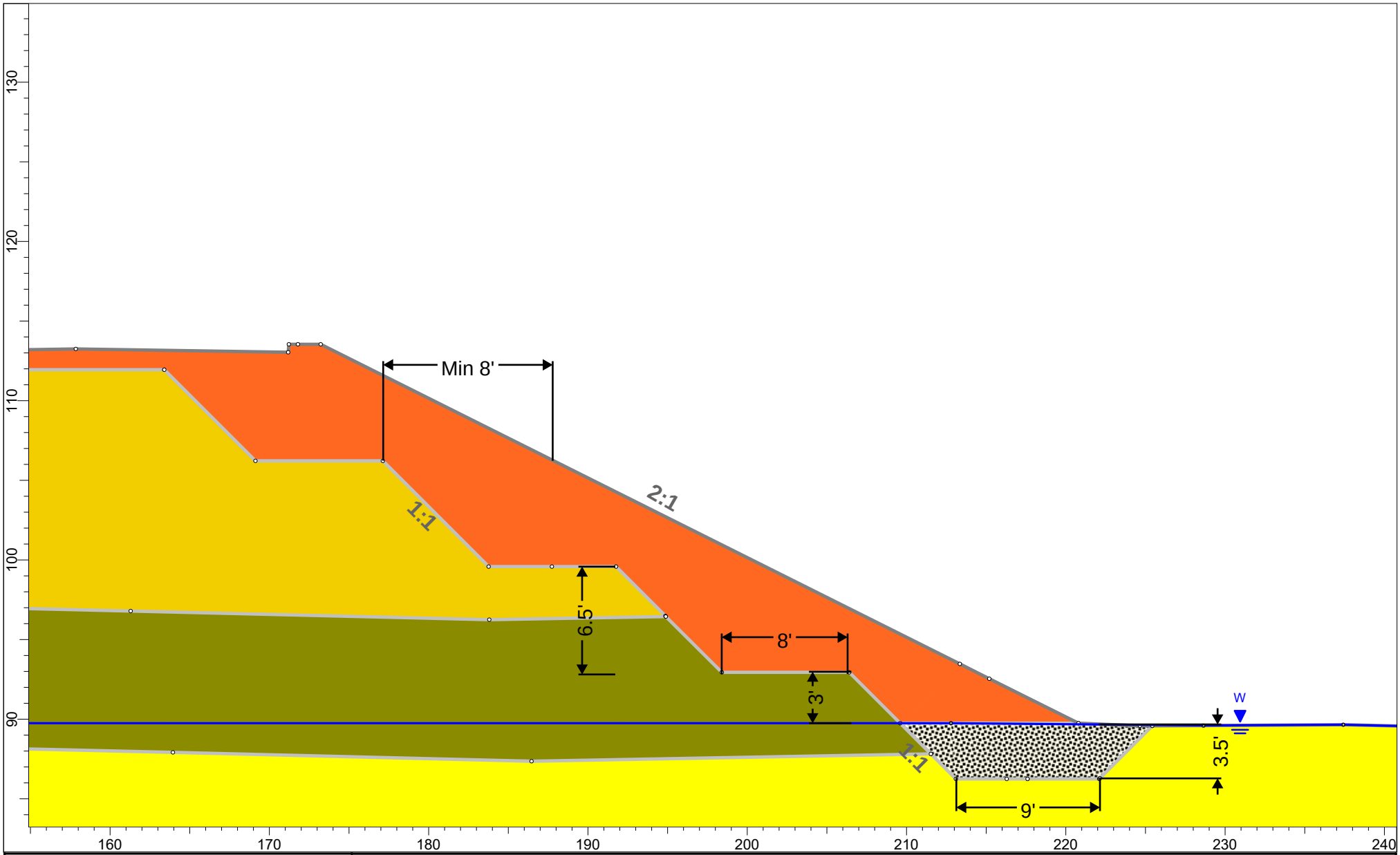
TTL associates inc
Environmental, Geotechnical Engineering & Testing

Project	OTIC 71-20-01 Bridge Deck Rehabilitation		
Group	ES	Scenario	ESSP
Drawn By	IJH	Company	TTL Associates, Inc
Date	6/11/21	File Name	ESSP - 9 ft toe + 8 ft bench + water.slim

Material Name	Color	Unit Weight (lbs/ ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface
Stiff to very Stiff Existing Fill		130	Mohr-Coulomb	1500	0	Water Surface
Very stiff to hard Existing Fills		130	Mohr-Coulomb	2000	0	Water Surface
Stiff to very Stiff Native		130	Mohr-Coulomb	1500	0	Water Surface
New Engineered Fill		120	Mohr-Coulomb	2000	0	Water Surface



TTL associates inc — Environmental, Geotechnical Engineering & Testing	*Project*	**OTIC 71-20-01 Bridge Deck Rehabilitation**	
	Group	*Scenario*	TSSP - Temporary Cut SLope
	Drawn By IJH	*Company*	TTL Associates, Inc
	Date 6/11/21	*File Name*	TSSP - Temporary Slope.slim



TTL associates inc — Environmental, Geotechnical Engineering & Testing	Project	**OTIC 71-20-01 Bridge Deck Rehabilitation**	
	Group: TS	Scenario: ---	
	Drawn By: IJH	Company: TTL Associates, Inc	
	Date: 6/11/21	File Name: Dimensions	