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March 15, 2024

Choice One Engineering
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Attention: Mr. Mitch Thobe, P.E.

Reference: **Report on Geotechnical Roadway Exploration**
MOT-CR74-4.40
MOT-WOODMAN DR. RECONSTRUCTION
PID 115003
Riverside, OH – Montgomery County
CTL Project No. 21050028WAP

Mr. Thobe:

CTL Engineering, Inc. has completed the geotechnical exploration for the above referenced project. The purpose of this exploration was to evaluate the subsurface conditions and provide recommendations and soil parameters for the pavement reconstruction within the City of Riverside. Various empirical correlations have been made in analyzing the subsurface soils of the site. These correlations were made using generally accepted geotechnical engineering practice and published documents.

Thank you for the opportunity to be of service to you on this project. If you have any questions, please contact our office.

Respectfully Submitted,

CTL ENGINEERING, INC.

Frederick L. Schoen, P.E.
Project Engineer

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REPORT ON GEOTECHNICAL
ROADWAY EXPLORATION - FINAL

MOT-CR74-4.40; WOODMAN DRIVE RECONSTRUCTION

CITY OF RIVERSIDE
MONTGOMERY COUNTY, OHIO
PID #115003

CTL PROJECT NO.: 21050028WAP

PREPARED FOR:

CHOICE ONE ENGINEERING
440 EAST HOEWISHER ROAD
SIDNEY, OHIO 45365

PREPARED BY:

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MARCH 15, 2024

RECORD OF REVISIONS

Date of Transmittal	Description	Remarks
6/22/2022	1st Submittal of Draft Report	--
9/9/2022	Stage 1 Revisions	Added WDCP (performed by ODOT) and made corrections to Plan and Profile sheets as indicated with ODOT comments
4/14/2023	Stage 2 Revisions	Made edits to Plan and Profile sheets as indicated with ODOT comments. Made changes to Introduction section of Geotechnical Roadway Exploration Report per ODOT comments
3/15/2024	Stage 3 Revisions	Replaced Geotechnical Plan and Profile Sheet 5 of 5 with clearer Wildcat DCP data

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I. EXECUTIVE SUMMARY

Project involves the reconstruction of Woodman Drive (State Route 835/CR 74), from just north of an existing pre-stressed concrete box beam bridge over a historic railroad spur turned walking path, near US Route 35 westbound to Eastman Avenue. The overall length of road reconstruction is approximately 2,200 feet. The reconstruction will include improvements of the deteriorating roadway, improvements of storm water drainage, installation of a multi-use path along west side of Woodman Dr., and upgrades to the existing traffic signals at the intersection of Woodman Dr. and Eastman Ave. An existing corrugated metal pipe (CMP) culvert is located near station 38+50; which will be extended with a new full height headwall.

Six (6) soil test borings, designated B-001-0-21 through B-006-0-21, were drilled and sampled through the existing paved roadway, into the subgrade soils to depths of 7.0 feet below the existing roadway surface. Borings were performed on August 16, 2021 utilizing a truck mounted, rotary drill rig with solid-flight augers. A copy of test boring records is appended to this report.

Two (2) dynamic cone penetration (DCP) soundings were performed by ODOT at the location of the proposed culvert headwall near station 38+50. Soundings were labeled as D-005-1-22 and D-005-2-22 and a copy of sounding records are appended to this report.

Based on the subsurface conditions encountered in the borings, and the results of the GB1 analyses, estimated CBR value of 7.0 may be used in the pavement thickness design of the roadways. Refer to the *Analyses and Recommendation* section of this for additional information

According to requirements outlined in ODOT's Geotechnical Bulletin 1 (GB1), some of the subgrade soils will require subgrade stabilization. Please refer to the *Analyses and Recommendation* section of this report for additional details.

Below the pavement, the borings generally exhibited both coarse-grained and fine-grained soils. The coarse-grained soils were described as gravel and/or stone fragments with sand (A-1-b), gravel and/or stone fragments with sand and silt (A-2-4), and the fine-grained soils were described as sandy silt (A-4a), silt and clay (A-6a), or silty clay (A-6b). Groundwater was not encountered during drilling and/or after the completion of drilling operations.

II. INTRODUCTION

Project involves the reconstruction of Woodman Drive (also known as State Route 835 and County Road 74), from just north of an existing pre-stressed concrete box beam bridge over a historic railroad spur turned walking path, near US Route 35 westbound to Eastman Avenue. The overall length of road reconstruction is approximately 2,200 feet. The reconstruction will include improvements of the deteriorating roadway, improvements of storm water drainage, installation of a multi-use path along west side of Woodman Dr., and upgrades to the existing traffic signals at the intersection of Woodman Dr. and Eastman Ave.

An existing corrugated metal pipe (CMP) culvert is located within the project limits near station 38+50. It is understood that this existing culvert will be extended to the west and a new full height headwall constructed. Furthermore, portions of Woodman Dr. are supported by earthen embankment several feet in height. Any modifications to the existing roadway embankments will not be addressed with this report.

The purpose of this geotechnical exploration is to determine the subgrade conditions for the design of the proposed roadway reconstruction.

III. GEOLOGY AND OBSERVATIONS OF THE PROJECT

A. Geology

According to the Soil Survey of Montgomery County, Ohio; surficial soils at the site include the following units:

- Miamian-Urban land complex, undulating, 2 to 6 percent slopes (MoB)
- Montgomery silty clay loam, 0 to 2 percent slopes (Mv)
- Sloan silt loam, 0 to 2 percent slopes (So)
- Miamian clay loam, 6 to 12 percent slopes, severely eroded (MnC3)
- Miamian-Urban land complex, rolling, 6 to 12 percent (MoC)
- Fox-Urban land complex, 2 to 6 percent slopes (FuB)

Soil units are as defined by the United States Department of Agriculture (USDA) - Natural Resources Conservation Service (NRCS). Mapped soils are described as having a high potential for frost action, a low risk for corrosion to buried concrete, and a high risk of corrosion to unprotected steel.

Project lies within the Southern Ohio Loamy Till Plain physiographic region, which falls inside the Central Lowlands Province of Ohio. The area is "characterized by end and recessional moraines between relatively flat-lying ground moraine. These morainal features are cut by steep-valleyed streams, with alternating broad and narrow flood plains. Buried valleys filled with glacial-outwash are common" (Debrewer, et. al., 2000). The project site is located within an existing ground moraine over a buried valley of sand and gravel.

During the Pleistocene Epoch, the Wisconsin glacial ice sheet covered Montgomery County, and most of northern Ohio. The surficial glacial deposits of Montgomery County are loamy, high-lime Wisconsinan-age till, outwash, and loess.

The project site is underlain by the Grant Lake Formation (Oglf) of Ordovician Age, which consists of interbedded limestone (50%) and shale (50%). Depths to top of rock is reported to be approximately 300 feet below existing surface grades.

Several karst related features are known within Montgomery County, but no known or probable karst areas are mapped near the project site according to the Ohio Karst Areas Map (ODNR). No underground mine related incidents are mapped near the project site according to the Mines of Ohio (ODNR) database.

B. Observations of the Project

Woodman Drive is a four-lane roadway with grass medians and turn lanes. The road surface appears to contain numerous fatigue and suspected reflection cracks. Land usage around the project is generally residential and commercial. The southern portion of the subject roadway is supported by an existing earthen embankment approximately 35 feet in height with side slope rates of about 2:1 (H:V). Side slopes are lined with trees and vegetation. Woodman Drive also intersects Woodman Park Drive within the project limits and an existing CMP culvert for a creek crossing under the roadway. Several underground and overhead utility lines were present within the project limits.

IV. EXPLORATION

No historical borings were found within the project limits when using the Ohio Department of Transportation's (ODOT) Transportation Information Mapping System (TIMS). Historic test borings were found immediately south of the project limits which were associated with US 35 and the prestressed concrete box beam bridge. Given that these borings are outside of the project limits, they are not presented with this report.

Six (6) soil test borings, designated B-001-0-21 through B-006-0-21, were each advanced to a depth of 7.0 feet below the existing ground surface within the existing roadway. The number and location of the soil test borings, along with the sampling intervals within the borings, were determined by CTL Engineering (CTL) to meet the Ohio Department of Transportation's (ODOT) guidelines and provide a general profile of the subsurface conditions across the site. The test borings were located in the field by CTL personnel and were positioned to avoid known underground and overhead utilities. Survey data at the test boring locations were interpolated from plan sheets provided by Choice One Engineering. Actual test boring locations are shown on the Soil Profile Sheets found in the appendices of this report, and are presented in *Table 1*.

Table 1 – Boring Elevations, Coordinates, and Depths

Boring No.	Ground Surface Elevation (ft.)	Station	Offset	Latitude* (N-Parallel)	Longitude* (E-Meridian)	Boring Depth (ft.)
B-001-0-21	910.2	22+85	37’ Lt.	39.746719	-84.120740	7.0
B-002-0-21	898.0	26+51	29’ Rt.	39.747705	-84.120411	7.0
B-003-0-21	879.5	30+57	6’ Lt.	39.748830	-84.120424	7.0
B-004-0-21	858.5	34+86	4’ Lt	39.749987	-84.120128	7.0
B-005-0-21	848.1	38+32	6’ Lt.	39.750908	-84.119914	7.0
B-006-0-21	847.7	41+35	5’ Lt.	39.751736	-84.119871	7.0

Test borings were performed by CTL Engineering on August 16, 2021; using a truck-mounted rotary drill rig and 4.0-inch diameter solid flight augers (SFA). Standard Penetration Tests (SPTs) were conducted in test borings during drilling using an automatic 140-pound hammer falling 30 inches to drive 2.0-inch outside diameter split-spoon samplers for 18 inches. The SPTs were performed continuously for the entire length of each boring. The automatic hammer used with the drill rig for the project was previously calibrated on June 1, 2019, and has a drill rod energy ratio of 86.8 percent.

Drilling, sampling, and field testing were performed in accordance with standard geotechnical engineering practices and current ASTM procedures. Soil samples obtained from drilling operations were preserved in glass jars and labeled, visually classified in the field, then delivered to CTL for laboratory testing and analysis. Each collected sample was subject to moisture content determination and hand penetrometer testing, if practical. In addition, eleven (11) samples were subjected to laboratory testing consisting of Atterberg Limits and particle size analysis. Four (4) select samples were also subjected to Loss-on-Ignition (LOI) testing, and six (6) samples were tested for water soluble sulfate content.

Two (2) dynamic cone penetration (DCP) soundings were performed by ODOT at the location of the proposed culvert headwall near station 38+50. Soundings were labeled as D-005-1-22 and D-005-2-22 and a copy of sounding records are appended to this report.

V. FINDINGS

A. General Stratigraphy

Pavement materials were encountered at the ground surface of the test borings. Borings B-001-0-21, B-005-21, and B-006-0-21 exhibited 9.0 to 12.0 inches of flexible asphalt pavement. Borings B-002-0-21, B-003-0-21, and B-004-0-21 exhibited 5.0 to 6.0 inches of asphalt pavement over 9.0 to 9.5 inches of concrete base. A summary of the pavement thickness encountered in the test borings is

provided in Table 2 below.

Table 2. Existing Pavement Thickness

Boring No.	Pavement Material Thickness (inches)	
	Asphalt	Concrete Base
B-001-0-21	9.0	--
B-002-0-21	5.0	9.0
B-003-0-21	5.5	9.5
B-004-0-21	6.0	9.0
B-005-0-21	12.0	--
B-006-0-21	11.0	--

Fine-grained cohesive materials and coarse-grained granular materials were encountered beneath the surficial materials. Soils were visually described as shades of black, gray, and brown. Fine-grained soils were found as medium stiff to hard sandy silt (A-4a), silt and clay (A-6a), and silty clay (A-6b). Coarse-grained soils were loose to very dense gravel and/or stone fragments with sand (A-1-b), and gravel and/or stone fragments with sand and silt (A-2-4).

22 of the 24 samples collected for this project were visually classified as previously placed fill materials (engineered fill). Borings B-004-0-21, B-005-0-21, and B-006-0-21 encountered slightly to moderately organic soils (LOI values ranging from 1.5 to 7.3 percent) at depths of 2.5 to 7.0 feet below existing surface grades.

Sulfate testing was performed following the Ohio Department of Transportation (ODOT) supplement specification SS 1122 on soil samples within the upper 3 feet of assumed proposed subgrade. The results of the sulfate tests are presented on the test boring logs. The soils exhibited sulfate values ranging from less than 100 ppm to 220 ppm.

Bedrock was not encountered.

Groundwater was not encountered during drilling and/or after the completion of drilling operations. Borehole cave-in occurred in each of the test borings at depths of 6.0 to 6.5 feet below surface grades.

B. Laboratory Test Results

Soil samples obtained from split-spoon sampling were subject of laboratory testing. Samples were tested to identify their moisture content. Soil samples were also subject of Atterberg Limits and grain size distribution testing, sulfate content testing, and organic content testing.

A summary of our findings includes:

- Hand penetrometer values ranged from 0.50 to 4.50 tpf, averaging 2.58 tpf.
- 63 percent of the samples tested were mechanically classified as a fine-grained soil.
- Liquid Limit (LL) values ranged from 17 to 38 percent, averaging 26 percent.
- Plasticity Index (PI) values ranged 3 to 23 percent, averaging 12 percent.
- Moisture content values ranged from 6 to 33 percent, averaging 16 percent.
- The estimated Optimum Moisture Content (OMC) values, based on the soil types per ODOT's Specification for Geotechnical Explorations (SGE) and Geotechnical Bulletin 1 (GB1), ranged from 6 to 16 percent, averaging 13 percent.
- A total of four soil samples from borings B-004-0-21, B-005-0-21, and B-006-0-21 were tested for organic content. Loss-on-Ignition (LOI) testing indicated soils between depths of 2.5 to 7.0 feet having organic contents of 1.5 to 7.3 percent.
- Four of six soil samples exhibited sulfate contents of less than 100 parts per million (ppm); and samples from borings B-003-0-21 and B-004-0-21 exhibited values of 220 and 200 ppm, respectively.

VI. ANALYSES AND RECOMMENDATIONS

It is estimated that subgrade stabilization may be required in portions of the project area. The subgrade stabilization may consist of excavate and replace per Item 204, or chemical stabilization.

Excavation of soils represented by the test borings can be accomplished using conventional earth moving equipment.

Surface drainage across the site may be altered with the proposed construction. It is recommended that all surface water run-off be collected or directed away from pavements into storm sewers or drainage ditches so that subgrade soils under pavements do not become saturated and lose strength. Any subgrade drainage tiles disturbed during construction should be reconnected, and groundwater flow should be redirected away from pavement areas.

Based upon the subsurface information obtained from the field and laboratory testing, the following recommendations are provided.

A. Subgrade Considerations

A subgrade analysis was performed utilizing the subsurface information from the drilled borings along with ODOT Geotechnical Bulletin 1 (GB1) guidelines. For estimating cut/fill per GB1, the proposed pavement thickness was assumed to be equal to 15.0 inches.

The following summary was analyzed of the near surface subgrade soils.

- SPT N_{60}-values ranged from 4 to 41 blows per foot (bpf), averaging 20 bpf in the upper 6 feet of the existing soil profiles.
- The lowest N_{60}-value (N_{60L}) from each boring ranged from 4 to 16 blows per foot (bpf), averaging 11 bpf.
- On average, the moisture contents of the samples tested were 3 percent higher than the average estimated optimum moisture content value.
- Group Index values were calculated for each of the subgrade samples tested. Group Index values for the samples tested ranged from 0 to 16, with an average value of 8.
- These Group Index values correspond to an estimated average California Bearing Ratio (CBR) value of 7.0 percent.

Based on the requirements outlined in GB1, it is estimated that subgrade stabilization may be required in portions of the project area. The subgrade stabilization may consist of excavate and replace per Item 204 with materials meeting the requirements of Item 703.16.C, Type B and/Type C Granular Material underlain by a geotextile fabric and/or geogrid per Item 712.09, Type D and 712.15. The approximate areas and depths estimated as needing stabilization are summarized in Table 3.

Furthermore, weak soils were encountered in borings B-005-0-21 at depths of 2.5 to 7.0 feet below existing grades. If during construction, weak soils are identified through proofroll, they may be undercut an additional 12 inches and the over-excavation backfilled with Item 703.16.C, Type B and/Type C Granular Material and multi-axial geogrid per Items 204 and 712.15 and Geotechnical Bulletin 1, section F.

Table 3. Estimated Excavate and Replace Locations and Depths

Approximate Limits	Approx. Depth of Excavate & Replace (in.)	
	With Geotextile	With Geogrid
Begin of Project to Sta. 24+20	Minimal, if any	
From Sta. 24+20 to Sta. 28+50	12	--
From Sta. 28+50 to Sta. 32+50	18	12
From Sta. 32+50 to Sta. 36+50	Minimal, if any	
From Sta. 36+50 to Sta. 40+20	24	18
Sta. 40+20 to End of Project	Minimal, if any	

The approximate depth of excavate and replace is measured from the top of the proposed pavement subgrade level. The locations and values are only an estimate. The actual depths and horizontal limits of excavate and replace will be determined by the Project Engineer in the field based upon proofrolling.

If the soils at the excavated depth exhibit unstable conditions, a bridge lift should be placed as outlined in Item 203.05 of the ODOT Construction and Material Specifications.

Moderately organic soils (organic matter between 4 to 10 percent) were encountered in borings B-005-0-21 and B-006-0-21 at depths of 2.8 to 5.8 feet below planned subgrade elevations. According to GB1, Section H, these soils should be completely removed or excavated to 3.0 feet below subgrade level, whichever is less. The excavation should be replaced with Item 204 material or granular material. Given that the organic soils are found mostly at depths greater than 3.0 feet below subgrade elevations, soils may remain, unless field evaluation indicate unstable conditions. Should design subgrades between station 36+50 to 46+50 be lowered from those presented with the plan sheets for this exploration, unsuitable organic soils will require excavation and removal.

According to GB1, as an alternative to excavate and replace, chemical stabilization using cement would be an option for this project. The GB1 subgrade analysis indicates that the subgrade improvement should extend to a depth of 14 inches.

In general, chemical stabilization is more economical when stabilizing large areas (greater than 1 mile of roadway). Based on the size of the project, the chemical stabilization option may not be cost effective for this project. Therefore, it is CTL's opinion that "Excavate and Replace" be considered for subgrade stabilization on this project.

The pavement for this project may be designed using a CBR value of 7.0, provided the pavement subgrade soils are prepared per ODOT requirements.

B. General Construction and Earthwork

1. Site preparation and earthwork should be performed in accordance with the ODOT Construction and Material Specifications, and applicable Geotechnical Bulletins.

2. Temporary excavations in excess of 4 feet in depth, if required, should be sloped or shored according to OSHA requirements.

VII. CHANGED CONDITIONS

The evaluations, conclusions, and recommendations in this report are based on our interpretation of the field and laboratory data obtained during the exploration, our understanding of the project and our experience with similar sites and subsurface conditions using generally accepted geotechnical engineering practices. Although individual test borings are representative of the subsurface conditions at the boring locations on the dates drilled, they are not necessarily representative of the subsurface conditions between boring locations or subsurface conditions during other seasons of the year.

In the event that changes in the project are proposed, additional information becomes available, or if it is apparent that subsurface conditions are different from those provided in this report, CTL Engineering should be notified so that our recommendations can be modified, if required.

VIII. TESTING AND OBSERVATION

During the design process, it is recommended that CTL Engineering work with the project designers to confirm that the geotechnical recommendations are properly incorporated into the final plans and specifications, and to assist with establishing criteria for the construction observation and testing.

CTL Engineering is not responsible for independent conclusions, opinions and recommendations made by others based on the data and recommendations provided in this report. It is recommended that CTL be retained to provide construction quality control services on this project. If CTL Engineering is not retained for these services, CTL shall assume no responsibility for compliance with the design concepts or recommendations provided.

IX. CLOSING

The report was prepared by CTL Engineering, Inc. (Consultant) solely for the use of the Client in accordance with an executed contract. The Client's use of or reliance on this report is limited by the terms and conditions of the contract and by the qualifications and limitations stated in the report. It is also acknowledged that the Client's use of and reliance of this report is limited for reasons which include: actual site conditions that may change with time; hidden conditions, not discoverable within the scope of the assessment, may exist at the site; and the scope of the investigation may have been limited by time, budget and other constraints imposed by the Client.

Neither the report, nor its contents, conclusions or recommendations, are intended for the use of any party other than the Client. Consultant and the Client assume no liability for any reliance placed on this report by such party. The rights of the Client under contract may not be assigned to any person or entity, without the consent of the Consultant which consent shall not be unreasonably withheld.

This geotechnical report does not address the environmental conditions of the site. The Consultant is not responsible for consequences or conditions arising from facts that were concealed, withheld, or not fully disclosed at the time the assessment was conducted.

To the fullest extent permitted by law, the Consultant and Client agree to indemnify and hold each other, and their officers and employees harmless from and against claims, damages, losses and expenses arising out of unknown or concealed conditions. Furthermore, neither the Consultant nor its employees shall be liable to the Owner in an amount in excess of the available professional liability insurance coverage of the Consultant. In addition, Client and Consultant agree neither shall be liable for any special, indirect or consequential damages of any kind or nature.

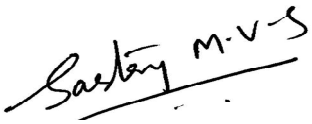
The Consultant's services have been provided consistent with its professional standard of care. No other warranties are made, either expressed or implied.

Thank you for the opportunity to be of service to you on this project. If you have any questions regarding our services, please contact our office.

Respectfully Submitted,
CTL ENGINEERING, INC.

Christopher Carey, E.I.
Project Engineer

Frederick Schoen, P.E.
Project Manager
OH License, E-66510



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APPENDIX A

SOIL PLAN & PROFILE SHEETS

PROJECT DESCRIPTION

PROJECT INVOLVES THE RECONSTRUCTION OF WOODMAN DRIVE (AS KNOWN AS STATE ROUTE 835 AND COUNTY ROAD 74), FROM JUST NORTH OF AN EXISTING PRE-STRESSED CONCRETE BOX BEAM BRIDGE OVER A HISTORIC RAILROAD SPUR TURNED WALKING PATH AND THE US ROUTE 35 WESTBOUND ON AND OFF RAMPS TO EASTMAN AVENUE. THE RECONSTRUCTION WILL INCLUDE IMPROVEMENTS OF THE DETERIORATING ROADWAY, IMPROVEMENTS OF STORM WATER DRAINAGE, INSTALLATION OF A MULTI-USE PATH ALONG WEST SIDE OF WOODMAN DR., AND UPGRADES TO THE EXISTING TRAFFIC SIGNALS AT THE INTERSECTION OF WOODMAN DR. AND EASTMAN AVE.

HISTORIC RECORDS

NO HISTORICAL BORINGS WERE FOUND WITHIN THE PROJECT LIMITS WHEN USING THE OHIO DEPARTMENT OF TRANSPORTATION'S (ODOT) TRANSPORTATION INFORMATION MAPPING SYSTEM (TIMS).

GEOLOGY

PROJECT LIES WITHIN THE SOUTHERN OHIO LOAMY TILL PLAIN PHYSIOGRAPHIC REGION, WHICH FALLS INSIDE THE CENTRAL LOWLANDS PROVINCE OF OHIO. THE AREA IS "CHARACTERIZED BY END AND RECESSIONAL MORAINES BETWEEN RELATIVELY FLAT-LYING GROUND MORAINE. THESE MORAINAL FEATURES ARE CUT BY STEEP-VALLEYED STREAMS, WITH ALTERNATING BROAD AND NARROW FLOOD PLAINS. BURIED VALLEYS FILLED WITH GLACIAL-OUTWASH ARE COMMON" (DEBREWER, ET. AL., 2000). THE PROJECT SITE IS LOCATED WITHIN AN EXISTING GROUND MORAINE OVER A BURIED VALLEY OF SAND AND GRAVEL.

THE PROJECT SITE IS UNDERLAIN BY THE GRANT LAKE FORMATION (OGLF) OF ORDOVICIAN AGE, WHICH CONSISTS OF INTERBEDDED LIMESTONE (50%) AND SHALE (50%). DEPTHS TO TOP OF ROCK IS REPORTED TO BE APPROXIMATELY 300 FEET BELOW EXISTING SURFACE GRADES.

SEVERAL KARST RELATED FEATURES ARE KNOWN WITHIN MONTGOMERY COUNTY, BUT NO KNOWN OR PROBABLE KARST AREAS ARE MAPPED NEAR THE PROJECT SITE ACCORDING TO THE OHIO KARST AREAS MAP (ODNR). NO UNDERGROUND MINE RELATED INCIDENTS ARE MAPPED NEAR THE PROJECT SITE ACCORDING TO THE MINES OF OHIO (ODNR) DATABASE.

RECONNAISSANCE

WOODMAN DRIVE IS A FOUR-LANE ROADWAY WITH GRASS MEDIANS AND TURN LANES. THE ROAD SURFACE APPEARS TO CONTAIN NUMEROUS FATIGUE AND SUSPECTED REFLECTION CRACKS. LAND USAGE AROUND THE PROJECT IS GENERALLY RESIDENTIAL AND COMMERCIAL. THE SOUTHERN PORTION OF THE SUBJECT ROADWAY IS SUPPORTED BY AN EXISTING EARTHEN EMBANKMENT APPROXIMATELY 35 FEET IN HEIGHT WITH SIDE SLOPE RATES OF ABOUT 2:1 (H:V). SIDE SLOPES ARE LINED WITH TREES AND VEGETATION. WOODMAN DRIVE ALSO INTERSECTS WOODMAN PARK DRIVE WITHIN THE PROJECT LIMITS AND AN EXISTING CMP CULVERT FOR A CREEK CROSSES UNDER THE ROADWAY. SEVERAL UNDERGROUND AND OVERHEAD UTILITY LINES WERE PRESENT WITHIN THE PROJECT LIMITS.

SUBSURFACE EXPLORATION

SIX (6) SOIL TEST BORINGS, DESIGNATED B-001-0-21 THROUGH B-006-0-21, WERE EACH ADVANCED TO A DEPTH OF 7.0 FEET BELOW THE EXISTING GROUND SURFACE WITHIN THE EXISTING ROADWAY. TEST BORINGS WERE PERFORMED BY CTL ENGINEERING ON AUGUST 16, 2021; USING A TRUCK-MOUNTED ROTARY DRILL RIG AND 4.0-INCH DIAMETER SOLID FLIGHT AUGERS. STANDARD PENETRATION TESTS (SPT) WERE CONDUCTED IN TEST BORINGS DURING DRILLING USING AN AUTOMATIC 140-POUND HAMMER FALLING 30 INCHES TO DRIVE 2.0-INCH OUTSIDE DIAMETER SPLIT-SPOON SAMPLERS FOR 18 INCHES. THE SPT WERE PERFORMED CONTINUOUSLY FOR THE ENTIRE LENGTH OF EACH BORING. THE AUTOMATIC HAMMER USED WITH THE DRILL RIG FOR THE PROJECT WAS PREVIOUSLY CALIBRATED ON JUNE 1, 2019, AND HAS A DRILL ROD ENERGY RATIO OF 86.8 PERCENT.

TWO (2) WILDCAT DYNAMIC CONE PENETROMETER (WDCP) SOUNDINGS, D-005-1-22 AND D-005-2-22, WERE COMPLETED BY ODOT CENTRAL LAB AND DISTRICT 7 PERSONNEL ALONG THE WESTERN EXTENT OF THE EXISTING CMP CULVERT TO EVALUATE FOUNDATION SOIL CONDITIONS AT THE EXISTING CREEK BOTTOM.

EXPLORATION FINDINGS

PAVEMENT MATERIALS WERE ENCOUNTERED AT THE GROUND SURFACE IN EACH OF THE TEST BORINGS. BORINGS B-001-0-21, B-005-21, AND B-006-0-21 EXHIBITED 9.0 TO 12.0 INCHES OF FLEXIBLE ASPHALT PAVEMENT. BORINGS B-002-0-21, B-003-0-21, AND B-004-0-21 EXHIBITED 5.0 TO 6.0 INCHES OF ASPHALT PAVEMENT OVER 9.0 TO 9.5 INCHES OF CONCRETE BASE. FINE-GRAINED COHESIVE MATERIALS AND COARSE-GRAINED GRANULAR MATERIALS WERE ENCOUNTERED BENEATH THE SURFICIAL MATERIALS. SOILS WERE VISUALLY DESCRIBED AS SHADES OF BLACK, GRAY, AND BROWN. FINE-GRAINED SOILS WERE FOUND AS MEDIUM STIFF TO HARD SANDY SILT (A-4a), SILT AND CLAY (A-6a), AND SILTY CLAY (A-6b).

LEGEND

DESCRIPTION	ODOT CLASS	CLASSIFIED MECH.	CLASSIFIED VISUAL
GRAVEL AND/OR STONE FRAGMENTS WITH SAND	A-1-b	2	1
GRAVEL AND/OR STONE FRAGMENTS W/SAND AND SILT	A-2-4	2	0
SANDY SILT	A-4a	1	3
SILT AND CLAY	A-6a	3	5
SILTY CLAY	A-6b	3	4
	TOTAL	11	13

XXXXXX PAVEMENT OR BASE =X= APPROXIMATE THICKNESS

WDCP SOUNDING LOCATION - PLAN VIEW

WDCP SOUNDING PLOTTED TO VERTICAL SCALE ONLY.

N' INDICATES WDCP CORRELATION DERIVED SPT N - VALUE.

EXPLORATION LOCATION - PLAN VIEW

DRIVE SAMPLE AND/OR ROCK CORE BORING PLOTTED TO VERTICAL SCALE ONLY. HORIZONTAL BAR INDICATES A CHANGE IN STRATIGRAPHY.

WC INDICATES WATER CONTENT IN PERCENT.

N_{60} INDICATES STANDARD PENETRATION RESISTANCE NORMALIZED TO 60% DRILL ROD ENERGY RATIO.

INDICATES A PLASTIC MATERIAL WITH A MOISTURE CONTENT EQUAL TO OR GREATER THAN THE LIQUID LIMIT MINUS 3.

AS INDICATES AUGER SAMPLE.

SS INDICATES A SPLIT SPOON SAMPLE, STANDARD PENETRATION TEST.

LOL INDICATES LOSS-ON-IGNITION LABORATORY TEST.

COARSE-GRAINED SOILS WERE LOOSE TO VERY DENSE GRAVEL AND/OR STONE FRAGMENTS WITH SAND (A-1-b), AND GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT (A-2-4). BORINGS B-004-0-21, B-005-0-21, AND B-006-0-21 ENCOUNTERED SLIGHTLY TO MODERATELY ORGANIC SOILS AT DEPTHS OF 2.5 TO 7.0 FEET BELOW EXISTING SURFACE GRADES. BEDROCK WAS NOT ENCOUNTERED. GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING AND/OR AFTER THE COMPLETION OF DRILLING OPERATIONS. BOREHOLE CAVE-IN OCCURRED IN EACH OF THE TEST BORINGS AT DEPTHS OF 6.0 TO 6.5 FEET BELOW SURFACE GRADES.

SPECIFICATIONS

THIS GEOTECHNICAL EXPLORATION WAS PERFORMED IN ACCORDANCE WITH THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, OFFICE OF GEOTECHNICAL ENGINEERING, SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS, DATED JANUARY 2022.

AVAILABLE INFORMATION

THE SOIL, BEDROCK, AND GROUNDWATER INFORMATION COLLECTED FOR THIS SUBSURFACE EXPLORATION THAT CAN BE CONVENIENTLY DISPLAYED ON THE SOIL PROFILE SHEETS HAS BEEN PRESENTED. GEOTECHNICAL REPORTS, IF PREPARED, ARE AVAILABLE FOR REVIEW ON THE OFFICE OF CONTRACT SALES WEBSITE.

LOCATION MAP

SCALE IN MILES

0 1 2 3 4

N

PARTICLE SIZE DEFINITIONS

12"	3"	2.0 mm	0.42 mm	0.074 mm	0.005 mm
BOULDERS	COBBLES	GRAVEL	COARSE SAND	FINE SAND	SILT	CLAY
		No. 10 SIEVE	No. 40 SIEVE	No. 200 SIEVE		

INDEX OF SHEETS

LOCATION FROM STA.	TO STA.	PLAN VIEW SHEET	PROFILE SHEET	CUT MAX.	FILL EMB. MAX.
COVER SHEET 1					
SUMMARY OF SOIL TEST DATA SHEET 2					
CR-74 (WOODMAN DRIVE)					
21+00.00	33+00.00	3	3	<0.5'	2.0'
33+00.00	46+00.00	4	4	<0.5'	2.5'
WDCP SOUNDING LOGS SHEET 5					

RECON. - JW 08/03/2021
DRILLING - CTL ENG. - 08/16/2021
DCP - PP, DG, JX - 08/29/2022
DRAWN - SACHINA - 03/15/2024
REVIEWED - FS 03/15/2024

GEOTECHNICAL PROFILE - ROADWAY

DESIGN AGENCY

CTL ENGINEERING
2860 FISHER ROAD
COLUMBUS, OHIO 43204
PHONE: (614)276-8123
FAX: (614)276-6377

DESIGNER N.K.S

REVIEWER FS 03-15-24

PROJECT ID 115003

SUBSET 1 TOTAL 5

SHEET - TOTAL -

MOT-CR 74-04.40

SUMMARY OF SOIL TEST DATA
CR-74 (WOODMAN DRIVE)

EXPLORATION NO., STATION & OFFSET	FROM	TO	SAMPLE ID	N_{60}	% REC	HP tsf	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO_4
B-001-0-21	01.00	02.50	AS-1	12	0	-	BROWN GRAVEL AND STONE FRAGMENTS WITH SAND								-	A-1-b (VISUAL)	-
STA. 22+85, 37' LT.	02.50	04.00	SS-2	27	100	2.50	13	8	16	34	29	31	15	16	16	A-6b (8)	<100
LATITUDE = 39.746719	04.00	05.50	SS-3	9	67	1.75	BROWN SILT AND CLAY								18	A-6a (VISUAL)	-
LONGITUDE = -84.120740	05.50	07.00	SS-4	22	100	4.00	BROWN SANDY SILT								11	A-4a (VISUAL)	-
B-002-0-21	01.00	02.50	SS-1	17	33	-	43	19	16	12	10	20	13	7	14	A-2-4 (0)	-
STA. 26+51, 29' RT.	02.50	04.00	SS-2	33	100	4.25	7	10	20	36	27	26	14	12	12	A-6a (6)	<100
LATITUDE = 39.747705	04.00	05.50	AS-3	30	0	-	BROWNISH GRAY SANDY SILT								-	A-4a (VISUAL)	-
LONGITUDE = -84.120411	05.50	07.00	SS-4	13	33	1.25	BROWN AND GRAY SILT AND CLAY								20	A-6a (VISUAL)	-
B-003-0-21	01.00	02.50	SS-1	17	33	-	45	22	14	11	8	17	14	3	14	A-1-b (0) ●	-
STA. 30+57, 6' LT.	02.50	04.00	SS-2	6	100	1.25	15	12	15	35	23	29	14	15	17	A-6a (7)	220
LATITUDE = 39.748830	04.00	05.50	SS-3	29	100	2.50	BROWN SILTY CLAY								13	A-6b (VISUAL)	-
LONGITUDE = -84.120424	05.50	07.00	SS-4	41	100	4.50	SAME AS SS-3								17	A-6b (VISUAL)	-
B-004-0-21	01.00	02.50	SS-1	16	100	2.25	13	13	24	30	20	18	13	5	11	A-4a (3)	200
STA. 34+86, 4' LT.	02.50	04.00	SS-2	22	100	3.25	7	6	14	37	36	34	15	19	15	A-6b (11)	-
LATITUDE = 39.749987	04.00	05.50	SS-3	25	100	1.25	BROWN AND GRAY SILT AND CLAY, SLIGHTLY ORGANIC								10	A-6a (VISUAL)	-
LONGITUDE = -84.120128	05.50	07.00	SS-4	27	33	2.75	BROWN AND GRAY SILTY CLAY								20	A-6b (VISUAL)	-
B-005-0-21	01.00	02.50	SS-1	20	100	-	30	27	20	13	10	19	13	6	6	A-1-b (0)	<100
STA. 38+32, 6' LT.	02.50	04.00	SS-2	7	100	1.50	36	24	15	13	12	22	12	10	9	A-2-4 (0)	-
LATITUDE = 39.750908	04.00	05.50	SS-3	4	33	0.50	BROWN SILT AND CLAY								14	A-6a (VISUAL)	-
LONGITUDE = -84.119914	05.50	07.00	SS-4	6	100	1.25	GRAY AND BLACK SILT AND CLAY, MODERATELY ORGANIC								21	A-6a (VISUAL)	-
B-006-0-21	01.00	02.50	SS-1	16	67	4.50	34	10	10	24	22	30	15	15	11	A-6a (4)	<100
STA. 41+35, 5' LT.	02.50	04.00	SS-2	32	100	4.50	11	9	15	33	32	38	15	23	15	A-6b (11)	-
LATITUDE = 39.751736	04.00	05.50	SS-3	29	67	3.00	BLACK SANDY SILT, BRICK FRAG., MODERATELY ORGANIC								33	A-4a (VISUAL) ●	-
LONGITUDE = -84.119871	05.50	07.00	SS-4	23	100	2.25	BROWN, BLACK AND BLUE SILTY CLAY								27	A-6b (VISUAL)	-

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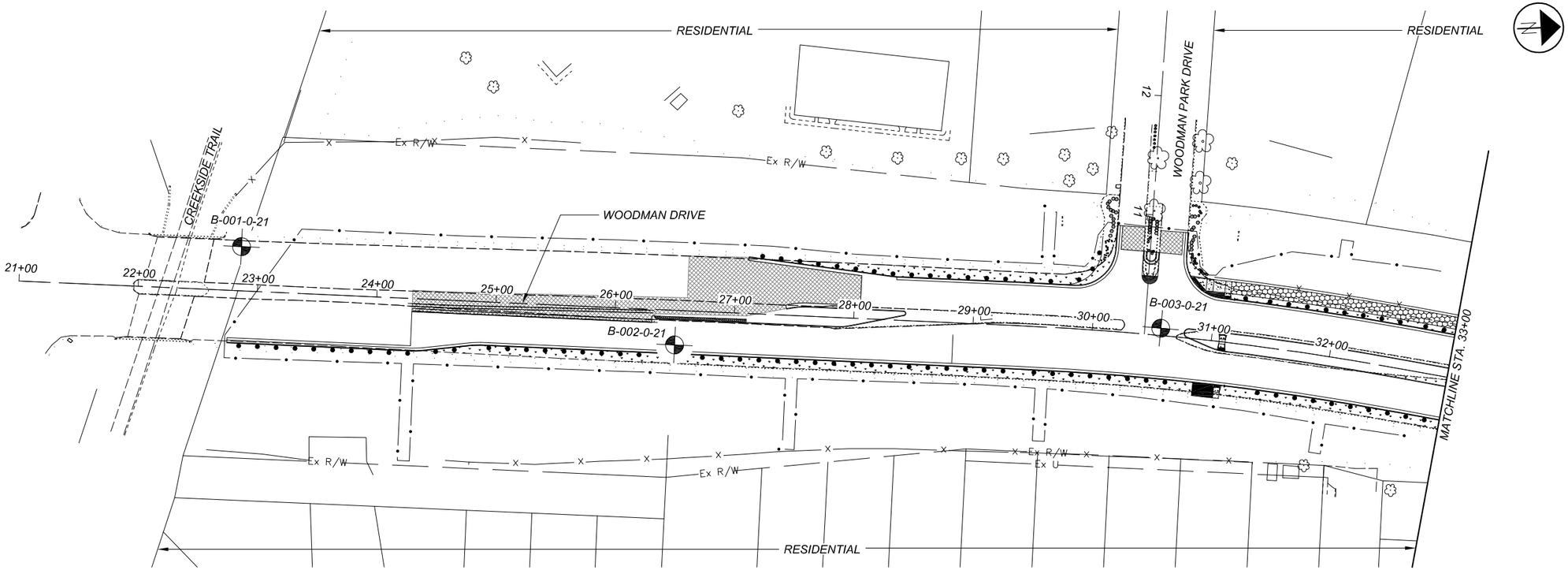
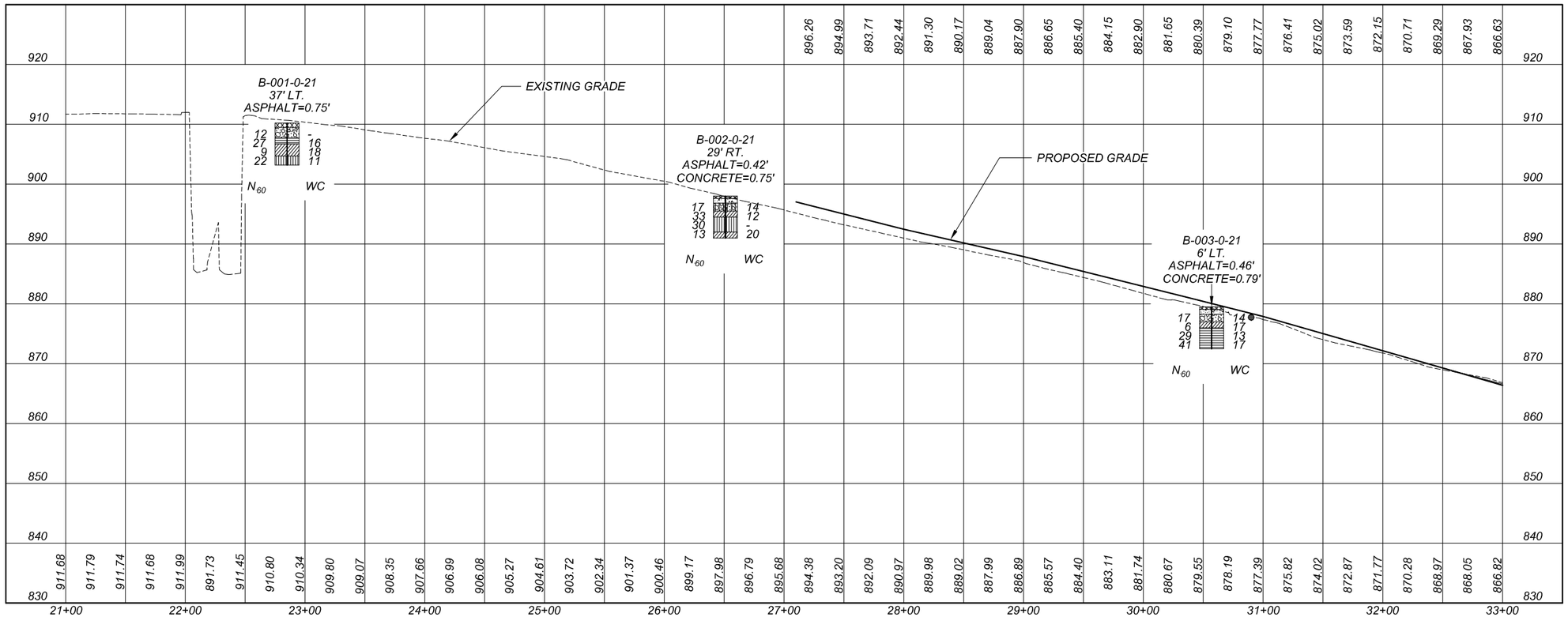
GEOTECHNICAL PROFILE - ROADWAY

SUMMARY OF SOIL TEST DATA



NOTE : SURFACE CONTOURS NOT PRESENTED



HORIZONTAL SCALE IN FEET
0 25 50 100

GEOTECHNICAL PROFILE - CR 74 (WOODMAN DRIVE)
STA. 21+00.00 TO STA. 33+00.00

MOT-CR 74-04.40

DESIGN AGENCY

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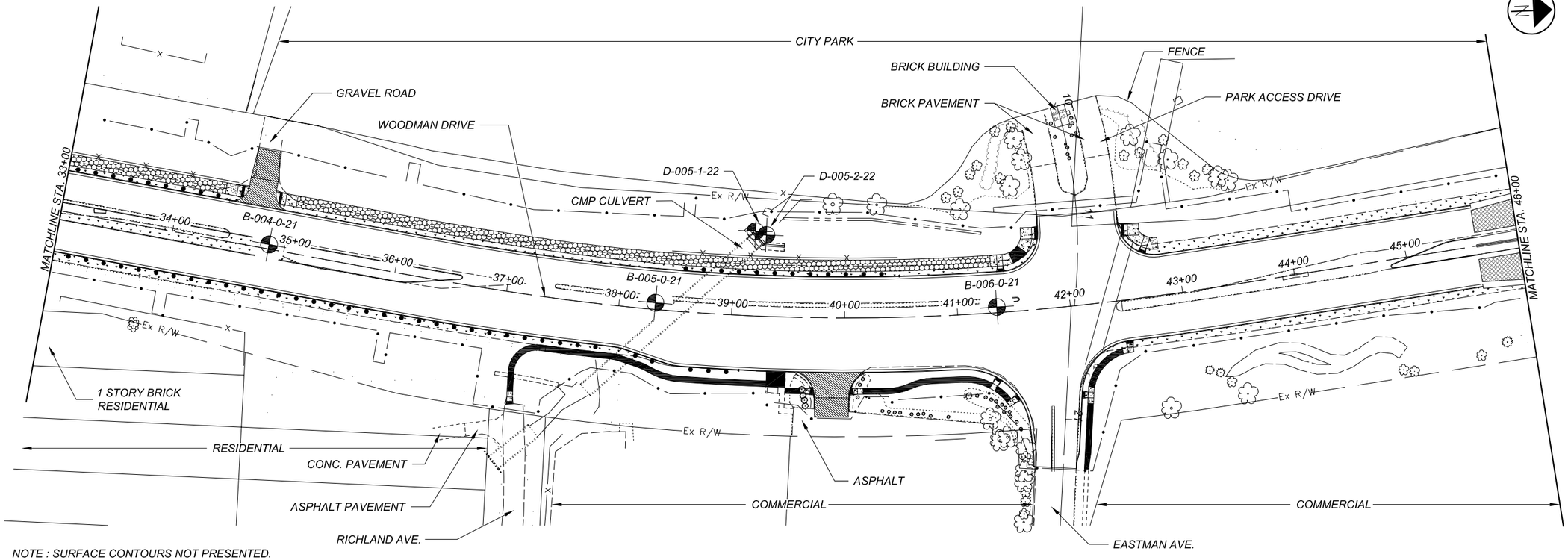
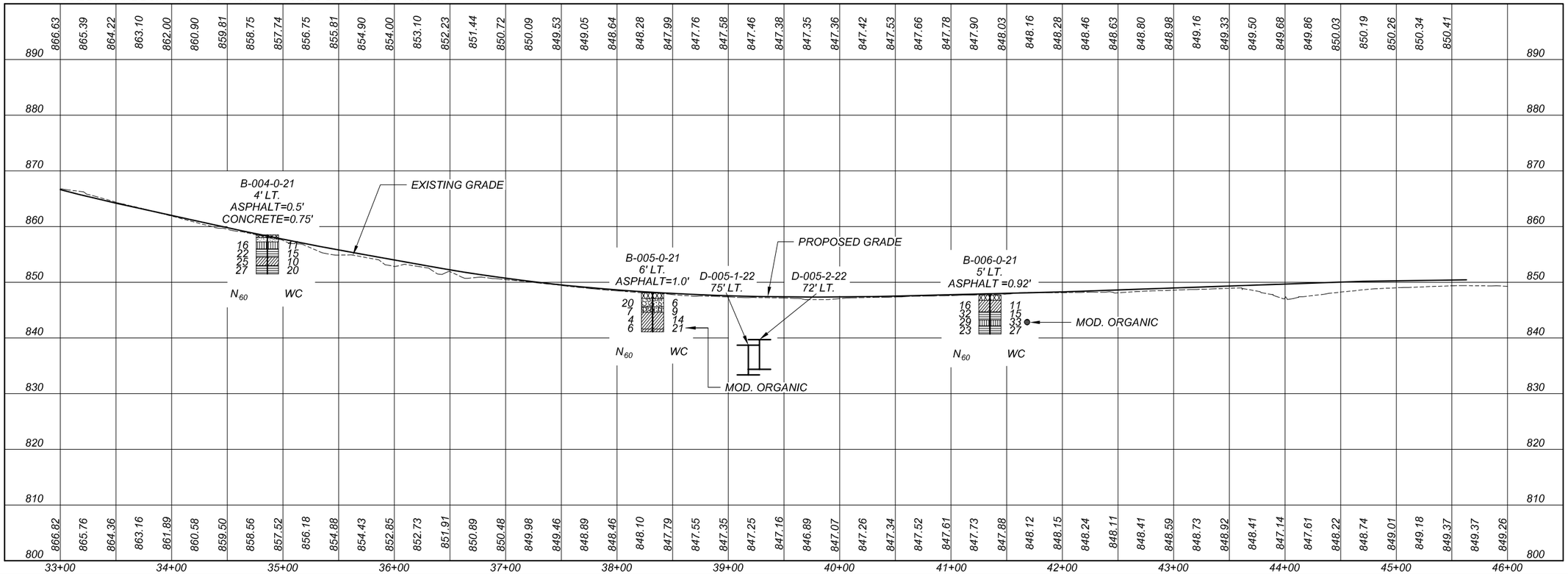
DESIGNER	N.K.S.
REVIEWER	FS 03-15-24
PROJECT ID	115003
SUBSET / TOTAL	3 / 5
SHEET / TOTAL	- / -



NOTE : SURFACE CONTOURS NOT PRESENTED.
NO ADDITIONAL BORING INFORMATION PROVIDED BEYOND STA. 46+00.



HORIZONTAL SCALE IN FEET
0 25 50 100

GEOTECHNICAL PROFILE - CR 74 (WOODMAN DRIVE)
STA. 33+00.00 TO STA. 46+00.00

MOT-CR 74-04.40

DESIGN AGENCY

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DESIGNER	N.K.S.
REVIEWER	FS 03-15-24
PROJECT ID	115003
SUBSET	4
TOTAL	5
SHEET	-
TOTAL	-

WILDCAT DYNAMIC CONE LOG

The Ohio Department of Transportation
Office of Geotechnical Engineering
1600 West Broad Street, Columbus, Ohio 43223

PROJECT NUMBER: 115003
DATE STARTED: 08-29-2022
DATE COMPLETED: 08-29-2022

HOLE #: D-005-1-22
CREW: P. Painter, D. Grilliot & J. Xie
PROJECT: MOT-Woodman Dr.
LAT/LONG: 39.751170925, -84.120138346
LOCATION: Montgomery County Ohio

SURFACE ELEVATION: 838.7
WATER ON COMPLETION: 9-inches
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	1	4.4	•	1	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 1 ft	1	4.4	•	1	VERY LOOSE	VERY SOFT
-	1	4.4	•	1	VERY LOOSE	VERY SOFT
-	1	4.4	•	1	VERY LOOSE	VERY SOFT
- 2 ft	9	40.0	••••••••••	11	MEDIUM DENSE	STIFF
-	6	26.6	•••••••	7	LOOSE	MEDIUM STIFF
-	7	31.1	•••••••••	8	LOOSE	MEDIUM STIFF
- 3 ft	16	71.0	••••••••••••••••••••	20	MEDIUM DENSE	VERY STIFF
- 1 m	28	124.3	••••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 4 ft	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 5 ft						
-						
-						
- 6 ft						
-						
- 2 m						
- 7 ft						
-						
-						
- 8 ft						
-						
-						
- 9 ft						
-						
-						
- 3 m 10 ft						
-						
-						
-						
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

WILDCAT DYNAMIC CONE LOG

The Ohio Department of Transportation
Office of Geotechnical Engineering
1600 West Broad Street, Columbus, Ohio 43223

PROJECT NUMBER: 115003
DATE STARTED: 08-29-2022
DATE COMPLETED: 08-29-2022

HOLE #: D-005-2-22
CREW: P. Painter, D. Grilliot & J. Xie
PROJECT: MOT-Woodman Dr.
LAT/LONG: 39.751193425, -84.120115768
LOCATION: Montgomery County Ohio

SURFACE ELEVATION: 839.7
WATER ON COMPLETION: 23-inches
HAMMER WEIGHT: 35 lbs.
CONE AREA: 10 sq. cm

DEPTH	BLOWS PER 10 cm	RESISTANCE Kg/cm²	GRAPH OF CONE RESISTANCE 0 50 100 150	N'	TESTED CONSISTENCY NON-COHESIVE	TESTED CONSISTENCY COHESIVE
-	1	4.4	•	1	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 1 ft	1	4.4	•	1	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
- 2 ft	1	4.4	•	1	VERY LOOSE	VERY SOFT
-	0	0.0		0	VERY LOOSE	VERY SOFT
-	1	4.4	•	1	VERY LOOSE	VERY SOFT
- 3 ft	2	8.9	••	2	VERY LOOSE	SOFT
- 1 m	1	4.4	•	1	VERY LOOSE	VERY SOFT
-	8	30.9	••••••••	8	LOOSE	MEDIUM STIFF
- 4 ft	12	46.3	••••••••••••	13	MEDIUM DENSE	STIFF
-	9	34.7	•••••••••	9	LOOSE	STIFF
-	4	15.4	••••	4	VERY LOOSE	SOFT
- 5 ft	3	11.6	•••	3	VERY LOOSE	SOFT
-	3	11.6	•••	3	VERY LOOSE	SOFT
-	1	3.9	•	1	VERY LOOSE	VERY SOFT
- 6 ft	1	3.9	•	1	VERY LOOSE	VERY SOFT
-	1	3.9	•	1	VERY LOOSE	VERY SOFT
- 2 m	0	0.0		0	VERY LOOSE	VERY SOFT
- 7 ft	1	3.4		0	VERY LOOSE	VERY SOFT
-	3	10.3	••	2	VERY LOOSE	SOFT
-	3	10.3	••	2	VERY LOOSE	SOFT
- 8 ft	2	6.8	•	1	VERY LOOSE	VERY SOFT
-	3	10.3	••	2	VERY LOOSE	SOFT
-	3	10.3	••	2	VERY LOOSE	SOFT
- 9 ft	4	13.7	•••	3	VERY LOOSE	SOFT
-	3	10.3	••	2	VERY LOOSE	SOFT
-	4	13.7	•••	3	VERY LOOSE	SOFT
- 3 m 10 ft	9	30.8	••••••••	8	LOOSE	MEDIUM STIFF
-	8	24.5	•••••••	6	LOOSE	MEDIUM STIFF
-	39	119.3	••••••••••••••••••••••••••••••••••	25+	DENSE	HARD
-	30	91.8	••••••••••••••••••••••••••	25+	MEDIUM DENSE	VERY STIFF
- 11 ft						
-						
-						
- 12 ft						
-						
-						
- 4 m 13 ft						

GEOTECHNICAL PROFILE - CR 74 (WOODMAN DRIVE)
WDCP SOUNDING LOGS FOR D-005-1-22 & D-005-2-22

DESIGN AGENCY
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DESIGNER: N.K.S
REVIEWER: FS 03-15-24
PROJECT ID: 115003
SUBSET: 5 TOTAL: 5
SHEET: - TOTAL: -

MOT-CR 74-04.40

APPENDIX B

TEST BORING RECORD(S)

EXPLANATION OF TERMS AND SOIL DESCRIPTIONS
(ODOT Specifications of Geotechnical Explorations)

CONSISTENCY AND RELATIVE DENSITY DESCRIPTIONS

Descriptors for soil consistency used in this report are based upon the Standard Penetration Test (SPT), ASTM D 1587, with the penetration (N) values corrected to N_{60}, based upon the efficiency of the SPT Hammer (Energy Ratio) used for the soil sampling.

NON-COHESIVE SOILS

Consistency	SPT-N_{60} (bpf)
Very Loose	< 5
Loose	5 – 10
Medium Dense	11 – 30
Dense	31 - 50
Very Dense	> 50

COHESIVE SOILS

Consistency	SPT-N_{60} (bpf)	Qu (tsf)
Very Soft	< 2	< 0.25
Soft	2 – 4	0.25 – 0.5
Medium Stiff	5 – 8	0.5 – 1.0
Stiff	9 – 15	1.0 – 2.0
Very Stiff	16 – 30	2.0 – 4.0
Hard	> 30	> 4.0

COMPONENT MODIFIERS

SOIL MODIFIERS

Modifier	% by Weight
Trace	0 – 10
Little	10 – 20
Some	20 – 35
"And"	35 – 50

ORGANIC CONTENT

Modifier	% by Weight
Organic	LL_{oven}/LL_{air} < 0.75
Slightly	2 – 4
Moderately	4 – 10
Highly	> 10

MOISTURE DESCRIPTIONS

Terms	Non-Cohesive Soils	Cohesive Soils
Dry	Moisture Absent	Powdery
Damp	Some Moisture	Below Plastic Limit
Moist	Damp to the Touch	Between Plastic and Liquid Limits
Wet	Visible Water	Above Liquid Limit

PARTICLE SIZE DESCRIPTIONS

Component	AASHTO Particle Size
Boulders	≥ 12-in. (300 mm)
Cobbles	< 12-in. (300 mm) to 3-in. (75 mm)
Coarse Gravel	< 3-in. (75 mm) to ¾-in. (19 mm)
Fine Gravel	< ¾-in. (19 mm) to #10 Sieve (2.0 mm)
Coarse Sand	< #10 Sieve (2.0 mm) to #40 Sieve (0.42 mm)
Fine Sand	< #40 Sieve (0.42 mm) to #200 Sieve (0.074 mm)
Silt	< #200 Sieve (0.074 mm) to 0.005 mm
Clay	< 0.005 mm

GTL ENGINEERING

KEY TO SYMBOLS

OHIO DEPARTMENT OF TRANSPORTION
OFFICE OF GEOTECHNICAL ENGINEERING

PROJECT MOT-CR74-04.40 **PID** 115003

OGE NUMBER 21050028WAP **PROJECT TYPE** SUBGRADE

LITHOLOGIC SYMBOLS
(Unified Soil Classification System)


A-1-B: Ohio DOT: A-1-b, gravel and/or stone fragments with sand


A-2-4: Ohio DOT: A-2-4, gravel and/or stone fragments with sand and silt


A-4A: Ohio DOT: A-4a, sandy silt


A-6A: Ohio DOT: A-6a, silt and clay


A-6B: Ohio DOT: A-6b, silty clay


CONCRETE: Concrete


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

ABBREVIATIONS

LL - LIQUID LIMIT (%)
PI - PLASTIC INDEX (%)
W - MOISTURE CONTENT (%)
DD - DRY DENSITY (PCF)
NP - NON PLASTIC
-200 - PERCENT PASSING NO. 200 SIEVE
PP - POCKET PENETROMETER (TSF)
TV - TORVANE
PID - PHOTOIONIZATION DETECTOR
UC - UNCONFINED COMPRESSION
ppm - PARTS PER MILLION
▽ Water Level at Time Drilling, or as Shown
▼ Water Level at End of Drilling, or as Shown
▼ Water Level After 24 Hours, or as Shown

PROJECT: MOT-CR74-04.40	DRILLING FIRM / OPERATOR: CTL / D. MCWHERTER	DRILL RIG: CME 75 TRUCK	STATION / OFFSET: 22+85, 37' LT.
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: CTL / M.HUGHES	HAMMER: CME AUTOMATIC	ALIGNMENT: WOODMAN DR.
PID: 115003 SFN: N/A	DRILLING METHOD: 4.0" SFA	CALIBRATION DATE: 6/1/19	ELEVATION: 910.2 (MSL) EOB: 7.0 ft.
START: 8/16/21 END: 8/16/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.8	LAT / LONG: 39.746719, -84.120740

EXPLORATION ID B-001-0-21

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 910.2	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	HOLE SEALED
ASPHALT (9")	909.5																		
MEDIUM DENSE, BROWN, **GRAVEL AND STONE FRAGMENTS WITH SAND**, (EX. FILL), DAMP	907.7	1	6 3 5	12	0	AS-1	-	-	-	-	-	-	-	-	-	-	A-1-b (V)	-	
VERY STIFF, BROWNISH GRAY, **SILTY CLAY**, SOME SAND, LITTLE GRAVEL, WITH SLAG FRAGMENTS, (EX. FILL), MOIST	906.7	2	7 8 11	27	100	SS-2	2.50	13	8	16	34	29	31	15	16	16	A-6b (8)	<100	
STIFF, BROWN, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, (EX. FILL), MOIST	904.7	3	3 3 3	9	67	SS-3	1.75	-	-	-	-	-	-	-	-	18	A-6a (V)	-	
VERY STIFF, BROWN, **SANDY SILT**, TRACE GRAVEL, (EX. FILL), MOIST	903.2	4	9 7 8	22	100	SS-4	4.00	-	-	-	-	-	-	-	-	11	A-4a (V)	-	
		5																	
		6																	
		EOB 7																	

NOTES: CAVED @ 6.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH HOLE PLUG

PROJECT: MOT-CR74-04.40	DRILLING FIRM / OPERATOR: CTL / D. MCWHERTER	DRILL RIG: CME 75 TRUCK	STATION / OFFSET: 26+51, 29' RT.	EXPLORATION ID B-002-0-21
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: CTL / M.HUGHES	HAMMER: CME AUTOMATIC	ALIGNMENT: WOODMAN DR.	
PID: 115003 SFN: N/A	DRILLING METHOD: 4.0" SFA	CALIBRATION DATE: 6/1/19	ELEVATION: 898.0 (MSL) EOB: 7.0 ft.	PAGE 1 OF 1
START: 8/16/21 END: 8/16/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.8	LAT / LONG: 39.747705, -84.120411	

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	HOLE SEALED
ASPHALT (5")	898.0																		
CONCRETE (9")	897.6																		
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, TRACE CLAY, (EX. FILL), MOIST	896.8	1	5 4 8	17	33	SS-1	-	43	19	16	12	10	20	13	7	14	A-2-4 (0)	-	
HARD, BROWN, **SILT AND CLAY**, SOME SAND, TRACE GRAVEL, (EX. FILL), DAMP	895.5	2																	
	894.5	3	15 12 11	33	100	SS-2	4.25	7	10	20	36	27	26	14	12	12	A-6a (6)	<100	
VERY STIFF, BROWNISH GRAY, **SANDY SILT**, TRACE GRAVEL, (EX. FILL), MOIST		4																	
	892.0	5	12 11 10	30	0	AS-3	-	-	-	-	-	-	-	-	-	-	A-4a (V)	-	
STIFF, BROWN AND GRAY, **SILT AND CLAY**, TRACE GRAVEL, (EX. FILL), MOIST	891.0	6	3 5 4	13	33	SS-4	1.25	-	-	-	-	-	-	-	-	20	A-6a (V)	-	
EOB		7																	

NOTES: CAVED @ 6.5'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH HOLE PLUG

PROJECT: MOT-CR74-04.40	DRILLING FIRM / OPERATOR: CTL / D. MCWHERTER	DRILL RIG: CME 75 TRUCK	STATION / OFFSET: 30+57, 6' LT.	EXPLORATION ID B-003-0-21
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: CTL / M.HUGHES	HAMMER: CME AUTOMATIC	ALIGNMENT: WOODMAN DR.	
PID: 115003 SFN: N/A	DRILLING METHOD: 4.0" SFA	CALIBRATION DATE: 6/1/19	ELEVATION: 879.5 (MSL) EOB: 7.0 ft.	PAGE 1 OF 1
START: 8/16/21 END: 8/16/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.8	LAT / LONG: 39.748830, -84.120424	

MATERIAL DESCRIPTION AND NOTES	ELEV. 879.5	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	HOLE SEALED
ASPHALT (5.5")	879.0																		
CONCRETE (9.5")	878.3																		
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (EX. FILL), DAMP	877.0	1	4 5 7	17	33	SS-1	-	45	22	14	11	8	17	14	3	14	A-1-b (0)	-	
STIFF, BROWN, **SILT AND CLAY**, SOME SAND, LITTLE GRAVEL WITH SILT SEAMS, (EX. FILL), MOIST	876.0	2	1 2 2	6	100	SS-2	1.25	15	12	15	35	23	29	14	15	17	A-6a (7)	220	
		3																	
		4	8 9 11	29	100	SS-3	2.50	-	-	-	-	-	-	-	-	13	A-6b (V)	-	
VERY STIFF, BROWN, **SILTY CLAY**, TRACE GRAVEL, WITH SILT SEAMS, (EX. FILL), DAMP @ 5.5' - HARD, MOIST	872.5	5	12 12 16	41	100	SS-4	4.50	-	-	-	-	-	-	-	-	17	A-6b (V)	-	
		EOB 6 7																	

NOTES: CAVED @ 6.0'

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH HOLE PLUG

PROJECT: MOT-CR74-04.40	DRILLING FIRM / OPERATOR: CTL / D. MCWHERTER	DRILL RIG: CME 75 TRUCK	STATION / OFFSET: 34+86, 4' LT.
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: CTL / M.HUGHES	HAMMER: CME AUTOMATIC	ALIGNMENT: WOODMAN DR.
PID: 115003 SFN: N/A	DRILLING METHOD: 4.0" SFA	CALIBRATION DATE: 6/1/19	ELEVATION: 858.5 (MSL) EOB: 7.0 ft.
START: 8/16/21 END: 8/16/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.8	LAT / LONG: 39.749987, -84.120128

EXPLORATION ID B-004-0-21

PAGE 1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV. 858.5	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	HOLE SEALED
ASPHALT (6")	858.0																		
CONCRETE (9")	857.3																		
VERY STIFF, BROWN WITH GRAY, **SANDY SILT**, SOME CLAY, LITTLE GRAVEL, (EX. FILL), DAMP	856.0	1	7 5 6	16	100	SS-1	2.25	13	13	24	30	20	18	13	5	11	A-4a (3)	200	
VERY STIFF, BROWN WITH GRAY, **SILTY CLAY**, LITTLE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, (EX. FILL), DAMP	854.5	2 3	7 4 11	22	100	SS-2	3.25	7	6	14	37	36	34	15	19	15	A-6b (11)	-	
STIFF, BROWN AND GRAY, **SILT AND CLAY**, LITTLE SAND, TRACE GRAVEL, SLIGHTLY ORGANIC, (EX. FILL), DAMP	853.0	4 5	8 8 9	25	100	SS-3	1.25	-	-	-	-	-	-	-	-	10	A-6a (V)	-	
VERY STIFF, BROWN AND GRAY, **SILTY CLAY**, TRACE GRAVEL, (EX. FILL), MOIST	EOB	6 7	8 9 10	27	33	SS-4	2.75	-	-	-	-	-	-	-	-	20	A-6b (V)	-	

NOTES: CAVED @ 6.5' : SS-2, LOI = 2.6%, SS-3, LOI = 1.5%

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH HOLE PLUG

PROJECT: MOT-CR74-04.40	DRILLING FIRM / OPERATOR: CTL / D. MCWHERTER	DRILL RIG: CME 75 TRUCK	STATION / OFFSET: 38+32, 6' LT.	EXPLORATION ID B-005-0-21
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: CTL / M.HUGHES	HAMMER: CME AUTOMATIC	ALIGNMENT: WOODMAN DR.	
PID: 115003 SFN: N/A	DRILLING METHOD: 4.0" SFA	CALIBRATION DATE: 6/1/19	ELEVATION: 848.1 (MSL) EOB: 7.0 ft.	PAGE 1 OF 1
START: 8/16/21 END: 8/16/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.8	LAT / LONG: 39.750908, -84.119914	

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	HOLE SEALED
ASPHALT (12")	848.1 847.1																		
MEDIUM DENSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND**, LITTLE SILT, TRACE CLAY, (EX. FILL), DAMP	845.6	1–2	10 8 6	20	100	SS-1	-	30	27	20	13	10	19	13	6	6	A-1-b (0)	<100	
LOOSE, BROWN, **GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT**, LITTLE CLAY, (EX. FILL), DAMP	844.6	2–3	2 2 3	7	100	SS-2	1.50	36	24	15	13	12	22	12	10	9	A-2-4 (0)	-	
MEDIUM STIFF, BROWN, **SILT AND CLAY**, TRACE GRAVEL, (EX. FILL), DAMP @ 5.5' - STIFF	841.6	4–5	1 1 2	4	33	SS-3	0.50	-	-	-	-	-	-	-	-	14	A-6a (V)	-	
STIFF, GRAY AND BLACK, **SILT AND CLAY**, TRACE SAND, TRACE GRAVEL, MODERATELY ORGANIC, MOIST	841.1	6–7 EOB	1 1 3	6	100	SS-4	1.25	-	-	-	-	-	-	-	-	21	A-6a (V)	-	

NOTES: CAVED @ 6.5' : SS-4, LOI = 4.8%

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH HOLE PLUG

PROJECT: MOT-CR74-04.40	DRILLING FIRM / OPERATOR: CTL / D. MCWHERTER	DRILL RIG: CME 75 TRUCK	STATION / OFFSET: 41+35, 5' LT.	EXPLORATION ID B-006-0-21
TYPE: SUBGRADE	SAMPLING FIRM / LOGGER: CTL / M.HUGHES	HAMMER: CME AUTOMATIC	ALIGNMENT: WOODMAN DR.	
PID: 115003 SFN: N/A	DRILLING METHOD: 4.0" SFA	CALIBRATION DATE: 6/1/19	ELEVATION: 847.7 (MSL) EOB: 7.0 ft.	PAGE 1 OF 1
START: 8/16/21 END: 8/16/21	SAMPLING METHOD: SPT	ENERGY RATIO (%): 86.8	LAT / LONG: 39.751736, -84.119871	

MATERIAL DESCRIPTION AND NOTES	ELEV. 847.7	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	HOLE SEALED
ASPHALT (11")	846.8																		
HARD, BROWNISH GRAY, **SILT AND CLAY**, LITTLE SAND, SOME GRAVEL, (EX. FILL), DAMP	844.7	1	7 5 6	16	67	SS-1	4.50	34	10	10	24	22	30	15	15	11	A-6a (4)	<100	
HARD, BROWNISH DARK GRAY, **SILTY CLAY**, SOME SAND, LITTLE GRAVEL, WITH CINDERS, (EX. FILL), DAMP	843.2	2	7 9 13	32	100	SS-2	4.50	11	9	15	33	32	38	15	23	15	A-6b (11)	-	
VERY STIFF, BLACK, **SANDY SILT**, WITH BRICK FRAGMENTS, MODERATELY ORGANIC, (EX. FILL), MOIST	842.2	3	12 11 9	29	67	SS-3	3.00	-	-	-	-	-	-	-	-	33	A-4a (V)	-	
VERY STIFF, BROWN, BLACK AND BLUE, **SILTY CLAY**, TRACE SAND, MOIST	840.7	4	10 8 8	23	100	SS-4	2.25	-	-	-	-	-	-	-	-	27	A-6b (V)	-	
	EOB	5																	
		6																	
		7																	

NOTES: CAVED @ 6.0' : SS-3, LOI = 7.3%

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS MIXED WITH HOLE PLUG

APPENDIX C

GB1 SUBGRADE ANALYSES

OHIO DEPARTMENT OF TRANSPORTATION

OFFICE OF GEOTECHNICAL ENGINEERING

PLAN SUBGRADES
Geotechnical Bulletin GB1

MOT-CR74-04.40
115003

Full depth reconstruction of approx. 2,360 ft. of Woodman Dr. (County Road 74), between US Route 35 and Eastman Ave. with the City of Riverside, Ohio

CTL Engineering, Inc.

Prepared By: F. Schoen, P.E.
Date prepared: Thursday, October 14, 2021

Frederick Schoen, P.E.
102 Commerce Drive
P.O. Box 44
Wapakoneta, OH 45895
(419) 738-1447
fschoen@ctleng.com

NO. OF BORINGS: 6

#	Boring ID	Alignment	Station	Offset	Dir	Drill Rig	ER	Boring EL.	Proposed Subgrade EL	Cut Fill
1	B-001-0-21	CL of Woodman Dr.	22+85	37	Lt	CME 75 Truck	86.8	910.2	909.0	1.2 C
2	B-002-0-21	CL of Woodman Dr.	26+51	29	Rt	CME 75 Truck	86.8	898.0	896.8	1.2 C
3	B-003-0-21	CL of Woodman Dr.	30+57	6	Lt	CME 75 Truck	86.8	879.5	878.3	1.3 C
4	B-004-0-21	CL of Woodman Dr.	34+86	4	Lt	CME 75 Truck	86.8	858.5	857.3	1.3 C
5	B-005-0-21	CL of Woodman Dr.	38+32	6	Lt	CME 75 Truck	86.8	848.1	846.9	1.3 C
6	B-006-0-21	CL of Woodman Dr.	41+35	5	Lt	CME 75 Truck	86.8	847.7	846.5	1.3 C

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

#	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	AS-1	1.0	2.5	-0.2	1.3	12		--							--	6	A-1-b	0						
	001-0	SS-2	2.5	4.0	1.3	2.8	27		2.5	31	15	16	34	29	63	16	16	A-6b	8	99					
	21	SS-3	4.0	5.5	2.8	4.3	9		1.75							18	14	A-6a	10						
		SS-4	5.5	7.0	4.3	5.8	22	9	4							11	10	A-4a	8						
2	B	SS-1	1.0	2.5	-0.2	1.3	17		--	20	13	7	12	10	22	14	10	A-2-4	0			Mc			**12"**
	002-0	SS-2	2.5	4.0	1.3	2.8	33		4.25	26	14	12	36	27	63	12	14	A-6a	6	99					**204 Geotextile**
	21	AS-3	4.0	5.5	2.8	4.3	30		--							--	10	A-4a	8						
		SS-4	5.5	7.0	4.3	5.8	13	13	1.25							20	14	A-6a	10						
3	B	SS-1	1.0	2.5	-0.3	1.3	17		--	17	14	3	11	8	19	14	6	A-1-b	0						**18"**
	003-0	SS-2	2.5	4.0	1.3	2.8	6		1.25	29	14	15	35	23	58	17	14	A-6a	7	220		HP & Mc			**204 Geotextile**
	21	SS-3	4.0	5.5	2.8	4.3	29		2.5							13	16	A-6b	16						
		SS-4	5.5	7.0	4.3	5.8	41	6	4.5							17	16	A-6b	16						
4	B	SS-1	1.0	2.5	-0.3	1.3	16		2.25	18	13	5	30	20	50	11	10	A-4a	3	200					
	004-0	SS-2	2.5	4.0	1.3	2.8	22		3.25	34	15	19	37	36	73	15	16	A-6b	11						
	21	SS-3	4.0	5.5	2.8	4.3	25		1.25							10	14	A-6a	10						
		SS-4	5.5	7.0	4.3	5.8	27	16	2.75							20	16	A-6b	16						
5	B	SS-1	1.0	2.5	-0.3	1.3	20		--	19	13	6	13	10	23	6	6	A-1-b	0	99					**24"**
	005-0	SS-2	2.5	4.0	1.3	2.8	7		1.5	22	12	10	13	12	25	9	10	A-2-4	0			HP			**204 Geotextile**
	21	SS-3	4.0	5.5	2.8	4.3	4		0.5							14	14	A-6a	10						
		SS-4	5.5	7.0	4.3	5.8	6	4	1.25							21	14	A-6a	10						
6	B	SS-1	1.0	2.5	-0.3	1.3	16		4.5	30	15	15	24	22	46	11	14	A-6a	4	99					
	006-0	SS-2	2.5	4.0	1.3	2.8	32		4.5	38	15	23	33	32	65	15	16	A-6b	11						
	21	SS-3	4.0	5.5	2.8	4.3	29		3							33	10	A-4a	8						
		SS-4	5.5	7.0	4.3	5.8	23	16	2.25							27	16	A-6b	16						

OHIO DEPARTMENT OF TRANSPORTATION

Subgrade Analysis

V. 14.5 1/18/2019

PID: 115003

County-Route-Section: MOT-CR74-04.40
No. of Borings: 6

Geotechnical Consultant: CTL Engineering, Inc.
Prepared By: F. Schoen, P.E.
Date prepared: 10/14/2021

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	7

% Samples within 6 feet of subgrade			
$N_{60} \leq 5$	4%	HP ≤ 0.5	4%
$N_{60} < 12$	21%	0.5 < HP ≤ 1	0%
$12 \leq N_{60} < 15$	8%	1 < HP ≤ 2	25%
$N_{60} \geq 20$	54%	HP > 2	50%
M+	8%		
Rock	0%		
Unsuitable	0%		

Excavate and Replace at Surface	
Average	3''
Maximum	12''
Minimum	0''

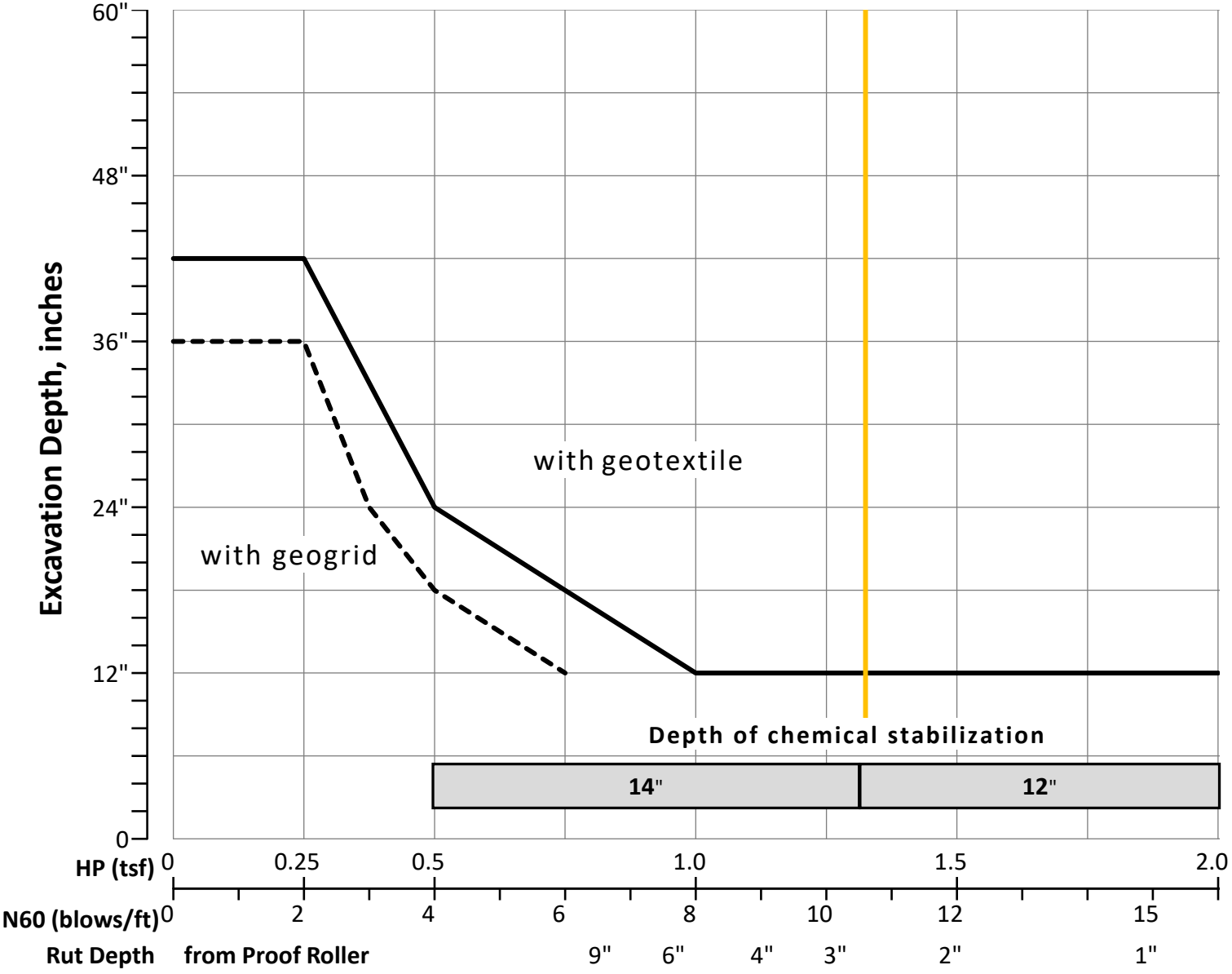
% Proposed Subgrade Surface	
Unstable & Unsuitable	19%
Unstable	19%
Unsuitable	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	20	11	2.58	26	14	12	25	21	46	16	13	8
Maximum	41	16	4.50	38	15	23	37	36	73	33	16	16
Minimum	4	4	0.50	17	12	3	11	8	19	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	0	3	2	0	0	0	0	0	4	0	0	8	7	0	0	0	0	24
Percent	0%	0%	13%	8%	0%	0%	0%	0%	0%	17%	0%	0%	33%	29%	0%	0%	0%	0%	100%
% Rock|Granular|Cohesive	0%	38%									63%								100%
Surface Class Count	0	0	3	2	0	0	0	0	0	2	0	0	5	4	0	0	0	0	16
Surface Class Percent	0%	0%	19%	13%	0%	0%	0%	0%	0%	13%	0%	0%	31%	25%	0%	0%	0%	0%	100%

GB1 Figure B – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
2.58	1.50	☐ HP
10.67	4.00	☐ N60L

Average HP
Average N_{60L}