



Subgrade Exploration Report
LUC-MR2339-0.30 Roundabout
Lucas County, Toledo, Ohio
S&ME Project No. 25780095

PREPARED FOR:

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September 16, 2026



September 16, 2026

Strand Associates, Inc.
615 Elsinore Place, Suite 320
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Attention: Mr. Jeff Heimann, P.E.
E: jeff.heimann@strand.com

Reference: **Subgrade Exploration Report**
LUC-MR2339-0.30 Roundabout
Lucas County, Toledo, Ohio
S&ME Project No. 25780095

Dear Jeff:

S&ME, Inc. (S&ME) has completed the subgrade exploration for the **LUC-MR2339-0.30 Roundabout** project in Lucas County, Ohio. The work was performed in general accordance with S&ME Proposal No. 25780095, dated May 16, 2025.

In accordance with Section 701 of the current ODOT Specifications for Geotechnical Explorations (SGE), S&ME is herewith submitting a "final" version of this report. This final report contains the information obtained from the borings, laboratory test results, as well as analyses and recommendations for the design and construction of this project. Soil Profile plan sheets are also attached with this report.

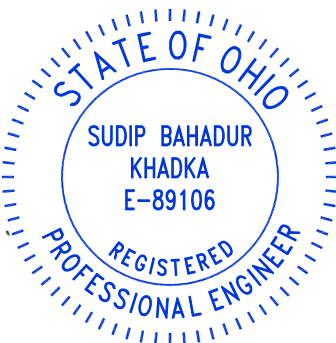
We appreciate having been given the opportunity to be of service on this project. If you require additional assistance or have any questions, please feel free to contact our office at 513-771-8471.

Sincerely,

S&ME, Inc.

A handwritten signature in blue ink, appearing to read 'Sudip B. Khadka'.

Sudip B. Khadka, P.E.
Geotechnical Service Manager



A handwritten signature in blue ink, appearing to read 'Benjamin C. Dusina'.

Benjamin C. Dusina, P.E.
Principal Engineer/Senior Reviewer

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1.0 Executive Summary

S&ME has completed the **LUC-MR2339-0.30 Roundabout** at Lucas County, Ohio. The summary provided below is based on the information provided by the client at the time of this report and our subsurface drilling operations. The information presented below is the summary intended for providing an overview of the project and site conditions. This summary cannot be used in lieu of reading the entire geotechnical report. This summary should not be considered apart from the entire text of the report with all the qualifications and considerations mentioned herein. Information related to the site is presented in the report text.

Category	Key Geotechnical Findings
Project Description	The site is currently within Washington Street, Indian Avenue, and 11th Street roundabout with family residential apartments, grass areas, and several parking lots within the immediate vicinity. There is a Lucas County Vehicle Maintenance located along the west side of Washington Street. Overhead utility lines are present throughout the project area with high traffic. Based on our reconnaissance and available aerial photographs and topographic maps, elevations within the site range from approximately 609 feet at the western end to 614 feet at the eastern edge.
Regional Geology	Based on the USDA web soil survey, the near-surface soil type at the project site is Urban Land (100%). According to the Ohio Geology Interactive Map maintained by Ohio Department of Natural Resources (ODNR), the overburden soils at the site consist of Lacustrine sand of Late Wisconsinan period with average thickness of 190 feet. Based on ODNR, the predominant bedrock on the site consists of olive gray to yellowish brown Tymochtee Dolomite from the Silurian age with bedrock thickness ranging from 0 to 140 feet. A portion of the site consists of olive gray to yellow brown Greenfield Dolomite of Silurian age with average bedrock thickness ranging from 0 to 80 feet. Bedrock was not encountered during this exploration to a maximum depth of 7.5 feet.
Subsurface Conditions	Five (5) Standard Penetration Test (SPT) borings were drilled at the site. Below asphalt pavement and topsoil, fill soils consisting of A-3a was encountered in B-001-0-25. Below surface cover and fill, soils consisting of A-3a, A-4a, A-4b, A-6a, A-7-6 and A-2-4 were encountered in boring locations to a planned depth of 7.0 to 7.5 feet below existing grade. A general summary of subsurface conditions encountered in our borings and recorded groundwater depths are summarized in Section 4.1.
Pavements	An estimated California Bearing Ratio (CBR) value of 7 percent with resilient modulus (M_R) of 8,400 psi can be used for preliminary design of pavements. If global chemical subgrade stabilization is considered, the M_R can be increased by a factor of 1.36 with factored M_R of 11,424 psi can be used for the design. All borrow materials used for this project shall have or meet the provided CBR value.



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- Vicinity Map
- Geotechnical Exploration Plan
- Pavement Core Locations

Appendix II – Additional Tables

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2.0 Introduction

S&ME has completed the Subgrade Exploration for the **LUC-MR2339-0.30 Roundabout** project in Lucas County, Ohio. The work was performed in general accordance with S&ME Proposal No. 25780095, dated May 16, 2025. The purpose of our subgrade exploration was to explore subsurface conditions and to provide analyses and recommendations for the design and construction of this project. This report describes our understanding of the project, presents the results of field exploration and laboratory testing, and provides our recommendations.

S&ME understands that this exploration program is to be performed for this project in accordance with the July 2025 update to the ODOT [Specifications for Geotechnical Explorations \(SGE\)](#).

2.1 Project and Site Information

The project details were provided by Mr. Jeff Heimann, P.E., from Strand Associates, Inc. (Strand). Based on his information and guidance, we understand that this project involves improvement of Washington Street from 17th Street to Summit Street, including the roundabout with Indiana Avenue and 11th Street. The new five (5) legged roundabout consists of curbs and concrete splitter islands. The site is currently within Washington Street, Indian Avenue, and 11th Street roundabout with family residential apartments, grass areas, and several parking lots within the immediate vicinity. There is a Lucas County Vehicle Maintenance facility located along the west side of Washington Street.

The project information and considerations detailed above should be reviewed and confirmed by the appropriate team members. Modifications to our recommendations may be required if the actual conditions vary from the project information and considerations described herein.

2.2 Geology and Observations of the Project

Based on the USDA web soil survey, the near-surface soil type at the project site is Urban Land (100%).

According to the Ohio Geology Interactive Map maintained by Ohio Department of Natural Resources (ODNR), the overburden soils at the site consist of Lacustrine sand of Late Wisconsinan period with average thickness of 190 feet. Based on ODNR, the predominant bedrock on the site consists of olive gray to yellowish brown Tymochtee Dolomite from the Silurian age with bedrock thickness ranging from 0 to 140 feet. A portion of the site consists of olive gray to yellow brown Greenfield Dolomite of Silurian age with average bedrock thickness ranging from 0 to 80 feet. Bedrock was not encountered during this exploration to a maximum depth of 7.5 feet.

2.3 Review of Regional Karst Sinkholes and Depressions

Our review of the available Karst records maintained by ODNR Division of Geological survey indicates that there are no Karsts sinkholes and depression available within 10 miles of the project site.

2.4 Review of Regional Mining Activities

Our review of the available mine records maintained by the ODNR Division of Geological survey indicates that there are no mines available within the immediate vicinity of the project site. The nearest Industrial Minerals-Surface Mine with ID: IM 2116 is located approximately 4.7 miles northeast of the site. Another Industrial Minerals-Surface Mine for topsoil and sand with ID: IM 2407 is located approximately 5.0 miles southwest of the project site. Few other Industrial Minerals-Surface Mine are located within the 10 miles radius of the project site. Figure 2-1 below illustrates the regional mining activities near the project site.

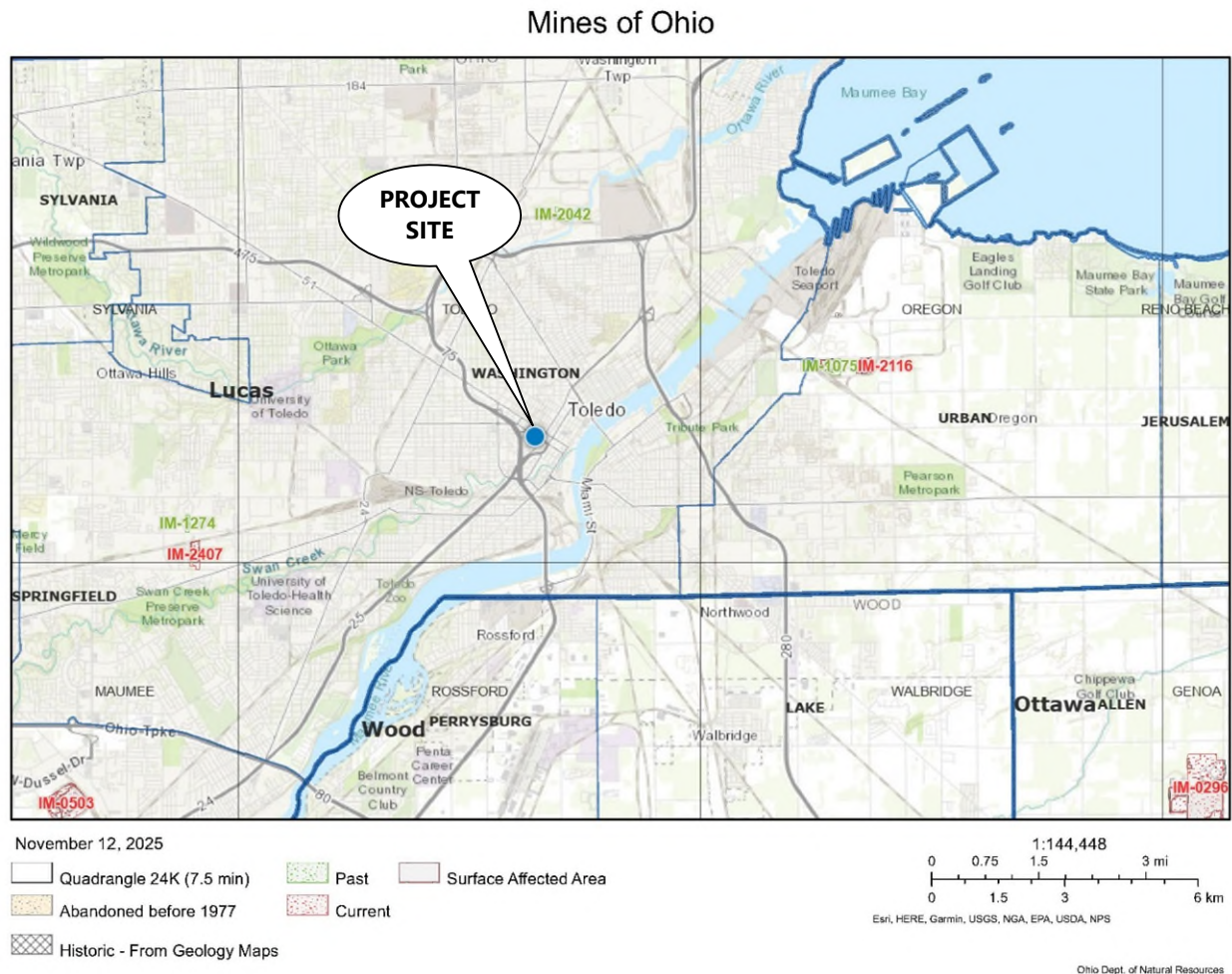


Figure 2-1 – Regional Mining Activities

2.5 Review of Oil and Gas Wells

Our review of the available Ohio Oil and Gas Wells maintained by ODNR Division of Oil and Gas indicates that there are no oil and gas wells available within the immediate vicinity of the project site. The nearest active Storage Wells: 34095200520000, 34095200530000, 34095200550000, and 34095200560000 are located approximately 4.6 miles northeast of the project site location.

3.0 Exploration

3.1 Available Information

S&ME performed a site reconnaissance of the project site to observe current site conditions, look for potential utility conflicts, select and mark boring locations. The site is currently within Washington Street, Indian Avenue, and 11th Street roundabout with family residential apartments, grass areas, and several parking lots within the immediate vicinity. There is a Lucas County Vehicle Maintenance facility located along the west side of Washington Street. Overhead utility lines are present throughout the project area with high traffic. Based on our reconnaissance and available aerial photographs and topographic maps, elevations within the site range from approximately 605 feet at the western end to 611 feet at the eastern edge. Figure 2-2 shows the site map outlined in red. No historic boring information was available through the ODOT TIMS site.



Figure 3-1 – Site Map

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The procedures used by S&ME for field and laboratory sampling and testing are in general accordance with ODOT procedures and established engineering practice. Appendix II contains brief descriptions of the procedures used in this exploration.

3.2 Field Exploration

Five (5) subgrade soil test borings and six (6) pavement cores were performed on this site for this geotechnical exploration. Additional six (6) pavement cores were performed in August 2026. The boring locations were staked on site by using the handheld GPS. The test locations were staked in the field prior to our field exploration by S&ME personnel. The subgrade borings were generally spaced at 400-foot intervals per ODOT SGE. Reported top of boring elevations and location coordinates were obtained from Google Earth™. Soil test borings for this project were extended to depths of 0.6 feet to 7.5 feet below the existing ground surface.

The borings were performed using S&ME D-50 track drill rig utilizing 3¼-inch hollow stem augers. Soil samples were obtained using a split-barrel sampler driven by an automatic hammer system in general accordance with ASTM D1586. Split-barrel samples were examined immediately after recovery and representative portions of each sample were placed in air-tight containers and retained for subsequent laboratory testing. Shelby tubes and rock cores were not collected for this project. Existing pavement thickness was measured from the side of borehole within the borings and provided on the logs. Six (6) pavement cores performed along Washington Street were utilized to obtain existing pavement thickness and provided in Table 4-2 on the following page. A general description of our field procedures, a test boring log legend, and boring logs are provided in Appendix II of this report. The stratification lines shown on the Boring Logs represent the approximate boundaries between soil types. The actual transitions may be more gradual than shown. Boring coordinates and elevations are summarized in Table 4-1. The approximate locations of the borings are shown on the Boring Location Plans (Figure 2) in Appendix I.

Table 4-1 – Boring Coordinate Summary

Boring No.	Northing (ft)	Easting (ft)	Surface Elevation (ft)	Topsoil/Asphalt Thickness (in)	Termination Depth (ft)
B-001-0-25	346629.8	192522.4	609.0	8.0 (Topsoil)	7.0
B-002-0-25	346504.0	192717.2	609.6	8.0 (Topsoil)	7.0
B-003-0-25	346429.4	192994.2	610.8	12.0 (Asphalt)	7.0
B-003-1-25	346428.6	192995.5	610.9	7.0 (Asphalt)	0.6 ²
B-003-2-25	346430.3	192993.0	610.9	8.0 (Asphalt)	0.7 ²
B-004-0-25	346459.6	192435.5	605.4	14.0 (Asphalt)	7.5
B-005-0-25	346573.3	192841.8	609.3	12.0 (Asphalt)	7.0
B-005-1-25	346573.6	192843.5	609.3	14.0 (Asphalt)	1.2 ²
B-005-2-25	346572.6	192840.5	609.4	12.0 (Asphalt)	1.0 ²

Note:

1. Coordinates and surface elevations were obtained from survey performed by Strand.
2. Auger refusal encountered.

Table 4-2 – Pavement Core Coordinate Summary

Boring No.	Latitude (°)	Longitude (°)	Surface Elevation (ft)	Asphalt Thickness (in)	Concrete Thickness (in)
X-001-0-25	41.650886	-83.545576	608	7.0	7.0
X-002-0-25	41.650794	-83.545160	609	9.5	-
X-003-0-24	41.650604	-83.544979	609	7.0	-
X-004-0-25	41.650502	-83.544526	610	14.0	-
X-005-0-25	41.650311	-83.544374	610	7.0	7.0
X-006-0-25	41.650155	-83.544029	611	6.0	6.0
X-006-0-26	41.652600	-83.549017	609	6.5/1.25	4.25
X-007-0-26	41.651626	-83.546884	604	8.0	-
X-008-0-26	41.651005	-83.545678	608	6.0	3.0
X-009-0-26	41.649546	-83.542649	611	13.25	-
X-010-0-26	41.648197	-83.539674	584	5.25	-
X-011-0-26	41.647160	-83.537505	582	5.0	6.5

Note:

- Latitude, Longitude and surface elevations were obtained from Google Earth™.

3.3 Laboratory Testing

Following retrieval, the recovered soil samples were preserved in airtight containers. In the laboratory, all soil samples were visually identified by geotechnical engineer and representative samples were tested for natural moisture content. Classification testing (liquid/plastic limit determinations and grain-size analyses) was performed on selected representative samples retrieved from the borings. One (1) sample from each boring was tested for Sulfate content for this project. The results of the laboratory index tests are recorded numerically on individual boring logs and the results of the strength tests are presented in Appendix II. The general summary of the lab tests performed are presented in Table 4-2 below.

Table 4-2 – Summary of Laboratory Tests on Soil

Boring No.	Sample Depth (ft)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Coarse (%)	Fines (%)	Organic Matter (%)	Soil Type (Group Index)
B-001-0-25	1.0-2.5	3	NP	NP	NP	72	28	1.5	A-3a (0)
B-001-0-25	2.5-4.0	21	34	20	14	53	47	-	A-6a (10)
B-001-0-25	5.5-7.0	24	31	19	12	-	-	-	A-6a (V)
B-002-0-25	1.0-2.5	4	NP	NP	NP	74	26	-	A-3a (0)
B-002-0-25	2.5-4.0	6	NP	NP	NP	79	21	-	A-3a (0)
B-003-0-25	2.5-4.0	22	27	18	9	6	94	-	A-4a (8)

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Boring No.	Sample Depth (ft)	Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Coarse (%)	Fines (%)	Organic Matter (%)	Soil Type (Group Index)
B-003-0-25	4.0-5.5	20	26	16	9	20	80	-	A-4a (8)
B-004-0-25	3.0-4.5	6	NP	NP	NP	78	22	0.2	A-2-4 (0)
B-004-0-25	4.5-6.0	5	14	10	4	68	32	-	A-2-4 (0)
B-005-0-25	2.5-4.0	21	27	16	11	9	91	-	A-6a (8)
B-005-0-25	4.0-5.5	22	27	18	9	7	93	-	A-6a (8)

Based on the results of the laboratory testing program, the field logs were modified, as necessary, and copies of the laboratory corrected boring logs are presented in Appendix II. Shown on these logs are: descriptions of the soil stratigraphy encountered; depths from which samples were preserved; sampling efforts (blow-counts) required to obtain the specimens in the borings; laboratory testing results; seepage and groundwater observations made at the time of drilling; and, values of hand-penetrometer measurements made in soil samples exhibiting cohesion. For your reference, hand-penetrometer values are roughly equivalent to the unconfined compressive strength of the cohesive fraction of the soil sample. An explanation of the symbols and terms used on the boring logs, definitions of the special adjectives used to denote the minor soil components, and information pertaining to sampling and identification are presented in Appendix II.

4.0 Findings

The following is a generalized description of the subsurface conditions. The stratification of the soil, as shown on the Boring Logs in Appendix II, represents the conditions at the actual boring locations. Lines of demarcation represent the approximate boundary between the soil types, but the transition may be gradual or not clearly defined.

4.1 General Subsurface Profile

Each of the borings were drilled through the asphalt pavement. The subsurface conditions were consistent with the published geological mapping information. Table 5-1 on the following page provides the generalized subsurface conditions of the soils encountered.

Table 4-1 – Boring Location Summary

Depth (ft.)	Group	Description ⁽¹⁾	Range of SPT N-Values (blows per foot)
0.0-3.0	Surface cover	8-inches of topsoil or 12 to 14-inches of asphalt or 18 to 22-inches of concrete	--
0.7-2.5	A	Fill: medium dense, brown, Coarse and Fine Sand (A-3a), contains ceramic plate pieces, moist <i>(only encountered in B-001-0-25)</i>	9
2.5-7.5	B	medium stiff to hard, brown to gray to dark gray, Silt and Clay (A-6a), Sandy Silt (A-4a), Clay (A-7-6), moist <i>(not encountered in B-004-0-25)</i>	7-50/1"
0.7-7.0	C	loose to dense, brown to gray, Coarse and Fine sand (A-3a), Silt (A-4b), Sandy Silt (A-4a), Gravel and/or Stone Fragments with Sand and Silt (A-2-4), dry to moist <i>(not encountered in B-003-0-25 and B-005-0-25)</i>	7-35

Note:

1. This is a generalized summary and may not accurately depict the actual conditions encountered in the test borings. These groups may not be encountered at each boring location.

4.2 Groundwater Observations

Seepage and groundwater observations were made during drilling operations and following the removal of tooling from the borings. Groundwater at boring B-002-0-25 was encountered at 6.5 feet below the ground surface during drilling and was "dry" at the end of the drilling. However, no groundwater was observed during and following the removal of tooling from rest of the borings, so they are indicated as "dry".

Fluctuations in the level of the groundwater table (or saturated soils/perched water levels) will occur due to seasonal variances in rainfall, drainage, types of soils present and other factors. We caution that groundwater can be perched at various elevations above the general static groundwater level after periods of rainfall, especially in the lower elevations and natural drainage paths of the site.

For further details of subsurface conditions encountered, refer to the individual Boring Logs presented in Appendix II. The stratum lines shown on the boring logs should be considered approximate.

5.0 Analyses and Recommendations

5.1 Pavement Subgrade Support Parameters

5.1.1 ODOT Subgrade Analysis

Section 600 of the ODOT *GDM* provides a standard approach to performing explorations and assessing roadway subgrades. The associated spreadsheet (*Roadway-Subgrade-Analysis*, Ver. 14.81, updated 07/21/2025) created by the ODOT Office of Geotechnical Engineering (OGE) is used to estimate roadway subgrade support parameters and identify areas requiring remediation. The spreadsheet (see Appendix IV) summarizes the soil type (by ODOT/HRB classification), group indices, depth, blow-counts, Atterberg Limit, and sulfate content values of the proposed subgrade soils encountered in the borings drilled for this project. Using this data, this spreadsheet computes an average of the estimated values of the California Bearing Ratio (CBR) for the soils encountered at or below the anticipated subgrade level of the proposed roadway profile.

The ODOT Subgrade Analysis spreadsheet also identifies subgrade soils which are “unsuitable” either by classification (A-4b, A-2-5, A-5, A-7-5, A-8a, A-8b) or if the Liquid Limit value is greater than 65%. The spreadsheet also determines if a subgrade soil may be potentially “unstable” and possibly require subgrade remediation by comparing the lab-measured moisture content to the estimated optimum moisture content of the subgrade soil, and/or by comparing the normalized blow-count (N_{60}) and the lowest N value (N_{60L}) from SPT sampling.

Based on these comparisons and correlations, the Subgrade Analysis spreadsheet provides alternative approaches to remediate and establish a stable soil subgrade using either “excavate and replace” (ODOT *Construction and Material Specifications* (CMS) Item 204) or chemical stabilization (CMS Item 206 and Supplement 1120). However, soils with a sulfate content above 5,000 ppm are generally prohibited from being chemically stabilized.

The subgrade remediation depths identified by the Subgrade Analysis spreadsheet presented in Appendix IV are based on the conditions encountered in the borings during this subsurface investigation. However, because the required amount of remediation is dependent on the moisture content of the subgrade soil at the time of construction, Section 600 of the ODOT *GDM* states that the ultimate decision on required remediation depths and limits should be based on observations during either proof-rolling or test-rolling operations.

5.1.2 Subgrade Support Parameters

Appendix IV in this report consists of ODOT Roadway Subgrade Analysis spreadsheet (*Roadway-Subgrade-Analysis*, Ver. 14.81, updated 07/21/2025) created by the ODOT OGE to summarize the soil type, group indices, depth, blow-counts, and Atterberg Limit values of the proposed subgrade soils encountered in the borings drilled for this project. This table also computes an average of the estimated values of the California Bearing Ratio (CBR) for the soils encountered at or below the anticipated subgrade level of the proposed roadway profile.

Based on the provided plan and profile, the following average California Bearing Ratio (CBR) is computed by the ODOT GB1 spreadsheet for the anticipated subgrade soils encountered in the borings along the entire project length:

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$$\text{CBR} = 7\%$$

Based on this average value and Section 203.1 of the current ODOT Pavement Design Manual, the following value of Resilient Modulus (MR) correlates to this average CBR value.

$$\text{MR} = 8,400 \text{ psi}$$

These subgrade support values may be used new flexible pavement thickness design on this project provided that the entire proposed pavement subgrade is prepared in strict accordance with Item 204 of the ODOT CMS, and that all borrow soil placed within 3 feet of the final subgrade level of a new embankment provides average subgrade support parameters which meet or exceed the above values. This subgrade evaluation also assumes that the existing subgrade soils in "at-grade" or "cut" areas are composed of the materials encountered in the borings. If, at the time of construction, it is determined that the subgrade consists of materials different than those encountered in the borings, the pavement design subgrade criteria should be reviewed and, if necessary, modified.

However, in the event that ODOT desires a global chemical subgrade stabilization program be performed for this project, Section 203.4.1 of the ODOT GDM states when the entire subgrade is chemically stabilized, the resilient modulus of the subgrade soil may be increased by a factor of 1.36. This increase in the design Resilient Modulus value would enable ODOT to use a thinner pavement section to carry the same volume of traffic. Therefore, provided a **global** chemical subgrade stabilization program is implemented, and that borrow soil within 3 feet of the proposed subgrade has an average CBR value no less than 6%, the following value of Resilient Modulus (M_{R-GCS}) may be considered for use during replacement pavement design:

$$M_{R-GCS} = 11,424 \text{ psi}$$

Additional discussions and recommendations pertaining to an "if desired" chemical subgrade remediation program are presented in Section 5.2.5 of this report.

5.1.3 Unsuitable Soils

None of the borings during this exploration encountered soils considered unsuitable by classification (A-2-5, A-4b, A-5, A-7-5, and A-8) at or near the anticipated proposed subgrade.

Because of the variable nature of the wide spacing of the explorations, it is possible that other areas of unsuitable organic, elastic, or silt materials that were not encountered in most of the borings may be encountered during earthwork and proof rolling operations. Visual observation of the proof rolling procedures by the Geotechnical Engineer of Record may potentially result in a reduction of over-excavation of unsuitable soils in these areas. Additionally, S&ME recommends that construction traffic be minimized or restricted once the planned soil subgrade level has been exposed or attained.

5.1.4 ODOT Roadway Subgrade Analysis

ODOT's Roadway Subgrade Analysis indicates that a comparison of the laboratory-measured moisture content to the estimated optimum moisture content of the subgrade soil, along with the normalized blow-count (N_{60}) from

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SPT sampling, may be used as an indicator of the potential need for subgrade treatment or remediation of unstable subgrade soil. The acceptable options presented by spreadsheet to remediate and establish a stable soil subgrade are either to “excavate and replace”, or chemical stabilization.

The ODOT Roadway Subgrade Analysis Spreadsheet, included in Appendix IV, summarizes the laboratory-measured moisture content of the samples obtained from each boring with respect to their estimated optimum moisture contents, along with the lowest N value (N_{60L}) obtained from the Standard Penetration Tests performed in each of these borings. This table also indicates the recommended Item 204 “excavate and replace” depths per ODOT Roadway Subgrade Analysis Spreadsheet for problematic soil or over-excavation depths for unsuitable soils at each boring location, and an assessment of the suitability of the subgrade soils at each boring for chemical stabilization.

The results of the ODOT Roadway Subgrade Analysis Spreadsheet (see Appendix IV) indicate that soils encountered at or near the anticipated subgrade level in two (2) (B-003-0-25 and B-005-0-25) of the five (5) subgrade borings possessed characteristics defined as problematic (excessive soil moisture content, low N_{60} value or low hand penetrometer value). Typical options for subgrade remediation per ODOT Roadway Subgrade Analysis Spreadsheet include Item 204 “excavate and replace”, either with or without geogrid, or chemical stabilization. According to the ODOT Roadway Subgrade Analysis Spreadsheet, where 30% or more of the subgrade area must be stabilized, then consideration should be given to stabilizing the entire project where new pavement is proposed (global stabilization).

However, S&ME anticipates that chemical stabilization may not be desirable, cost effective, or physically practical for this project based on the project length and numerous underground utilities in the vicinity. As such, S&ME recommends that 12 inches of “Excavate and Replace” subgrade remediation be planned as described in the following section of this project.

5.1.5 “Excavate and Replace” Subgrade Remediation

Based on the results of the ODOT Roadway Subgrade Analysis Spreadsheet, an ODOT CMS Item 204 “excavate and replace” remediation approach, is recommended to remediate unstable areas of exposed subgrade beneath the new pavement.

The lateral limits of the subgrade remediation should extend to at least 18 inches outside the outside edge of the proposed widened pavement or paved shoulder, including beneath any curbs and gutters.

The estimated subgrade remediation depths are based on conditions encountered in the borings during this subsurface investigation. However, because the required amount of remediation is dependent on the moisture content of the subgrade soil at the time of construction, the GDM states that the ultimate decision on required remediation depths and limits should be based on observations during proof rolling operations.

5.1.6 Additional Subgrade Remediation Considerations

In accordance with the GDM, where “excavate and replace” is used for subgrade remediation, Item 712.09 Geotextile Fabric Type D is to be placed at the bottom of the undercuts, and Item 204 Granular Material is to be used to backfill the over-excavation. S&ME recommends that Item 204 Granular Material, Type B or C be utilized.

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It should be noted, however, that GDM specifies that Item 204 Granular Material Type B without a geotextile fabric be utilized to backfill undercuts performed in the vicinity of any underdrains. It is also recommended that over-excavated subgrade areas backfilled with granular soil be drained to an underdrain, catch basin, or pipe.

Because of the moisture sensitive nature of the cohesive soils (A-6a, A-6b, A-7-6), when encountered during construction, S&ME recommends construction traffic be minimized once the required subgrade level has been attained. Construction traffic resulting from cyclical haul routes or limited access points may increase the quantity of soil identified by proof rolling as requiring removal, particularly during periods of moist weather.

5.1.7 Borrow Requirements and Compaction Criteria

Six (6) pavement cores performed along Washington Street at the project site consisted of existing pavement (Asphalt and Concrete) in thickness ranging from 7 inches to 14 inches. Subgrade borings B-003-0-25 through B-005-0-25 encountered asphalt, concrete and/or sub-base materials with thickness ranging from 30 inches to 36 inches. Before commencing earthwork operations, it is recommended that all existing pavement, granular base, grass, topsoil, vegetation, and other miscellaneous materials be completely removed from the entire footprint of the proposed roadway subgrade. Following the removal of these materials, it is recommended that the entire exposed subgrade and embankment foundation surface be examined by the Geotechnical Engineer of Record or their designated representative to identify any weak, wet, organic, or otherwise unsuitable soils that were not encountered during the subsurface exploration, especially in widened areas. Any such materials identified should be removed and replaced with suitable compacted fill (Item 203, or Item 204 when within 12 inches of the proposed subgrade).

Existing underground utility lines are present beneath and adjacent to the existing roadway, and the type of material used and the relative compactness of backfill within any such utility trenches are unknown. S&ME recommends any planned utility relocation be performed prior to proofrolling. Some instability of utility trench backfill may occur during earthwork operations and/or proofrolling, and some recompaction of granular utility trench backfill may become necessary. Additionally, if water has accumulated within the utility backfill, the subgrade soil in the vicinity of any saturated utility trenches may have become sufficiently weak, soft, and/or wet that proofrolling may identify these additional areas as requiring overexcavation and replacement. In any case, care should be taken not to disturb any shallow utilities during proofrolling or overexcavation activities.

Soil used as borrow for this project should consist of inorganic soil free of all miscellaneous materials, cobbles, and boulders, which is placed in uniform, thin layers and then compacted in accordance with either ODOT CMS Item 203 or when within 12 inches of the proposed subgrade level, CMS Item 204. Borrow materials should not be placed in a frozen condition or upon a frozen surface.

Any borrow materials to be used as new fill or backfill within 3 feet of the proposed subgrade level should be tested in the laboratory to determine that the borrow materials are capable of exhibiting subgrade support characteristics that are no less than the CBR value used during the pavement design.

If a chemical stabilization program is implemented, all soil placed as borrow within 2 feet of the proposed pavement subgrade elevation must be tested in the laboratory to determine that the Plasticity Index of the borrow soil is less than 20.

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During recompaction, the moisture content of the subgrade soil should be maintained or adjusted in accordance with ODOT CMS Item 203.07.A. Compaction requirements are based on ODOT CMS Item 203.07.B which specifies a minimum percent compaction based on the dry unit weight of the type of soil fill being placed as borrow. S&ME recommends that once the source of borrow for this project is determined, sampling and testing of this borrow material be performed prior to construction to verify that the borrow soils are suitable for the planned construction.

5.2 Groundwater Considerations for Roadway Subgrade

Based upon observations made at the time of this investigation, significant groundwater problems are not anticipated in connection with the proposed roundabout construction. The new roundabout subgrade should be graded to prevent surface runoff from pooling on the cohesive soils during construction as exposure of cohesive soils to moisture will result in a decrease in strength and an increase in compressibility. Soil softened by standing water or disturbed by construction activities should be removed before proceeding with construction.

In addition to proper subgrade preparation, we recommend that the pavement construction include surface and subsurface drainage measures. Water which infiltrates the pavement and remains trapped within the pavement components during traffic loading is one of the leading causes of premature pavement failure. Effective design measures include the use of perforated underdrain pipes or finger drains below pavements and/or the use of perimeter swales, perimeter edge drains, curbs, or a combination of these features to collect surface water runoff from areas adjacent to the pavement. Cohesive subgrade soils should be crowned or sloped to promote drainage of infiltrating water towards subsurface drainage collection systems.

The contractor should make provisions to direct water away from the excavations during construction via site grading, drainage ditches, sump pits, etc. Water should never be allowed to pond in or around the excavations.

6.0 Limitations of Report

This report has been prepared in accordance with generally accepted geotechnical engineering practice for specific application to this project. The conclusions and recommendations contained in this report are based upon applicable standards of our practice in this geographic area at the time this report was prepared. No other representation or warranty, either express or implied, is made.

We relied on project information given to us to develop our conclusions and recommendations. If the project information described in this report is not accurate, or if it changes during project development, we should be notified of the changes so that we can modify our recommendations based on this additional information if necessary.

Our conclusions and recommendations are based on limited data from a field exploration program. Subsurface conditions can vary widely between explored areas. Some variations may not become evident until construction. If conditions are encountered which appear different than those described in our report, we should be notified. This report should not be construed to represent subsurface conditions for the entire site.

Unless specifically noted otherwise, our field exploration program did not include an assessment of regulatory compliance, environmental conditions or pollutants or presence of any biological materials (mold, fungi, bacteria).

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If there is a concern about these items, other studies should be performed. S&ME can provide a proposal and perform these services if requested.

S&ME should be retained to review the final plans and specifications to confirm that earthwork, and other recommendations are properly interpreted and implemented.

For more information on the use and limitations of this report, please read the Geoprofessional Business Association (GBA) document that follows this page.



Appendices



Appendix I – Additional Figures

Geotechnical Engineering Report Information
Vicinity Map
Geotechnical Exploration Plan
Pavement Core Locations



Important Information About Your Geotechnical Engineering Report

Variations in subsurface conditions can be a principal cause of construction delays, cost overruns and claims. The following information is provided to assist you in understanding and managing the risk of these variations.

Geotechnical Findings Are Professional Opinions

Geotechnical engineers cannot specify material properties as other design engineers do. Geotechnical material properties have a far broader range on a given site than any manufactured construction material, and some geotechnical material properties may change over time because of exposure to air and water, or human activity.

Site exploration identifies subsurface conditions at the time of exploration and only at the points where subsurface tests are performed or samples obtained. Geotechnical engineers review field and laboratory data and then apply their judgment to render professional opinions about site subsurface conditions. Their recommendations rely upon these professional opinions. Variations in the vertical and lateral extent of subsurface materials may be encountered during construction that significantly impact construction schedules, methods and material volumes. While higher levels of subsurface exploration can mitigate the risk of encountering unanticipated subsurface conditions, no level of subsurface exploration can eliminate this risk.

Scope of Geotechnical Services

Professional geotechnical engineering judgment is required to develop a geotechnical exploration scope to obtain information necessary to support design and construction. A number of unique project factors are considered in developing the scope of geotechnical services, such as the exploration objective; the location, type, size and weight of the proposed structure; proposed site grades and improvements; the construction schedule and sequence; and the site geology.

Geotechnical engineers apply their experience with construction methods, subsurface conditions and exploration methods to develop the exploration scope. The scope of each exploration is unique based on available project and site information. Incomplete project information or constraints on the scope of exploration increases the risk of variations in subsurface conditions not being identified and addressed in the geotechnical report.

Services Are Performed for Specific Projects

Because the scope of each geotechnical exploration is unique, each geotechnical report is unique. Subsurface conditions are explored and recommendations are made for a specific project.

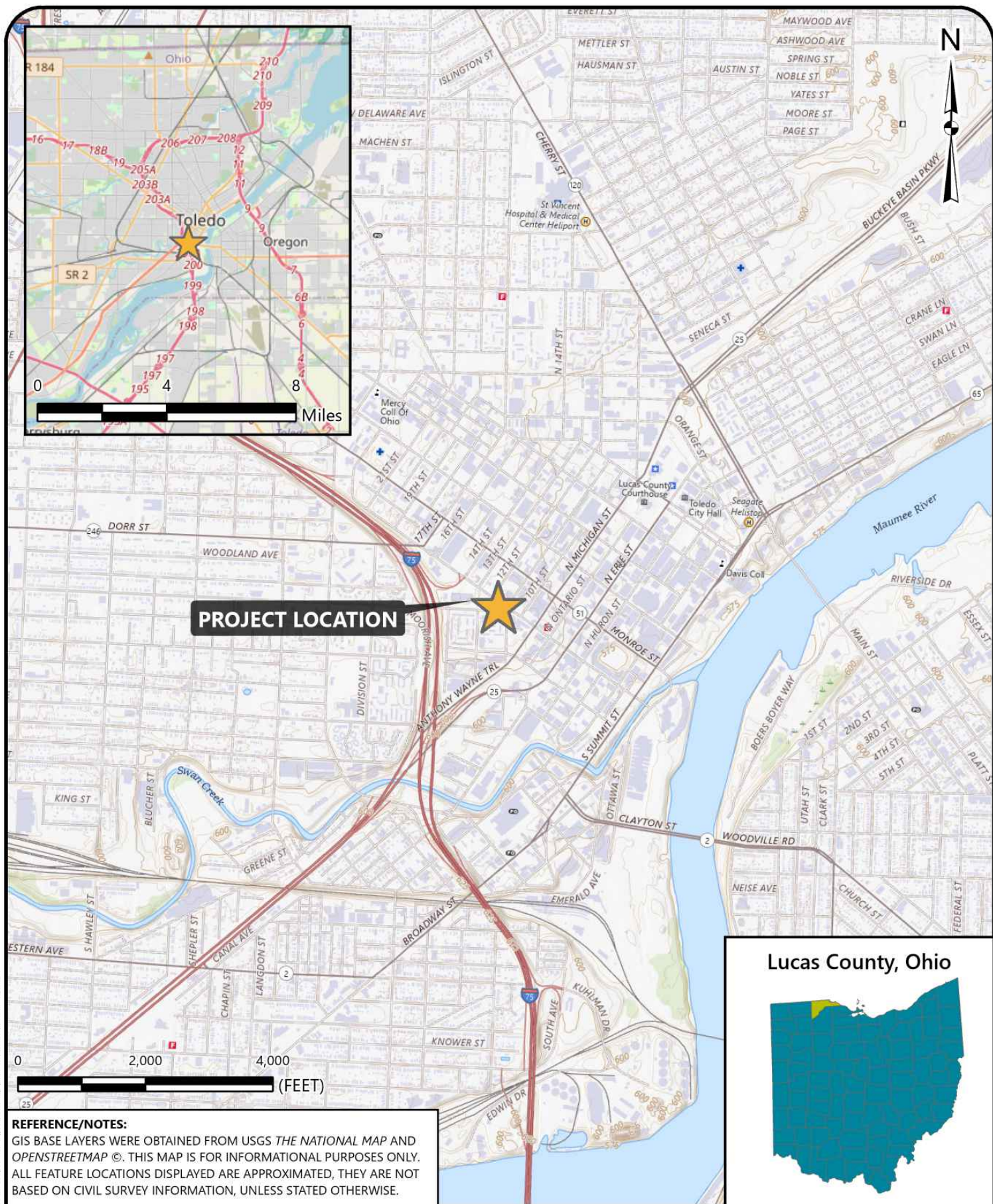
Subsurface information and recommendations may not be adequate for other uses. Changes in a proposed structure location, foundation loads, grades, schedule, etc. may require additional geotechnical exploration, analyses, and consultation. The geotechnical engineer should be consulted to determine if additional services are required in response to changes in proposed construction, location, loads, grades, schedule, etc.

Geo-Environmental Issues

The equipment, techniques, and personnel used to perform a geo-environmental study differ significantly from those used for a geotechnical exploration. Indications of environmental contamination may be encountered incidental to performance of a geotechnical exploration but go unrecognized. Determination of the presence, type or extent of environmental contamination is beyond the scope of a geotechnical exploration.

Geotechnical Recommendations Are Not Final

Recommendations are developed based on the geotechnical engineer's understanding of the proposed construction and professional opinion of site subsurface conditions. Observations and tests must be performed during construction to confirm subsurface conditions exposed by construction excavations are consistent with those assumed in development of recommendations. It is advisable to retain the geotechnical engineer that performed the exploration and developed the geotechnical recommendations to conduct tests and observations during construction. This may reduce the risk that variations in subsurface conditions will not be addressed as recommended in the geotechnical report.



PROJECT LOCATION

Lucas County, Ohio



REFERENCE/NOTES:

GIS BASE LAYERS WERE OBTAINED FROM USGS THE NATIONAL MAP AND OPENSTREETMAP ©. THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED, THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.

VICINITY MAP

LUC-MR2339-0.30
LUCAS COUNTY, TOLEDO, OHIO

SCALE:
1" = 2,000'

DATE:
12/2/2025

PROJECT NUMBER
25780095

FIGURE NO.

1

Drawing Path: plotted by jschneider 12-03-2025>



GEOTECHNICAL EXPLORATION PLAN

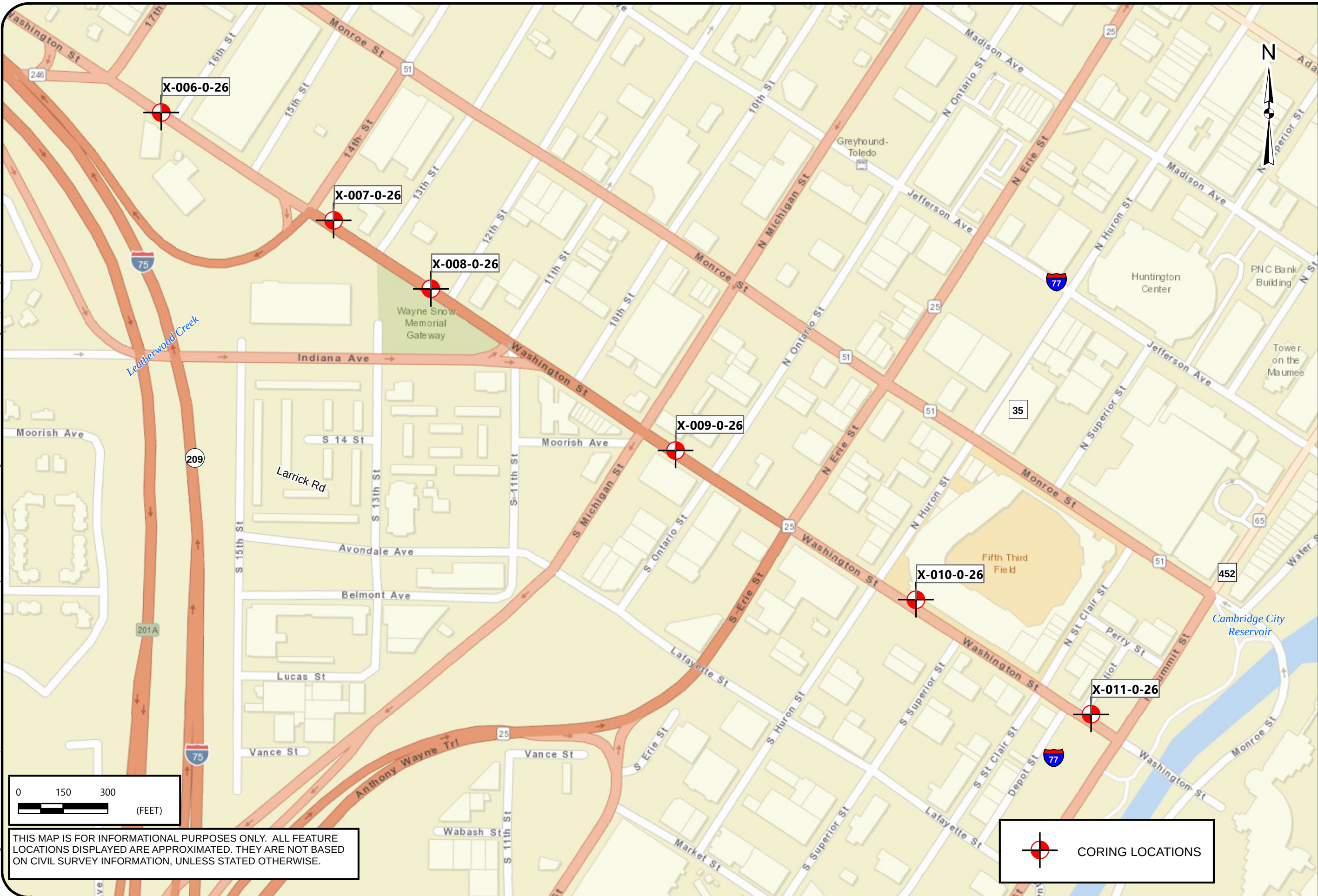
LUC-MR2339-0.30
LUCAS COUNTY, TOLEDO, OHIO

SCALE:
1" = 100'
DATE:
12/3/2025
PROJECT NUMBER
25780095

FIGURE NO.

2

Drawing Path: T:\Cincinnati\1178\Proposals\25780095_Strand\LUC-MR2339-030\Layout\2026-08-14_Cores_LGH\Coring Location Plan\LUC-MR2339-030_Coring.mxd plotted by Haydu 09-15-2026



THIS MAP IS FOR INFORMATIONAL PURPOSES ONLY. ALL FEATURE LOCATIONS DISPLAYED ARE APPROXIMATED. THEY ARE NOT BASED ON CIVIL SURVEY INFORMATION, UNLESS STATED OTHERWISE.



CORING LOCATION PLAN

LUC-MR2339-0.30 ROUNDABOUT
TOLEDO, LUCAS COUNTY, OHIO

SCALE:
1" = 300'

DATE:
9-15-26

PROJECT NUMBER
25780095

FIGURE NO.

3



CORING LOCATIONS



Appendix II – Additional Tables

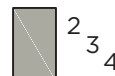
Soil Log Legend
Test Boring Logs
Pavement Core Photographs
Additional Pavement Core Photographs
Summary of Field Procedures

ODOT SOIL LOG

LEGEND



The **STANDARD PENETRATION TEST (SPT)** as defined by AASHTO T206 (or ASTM D1586) is a method to obtain a disturbed soil sample for examination and testing and to obtain relative density and consistency information. A standard 1.4-inch I.D./2-inch O.D. split-barrel sampler is driven three 6-inch increments (see graphic at right) with a 140 lb. hammer freely falling 30 inches. The hammer can either be of a trip, free-fall design, or actuated by a rope and cathead. The SPT N Value is determined by adding the number of blows from the 2nd and 3rd 6-inch increments.



SPT BLOWCOUNT CORRECTION FOR HAMMER EFFICIENCY (N_{60}) is determined by the following equation: $N_{60} = N * [\text{Drill Rod Energy Ratio} (\%) / 60]$, and where the drill rod energy ratio is determined in accordance with ASTM D4633. If the drill rod energy ratio exceeds 90%, it is limited to 90% to determine the N_{60} value and is shown on the log as 90*.

SHELBY TUBE (ST) samples are obtained by hydraulically pushing a thin-walled tube (typically 3-inches in diameter) to obtain a relatively undisturbed sample for testing of fine-grained soils to determine engineering properties such as strength, compressibility, permeability, and density. Shelby tubes are sampled in general accordance with ASTM D1587 (AASHTO T207).



DESCRIPTIVE ORDER OF SOIL STRATA: Consistency/Density, color, ODOT soil classification description, minor soil constituents with percentage modifiers, organic content, miscellaneous constituents or descriptions, relative moisture condition.

ODOT SOIL CLASSIFICATION DESCRIPTION AND SYMBOL

	GRAVEL (A-1-a)		SILT (A-4-b)		ORGANIC CLAY (A-8b)
	GRAVEL WITH SAND (A-1-B)		ELASTIC SILT AND CLAY (A-5)		PEAT
	FINE SAND (A-3)		SILT AND CLAY (A-6a)		UNCONTROLLED FILL
	COARSE AND FINE SAND (A-3a)		SILTY CLAY (A-6b)		BOULDERY ZONE
	GRAVEL WITH SAND AND SILT (A-2-4 OR A-2-5)		ELASTIC CLAY (A-7-5)		SOD/ROOTMAT/TOPSOIL
	GRAVEL WITH SAND, SILT AND CLAY (A-2-6 OR A-2-7)		CLAY (A-7-6)		PAVEMENT OR BASE
	SANDY SILT (A-4a)		ORGANIC SILT (A-8a)		CONCRETE

SOIL LOG SYMBOLS

SS - Split-Spoon Sample	Qu - Unconfined Compressive Strength	FS - Fine Sand Content, %
ST - Shelby Tube Sample	γ_d - Dry Unit Weight, pcf	SI - Silt Content, %
TR - Top of Rock	γ_m - Moist Unit Weight, pcf	CL - Clay Content, %
REC - Sample Recovery, %	GR - Gravel Content, %	LL - Liquid Limit
HP - Hand Penetrometer Value, tsf	CS - Coarse Sand Content, %	PL - Plastic Limit
LOI - Loss on Ignition Test, %		PI - Plasticity Index
		WC - Natural Water Content, %

NOTE: Particle size contents are expressed % by weight.

PARTICLE SIZE

Particle	Size	US Sieve Size
Boulder	>300 mm (12 in.)	12 in.
Cobble	75 - 300 mm (3 - 12 in.)	3 - 12 in.
Coarse gravel	19 - 75 mm (3/4 - 3 in.)	3/4 - 3 in.
Fine gravel	2 - 19 mm (0.08 - 3/4 in.)	#10 - 3/4 in.
Coarse sand	0.42 - 2.0 mm	#40 - #10
Fine sand	0.074 - 0.42 mm	#200 - #40
Silt	0.005 - 0.074 mm	NA
Clay	< 0.005 mm	NA

FINE-GRAINED SOIL (Relative Consistency)

	N_{60}	HP
Very soft	< 2 bpf	< 0.25 tsf
Soft	2 - 4 bpf	> 0.25 - 0.5 tsf
Medium stiff	5 - 8 bpf	> 0.5 - 1.0 tsf
Stiff	9 - 15 bpf	> 1.0 - 2.0 tsf
Very stiff	16 - 30 bpf	> 2.0 - 4.0 tsf
Hard	> 30 bpf	> 4.0 tsf

COARSE-GRAINED SOIL (Relative Density)

	N_{60}
Very loose	< 5 bpf
Loose	5 - 10 bpf
Medium dense	11 - 30 bpf
Dense	31 - 50 bpf
Very dense	> 50 bpf

MINOR CONSTITUENTS (% By Weight)

	Percentage
Trace	0% - 10%
Little	>10% - 20%
Some	>20% - 35%
"And"	$\geq 35\%$

ORGANIC CONTENT OF SOIL (Determined by ASTM D2974 or AASHTO T267)

Classification	Percentage
Slightly organic	2% - 4%
Moderately organic	>4% - 10%
Highly organic	> 10%

RELATIVE MOISTURE CONDITION

Dry	Cohesive - Powdery, WC well below PL Granular - No moisture present
Damp	Cohesive - Leaves very little moisture when pressed, WC < PL Granular - Internal moisture, little to no surface moisture
Moist	Cohesive - Leaves moisture when pressed, PL < WC < LL - 3 Granular - Free water on surface, shiny appearance
Wet	Cohesive - Mushy, WC near or above LL Granular - Voids filled with free water

At Time of Drilling

At end of Drilling

24 hrs After Drilling

Free water (seepage or groundwater) observation made anytime during the drilling process. Depending on time of reading and drilling methodologies, this value may be influenced by the drilling process.

Free water measurement soon after the drilling processes are complete, and the borehole is at final depth. Drilling fluids, if introduced during drilling, may influence this measurement.

Free water measurements made in a borehole hours to days after drilling is complete including the time elapsed (i.e., "24 hrs" as shown at left). Depending on subsurface conditions, elapsed time, drilling process, etc. this observation may reflect a stabilized level.

REFERENCES:

Ohio Department of Transportation (ODOT), Specifications for Geotechnical Explorations (SGE)



PROJECT: LUC-2339-00.30	DRILLING FIRM / OPERATOR: S&ME / J. BEANE	DRILL RIG: S&ME D50 TRACK	STATION / OFFSET: 29+55, 61' RT	EXPLORATION ID
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: S&ME / S. MARAHATTA	HAMMER: CME AUTOMATIC	ALIGNMENT: WASHINGTON STREET	B-001-0-25
PID: 123598 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 8/29/23	ELEVATION: 609.0 (MSL) EOB: 7.0 ft.	PAGE
START: 8/19/25 END: 8/19/25	SAMPLING METHOD: SPT	ENERGY RATIO (%): 87.5	COORD: 346629.8485 N, 192522.3543 E	1 OF 1

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO ₄ ppm	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI				
TOPSOIL 8 INCHES	609.0																		
	608.3																		
MEDIUM DENSE, BROWN, COARSE AND FINE SAND , TRACE GRAVEL, LITTLE CLAY, LITTLE SILT, FEW CERAMIC PLATE PIECES, TRACE ROOTS, FILL, MOIST		1																	
			9	5	13	83	SS-1	10	8	54	14	14	-	-	-	3	A-3a (V)	-	
	606.5	2																	
VERY STIFF, BROWN, SILT AND CLAY , TRACE FINE TO COARSE SAND, TRACE GRAVEL, MOIST																			
		3	6	5	15	67	SS-2	3	1	1	2	49	47	34	20	14	21	A-6a (10)	-
	605.0	4																	
STIFF TO VERY STIFF, BROWN, SILT AND CLAY , TRACE FINE TO COARSE SAND, MOIST																			
			3	3	10	100	SS-3	1.25	-	-	-	-	-	-	-	22	A-6a (V)	-	
		5																	
		6	4	5	15	100	SS-4	2.25	-	-	-	-	-	31	19	12	24	A-6a (V)	-
	602.0																		
		EOB																	
		7																	

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING. LOCATION COORDINATES AND ELEVATIONS WERE OBTAINED FROM SURVEY PERFORMED BY STRAND.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS



PROJECT: LUC-2339-00.30		DRILLING FIRM / OPERATOR: S&ME / J. BEANE		DRILL RIG: S&ME D50 TRACK		STATION / OFFSET: 31+87, 62' RT		EXPLORATION ID												
TYPE: ROADWAY		SAMPLING FIRM / LOGGER: S&ME / S. MARAHATTA		HAMMER: CME AUTOMATIC		ALIGNMENT: WASHINGTON STREET		B-002-0-25												
PID: 123598 BR ID: N/A		DRILLING METHOD: 3.25" HSA		CALIBRATION DATE: 8/29/23		ELEVATION: 609.6 (MSL) EOB: 7.0 ft.		PAGE												
START: 8/19/25 END: 8/19/25		SAMPLING METHOD: SPT		ENERGY RATIO (%): 87.5		COORD: 346504.0158 N, 192717.2057 E		1 OF 1												
MATERIAL DESCRIPTION AND NOTES		ELEV.	DEPTHS	SPT/RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
		609.6							GR	CS	FS	SI	CL	LL	PL	PI				
TOPSOIL 8 INCHES		608.9																		
MEDIUM DENSE, BROWN, COARSE AND FINE SAND, LITTLE GRAVEL, LITTLE SILT, LITTLE CLAY, DRY			1	7	25	67	SS-1		20	6	48	12	14	NP	NP	NP	4	A-3a (0)	-	
		607.1		10																
MEDIUM DENSE, BROWN, COARSE AND FINE SAND, TRACE GRAVEL, TRACE SILT, LITTLE CLAY, DRY			3	12	29	56	SS-2		8	11	60	7	14	NP	NP	NP	6	A-3a (0)	-	
		605.6		10																
MEDIUM DENSE, BROWN, SANDY SILT, TRACE GRAVEL, MOIST			4	12	28	100	SS-3		-	-	-	-	-	-	-	-	11	A-4a (V)	-	
		604.1		10																
DENSE, BROWN, SILT, TRACE FINE TO COARSE SAND, MOIST			6	14	35	100	SS-4		-	-	-	-	-	-	-	-	17	A-4b (V)	-	
		603.1		7																
		602.6	EOB																	
Groundwater encountered at 6.5 feet during drilling and "dry" at end of drilling.																				
NOTES: LOCATION COORDINATES AND ELEVATIONS WERE OBTAINED FROM SURVEY PERFORMED BY STRAND.																				
ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS																				

PLATE 3



PROJECT: LUC-2339-00.30		DRILLING FIRM / OPERATOR: S&ME / J. BEANE				DRILL RIG: S&ME D50 TRACK				STATION / OFFSET: 34+60, 23' LT				EXPLORATION ID B-003-1-25								
TYPE: ROADWAY		SAMPLING FIRM / LOGGER: S&ME / S. MARAHATTA				HAMMER: CME AUTOMATIC				ALIGNMENT: WASHINGTON STREET												
PID: 123598 BR ID: N/A		DRILLING METHOD: 3.25" HSA				CALIBRATION DATE: 8/29/23				ELEVATION: 610.9 (MSL) EOB: 0.6 ft.				PAGE 1 OF 1								
START: 8/19/25 END: 8/19/25		SAMPLING METHOD: SPT				ENERGY RATIO (%): 87.5				COORD: 346428.6051 N, 192995.5468 E												
MATERIAL DESCRIPTION AND NOTES			ELEV.	DEPTHS		SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG				ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
ASPHALT 7 inches of asphalt			610.9																			
			610.3	EOB																		
CONCRETE Encountered concrete at 0.6 feet and could not drill through.																						
NOTES: 1.5 FEET OFFSET IN NORTHWEST DIRECTION. LOCATION COORDINATES AND ELEVATIONS WERE OBTAINED FROM SURVEY PERFORMED BY STRAND.																						
ABANDONMENT METHODS. MATERIALS. QUANTITIES: ASPHALT PATCH																						



PROJECT: LUC-2339-00.30	DRILLING FIRM / OPERATOR: S&ME / J. BEANE	DRILL RIG: S&ME D50 TRACK	STATION / OFFSET: 34+63, 23' LT	EXPLORATION ID B-003-2-25
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: S&ME / S. MARAHATTA	HAMMER: CME AUTOMATIC	ALIGNMENT: WASHINGTON STREET	
PID: 123598 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 8/29/23	ELEVATION: 610.9 (MSL) EOB: 0.7 ft.	PAGE 1 OF 1
START: 8/19/25 END: 8/19/25	SAMPLING METHOD: SPT	ENERGY RATIO (%): 87.5	COORD: 346430.3271 N, 192992.9588 E	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI				
ASPHALT 8 inches of asphalt	610.9																		
	610.2																		

CONCRETE Encountered concrete at 0.7 feet and could not drill through.

NOTES: 1.6 FEET OFFSET IN SOUTHEAST DIRECTION. LOCATION COORDINATES AND ELEVATIONS WERE OBTAINED FROM SURVEY PERFORMED BY STRAND.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH



NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING. LOCATION COORDINATES AND ELEVATIONS WERE OBTAINED FROM SURVEY PERFORMED BY STRAND.
ABANDONMENT METHODS MATERIAL S QUANTITIES: AUGER CUTTINGS



PROJECT: LUC-2339-00.30	DRILLING FIRM / OPERATOR: S&ME / J. BEANE	DRILL RIG: S&ME D50 TRACK	STATION / OFFSET: 32+55, 63' LT	EXPLORATION ID B-005-0-25
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: S&ME / S. MARAHATTA	HAMMER: CME AUTOMATIC	ALIGNMENT: WASHINGTON STREET	
PID: 123598 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 8/29/23	ELEVATION: 609.3 (MSL) EOB: 5.58 ft.	
START: 8/19/25 END: 8/19/25	SAMPLING METHOD: SPT	ENERGY RATIO (%): 87.5	COORD: 346573.252 N, 192841.7561 E	

MATERIAL DESCRIPTION AND NOTES	ELEV.	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI				
ASPHALT 12 INCHES	609.3																		
CONCRETE 18 INCHES	608.3	1																	
		2																	
MEDIUM STIFF, BROWN, SILT AND CLAY, TRACE GRAVEL, TRACE FINE TO COARSE SAND, MOIST	606.8																		
		3	1	1	7	100	SS-1	0.5	2	3	6	46	43	27	16	11	21	A-6a (8)	-
	605.3	4																	
HARD, BROWN, SANDY SILT, AND CLAY, TRACE GRAVEL, MOIST			1	2	-	93	SS-2	0.5	2	2	5	48	43	27	18	9	22	A-4a (8)	-
		5																	
	603.7																		
		EOB	50-1"	-	0	SS-3		-	-	-	-	-	-	-	-	-	-	A-4a (V)	-

NOTES: GROUNDWATER WAS NOT ENCOUNTERED DURING DRILLING. LOCATION COORDINATES AND ELEVATIONS WERE OBTAINED FROM SURVEY PERFORMED BY STRAND.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: AUGER CUTTINGS

S&ME ODOT SULFATE (8.5X11) - SGE 01/2019 - OH DOT GDT - 12/2/25 16:42 - T:\CINCINNATI\1178\PROJECTS\2025\25780095 - STRAND LUC-MR2339-0030\GEO\PROJECT DOCS\RE

S&ME JOB: 25780095



PROJECT: LUC-2339-00.30	DRILLING FIRM / OPERATOR: S&ME / J. BEANE	DRILL RIG: S&ME D50 TRACK	STATION / OFFSET: 32+55, 62' LT	EXPLORATION ID B-005-1-25
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: S&ME / S. MARAHATTA	HAMMER: CME AUTOMATIC	ALIGNMENT: WASHINGTON STREET	
PID: 123598 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 8/29/23	ELEVATION: 609.3 (MSL) EOB: 1.2 ft.	PAGE 1 OF 1
START: 8/19/25 END: 8/19/25	SAMPLING METHOD: SPT	ENERGY RATIO (%): 87.5	COORD: 346573.6486 N, 192843.469 E	

MATERIAL DESCRIPTION AND NOTES	ELEV. 609.3	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI				
ASPHALT 14 inches of asphalt																			
	608.1	EOB																	

CONCRETE Encountered concrete at 1.2 feet and could not drill through.

NOTES: 1.8 FEET OFFSET IN NORTHEAST DIRECTION. LOCATION COORDINATES AND ELEVATIONS WERE OBTAINED FROM SURVEY PERFORMED BY STRAND.
ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH

S&ME ODOT SULFATE (8.5X11) - SGE 01/2019 - OH DOT GDT - 12/2/25 16:42 - T:\CINCINNATI\1178\PROJECTS\2025\25780095 - STRAND LUC-MR2339-0030\GEO\PROJECT DOCS\RE

S&ME JOB: 25780095



PROJECT: LUC-2339-00.30	DRILLING FIRM / OPERATOR: S&ME / J. BEANE	DRILL RIG: S&ME D50 TRACK	STATION / OFFSET: 32+57, 64' LT	EXPLORATION ID B-005-2-25
TYPE: ROADWAY	SAMPLING FIRM / LOGGER: S&ME / S. MARAHATTA	HAMMER: CME AUTOMATIC	ALIGNMENT: WASHINGTON STREET	
PID: 123598 BR ID: N/A	DRILLING METHOD: 3.25" HSA	CALIBRATION DATE: 8/29/23	ELEVATION: 609.4 (MSL) EOB: 1.0 ft.	PAGE 1 OF 1
START: 8/19/25 END: 8/19/25	SAMPLING METHOD: SPT	ENERGY RATIO (%): 87.5	COORD: 346572.6133 N, 192840.5013 E	

MATERIAL DESCRIPTION AND NOTES	ELEV. 609.4	DEPTHS	SPT/ RQD	N ₆₀	REC (%)	SAMPLE ID	HP (tsf)	GRADATION (%)					ATTERBERG			WC	ODOT CLASS (GI)	SO4 ppm	HOLE SEALED
								GR	CS	FS	SI	CL	LL	PL	PI				
ASPHALT 12 inches of asphalt																			
	608.4	EOB	1																

CONCRETE Encountered concrete at 1.0 feet and could not drill through.

NOTES: 1.4 FEET OFFSET IN SOUTHWEST DIRECTION. LOCATION COORDINATES AND ELEVATIONS WERE OBTAINED FROM SURVEY PERFORMED BY STRAND.

ABANDONMENT METHODS, MATERIALS, QUANTITIES: ASPHALT PATCH

Subgrade Exploration Report
LUC-MR2339-0.30 Roundabout (PID: 123598)

Lucas County, Toledo, Ohio
S&ME Project No. 25780095



		Date: 10/17/2025
Photographer: Bishal Chand, E.I.T.		
1	Location / Orientation	X-001-0-25
	Remarks	14 inches thick (Asphalt=7 inches; Concrete=7 inches)

		Date: 10/17/2025
Photographer: Bishal Chand, E.I.T.		
2	Location / Orientation	X-002-0-25
	Remarks	9.5 inches thick Asphalt

Subgrade Exploration Report
LUC-MR2339-0.30 Roundabout (PID: 123598)

Lucas County, Toledo, Ohio
 S&ME Project No. 25780095



		Date: 10/17/2025
		Photographer: Bishal Chand, E.I.T.
3	Location / Orientation	X-003-0-25
	Remarks	7.0 inches thick Asphalt

		Date: 10/17/2025
		Photographer: Bishal Chand, E.I.T.
4	Location / Orientation	X-004-0-25
	Remarks	14.0 inches thick Asphalt

Subgrade Exploration Report
LUC-MR2339-0.30 Roundabout (PID: 123598)

Lucas County, Toledo, Ohio
 S&ME Project No. 25780095



			Date: 10/17/2025
			Photographer: Bishal Chand, E.I.T.
5	Location / Orientation	X-005-0-25	
	Remarks	14 inches thick (Asphalt=7 inches; Concrete=7 inches)	

			Date: 10/17/2025
			Photographer: Bishal Chand, E.I.T.
6	Location / Orientation	X-006-0-25	
	Remarks	12 inches thick (Asphalt=6 inches; Concrete=6 inches)	

Subgrade Exploration Report
LUC-MR2339-0.30 Roundabout (PID: 123598)

Lucas County, Toledo, Ohio
S&ME Project No. 25780095



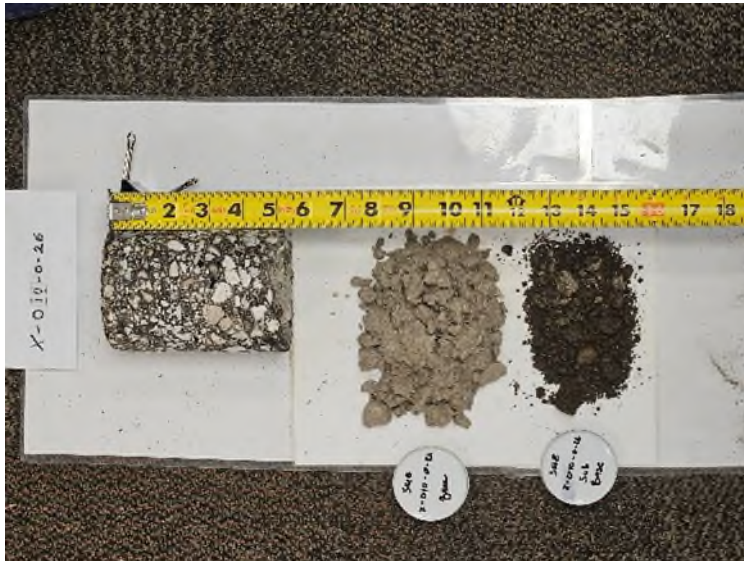
		Date: 9/1/2026
		Photographer: Luke G. Holmes
7	Location / Orientation	X-006-0-26 (41.652600°, -83.549017°)
	Remarks	0-6.5 inches (Asphalt); 6.5-10 inches (Brick Paver); 10-11.25 inches (Asphalt); 11.25-15.5 inches (Concrete); 15.5-25 inches (Base)
		Date: 9/1/2026
		Photographer: Luke G. Holmes
8	Location / Orientation	X-007-0-26 (41.651626°, -83.546884°)
	Remarks	0-8 inches (Asphalt); 8-13.5 inches (Base); 13.5-19.5 inches (Fill: A-3a trace gravel); 19.5-23 inches (Natural soil: A-4a)

Subgrade Exploration Report
LUC-MR2339-0.30 Roundabout (PID: 123598)

Lucas County, Toledo, Ohio
 S&ME Project No. 25780095



			Date: 9/1/2026
			Photographer: Luke G. Holmes
9	Location / Orientation	X-008-0-26 (41.651005°, -83.545678°)	
	Remarks	0.0-6.0 inches (Asphalt); 6.0-9.25 inches (Brick Paver); 9.25-13.25 inches (Fill: A-3a with some gravel); 12.0-17.0 inches (Wood/Concrete); 17.0-25.0 inches (Base)	
			Date: 9/1/2026
			Photographer: Luke G. Holmes
10	Location / Orientation	X-009-0-26 (41.649546°, -83.542649°)	
	Remarks	0-13.25 inches (Asphalt); 13.25-25.0 inches (Base)	

			Date: 9/1/2026
			Photographer: Luke G. Holmes
11	Location / Orientation	X-010-0-26 (41.648197°, -83.539674°)	
	Remarks	0-5.25 inches (Asphalt); 5.25-16.0 inches (Fill: A-1-b); 16.0-22.0 inches (Fill: A-3a with some gravel)	

			Date: 9/1/2026
			Photographer: Luke G. Holmes
12	Location / Orientation	X-011-0-26 (41.647160°, -83.537505°)	
	Remarks	0-5.0 inches (Asphalt); 5.0-8.25 inches (Stone Paver); 8.25-11.75 inches (Fill: A-3a trace gravel); 11.75-18.25 inches (Concrete); 18.25-25.0 inches (Fill: A-3a trace gravel); 25.0-36.0 (Fill: A-6b, little gravel, little plaster)	



Appendix III – Additional Tables

Laboratory Test Results Summary
Organic Content Test Results
Sulfate Content in Soils Supplement 1122
Summary of Lab Procedures

PROJECT	LUC-MR2339		
LOCATION	LUCAS COUNTY, TOLEDO, OHIO		
JOB NO.	25780095	DATE	10/31/25

MOISTURE, ASH, AND ORGANIC MATTER



ASTM D-2974

S&ME, Inc. Cincinnati: 862 East Crescentville Road, West Chester, OH 45246

Project #:	25780095	Report Date:	10/28/25
Project Name:	LUC-MR2339-0.30 Roundabout	Test Date(s):	10/08/25
Client Name:	Jeff Heimann		
Client Address:	615 Elsinore Place, Suite 320, Cincinnati, OH 45202		
Boring No.	B-001-0-25	Sample No.	SS-1
		Sample Date:	8/18/25
Location:		Sampled by:	Depth (ft.) 1.0-2.25

Equipment:	Balance: 0.01 g readability
Balance:	S&ME ID #: 26700 Cal. Date: 1/21/25 Due: 01/21/26

Method A: Moisture Content Determination

Required Oven Temperature : $110 \pm 5^{\circ}\text{C}$

Oven Temperature: 110°C		Tare #	34
t	Tare Weight (Dish plus Aluminum Foil Cover)	grams	21.72
a	Mass of As-Received Specimen + Tare Wt.	grams	97.10
b	Mass of Oven Dry Specimen + Tare Wt.	grams	87.16
w	Water Weight	(a-b)	9.94
A	Mass of As-Received Specimen	(a-t)	75.38
B	Mass of Oven Dry Specimen	(b-t)	65.44
% Moisture Content as a % of As Received or Total Mass		(w/A)*100	13.2%
% Moisture Content as a % of Oven-dried Mass		(w/B)*100	15.2%

Oven	S&ME ID #: 27008 Cal. Date: 12/27/24 Due: 12/27/25
------	--

Method C (440 ° C) or D (750 ° C): Ash Content and Organic Matter Determination

Muffle Furnace: 440°C		Tare #	C
t	Tare Weight (Dish plus Aluminum Foil Cover)	grams	88.81
b	Mass of Oven Dry Specimen + Tare Wt.	grams	154.50
c	Ash Weight + Tare Wt.	grams	153.51
C	Ash Weight	c-t	64.70
B	Mass of Oven Dry Specimen	(b-t)	65.69
D	% Ash Content	(C/B)*100	98.5%
	% Organic Matter	100-D	1.5%

Muffle Furnace:	S&ME ID #: 24239 Cal. Date: Due:
-----------------	----------------------------------

Notes / Deviations / References: ASTM D2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

K.Cannady
Technician Name

10/8/2025
Date

on file
Signature

P5
Level/Certification

K. Cannady
Technical Responsibility

Signature

OAS
Position

10/9/2025
Date

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MOISTURE, ASH, AND ORGANIC MATTER



ASTM D-2974

S&ME, Inc. Cincinnati: 862 East Crescentville Road, West Chester, OH 45246

Project #:	25780095	Report Date:	10/28/25
Project Name:	LUC-MR2339-0.30 Roundabout	Test Date(s):	10/08/25
Client Name:	Jeff Heimann		
Client Address:	615 Elsinore Place, Suite 320, Cincinnati, OH 45202		
Boring No.	B-004-0-25	Sample No.	SS-1
		Sample Date:	8/18/25
Location:		Sampled by:	Depth (ft.) 3.0-4.5

Equipment:	Balance: 0.01 g readability
Balance:	S&ME ID #: 26700 Cal. Date: 1/21/25 Due: 01/21/26

Method A: Moisture Content Determination

Required Oven Temperature : $110 \pm 5^{\circ}\text{C}$

Oven Temperature: 110°C		Tare #	f-5
t	Tare Weight (Dish plus Aluminum Foil Cover)	grams	21.81
a	Mass of As-Received Specimen + Tare Wt.	grams	88.58
b	Mass of Oven Dry Specimen + Tare Wt.	grams	85.01
w	Water Weight	(a-b)	3.57
A	Mass of As-Received Specimen	(a-t)	66.77
B	Mass of Oven Dry Specimen	(b-t)	63.20
% Moisture Content as a % of As Received or Total Mass		(w/A)*100	5.3%
% Moisture Content as a % of Oven-dried Mass		(w/B)*100	5.6%

Oven	S&ME ID #: 27008 Cal. Date: 12/27/24 Due: 12/27/25
------	--

Method C (440 ° C) or D (750 ° C): Ash Content and Organic Matter Determination

Muffle Furnace: 440°C		Tare #	b
t	Tare Weight (Dish plus Aluminum Foil Cover)	grams	89.69
b	Mass of Oven Dry Specimen + Tare Wt.	grams	152.90
c	Ash Weight + Tare Wt.	grams	152.77
C	Ash Weight	c-t	63.08
B	Mass of Oven Dry Specimen	(b-t)	63.21
D	% Ash Content	(C/B)*100	99.8%
	% Organic Matter	100-D	0.2%

Muffle Furnace:	S&ME ID #: 24239 Cal. Date: Due:
-----------------	----------------------------------

Notes / Deviations / References: ASTM D2974: Moisture, Ash, and Organic Matter of Peat and Other Organic Soils

K.Cannady
Technician Name

10/8/2025
Date

on file
Signature

P5
Level/Certification

K. Cannady
Technical Responsibility

Signature

OAS
Position

10/9/2025
Date

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Analytical Report



Client: S&ME
Project: LUC-MR2339-0.30 Roundabout; 25780095
Matrix: SOIL/SOLID

Work Order: CC2507102
Date Collected: 09/08/25 13:00
Date Received: 09/08/25 15:44

CLIENT ID: B-001-0-25

Lab ID: CC2507102-001

Analyte	Method	Results	Qual	Units	MRL	Dilution Factor	Date Analyzed	Date Extracted
General Chemistry Parameters								
Percent Moisture	SM 2540 B-2016	15.1		%	0.1	1	09/11/25 15:00	NA
Sulfate	TEX-145-E	178		ppm-dry	118	1	09/12/25 12:34	NA

Analytical Report



Client: S&ME
Project: LUC-MR2339-0.30 Roundabout; 25780095
Matrix: SOIL/SOLID

Work Order: CC2507102
Date Collected: 09/08/25 13:00
Date Received: 09/08/25 15:44

CLIENT ID: B-002-0-25

Lab ID: CC2507102-002

Analyte	Method	Results	Qual	Units	MRL	Dilution Factor	Date Analyzed	Date Extracted
General Chemistry Parameters								
Percent Moisture	SM 2540 B-2016	3.5		%	0.1	1	09/11/25 15:00	NA
Sulfate	TEX-145-E	152		ppm-dry	104	1	09/12/25 12:34	NA

Analytical Report



Client: S&ME
Project: LUC-MR2339-0.30 Roundabout; 25780095
Matrix: SOIL/SOLID

Work Order: CC2507102
Date Collected: 09/08/25 13:00
Date Received: 09/08/25 15:44

CLIENT ID: B-003-0-25	Lab ID: CC2507102-003
------------------------------	------------------------------

Analyte	Method	Results	Qual	Units	MRL	Dilution Factor	Date Analyzed	Date Extracted
General Chemistry Parameters								
Percent Moisture	SM 2540 B-2016	4.1		%	0.1	1	09/11/25 15:00	NA
Sulfate	TEX-145-E	1500		ppm-dry	104	1	09/12/25 12:34	NA

Analytical Report



Client: S&ME
Project: LUC-MR2339-0.30 Roundabout; 25780095
Matrix: SOIL/SOLID

Work Order: CC2507102
Date Collected: 09/08/25 13:00
Date Received: 09/08/25 15:44

CLIENT ID: B-004-0-25	Lab ID: CC2507102-004
------------------------------	------------------------------

Analyte	Method	Results	Qual	Units	MRL	Dilution Factor	Date Analyzed	Date Extracted
General Chemistry Parameters								
Percent Moisture	SM 2540 B-2016	22.1		%	0.1	1	09/11/25 15:00	NA
Sulfate	TEX-145-E	346		ppm-dry	128	1	09/12/25 12:34	NA

Analytical Report



Client: S&ME
Project: LUC-MR2339-0.30 Roundabout; 25780095
Matrix: SOIL/SOLID

Work Order: CC2507102
Date Collected: 09/08/25 13:00
Date Received: 09/08/25 15:44

CLIENT ID: B-005-0-25

Lab ID: CC2507102-005

Analyte	Method	Results	Qual	Units	MRL	Dilution Factor	Date Analyzed	Date Extracted
General Chemistry Parameters								
Percent Moisture	SM 2540 B-2016	22.3		%	0.1	1	09/12/25 14:00	NA
Sulfate	TEX-145-E	411		ppm-dry	129	1	09/12/25 12:34	NA



Summary of Laboratory Procedures

Recovered disturbed and undisturbed samples and the drillers' field logs were transported to the laboratory where they were examined by the geotechnical engineer. Selected samples representative of certain groups of soils were subjected to simple classification tests by hand or other simple means.

Recovered disturbed and undisturbed samples and the drillers' field logs were transported to the laboratory where they were examined by the geotechnical engineer. Selected samples representative of certain groups of soils were subjected to simple classification tests by hand or other simple means. Other samples were tested in the laboratory to determine their strength or consolidation properties.

◆ Laboratory Tests of Soil

Examination of Split Spoon Soil Samples

Soil and rock samples and field boring records were reviewed in the laboratory by the geotechnical engineer. Soils were classified in general accordance with the visual-manual method described in ASTM D 2488, *Standard Practice for Description and Identification of Soils (Visual-Manual Method)*. The geotechnical engineer also prepared the final boring records enclosed with this report.

Examination of Split Spoon Soil Samples

Soil and rock samples and field boring records were reviewed in the laboratory by the geotechnical engineer. Representative soil samples were selected for classification testing to provide grain size and plasticity data to allow classification of the samples in general accordance with the AASHTO Classification method described in ASTM D3282, *Standard Practice for Classification of Soils and Soil Aggregate Mixtures for Highway Construction Purposes*. The geotechnical engineer also prepared the final boring records enclosed with this report.

Moisture Content Testing of Soil Samples by Oven Drying

Moisture content was determined in general conformance with the methods outlined in ASTM D2216, "Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil or Rock by Mass." This method is limited in scope to Group B, C, or D samples of earth materials which do not contain appreciable amounts of organic material, soluble solids such as salt or reactive solids such as cement. This method is also limited to samples which do not contain contamination.

A representative portion of the soil was divided from the sample using one of the methods described in Section 9 of ASTM D2216. The split portion was then placed in a drying oven and heated to approximately 110 degrees C overnight or until a constant mass was achieved after repetitive weighing. The moisture content of the soil was then computed as the mass of water removed from the sample by drying, divided by the mass of the sample dry, times 100 percent. No attempt was made to exclude any particular particle size from the portion split from the sample.

Liquid and Plastic Limits Testing

Atterberg limits of the soils was determined generally following the methods described by ASTM D4318, *Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*. Albert Atterberg originally defined "limits of consistency" of fine grained soils in terms of their relative ease of deformation at various moisture contents. In current engineering usage, the liquid limit of a soil is defined as the moisture content, in percent, marking the upper limit of viscous flow and the boundary with a semi-liquid state. The plastic limit defines the lower limit of plastic behavior, above which a soil behaves plastically below which it retains its shape upon drying. The plasticity index (PI) is the range of water content over which a soil behaves plastically. Numerically, the PI is the difference between liquid limit and plastic limit values.

Representative portions of fine grained Group A, B, C, or D samples were prepared using the wet method described in Section 10.1 of ASTM D4318. The liquid limit of each sample was determined using the multipoint method (Method A) described in Section 11. The liquid limit is by definition the moisture content where 25 drops of a hand operated liquid limit device are required to close a standard width groove cut in a soil sample placed in the device. After each test, the moisture content of the sample was adjusted and the sample replaced in the device. The test was repeated to provide a minimum of three widely spaced combinations of N versus moisture content. When plotted on semilog paper, the liquid limit moisture content was determined by straight line interpolation between the data points at N equals 25 blows.

The plastic limit was determined using the procedure described in Section 17 of ASTM D4318. A selected portion of the soil used in the liquid limit test was kneaded and rolled by hand until it could no longer be rolled to a 3.2 mm thread on a glass plate. This procedure was repeated until at least 6 grams of material was accumulated, at which point the moisture content was determined using the methods described in ASTM D2216.

Grain Size Analysis of Samples

The distribution of particle sizes greater than 75 μm was determined in general accordance with the procedures described by ASTM D421, *Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants*, and D422, *Standard Test Method for Particle Size Analysis of Soils*. During preparation samples were divided into two portions. The material coarser than the No. 30 U.S. sieve size fraction was dry sieved through a nest of standard sieves as described in Article 6. Material passing the No. 30 sieve was independently passed through a nest of sieves down to the No. 200 size.

Grain Size Analysis of Samples with Hydrometer

The distribution of particle sizes was determined in general accordance with the procedures described by ASTM D421, *Standard Practice for Dry Preparation of Soil Samples for Particle-Size Analysis and Determination of Soil Constants*, and D422, *Standard Test Method for Particle Size Analysis of Soils*. During preparation samples were divided into two portions. The material coarser than the No. 10 U.S. sieve size fraction was dry sieved through a nest of standard sieves as described in Article 6. Material passing the No. 10 sieve was soaked in demineralized water and a dispersing agent, then the soil-water slurry placed in a glass sedimentation chamber and the specific gravity of the slurry recorded at various time intervals. The grain size distribution was calculated from the time rate of sedimentation of the various size particles. After the final hydrometer reading was obtained, the suspension was washed through the No. 200 sieve. The remaining material retained on the No. 200 sieve was oven dried, and then passed through a standard nest of sieves.

Percent Fines Determination of Samples

A selected specimen of soils was washed over a No. 200 sieve after being thoroughly mixed and dried. This test was conducted in general accordance with ASTM D1140, *Standard Test Method for Amount of Material Finer Than the No. 200 Sieve*. Method A, using water to wash the sample through the sieve without soaking the sample for a prescribed period of time, was used and the percentage by weight of material washing through the sieve was deemed the "percent fines" or percent clay and silt fraction.

Percent Organics (Organic Loss on Ignition)

The content of relatively undecayed or undecomposed vegetative matter in the soils is determined for representative samples of topsoil or stained subsoils using the procedures described by AASHTO T-267, *Determination of Organic Content in Soils by Loss on Ignition*. Representative samples of the minus No. 10 sieve size are dried at 105 C, then heated in a muffle furnace at 455 C for six hours. The resulting dry weight of the sample after ignition is then compared to the pre-ignition dry weight to estimate the organic content.

Laboratory Sulfate Ion Content Test

External sulfate can occur when concrete is in contact with sulfate containing water e.g. seawater, swamp water, ground water or sewage water. The often massive formation of gypsum and ettringite formed during the external sulfate attack may cause concrete to crack and scale.

Water soluble sulfate ion content is determined using either Method A or B as described by AASHTO T-290-95(2003), *Determining Water-Soluble Sulfate Ion Content in Soil*. Soil specimens were first prepared by splitting and quartering representative portions from recovered samples as described in Section 7.2.

Method A, the Gravimetric Method, determines sulfate content by precipitation of barium sulfate from a heated solution of the soil and chemical reagents. Method B, the Turbidimetric Method, relies on a photoelectric colorimeter to determine the turbidity of a barium sulfate suspension after chemical reagents are added. Laboratory test data sheets will indicate the method used.



Appendix IV– Roadway Subgrade Analysis

OHIO DEPARTMENT OF TRANSPORTATION**OFFICE OF GEOTECHNICAL ENGINEERING****PLAN SUBGRADES****Geotechnical Design Manual Section 600****LUC-MR2339-0.30****PID: 123598****Roundabout Addition along Washington Street and Indiana Avenue****S&ME, Inc.**

Prepared By: Sudip B. Khadka, P.E.
Date prepared: Tuesday, December 2, 2025

S&ME, Inc.
862 E Crescentville Road
Cincinnati, Ohio 45246

513-771-8471
skhadka@smeinc.com

NO. OF BORINGS: 5**NO. OF DCPS:**



#	Boring ID	Alignment	Station	Add DCP Test Data Worksheets				Boring EL.	Proposed Subgrade EL	Cut Fill
				Offset	Dir	Drill Rig	ER			
1	B-001-0-25	Washington St	29+55	61	RT	S&ME D50 track	0.875	611.0	610.0	1.0 C
2	B-002-0-25	Washington St	31+87	62	RT	S&ME D50 track	0.875	613.0	612.0	1.0 C
3	B-003-0-25	Washington St	34+61	23	LT	S&ME D50 track	0.875	614.0	613.0	1.0 C
4	B-004-0-25	Indiana Ave	315+13	12	LT	S&ME D50 track	0.875	609.0	608.0	1.0 C
5	B-005-0-25	11th St	32+55	63	LT	S&ME D50 track	0.875	612.0	611.0	1.0 C

[illegible]

PID: PID: 123598

County-Route-Section: LUC-MR2339-0.30

No. of Borings: 5

Geotechnical Consultant: S&ME, Inc.

Prepared By: Sudip B. Khadka, P.E.

Date prepared: 12/2/2025

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

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

Design CBR	7
------------	---

% Samples within 3 feet of subgrade			
$N_{60} \leq 5$	6%	$HP \leq 0.5$	12%
$N_{60} < 12$	18%	$0.5 < HP \leq 1$	0%
$12 \leq N_{60} < 15$	6%	$1 < HP \leq 2$	12%
$N_{60} \geq 20$	24%	$HP > 2$	6%
M+	18%		
Rock	0%		
Unsuitable Soil	0%		

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

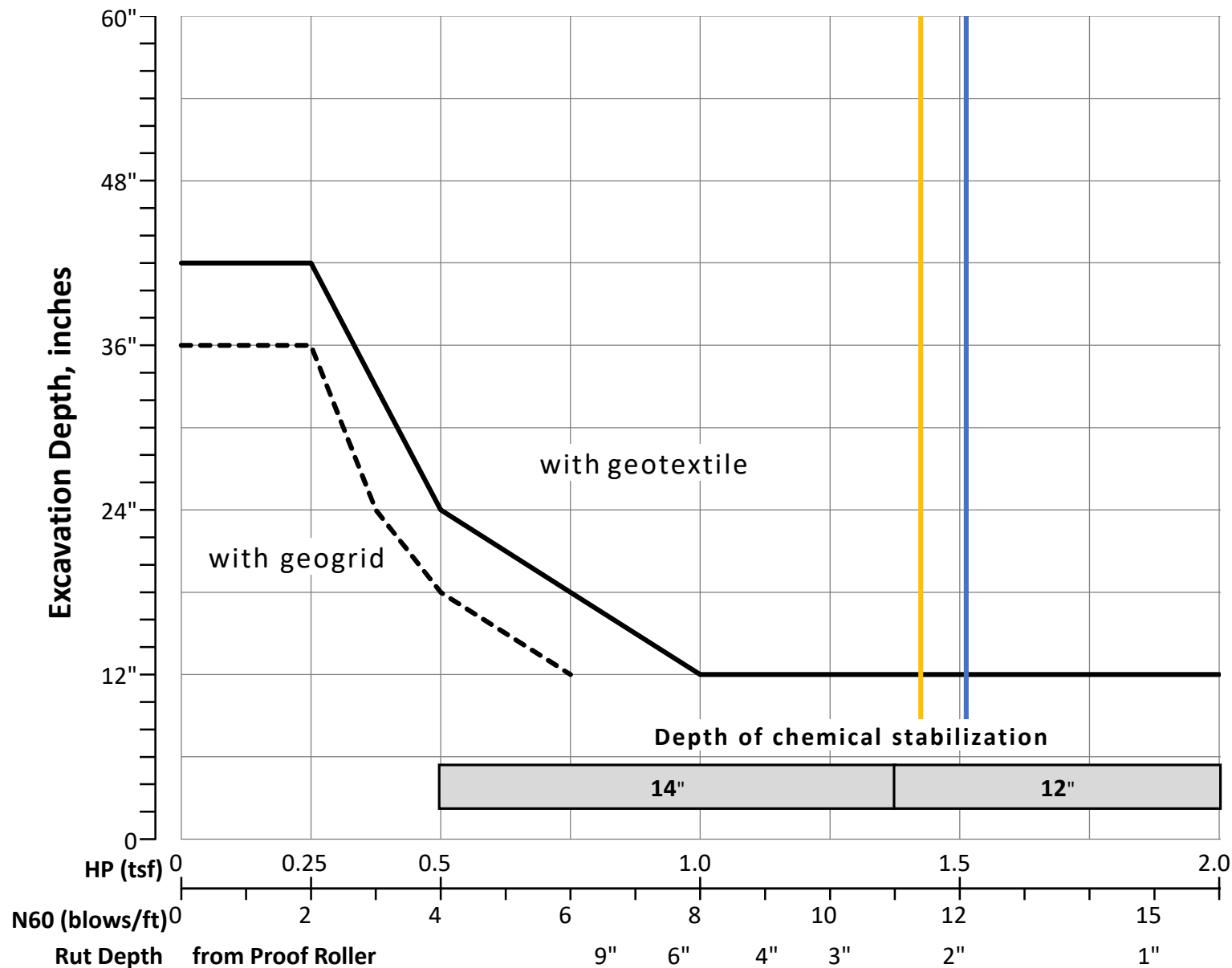
% Proposed Subgrade Surface	
Unstable & Unsuitable	43%
Unstable	43%
Unsuitable (Soil & Rock)	0%

	N_{60}	N_{60L}	HP	LL	PL	PI	Silt	Clay	P 200	M_C	M_{OPT}	GI
Average	22	11	1.51	13	8	8	30	28	58	16	12	7
Maximum	50	25	3.00	34	20	14	49	48	96	24	18	16
Minimum	5	5	0.50	0	0	4	7	8	21	3	8	0

Classification Counts by Sample																					
ODOT Class	UCF	Rock	A-1-a	A-1-b	A-2-4	A-2-5	A-2-6	A-2-7	A-3	A-3a	A-4a	A-4b	A-5	A-6a	A-6b	A-7-5	A-7-6	A-8a	A-8b	Totals	
Count	0	0	0	0	2	0	0	0	0	3	5	1	0	5	0	0	1	0	0	17	
Percent	0%	0%	0%	0%	12%	0%	0%	0%	0%	18%	29%	6%	0%	29%	0%	0%	6%	0%	0%	100%	
% Rock Granular Cohesive	0%	0%	59%									41%									100%
Surface Class Count	0	0	0	0	1	0	0	0	0	3	1	0	0	2	0	0	0	0	0	7	
Surface Class Percent	0%	0%	0%	0%	14%	0%	0%	0%	0%	43%	14%	0%	0%	29%	0%	0%	0%	0%	0%	100%	



Fig. 600-1 – Subgrade Stabilization



OVERRIDE TABLE

Calculated Average	New Values	Check to Override
1.51		☐ HP
11.40		☐ N60L

Average HP

Average N_{60L}





Appendix V– Soil Profile Sheets

PROJECT DESCRIPTION

THIS PROJECT INVOLVES IMPROVEMENT OF WASHINGTON STREET FROM 17TH STREET TO SUMMIT STREET, INCLUDING THE ROUNDABOUT WITH INDIANA AVENUE AND 11TH STREET. THE NEW FIVE (5) LEGGED ROUNDABOUT CONSISTS OF CURBS AND CONCRETE SPLITTER ISLANDS. THE SITE IS CURRENTLY WITHIN WASHINGTON STREET, INDIAN AVENUE, AND 11TH STREET ROUNDABOUT WITH FAMILY RESIDENTIAL APARTMENTS, GRASS AREAS, AND SEVERAL PARKING LOTS WITHIN THE IMMEDIATE VICINITY.

HISTORIC RECORDS

S&ME SEARCHED THE ONLINE ODOT TRANSPORTATION INFORMATION MAPPING SYSTEM (TIMS) RECORDS FOR HISTORIC BORING INFORMATION FOR THE EXISTING SITE; HOWEVER, NO AVAILABLE HISTORIC BORING RECORDS WERE LOCATED FOR THIS SITE.

GEOLOGY

BASED ON THE USDA WEB SOIL SURVEY, THE NEAR-SURFACE SOIL TYPE AT THE PROJECT SITE IS URBAN LAND (100%).

ACCORDING TO THE OHIO GEOLOGY INTERACTIVE MAP MAINTAINED BY OHIO DEPARTMENT OF NATURAL RESOURCES (ODNR), THE OVERBURDEN SOILS AT THE SITE CONSIST OF LACUSTRINE SAND OF LATE WISCONSINAN PERIOD WITH AVERAGE THICKNESS OF 190 FEET. BASED ON ODNR, THE PREDOMINANT BEDROCK ON THE SITE CONSISTS OF OLIVE GRAY TO YELLOWISH BROWN TYMOCHTEE DOLOMITE FROM THE SILURIAN AGE WITH BEDROCK THICKNESS RANGING FROM 0 TO 140 FEET. A PORTION OF THE SITE CONSISTS OF OLIVE GRAY TO YELLOW BROWN GREENFIELD DOLOMITE OF SILURIAN AGE WITH AVERAGE BEDROCK THICKNESS RANGING FROM 0 TO 80 FEET. BEDROCK WAS NOT ENCOUNTERED DURING THIS EXPLORATION TO A MAXIMUM DEPTH OF 7.5 FEET.

OUR REVIEW OF THE AVAILABLE KARST RECORDS MAINTAINED BY ODNR DIVISION OF GEOLOGICAL SURVEY INDICATES THAT THERE ARE NO KARSTS SINKHOLES AND DEPRESSION AVAILABLE WITHIN 10 MILES OF THE PROJECT SITE.

OUR REVIEW OF THE AVAILABLE MINE RECORDS MAINTAINED BY THE ODNR DIVISION OF GEOLOGICAL SURVEY INDICATES THAT THERE ARE NO MINES AVAILABLE WITHIN THE IMMEDIATE VICINITY OF THE PROJECT SITE. THE NEAREST INDUSTRIAL MINERALS-SURFACE MINE WITH ID: IM 2116 IS LOCATED APPROXIMATELY 4.7 MILES NORTHEAST OF THE SITE. ANOTHER INDUSTRIAL MINERALS-SURFACE MINE FOR TOPSOIL AND SAND WITH ID: IM 2407 IS LOCATED APPROXIMATELY 5.0 MILES SOUTHWEST OF THE PROJECT SITE. FEW OTHER INDUSTRIAL MINERALS-SURFACE MINE ARE LOCATED WITHIN THE 10 MILES RADIUS OF THE PROJECT SITE.

OUR REVIEW OF THE AVAILABLE OHIO OIL AND GAS WELLS MAINTAINED BY ODNR DIVISION OF OIL AND GAS INDICATES THAT THERE ARE NO OIL AND GAS WELLS AVAILABLE WITHIN THE IMMEDIATE VICINITY OF THE PROJECT SITE. THE NEAREST ACTIVE STORAGE WELLS: 34095200520000, 34095200530000, 34095200550000, AND 34095200560000 ARE LOCATED APPROXIMATELY 4.6 MILES NORTHEAST OF THE PROJECT SITE LOCATION.

RECONNAISSANCE

A SITE RECONNAISSANCE OF THE PROJECT SITE WAS PERFORMED TO OBSERVE CURRENT SITE CONDITIONS, LOOK FOR POTENTIAL UTILITY CONFLICTS, AND SELECT AND MARK BORING LOCATIONS. THE SITE IS CURRENTLY WITHIN WASHINGTON STREET, INDIAN AVENUE, AND THE 11TH STREET ROUNDABOUT WITH FAMILY RESIDENTIAL APARTMENTS, GRASS AREAS, AND SEVERAL PARKING LOTS WITHIN THE IMMEDIATE VICINITY. THERE IS A LUCAS COUNTY VEHICLE MAINTENANCE FACILITY LOCATED ALONG THE WEST SIDE OF WASHINGTON STREET. OVERHEAD UTILITY LINES ARE PRESENT THROUGHOUT THE PROJECT AREA WITH HIGH TRAFFIC. BASED ON OUR RECONNAISSANCE AND AVAILABLE AERIAL PHOTOGRAPHS AND TOPOGRAPHIC MAPS, ELEVATIONS WITHIN THE SITE RANGE FROM APPROXIMATELY 605 FEET AT THE WESTERN END TO 611 FEET AT THE EASTERN EDGE.

SUBSURFACE EXPLORATION

FIVE (5) SUBGRADE SOIL TEST BORINGS AND SIX (6) PAVEMENT CORES WERE PERFORMED ON THIS SITE FOR THIS GEOTECHNICAL EXPLORATION. THE BORING LOCATIONS WERE STAKED ON SITE BY USING THE HANDHOLD GPS. THE TEST LOCATIONS WERE STAKED IN THE FIELD PRIOR TO OUR FIELD EXPLORATION BY S&ME PERSONNEL. THE SUBGRADE BORINGS WERE GENERALLY SPACED AT 400-FOOT INTERVALS PER ODOT SGE. REPORTED TOP OF BORING ELEVATIONS AND LOCATION COORDINATES WERE OBTAINED FROM GOOGLE EARTH™. SOIL TEST BORINGS FOR THIS PROJECT WERE EXTENDED TO DEPTHS OF 0.6 FEET TO 7.5 FEET BELOW THE EXISTING GROUND SURFACE.

THE BORINGS WERE PERFORMED USING S&ME D-50 TRACK DRILL RIG UTILIZING 3¼-INCH HOLLOW STEM AUGERS. SOIL SAMPLES WERE OBTAINED USING A SPLIT-BARREL SAMPLER DRIVEN BY AN AUTOMATIC HAMMER SYSTEM IN GENERAL ACCORDANCE WITH ASTM D1586. SPLIT-BARREL SAMPLES WERE EXAMINED IMMEDIATELY AFTER RECOVERY AND REPRESENTATIVE PORTIONS OF EACH SAMPLE WERE PLACED IN AIR-TIGHT CONTAINERS AND RETAINED FOR SUBSEQUENT LABORATORY TESTING. SHELBY TUBES AND ROCK CORES WERE NOT COLLECTED FOR THIS PROJECT. EXISTING PAVEMENT THICKNESS WAS MEASURED FROM THE SIDE OF BOREHOLE WITHIN THE BORINGS AND PROVIDED ON THE LOGS. SIX (6) PAVEMENT CORES PERFORMED ALONG WASHINGTON STREET WERE UTILIZED TO OBTAIN EXISTING PAVEMENT THICKNESS.

EXPLORATION FINDINGS

SURFICIAL MATERIALS CONSISTING OF 8-INCHES OF TOPSOIL OR 12 TO 14-INCHES OF ASPHALT OR 18 TO 22-INCHES OF CONCRETE WERE ENCOUNTERED IN THE BORINGS.

FILL CONSISTING OF MEDIUM DENSE, BROWN, COARSE AND FINE SAND (A-3a), CONTAINING CERAMIC PLATE PIECES, WAS ENCOUNTERED IN BORING B-001-0-25.

NATURAL SOILS CONSISTING OF MEDIUM STIFF TO HARD, BROWN TO GRAY TO DARK GRAY, SILT AND CLAY (A-6a), SANDY SILT (A-4a), CLAY (A-7-6), AND LOOSE TO DENSE, BROWN TO GRAY, COARSE AND FINE SAND (A-3a), SILT (A-4b), SANDY SILT (A-4a), GRAVEL AND/OR STONE FRAGMENTS WITH SAND AND SILT (A-2-4) WERE ENCOUNTERED IN THE BORINGS.

SPECIFICATIONS

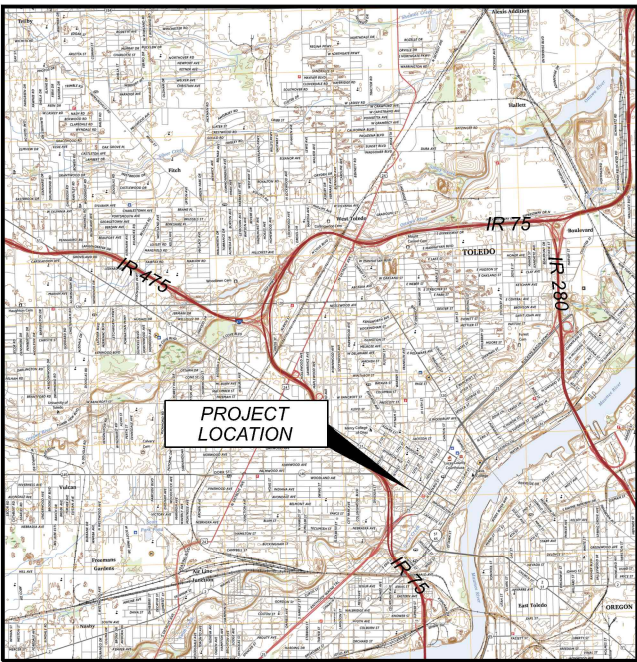
THIS GEOTECHNICAL EXPLORATION WAS PERFORMED IN ACCORDANCE WITH THE STATE OF OHIO, DEPARTMENT OF TRANSPORTATION, OFFICE OF GEOTECHNICAL ENGINEERING, SPECIFICATIONS FOR GEOTECHNICAL EXPLORATIONS, DATED JULY 2025.

AVAILABLE INFORMATION

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

LEGEND

DESCRIPTION	ODOT CLASS	CLASSIFIED MECH./VISUAL	
 GRAVEL WITH SAND AND SILT	A-2-4	1	1
 COARSE AND FINE SAND	A-3a	2	1
 SANDY SILT	A-4a	3	3
 SILT	A-4b	--	1
 SILT AND CLAY	A-6a	2	2
 CLAY	A-7-6	--	1
	TOTAL	8	9
 SOD AND TOPSOIL = X = APPROXIMATE THICKNESS	VISUAL		
 PAVEMENT OR BASE = X = APPROXIMATE THICKNESS	VISUAL		
 BORING 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.		
W—	INDICATES FREE WATER ELEVATION.		
X/D"	NUMBER OF BLOWS FOR STANDARD PENETRATION TEST (SPT): X/D"= NUMBER OF BLOWS (UNCORRECTED) FOR D" OF PENETRATION AT REFUSAL.		
SS	INDICATES A SPLIT SPOON SAMPLE.		
NP	INDICATES A NON-PLASTIC SAMPLE.		

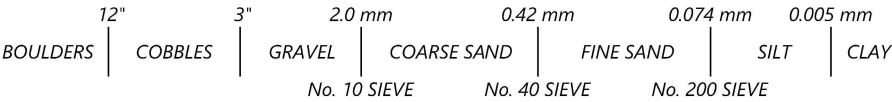


LOCATION MAP

SCALE IN MILES



PARTICLE SIZE DEFINITIONS



INDEX OF SHEETS

SUMMARY OF SOIL TEST DATA, SHEET 2

LOCATION FROM STA.	TO STA.	PLAN	PROFILE	CROSS SECTION
WASH. ST.				
25+00	39+50	3	3	--
IND. AVE				
312+00	320+00	4	4	--

RECON. - S&ME 7/29/25

DRILLING - S&ME 8/19/25

DRAWN - KAH 12/22/25 - 12/24/25

REVIEWED - SBK 12/24/25

DESIGN AGENCY



DESIGNER

KAH

REVIEWER

SBK

PROJECT ID

123598

SUBSET TOTAL

1

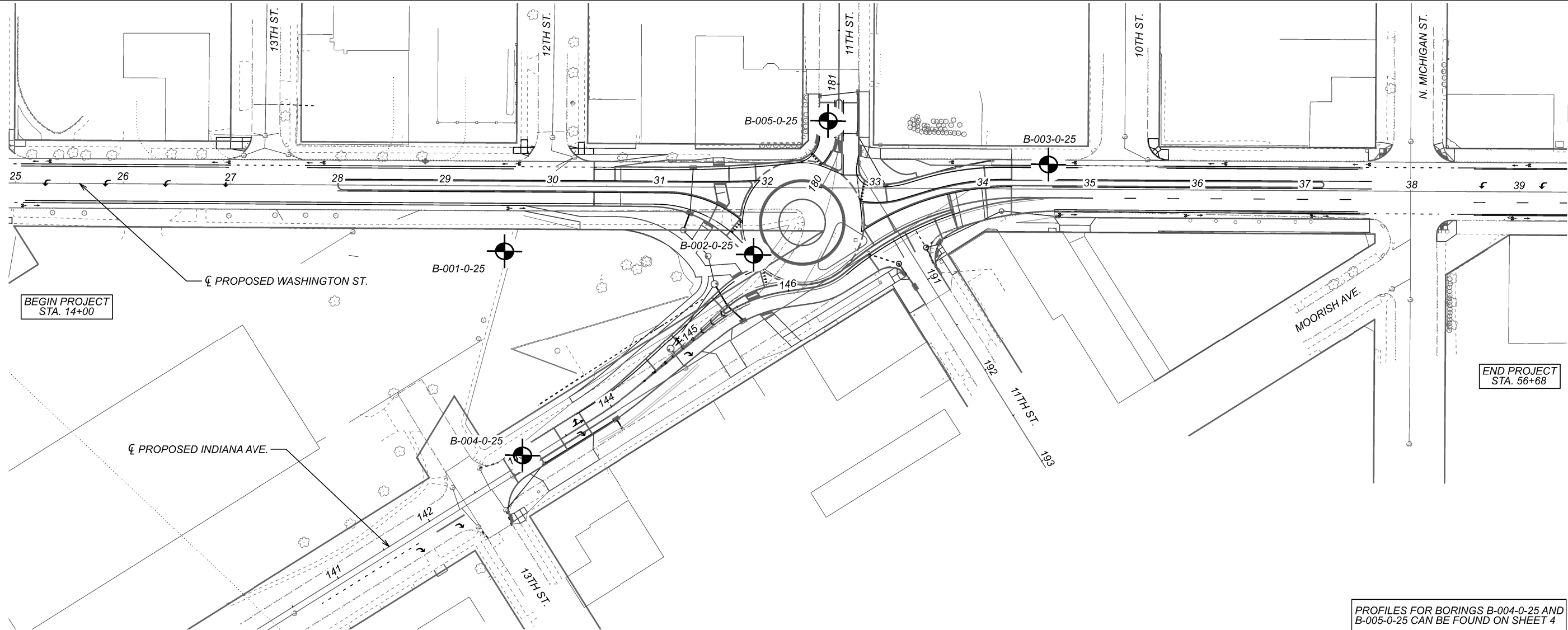
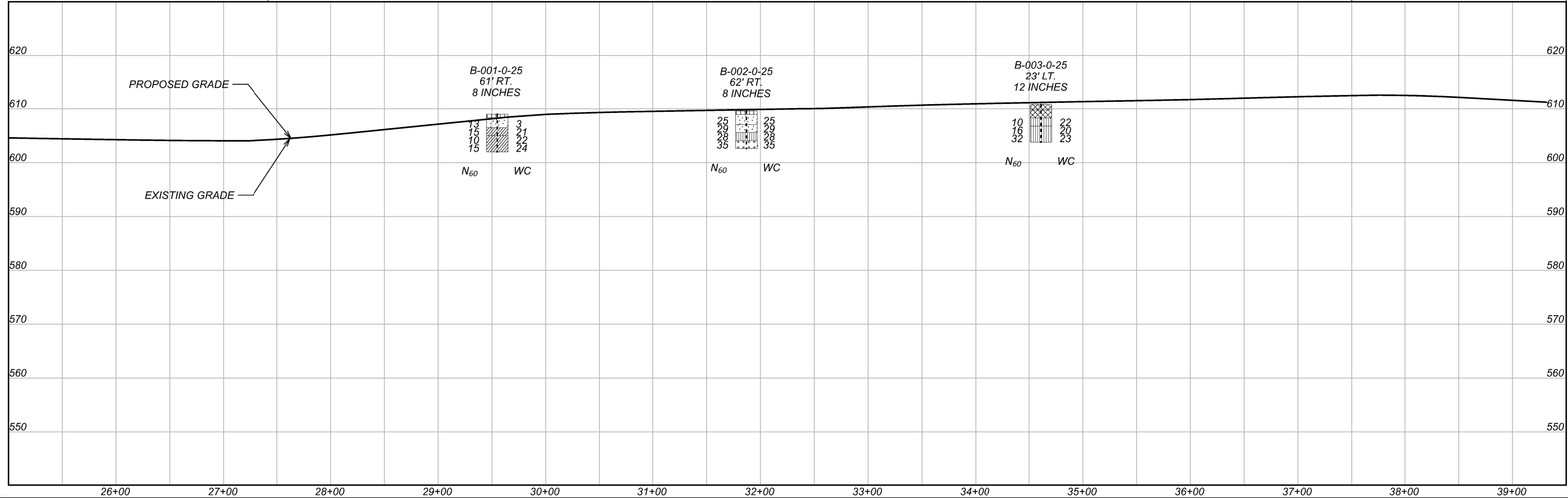
4

SHEET TOTAL

P. 1

SUMMARY OF SOIL TEST DATA WASHINGTON ST.																
EXPLORATION ID., STATION & OFFSET	FROM - TO	SAMPLE ID	N ₆₀	% REC	tsf HP	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO ₄
B-001-0-25 STA. 29+55, 61' RT. NORTHING: 346629.8485 EASTING: 192522.3543	1.0 - 2.5	SS-1	13	83	-	10	8	54	14	14				3	A-3a (VISUAL)	178
	2.5 - 4.0	SS-2	10	67	3.0	1	1	2	49	47	34	20	14	21	A-6a (10)	-
	4.0 - 5.5	SS-3	10	100	1.25				STIFF TO VERY STIFF BROWN SILT AND CLAY					22	A-6a (VISUAL)	-
	5.5 - 7.0	SS-4	15	100	2.25				SAME AS SS-3				19	24	A-6a (VISUAL)	-
B-002-0-25 STA. 31+87, 62' RT. NORTHING: 346504.0158 EASTING: 192717.2057	1.0 - 2.5	SS-1	25	67	-	20	6	48	12	14	NP	NP	NP	4	A-3a (0)	152
	2.5 - 4.0	SS-2	25	58	-	8	11	60	7	14	NP	NP	NP	6	A-3a (0)	-
	4.0 - 5.5	SS-3	28	100	-			MEDIUM DENSE BROWN SANDY SILT						11	A-4a (VISUAL)	-
	5.5 - 7.0	SS-4	35	100	-			DENSE BROWN SILT						17	A-4b (VISUAL)	-
B-003-0-25 STA. 34+61, 23' LT. NORTHING: 346429.3921 EASTING: 192994.1763	2.5 - 4.0	SS-1	11	100	1.5	0	1	5	46	48	27	18	9	22	A-4a (8)	1500
	4.0 - 5.5	SS-2	16	100	-	4	4	12	41	39	25	16	9	20	A-4a (8)	-
	5.5 - 7.0	SS-3	32	89	0.5			SAME AS SS-2						23	A-4a (VISUAL)	-

SUMMARY OF SOIL TEST DATA INDIANA AVE.																
EXPLORATION ID., STATION & OFFSET	FROM - TO	SAMPLE ID	N ₆₀	% REC	tsf HP	% GR	% CS	% FS	% SILT	% CLAY	LL	PL	PI	% WC	ODOT CLASS (GI)	ppm SO ₄
B-004-0-25 STA. 315+13, 12' LT. NORTHING: 346459.7561 EASTING: 192435.5475	3.0 - 4.5	SS-1	16	44	-	48	19	11	14	8	14	10	4	6	A-2-4 (VISUAL)	346
	4.5 - 6.0	SS-2	7	39	-	30	24	14	21	11				5	A-2-4 (0)	-
	6.0 - 7.5	SS-3	13	56	2.5				VERY STIFF GRAY CLAY					23	A-7-6 (VISUAL)	-
B-005-0-25 STA. 32+55, 63' LT. NORTHING: 346573.252 EASTING: 192841.7561	2.5 - 4.0	SS-1	7	100	0.5	2	3	6	46	43	27	16	11	21	A-6a (8)	411
	4.0 - 5.3	SS-2	3	93	0.5	2	2	5	48	43	27	18	9	22	A-4a (8)	-
	5.5 - 5.6	SS-3			-										A-4a (VISUAL)	-





HORIZONTAL SCALE IN FEET



GEOTECHNICAL PROFILE - ROADWAY

STA. 25+00 TO STA. 39+50 WASHINGTON ST.



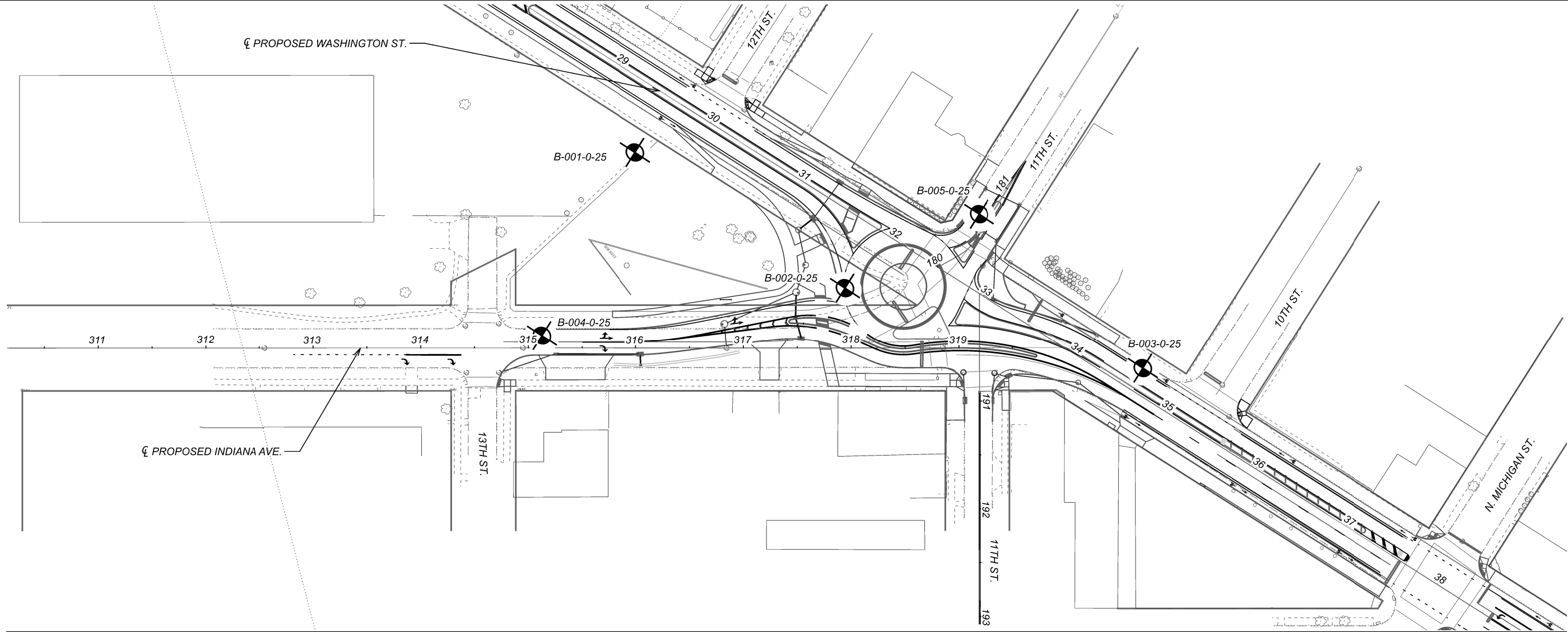
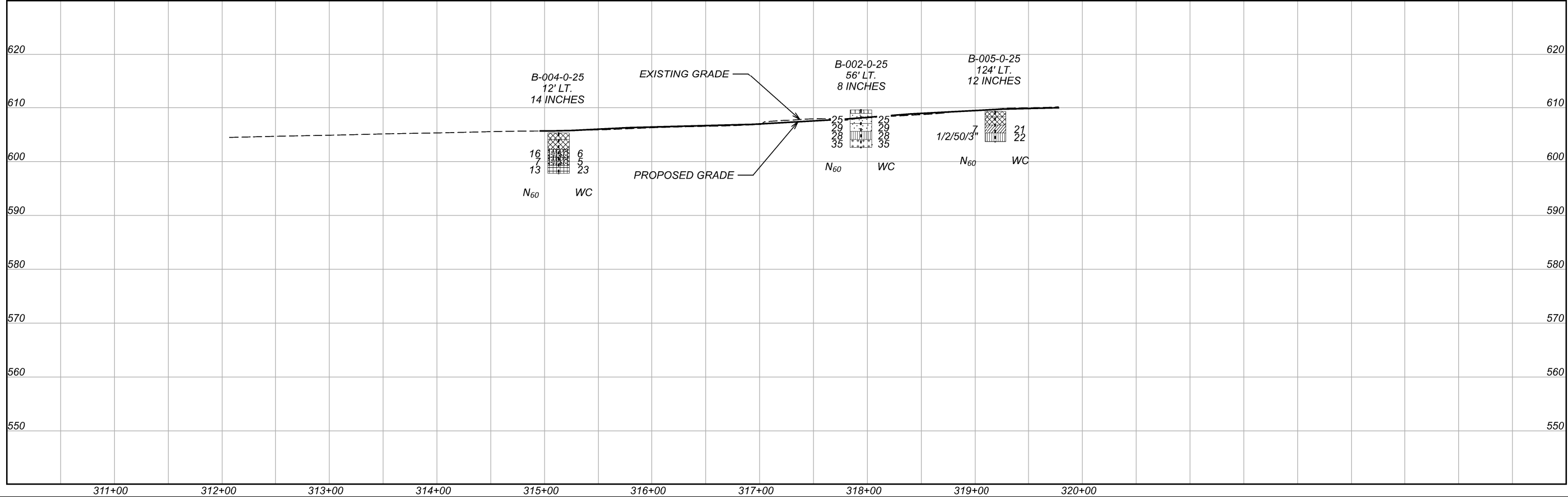
DESIGNER
KAH

REVIEWER
SBK

PROJECT ID
123598

SUBSET	TOTAL
3	4

SHEET	TOTAL
P. 1	1



HORIZONTAL
SCALE IN FEET
0 25 50 100

GEOTECHNICAL PROFILE - ROADWAY
STA. 312+00 TO STA. 320+00 INDIANA AVE.

DESIGNER
KAH
REVIEWER
SBK
PROJECT ID
123598
SUBSET
4
TOTAL
4
SHEET
P. 1
TOTAL
1