Construction & Geotechnical Material Testing, Inc.

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April 30, 2021 / Revised May 28, 2021

Mr. Patrick J. Glenn, P.E., CFM
Gewalt Hamilton Associates, Inc.
625 Forest Edge Drive
Vernon Hills, Illinois 60061

CGMT Project No. 21G0190R1

Reference: ***Report of Subsurface Exploration and Geotechnical Engineering Services, Proposed Utility Improvements, Various Locations, Lake County, Illinois***

Dear Mr. Glenn:

CGMT, Inc. has completed the subsurface exploration and geotechnical engineering analyses for the Proposed Utility Improvements located along W. Columbia Bay Road, Oak Grove Drive, Hilltop Road, Catalpa Drive and Midland Drive in Lake County, Illinois. This report describes the subsurface exploration procedures, laboratory testing, and geotechnical recommendations for project construction. A Boring Location Plan is included in the Appendix of this report along with the Boring Logs performed for the exploration.

We appreciate this opportunity to be of service to the Gewalt Hamilton Associates, Inc. during the design phase of this project. If you have any questions with regard to the information and recommendations presented in this report, or if we can be of further assistance to you in any way during the planning or construction of this project, please do not hesitate to contact us.

Respectfully,

CONSTRUCTION AND GEOTECHNICAL MATERIAL TESTING, INC.

Pratik Patel, P.E.
Vice President

3pc: Encl.

REPORT OF

**SUBSURFACE EXPLORATION AND
GEOTECHNICAL ENGINEERING SERVICES**

**PROPOSED UTILITY IMPROVEMNTS
VARIOUS LOCATIONS
LAKE COUNTY, ILLINOIS**

CGMT PROJECT NO. 21G0190R1

FOR

**GEWALT HAMILTON ASSOCIATES, INC.
VERNON HILLS, ILLINOIS**

APRIL 30, 2021 / REVISED MAY 28, 2021

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EXECUTIVE SUMMARY

Construction & Geotechnical Material Testing, Inc. (CGMT) has completed your subsurface exploration and geotechnical engineering project. The subsurface conditions encountered during our exploration and CGMT's conclusions and recommendations are summarized below. This summary should not be considered apart from the entire text of the report with all the qualifications and considerations mentioned herein. Details of our conclusions and recommendations are discussed in the following sections and in the Appendix of this report.

The project site is located along W. Columbia Bay Road, Oak Grove Drive, Hilltop Road, Catalpa Drive and Midland Drive in Lake County Illinois. A total of eight (8) borings, B-1 through B-8 and six (6) pavement cores, C-1 through C-6 were performed for this project. The soil conditions encountered at the borings performed at the site are summarized as follows:

Approximately 3 1/4 to 4 1/8 inches of asphalt pavement underlain by approximately 13 to 17 ½ inches of brown sand and gravel fill soils were encountered at the ground surface in the Borings B-1 through B-3. Approximately 6 to 11 ½ inches of asphalt pavement underlain by approximately 5 to 9 inches of aggregate base course were encountered at the ground surface in the Borings B-4 and B-6. Approximately 7 1/2 inches of asphalt pavement was encountered at the ground surface in the Borings B-5. Approximately 6 to 9 inches of topsoil was encountered at the ground surface in the Borings B-7 and B-8. The surface materials were underlain by very soft to very stiff dark brown, brown or gray silty clay fill soils that extended to depths of approximately 3½ to 6 feet below the existing grade in the Borings B-1, B-2, B-4, B-6 and B-7. The surface materials were underlain by natural, stiff to hard gray sandy clay soils that extended to the boring termination depth of approximately 10 feet below the existing grade in the Boring B-3. The surface materials were underlain by natural, very stiff to hard brown or gray silty clay soils that extended to a depth of approximately 8½ feet below the existing grade in the Boring B-5. The surface materials were underlain by natural, very stiff brown sandy clay soils that extended to a depth of approximately 6 feet below the existing grade in the Boring B-8. The silty clay fill soils were underlain by natural, very stiff brown silty clay soils that extended to a depth of approximately 8½ feet below the existing grade in the Boring B-1. The silty clay fill soils were underlain by natural, stiff to very stiff brown sandy clay soils that extended to a depth of approximately 8½ feet below the existing grade in the Boring B-2. The silty clay fill soils were underlain by natural, very stiff to hard brown, brown and gray or gray silty clay soils that extended to the boring termination depths of approximately 10 feet below the existing grade in the Borings B-4, B-6 and B-7. The silty clay soils were underlain by natural, medium dense brown and gray clayey silt soils that extended to the boring termination depth of approximately 10 feet below the existing grade in the Boring B-1. The sandy clay soils were underlain by natural, hard brown or brown and gray silty clay soils that extended to the boring termination depths of approximately 10 feet below the existing grade in the Borings B-2 and B-8. The silty clay soils were underlain by natural, medium dense brown sand soils that extended to the boring termination depth of approximately 10 feet below the existing grade in the Boring B-5.

We anticipate the new utilities will be installed with conventional cut and cover excavation techniques. Based on the boring data, the new utility is anticipated to be installed in primarily interbedded in the natural, brown or brown and gray very stiff to hard silty clay soils or the existing fill soils. These soils are generally considered suitable for direct pipe support provided that bedding material meeting the pipe manufacturer's recommendations is placed beneath the pipe. Subgrade soils that become saturated, loosened and/or softened during construction operations could be overexcavated and replaced. Backfill material in the overexcavated areas should consist of the on-site sand soils or 1-inch maximum size crushed stone or gravel containing no fines. The granular fill should be placed in lifts not more than 8 inches thick and compacted using vibratory equipment.

Horizontal Directional Drilling (HDD) is typically used when trenching or open excavation is not practical, such as water crossings, road/railway crossings, or in other sensitive crossings.

HDD is compatible with a wide range of soil conditions. Glacial till soils may be laden with cobbles and boulders. The presence of obstacles should be anticipated during utility installation. In addition, very loose, soft, squeezing, collapsible, or flowing soils that are not self-supporting and highly permeable, large-grained cohesionless soils and fractured rock are problematic for HDD. These problematic soils could present some difficulties related to bore stability, settlement, and inadvertent drilling fluid returns, depending on the type of soil. Based on the boring field and laboratory test data, the soils encountered in the Borings B-1, B-5 and B-6 may be problematic soils for HDD installation.

The presence of problematic soils does not necessarily preclude horizontal drilling operations but the contractor should be prepared to retain the soils with bracing as necessary. The presence of obstructions, cobbles and boulders within the existing soils along the proposed alignment may also be possible, and plans and specifications should include provisions for the protection of the pipe during horizontal drilling operations and the removal of such obstructions.

Subgrade preparation for complete reconstruction should be initiated by removing the existing asphalt pavement, along with the underlying stone base course. Although not encountered at the boring locations, any topsoil and/or soft layers encountered immediately below the base course, should also be stripped from the pavement subgrade at this time. The existing granular base course should be evaluated at the time of construction to determine whether these materials could be stockpiled for reuse. Care would be needed during stockpiling of the granular materials to avoid contaminating the material with underlying clays.

Following the removal of the existing pavement section and removal of any visibly unsuitable materials, such as utility trench fill, the exposed soil subgrade should be closely observed and proofrolled. The proofrolling should be performed using a fully loaded tandem axle dump truck or other equipment providing an equivalent subgrade loading. A minimum gross weight of 25 tons is recommended for the proofrolling equipment.

For the design and construction of exterior pavements, we recommend that the existing pavement section and unsuitable materials be removed before construction of new pavements and that new pavements will be supported by stable and approved subgrades consisting of silty clay fill soils or on new engineered fill.

Assuming the pavement subgrade will consist predominantly of the cohesive soils and new fill prepared in accordance with the recommendations given in this report, an estimated IBR value of 3 could be used in proportioning a flexible pavement section. Similarly, an estimated modulus of subgrade reaction value equal to 100 pounds per cubic inch could be used for design of rigid concrete pavement sections. A Subgrade Stability Rating (SSR) rating of (Poor) should be used for pavement design. Concrete pavements should be air-entrained Portland cement concrete with a minimum compressive strength of 4,000 psi and a minimum flexural strength of 650 psi. Concrete strength requirements are outlined in article 1020.04 of the Standard Specifications for Road and Bridge Construction, effective April 1, 2016.

We recommend that the utility excavations, preparation of subgrades, and pavement construction be monitored full-time by a CGMT geotechnical engineer or his representative to verify that the exposed subgrade materials will be suitable for the pavement support.

Report Prepared By:	Report Reviewed By:
Blake Sloan	*Nicholas Wolff*
Blake A. Sloan Staff Engineer	Nicholas P. Wolff, P.E. Geotechnical Engineer

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PROJECT OVERVIEW

Introduction

This report presents the results of our subsurface exploration and engineering services for the Proposed Utility Improvements in Lake County, Illinois. A General Location Plan included in the Appendix of this report, shows the approximate location of this project.

Project Description

ITEM	DESCRIPTION
Site Layout	See Boring Location Diagram in the Appendix
Proposed Construction	Based on the information provided to us, the proposed construction will consist of the installation of new utilities. We anticipate the new utilities will be installed with standard cut and cover installation techniques. The design of the new utilities has not been provided. Horizontal Directional Drilling (HDD) installation may be considered for water crossings, road/railway crossings, or in other sensitive crossings.
Grading and Existing Site Considerations	Site grading including cuts and fills are anticipated to be less than 1 foot will be needed to develop the final site grades across the site.
Ancillary Improvements	Additionally, Gewalt Hamilton Associates, Inc. is proposing to rehabilitate the existing pavements on W. Columbia Bay Road, Oak Grove Drive, Hilltop Road, Catalpa Drive and Midland Drive.

Scope of Work

The conclusions and recommendations contained in this report are based on the soil borings performed in the vicinity of the proposed pavement areas, and associated laboratory testing of selected soil samples. The scope of the subsurface exploration included the following.

Number of Borings	**Depth (feet)**
8	10
Number of Pavement Cores	**Depth (inches)**
6	15 to 21 5/8

The results of the soil borings, along with a Boring Location Plan showing the approximate locations where the borings were performed, are included in the Appendix of this report. Once the samples were returned to our laboratory we laboratory tests on selected representative soil samples from the borings to evaluate pertinent engineering properties, and, we analyzed the field and laboratory data to develop appropriate engineering recommendations.

The purpose of this report is to provide information and geotechnical engineering recommendations with regard to:

- Subsurface Soil and Groundwater Conditions
- Pavement Design and Construction
- Site Preparation and Earthwork

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EXPLORATION RESULTS

Site Description

ITEM	DESCRIPTION
Project Locations	The project site is located along W. Columbia Bay Road, Oak Grove Drive, Hilltop Road, Catalpa Drive and Midland Drive in Lake County, Illinois
Existing Site Improvements	At the time of our exploration the project site, the right of ways along W. Columbia Bay Road, Oak Grove Drive, Hilltop Road, Catalpa Drive and Midland Drive were covered with grass and trees. The existing pavements on W. Columbia Bay Road, Oak Grove Drive, Hilltop Road, Catalpa Drive and Midland Drive were relatively in poor condition with many cracks in longitudinal, transverse, and random orientations. Areas of alligator cracking were also present throughout the existing pavement. In our opinion, the pavement appeared to be near the end of its useful life.

Core Summary

A total of six (6) pavement cores, C-1 through C-6 were performed for this project. The core thicknesses and the subgrade conditions are summarized in the table below:

Pavement Core	Location	Total Depth of Exploration (Inches)	Pavement Components	Comments
C-1	W. Columbia Bay Road	21 5/8 Inches	1 3/4" Asphalt	Surface Course, Little Voids, Poor Bond
			2 3/8" Asphalt	Binder Course, Little Voids
			17 1/2" Subgrade	Sand and Gravel, Brown (SP-GP FILL)
C-2	W. Columbia Bay Road	17 1/4 Inches	1 3/8" Asphalt	Surface Course, Little Voids, Good Bond
			1 7/8" Asphalt	Binder Course, Little Voids
			14" Subgrade	Sand and Gravel, Brown (SP-GP FILL)
C-3	W. Columbia Bay Road	17 Inches	1 1/2" Asphalt	Surface Course, Little Voids, Good Bond
			2 1/2" Asphalt	Binder Course, Little Voids
			13" Subgrade	Sand and Gravel, Brown (SP-GP FILL)
C-4	Oak Grove Drive	15 Inches	2 1/4" Asphalt	Surface Course, Little Voids, Poor Bond
			1 3/4" Asphalt	Surface Course, Trace Voids, Poor Bond
			2" Asphalt	Binder Course, Trace Voids
			9" Base Course	Apparent IDOT CA06
C-5	Hilltop Road	7 1/2 Inches	1 1/4" Asphalt	Surface Course, Trace Voids, Good Bond
			6 1/4" Asphalt	Binder Course, Trace Voids

Pavement Core	Location	Total Depth of Exploration (Inches)	Pavement Components	Comments
C-6	Catalpa Drive	16 1/2 Inches	2 1/4" Asphalt	Surface Course, Little Voids, Good Bond
			2 1/2" Asphalt	Surface Course, Little Voids, Poor Bond
			6 3/4" Asphalt	Binder Course, Little Voids
			5" Base Course	Apparent IDOT CA06

Soil Conditions

A total of eight (8) borings, B-1 through B-8 were performed for this project. The soil conditions encountered at the borings performed at the site are summarized as follows:

Approximately 3 1/4 to 4 1/8 inches of asphalt pavement underlain by approximately 13 to 17 ½ inches of brown sand and gravel fill soils were encountered at the ground surface in the Borings B-1 through B-3. Approximately 6 to 11 ½ inches of asphalt pavement underlain by approximately 5 to 9 inches of aggregate base course were encountered at the ground surface in the Borings B-4 and B-6. Approximately 7 1/2 inches of asphalt pavement was encountered at the ground surface in the Borings B-5. Approximately 6 to 9 inches of topsoil was encountered at the ground surface in the Borings B-7 and B-8. The surface materials were underlain by very soft to very stiff dark brown, brown or gray silty clay fill soils that extended to depths of approximately 3½ to 6 feet below the existing grade in the Borings B-1, B-2, B-4, B-6 and B-7. The surface materials were underlain by natural, stiff to hard gray sandy clay soils that extended to the boring termination depth of approximately 10 feet below the existing grade in the Boring B-3. The surface materials were underlain by natural, very stiff to hard brown or gray silty clay soils that extended to a depth of approximately 8½ feet below the existing grade in the Boring B-5. The surface materials were underlain by natural, very stiff brown sandy clay soils that extended to a depth of approximately 6 feet below the existing grade in the Boring B-8. The silty clay fill soils were underlain by natural, very stiff brown silty clay soils that extended to a depth of approximately 8½ feet below the existing grade in the Boring B-1. The silty clay fill soils were underlain by natural, stiff to very stiff brown sandy clay soils that extended to a depth of approximately 8½ feet below the existing grade in the Boring B-2. The silty clay fill soils were underlain by natural, very stiff to hard brown, brown and gray or gray silty clay soils that extended to the boring termination depths of approximately 10 feet below the existing grade in the Borings B-4, B-6 and B-7. The silty clay soils were underlain by natural, medium dense brown and gray clayey silt soils that extended to the boring termination depth of approximately 10 feet below the existing grade in the Boring B-1. The sandy clay soils were underlain by natural, hard brown or brown and gray silty clay soils that extended to the boring termination depths of approximately 10 feet below the existing grade in the Borings B-2 and B-8. The silty clay soils were underlain by natural, medium dense brown sand soils that extended to the boring termination depth of approximately 10 feet below the existing grade in the Boring B-5.

SOILS	SOIL CHARACTERISTICS
Fill: Cohesive Soils	3 to 12 blows per foot Unconfined Compressive Strengths: <0.25 to 4.5+ tsf; Very Soft to Hard Moisture Contents: 18.3 to 27.2 percent Dry Densities: 98.0 to 105.9 lbs/ft^3
Silty Clay Soils	8 to 50+ blows per foot Unconfined Compressive Strengths: 2.0 to 4.5+ tsf; Very Stiff to Hard Moisture Contents: 14.4 to 19.0 percent
Clayey Silt Soils	22 blows per foot; Medium Dense Moisture Contents: 19.5 percent

SOILS	SOIL CHARACTERISTICS
Sand Soils	13 blows per foot; Medium Dense Moisture Contents: 11.1 percent

The specific soil types observed at the borings are noted on the boring logs, enclosed in the Appendix.

Groundwater Observations

Observations for groundwater were made during sampling and upon completion of the drilling operations at the boring locations. In auger drilling operations, water is not introduced into the boreholes, and the groundwater position can often be obtained by observing water flowing into or out of the boreholes. Furthermore, visual observation of the soil samples retrieved during the auger drilling exploration can often be used in evaluating the groundwater conditions. Groundwater levels were observed during drilling and immediately the completion of drilling. Groundwater measurements are summarized in the table below.

Groundwater Summary

BORINGS	GROUNDWATER LEVELS	
	DURING DRILLING	IMMEDIATELY AFTER COMPLETION
Boring B-1	3 feet	None
Boring B-4	None	9 feet
Boring B-6	7 feet	7 feet
Borings B-2, B-3, B-5, B-8 and B-9	None	None

Glacial till soils in the Midwest frequently oxidize from gray to brown above the level at which the soil remains saturated. The seasonal high water table is often interpreted to be near this zone of color change. Based on the results of this exploration, the season high water table may be located at depths of approximately 1½ to 8½ feet below the existing grade.

More definitive evidence of prevailing groundwater levels could be obtained through the use of groundwater monitoring wells, which CGMT could install and monitor if requested.

It should be noted that the groundwater level can vary based on precipitation, evaporation, surface run-off and other factors not immediately apparent at the time of this exploration. Surface water runoff will be a factor during general construction, and steps should be taken during construction to control surface water runoff and to remove any water that may accumulate in the proposed excavations as well as floor slab and pavement areas. Precipitation generally varies seasonally. To assist in anticipating groundwater fluctuations changes throughout the year, average monthly precipitation is provided in the table below. Average precipitation levels were obtained from wunderground.com.

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Seasonal Precipitation Summary

Month	January	February	March	April	May	June	July	August	September	October	November	December	Total
Normal Precipitation (inches)	1.27	1.02	1.26	3.78	9.30	2.64	2.24	0.80	3.18	3.58	1.72	2.55	33.34

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ANALYSIS AND RECOMMENDATIONS

Overview

The following recommendations have been developed on the basis of the previously described project characteristics and subsurface conditions encountered. If there are any changes to the project characteristics or if different subsurface conditions are encountered during construction, CGMT should be consulted so that the recommendations of this report can be reviewed.

The utility installation methods that could be considered would include:

- Cut and Cover Trench Excavation
- Horizontal Directional Drilling (HDD)

The pavement rehabilitation methods that could be considered would include:

- Complete Reconstruction of aggregate base and pavement
- Partial Reconstruction
- Milling and Overlay

Based on the observed condition of the pavements which include severe longitudinal, transverse, and alligator cracking, at the boring locations, a partial reconstruction program or a milling and overlay program will probably be best suited in most areas. A complete reconstruction of aggregate base and pavement program would likely be the most expensive alternate but would provide higher confidence of the subgrade and subbase materials would likely be best suited.

Complete reconstruction would consist of removing the entire existing pavement section down to the soil subgrade. It is possible that undercutting may be necessary when subgrade soils consisting of high moisture and/or organic soils are exposed following removal of the asphalt pavement layers.

Cut and Cover Trench Excavation

We anticipate the new utilities will be installed with conventional cut and cover excavation techniques. Based on the boring data, the new utility is anticipated to be installed in primarily interbedded in the natural, brown, brown and gray or gray very stiff to hard silty clay soils; natural, brown or gray stiff to hard sandy clay soils; natural, brown and gray medium dense clayey silt soils; natural, brown medium dense sand soils or the existing fill soils. These soils are generally considered suitable for direct pipe support provided that bedding material meeting the pipe manufacturer's recommendations is placed beneath the pipe. Subgrade soils that become saturated, loosened and/or softened during construction operations could be overexcavated and replaced. Backfill material in the overexcavated areas should consist of the on-site sand soils or 1-inch maximum size crushed stone or gravel containing no fines. The granular fill should be placed in lifts not more than 8 inches thick and compacted using vibratory equipment.

Care should be taken during excavation to protect the structural integrity of any existing structures, pavements or adjacent underground utilities. In particular, the interface of any existing trench backfill and native soils can form a ready failure surface where intersected by excavations for new utilities. Temporary sheeting, shoring, and underpinning may be required depending upon factors such as the depth of the excavation, limitations on width of the excavation, the location of existing structures, groundwater and soils conditions. We could provide lateral earth pressure parameters for design of braced excavations, if requested. The geometry of the braced excavation area with reference to the surrounding structures and their loading would need to be defined for this type of analysis.

Some lateral movement of shoring and bracing systems normally occurs which can cause some loss of support for surrounding pavements or utilities. Portions of pavement nearest the excavations can be removed so that the remaining pavement base can be recompacted and stabilized after trench excavations are backfilled and shoring is removed, so that reflective cracking of pavements is reduced.

All vehicles, construction equipment and soil piles should be kept a significant lateral distance from the crest of confined excavations to maintain safe working conditions. Vehicles and soil piles located adjacent to excavations and the roadway embankment, would significantly influence the stability of the slopes as outlined by the OSHA regulations. A more detailed stability analysis would be required for these conditions. Exposed excavations slope faces should be protected from the elements.

Harmful odors could be encountered in the trench excavations during construction. The contractor should check for gas and/or oxygen deficiency prior to any workers entering the excavations. All the necessary monitoring and safety precautions should be strictly observed during construction.

Horizontal Directional Drilling (HDD)

Horizontal Directional Drilling (HDD) is typically used when trenching or open excavation is not practical, such as water crossings, road/railway crossings, or in other sensitive crossings.

HDD is compatible with a wide range of soil conditions. Glacial till soils may be laden with cobbles and boulders. The presence of obstacles should be anticipated during utility installation. In addition, very loose, soft, squeezing, collapsible, or flowing soils that are not self-supporting and highly permeable, large-grained cohesionless soils and fractured rock are problematic for HDD. These problematic soils could present some difficulties related to bore stability, settlement, and inadvertent drilling fluid returns, depending on the type of soil. Based on the boring field and laboratory test data, the soils encountered in the Borings B-1, B-5 and B-6 may be problematic soils for HDD installation.

The problematic soils for HDD installation encountered in the borings can be summarized in the table below:

Problematic Soils for HDD Installation

Boring	Material	Depth
Boring B-1	Brown and Gray Clayey Silt – Not Self-Supporting and Highly Permeable Soils	8½ to 10 feet
Boring B-5	Brown Sand – Not Self-Supporting and Highly Permeable Soils	8½ to 10 feet
Boring B-6	Gray Silty Clay – Very Soft, Not Self-Supporting Soils	3½ to 6 feet

The presence of problematic soils does not necessarily preclude horizontal drilling operations but the contractor should be prepared to retain the soils with bracing as necessary. The presence of obstructions, cobbles and boulders within the existing soils along the proposed alignment may also be possible, and plans and specifications should include provisions for the protection of the pipe during horizontal drilling operations and the removal of such obstructions.

Trench Backfill

The uppermost 2 feet of fill placed in paved areas should consist of well-graded granular material, such as IDOT gradation CA-6. Backfill should be placed in lifts not exceeding 9-inches in loose thickness and each lift compacted with vibratory equipment to at least 95 percent of the material's modified Proctor maximum dry density (ASTM D-1557). The moisture content of the granular fill should be within 3 percent below and 3 percent above the optimum moisture content for the material based on the modified Proctor test (ASTM D-1557).

Cohesive soils may be suitable for reuse as fill provided the trench is wide enough to allow placement of fill in relatively thin lifts and proper sheepsfoot-type compaction equipment can access the trenches. However, we do recommend some limitations to the use of the cohesive soils. Some portions of the clay soils excavated from the trench may have water contents that are too high for immediate use as trench backfill and there is the likelihood that compaction of on-site soils will require some moisture adjustment.

Subgrade Preparation Recommendations for Complete Reconstruction

Subgrade preparation for complete reconstruction should be initiated by removing the existing asphalt pavement, along with the underlying stone base course. Although not encountered at the boring locations, any topsoil and/or soft layers encountered immediately below the base course, should also be stripped from the pavement subgrade at this time. The existing granular base course should be evaluated at the time of construction to determine whether these materials could be stockpiled for reuse. Care would be needed during stockpiling of the granular materials to avoid contaminating the material with underlying clays. The organic soils discussed above should be completely removed from pavement areas and replaced with new engineered fill.

Following the removal of the existing pavement section and removal of any visibly unsuitable materials, such as utility trench fill, the exposed soil subgrade should be closely observed and proofrolled. The proofrolling should be performed using a fully loaded tandem axle dump truck or other equipment providing an equivalent subgrade loading. A minimum gross weight of 25 tons is recommended for the proofrolling equipment.

Proofrolling will aid in providing a firm base for compaction of new fill or subbase materials and in delineating soft or unstable subgrade conditions. Soft or unstable subgrades identified by proofrolling should be scarified in-place, moisture conditioned as necessary, and recompacted as recommended below. If adequate stability cannot be achieved through scarification and recompaction, or project schedules or weather conditions do not allow scarification and recompaction, the unstable material should be undercut and replaced with suitable engineered fill. Although the borings did not suggest that extensive areas of undercutting would be required, subgrade conditions between borings and core holes could vary and some contingency for undercutting should be provided in the contract documents.

Where required undercuts are less than about 1 foot in depth, IDOT Gradation CA-6 granular fill materials or stockpiled granular base material should be used to backfill the undercut. Where undercuts exceed about 1 foot, consideration could be given to backfilling the undercuts with an approved coarse crushed stone. However, these coarser materials should be "choked off" with a minimum 6-inch thickness of CA-6. The use of geotextile or geogrid materials to separate and reinforce the engineered fill could also be considered. Geotextiles can often provide some savings by reducing the required depths of cut and subsequent fill volumes. If undercut depths excess about 1.5 to 2 feet, consideration should be given to using geotextiles.

We should note that the use of granular soils as undercut backfill can create localized areas for water to collect below pavements, which can contribute to subgrade saturation, pumping and frost heave. If conditions warrant such undercuts and granular backfill, it may also be necessary to provide an outlet, such as a gravel filled trench extended to a catch basin or sewer trench backfill, to drain the zone of granular fill.

Some of the near surface soils encountered in the borings had somewhat high moisture contents, and sand or silt layers will likely be encountered near the ground surface. These soil types could be encountered in isolated to relatively broad areas during grading. Instability and disturbance of these soil types could occur during construction, particularly if wetted by surface water or seepage. These soils may exhibit a relatively firm/stable condition upon initial exposure at the subgrade level. However, repetitive construction traffic and/or wetting will deteriorate the strength of these soils. It is likely that portions of the pavement subgrades could become unstable during proofrolling and construction operations and some means of subgrade stabilization may be required to facilitate construction.

Representatives of CGMT should be present on an on-going basis to perform observations and testing during the preparation of the pavement areas.

Subgrade Preparation Recommendations for Partial Reconstruction

Site preparation for a partial pavement reconstruction would involve the primary steps outlined above, with the exception of removing only a portion of the existing aggregate base course. The amount of base course to be removed would be dependent upon the pavement section thickness used to reconstruct the pavement (see previous section of report).

Any aggregate base course which is disturbed during the removal process should be recompacted. After excavating to grade and recompacting as necessary, the proofrolling and undercutting procedures outlined earlier should be performed.

Milling and Overlay

Milling and overlaying the existing asphalt pavement for pavement rehabilitation could also be considered. Areas of alligator cracking or rutting would likely need to be removed and replaced with a thicker section of new asphalt. Following the milling operation, cracks in the exposed asphalt pavement should be sealed and a crack resistant fabric should be placed over the existing milled asphalt surface prior to the placing the overlay.

Milling over thin sections of existing asphalt pavement (less than 3 or 4 inches) may not be feasible since existing cracks probably extend completely through the existing asphalt pavement and may cause the pavement break up during milling. Therefore, a combination of asphalt pavement removal would probably need to be performed in conjunction with any mill and overlay program.

The planned thickness of new overlay could exceed the practical depth of milling (particularly where existing pavements are thin). The asphalt overlay could extend above the flow line along existing curb and gutter in some areas or additional milling would probably need to be performed around existing manhole structures and curbs to match existing elevations.

Engineered Fill

Where new fill material is required for backfill or to otherwise reach the design subgrade elevation beneath pavements, we recommend that engineered fill be used. Any soil placed as engineered fill should be an approved material, free of organic matter or debris, be a non-frost susceptible soil, and have a liquid limit and plasticity index less than 40 and 15, respectively. The project geotechnical engineer should be consulted to determine the suitability of off-site/on-site materials for use as engineered fill, prior to use or placement. Fill materials containing large voids are more susceptible to future movement that may become unstable resulting in excessive and variable settlement.

Fill should be placed in lifts not exceeding 8 inches in loose thickness, moisture conditioned to within 2 percent of the optimum moisture content and compacted to at least 95 percent of the maximum dry density obtained in accordance with ASTM Specification D 1557, Modified Proctor Method. Fill placed below footing base elevations should be compacted to at least 95 percent of the material's modified Proctor maximum dry density (ASTM D 1557). Engineered fill placed to support foundations should extend 1 foot beyond the outside edges of the footings and from that point outward laterally 1 foot for every 2 feet of fill thickness below the footings. Laboratory proctor tests should be performed on fill materials to determine the maximum dry density and optimum moisture content. A shrinkage factor of 15 percent can be assumed for estimating earthwork quantities for bidding purposes.

We recommend suitable silty clays used to raise the grade or backfill undercuts should be compacted with a sheepsfoot roller. Granular engineered fill should be compacted with a smooth drum roller or adequate heavy vibratory plate. Moisture control during earthwork operations, including the use of disking or appropriate drying equipment and techniques, should be expected.

In-place density tests should be performed with a minimum of 1 test per 2,000 square feet of fill area for each lift of fill placed. We recommend that the placement of engineered fill be monitored full-time by CGMT representative and in-place density tests should be performed to verify the adequacy of the compaction for each lift of fill placed.

Pavements

For the design and construction of the pavements, we recommend that the existing pavement and any vegetation, topsoil, organic soils and/or unsuitable/deleterious materials should be removed and replaced with new, properly compacted engineered fill as discussed in the **Subgrade Preparation** sections. If the removal is performed in accordance with these recommendations, we anticipate the pavements will be supported on stable and approved subgrades consisting of natural, brown, brown and gray or gray very stiff to hard silty clay soils; natural, brown or gray stiff to hard sandy clay soils; the existing fill soils or on new, properly compacted engineered fill.

It is assumed that the existing pavement subgrade has performed satisfactorily during the proofroll discussed in the **Subgrade Preparation** subsection, even though the existing fill soils were encountered at depths greater than those explored. Provided that the pavement subgrade passes a proofroll, the risk of excessive settlement is low. However, if the pavement subgrade does not pass the proofroll, some undercutting and placement of controlled backfill will be required.

We anticipate the new pavement will be constructed of asphaltic concrete or Portland cement concrete. We expect that the pavements will generally be utilized for light duty traffic. We recommend the pavement subjected to light traffic be underlain by a minimum of 8 inches of base course granular material, similar to Illinois Department of Transportation gradation CA-6.

Assuming the pavement subgrade will consist predominantly of the cohesive soils and new fill prepared in accordance with the recommendations given in this report, an estimated IBR value of 3 could be used in proportioning a flexible pavement section. Similarly, an estimated modulus of subgrade reaction value equal to 100 pounds per cubic inch could be used for design of rigid concrete pavement sections. A Subgrade Stability Rating (SSR) rating of (Poor) should be used for pavement design. Concrete pavements should be air-entrained Portland cement concrete with a minimum compressive strength of 4,000 psi and a minimum flexural strength of 650 psi. Concrete strength requirements are outlined in article 1020.04 of the Standard Specifications for Road and Bridge Construction, effective April 1, 2016.

Final design sections should consider details such as final grades, traffic loadings, traffic volumes, the desired design life and any local, county or city codes. If you wish, we would be pleased to perform a detailed pavement section design using AASHTO or Asphalt Institute procedures when this information is available. Minimum design requirements for hot-mix asphalt (HMA) shall follow Article 1030.05 of the Standard Specifications for Road and Bridge Construction, effective April 1, 2016. During asphalt pavement construction, the wearing and leveling course should be compacted to a minimum of 93 percent of the theoretical density value. Prior to placing the granular material, the pavement subgrade soil should be properly compacted, proofrolled, and free of standing water, mud, and frozen soil.

An important consideration with the design and construction of pavements is surface and subsurface drainage. Where standing water develops, either on the pavement surface or within the base course layer, softening of the subgrade and other problems related to the deterioration of the pavement can be expected. Furthermore, good drainage should reduce the possibility of the subgrade materials becoming saturated over a long period of time. We would be pleased to be of further assistance to you in the design of the project pavements by providing additional recommendations during construction of the project.

Periodic maintenance of pavements should be anticipated. The subgrade parameters provided in this report consider that significant changes in the subgrade moisture content do not occur. To reduce the potential for changes in subgrade moisture, all paved areas should be sloped to provide rapid drainage of surface water and to drain water away from the pavement edges. Water that is allowed to pond on or adjacent to the pavement can saturate and soften the subgrade soils and subsequently accelerate pavement deterioration.

Granular base or subbase materials directly below pavement sections can also collect infiltrated surface water and soften the subgrade as well as increase the effects of frost action, both of which can be detrimental to pavements. For these reasons, where granular materials are used over a cohesive soil subgrade or where the groundwater level is within 3.5 feet of finished pavement subgrade, we recommend that consideration be given to using pavement underdrains hydraulically connected to the granular base or subbase to improve the pavement performance and extend its service life. Underdrains should be installed at 300 to 500 feet intervals and at low points in the roadway profile. Pipe underdrains shall be installed according to Check Sheet #19 of the Supplemental Specifications and Recurring Special Provisions, effective January 1, 2015.

General Construction Considerations

We recommend that the subgrade preparation, installation of the new utility be monitored by a CGMT geotechnical engineer or his representative to verify that the exposed subgrade materials will be suitable for the new utility and are consistent with the boring log information obtained during this geotechnical exploration. We would be pleased to provide these services. Methods of verification and identification such as proofrolling, DCP testing and hand auger probe holes will be necessary to further evaluate the subgrade soils and identify unsuitable soils. The contractor should be prepared to overexcavate any unsuitable subgrade soils that may be encountered at isolated locations.

All unsuitable materials should be removed and replaced with environmentally clean, inorganic fill and free of debris or harmful matter. Unsuitable materials removed from the project site should be disposed of in accordance with all applicable federal, state, and local regulations.

The contractor should avoid stockpiling excavated materials immediately adjacent to the excavation walls. We recommend that stockpile materials be kept back from the excavation a minimum distance equal to the excavation depth to avoid surcharging the excavation walls. If this is impractical due to space constraints, the excavation walls should be retained with bracing designed for the anticipated surcharge loading.

Excavations should comply with the requirements of OSHA 29CFR, Part 1926, Subpart P, "Excavations" and its appendices, as well as other applicable codes. This document states that the contractor is solely responsible for the design and construction of stable, temporary excavations. The excavations should not only be in accordance with current OSHA excavation and trench safety standards but also with applicable local, state, and federal regulations. The contractor should shore, slope or bench the excavation sides when appropriate. In no case should excavations extend below the level of adjacent structures, utilities or pavements, unless underpinning or other adequate support is provided. Site safety is the sole responsibility of the contractor, who shall also be responsible for the means, methods and sequencing of construction operations.

12
EXPLORATION PROCEDURES

Subsurface Exploration Procedures

The soil borings were located in the field by a CGMT Field Engineer based on the proposed boring site plan provided to us. As required by the State of Illinois, the driller notified Illinois One-Call System, JULIE, to verify underground utilities in the vicinity of the project site prior to drilling operations.

The soil borings were performed with a truck-mounted rotary-type auger drill rig, which utilized continuous hollow stem augers to advance the boreholes. Representative soil samples were obtained at 2½ foot intervals for the first 10 feet and 5 foot intervals thereafter by means of conventional split-barrel sampling procedures. In this procedure, a 2-inch O.D., split-barrel sampler is driven into the soil a distance of 18 inches by a 140-pound hammer falling 30 inches. The number of blows required to drive the sampler through a 12-inch interval, after initial setting of 6 inches, is termed the Standard Penetration Test (SPT) or N-value and is indicated for each sample on the boring logs. The SPT value can be used as a qualitative indication of the in-place relative density of cohesionless soils. In a less reliable way, it also indicates the consistency of cohesive soils. This indication is qualitative, since many factors can significantly affect the standard penetration resistance value and prevent a direct correlation between drill crews, drill rigs, drilling procedures, and hammer-rod-sampler assemblies. The drill rig utilized an automatic trip hammer to drive the sampler. Consideration of the effect of the automatic hammer's efficiency was included in the interpretation of subsurface information for the analyses prepared for this report.

The drill crew maintained a field log of the soils encountered in the borings. After recovery, each geotechnical soil sample was removed from the sampler and visually classified. Representative portions of each soil sample were then sealed in jars and brought to our laboratory in Elk Grove Village, Illinois for further visual examination and laboratory testing. After completion of the drilling operations, the boreholes were backfilled with auger cuttings to the existing ground surface.

Laboratory Testing Program

Representative soil samples were selected and tested in our laboratory to check field classifications and to determine pertinent engineering properties. The laboratory testing program included visual classifications and unconfined compressive strength and moisture content determinations.

An experienced geotechnical engineer classified each soil sample on the basis of texture and plasticity in accordance with the Unified Soil Classification System. The group symbols for each soil type are indicated in parentheses following the soil descriptions on the boring logs. A brief explanation of the Unified System is included with this report. The geotechnical engineer grouped the various soil types into the major zones noted on the boring logs. The stratification lines designating the interfaces between earth materials on the boring logs and profiles are approximate; in situ, the transitions may be gradual.

Unconfined compressive strength tests were performed on cohesive soil samples with the use of a calibrated hand penetrometer. In the hand penetrometer test, the unconfined compressive strength of a soil sample is estimated, to a maximum of 4½ tons per square foot (tsf) by measuring the resistance of a soil sample to penetration of a small, calibrated spring-loaded cylinder.

The soil samples will be retained in our laboratory for a period of 60 days, after which, they will be discarded unless other instructions are received as to their disposal.

13
CLOSING

We recommend that the construction activities be monitored by CGMT to provide the necessary overview and to check the suitability of the subgrade soils for supporting the new utility. Once the final design becomes available, CGMT must be contacted to review the recommendations presented herein.

This report has been prepared in order to aid in the evaluation of this property and to assist the architect and/or engineer in the design of this project. The scope is limited to the specific project and locations described herein and our description of the project represents our understanding of the significant aspects relative to soil characteristics. In the event that any change in the nature or location of the proposed construction outlined in this report are planned, we should be informed so that the changes can be reviewed and the conclusions of this report modified or approved in writing by the geotechnical engineer. It is recommended that all construction operations dealing with earthwork be reviewed by an experienced geotechnical engineer to provide information on which to base a decision as to whether the design requirements are fulfilled in the actual construction. If you wish, we would welcome the opportunity to provide field construction services for you during construction.

The analysis and recommendations submitted in this report are based upon the data obtained from the soil borings and tests performed at the locations as indicated on the Boring Location Plan and other information referenced in this report. This report does not reflect any variations, which may occur between the borings. In the performance of the subsurface exploration, specific information is obtained at specific locations at specific times. However, it is a well-known fact that variations in soil conditions exist on most sites between boring locations and also such situations as groundwater levels vary from time to time. The nature and extent of variations may not become evident until the course of construction. If variations then appear evident, after performing on-site observations during the construction period and noting characteristics and variations, a reevaluation of the recommendations for this report will be necessary.

APPENDIX

Vicinity Map

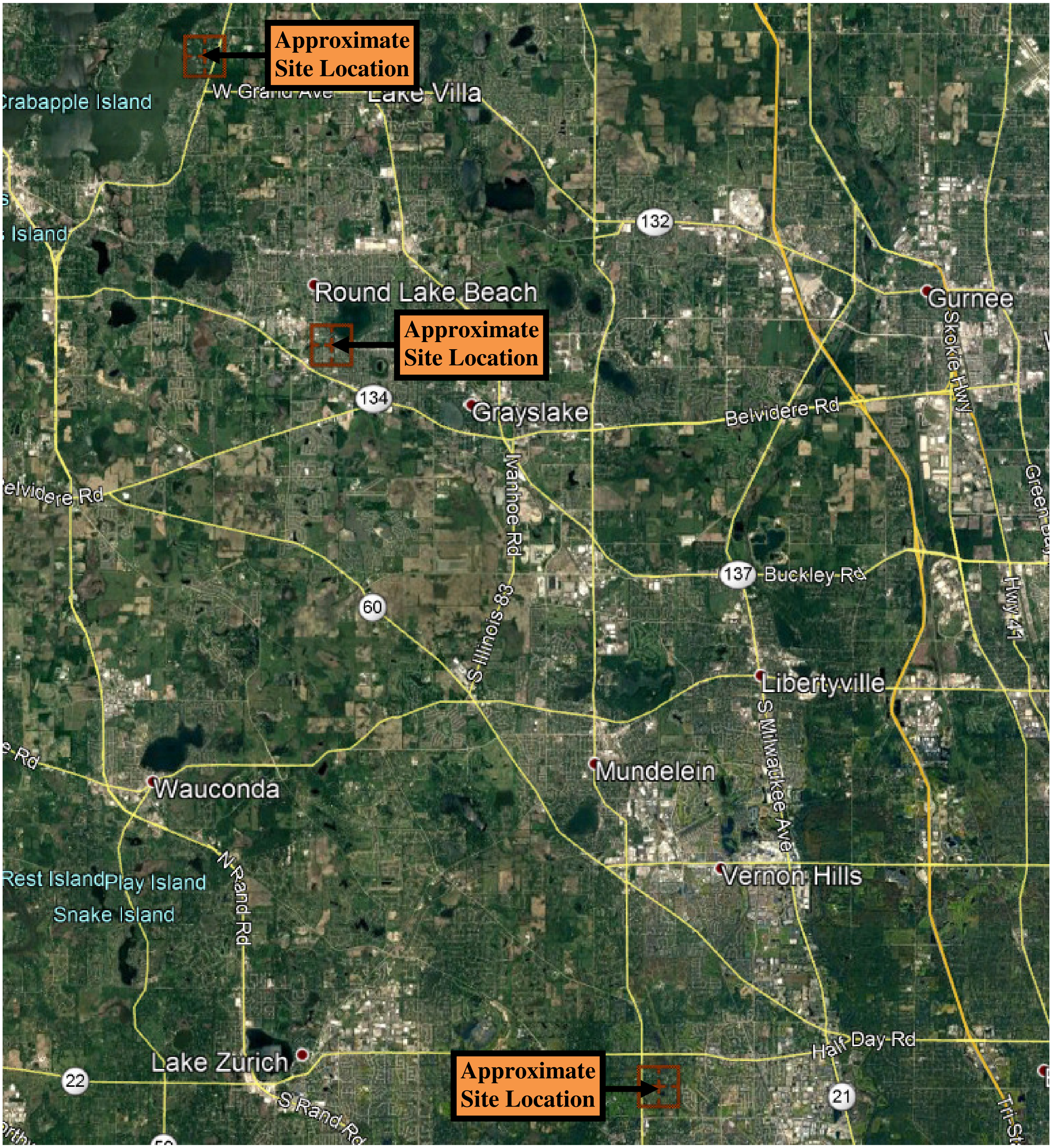
Boring Location Plan(s)

Boring Log(s)

Core Picture(s)

Unified Soil Classification System

Reference Notes for Boring Logs



	VICINITY MAP		CGMT Project No. 21G0190R1 Proposed Utility Improvements, Various Locations, Lake County, Illinois

Drawing Not To Scale

LEGEND

- Approximate Soil Boring Location

Soil Boring Location Diagram	
Proposed Utility Improvements	
W. Columbia Bay Road Lake Villa, Illinois 60046	
Project Manager	Project Number
N. Wolff	21G0190
Date	Sheet Number
4/30/2021	Fig. 1

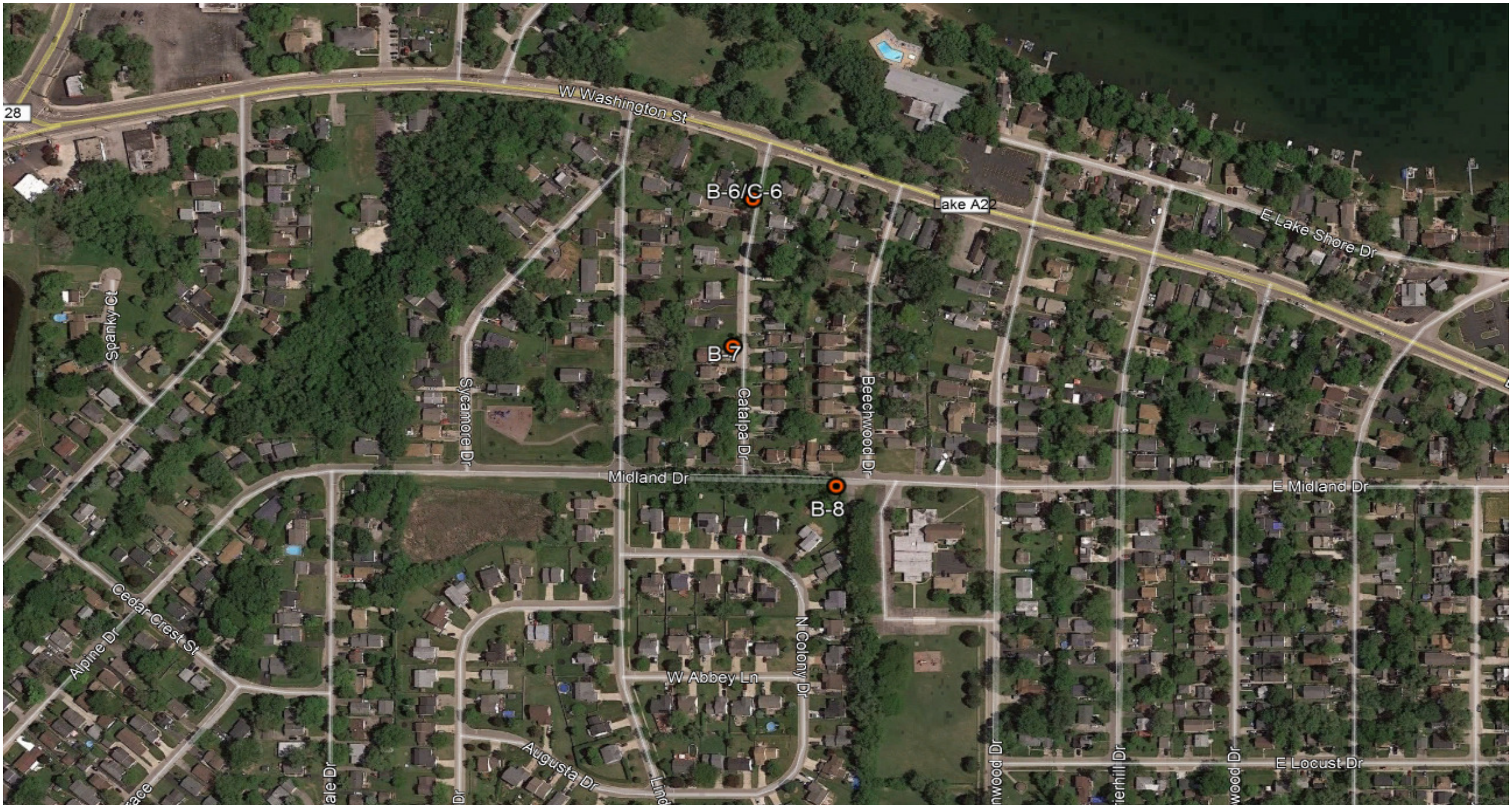
Drawing Not To Scale

N

LEGEND

- Approximate Soil Boring Location

Soil Boring Location Diagram	
Proposed Utility Improvements	
Oak Grove Drive & Hilltop Road Long Grove, Illinois 60047	
Project Manager	Project Number
N. Wolff	21G0190
Date	Sheet Number
4/30/2021	Fig. 2



Drawing Not To Scale

N

LEDGEND

- Approximate Soil Boring Location

Soil Boring Location Diagram	
Proposed Utility Improvements	
Catalpa Drive & Midland Drive Round Lake, Illinois 60073	
Project Manager	Project Number
N. Wolff	21G0190
Date	Sheet Number
4/30/2021	Fig. 3

Soil Boring Log

Construction & Geotechnical Material Testing, Inc.
60 Martin Lane, Elk Grove Village, Illinois 60007
Telephone (630) 595-1111 ♦ Fax (630) 595-1110

Soil Boring Prepared for:
Mr. Patrick J. Glenn, P.E., CFM
Gewalt Hamilton Associates, Inc.
625 Forest Edge Drive
Vernon Hills, Illinois 60061

Boring No.: B-01/C-1
Date: Wednesday, April 14, 2021
Project: Proposed Utility Improvements
W. Columbia Bay Road
Lake Villa, Illinois 60046
Project No.: 21G0190
Boring Location: See Boring Location Diagram
Logged By: L.S.H.
Ground Elevation:

Elevation	Depth	Strata	Soil / Rock Description	Sample Type & No. Depth Interval (Ft) Recovery (in)	Blow Count	Moisture Content (%)	Unconfined Compressive Strength (TSF)	Notes & Test Results
	0.0		Approximately 4 1/8" of Asphalt Pavement Approximately 17 1/2" of Sand and Gravel (SP-GP FILL)					Unconfined compressive strength of soil samples estimated using a calibrated penetrometer.
	1.0			SS-1	3	-	-	
			Silty Clay, Trace Sand and Gravel, brown, very stiff (CL FILL)	1.0' - 2.5'	4	23.9	2.5	
	2.0			9" Recovery	7			
	3.0							Dry Density: 1.0' - 2.5' = 98.0 lbs/ft^3
			Silty Clay, Trace Sand and Gravel, brown very stiff (CL)	SS-2	3			
	4.0			3.5' - 5.0'	6	16.3	2.5	
				18" Recovery	7			
	5.0							
	6.0			SS-3	6			
				6.0' - 7.5'	12	18.2	2.0	
	7.0			18" Recovery	13			
	8.0							
			Clayey Silt, Trace Gravel, brown and gray, medium dense (ML)	SS-4	5			
	9.0			8.5' - 10.0'	10	19.5	-	
			Saturated	16" Recovery	12			
	10.0		END of BORING at 10 Feet					
	11.0							
	12.0							
	13.0							
	14.0							
	15.0							
	16.0							
	17.0							
	18.0							
	19.0							
	20.0							

Drilling Contractor: CGMT, Inc.
Drilling Method: 3¼" O.D. H.S.A. Split Spoon Sampling
Drilling Equipment: CME-45C Truck Mounted Drill Rig
REVIEWED BY: NPW

Water Level (Ft.)
During Drilling: 3 feet
Immediately After Drilling: None

Soil Boring Log

Construction & Geotechnical Material Testing, Inc.
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Soil Boring Prepared for:
Mr. Patrick J. Glenn, P.E., CFM
Gewalt Hamilton Associates, Inc.
625 Forest Edge Drive
Vernon Hills, Illinois 60061

Boring No.: B-02/C-2
Date: Wednesday, April 14, 2021
Project: Proposed Utility Improvements
W. Columbia Bay Road
Lake Villa, Illinois 60046
Project No.: 21G0190
Boring Location: See Boring Location Diagram
Logged By: L.S.H.
Ground Elevation:

Elevation	Depth	Strata	Soil / Rock Description	Sample Type & No. Depth Interval (Ft) Recovery (in)	Blow Count	Moisture Content (%)	Unconfined Compressive Strength (TSF)	Notes & Test Results
	0.0		Approximately 3 1/4" of Asphalt Pavement Approximately 14" of Sand and Gravel (SP-GP FILL)					Unconfined compressive strength of soil samples estimated using a calibrated penetrometer.
	1.0		Sandy Clay, Trace Gravel, dark brown, stiff (CL FILL)	SS-1 1.0' - 2.5' 9" Recovery	3 3 5	- 18.3	- 1.5	
	2.0							
	3.0		Sandy Clay, Trace Gravel, brown, stiff to very stiff (CL)	SS-2 3.5' - 5.0' 17" Recovery	5 5 7	12.6	2.5	
	4.0							
	5.0							
	6.0			SS-3 6.0' - 7.5' 8" Recovery	8 13 18	12.8	1.5	
	7.0							
	8.0		Silty Clay, Trace Sand and Gravel, brown, hard (CL)	SS-4 8.5' - 10.0' 5" Recovery	9 16 45	14.6	4.5+	
	9.0							
	10.0		END of BORING at 10 Feet					
	11.0							
	12.0							
	13.0							
	14.0							
	15.0							
	16.0							
	17.0							
	18.0							
	19.0							
	20.0							

Drilling Contractor: CGMT, Inc.
Drilling Method: 3¼" O.D. H.S.A. Split Spoon Sampling
Drilling Equipment: CME-45C Truck Mounted Drill Rig
REVIEWED BY: NPW

Water Level (Ft.)
During Drilling: None
Immediately After Drilling: None

Soil Boring Log

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Telephone (630) 595-1111 ♦ Fax (630) 595-1110

Soil Boring Prepared for:
Mr. Patrick J. Glenn, P.E., CFM
Gewalt Hamilton Associates, Inc.
625 Forest Edge Drive
Vernon Hills, Illinois 60061

Boring No.: B-03/C-3
Date: Wednesday, April 14, 2021
Project: Proposed Utility Improvements
W. Columbia Bay Road
Lake Villa, Illinois 60046
Project No.: 21G0190
Boring Location: See Boring Location Diagram
Logged By: L.S.H.
Ground Elevation:

Sheet 1 of 1

Elevation	Depth	Strata	Soil / Rock Description	Sample Type & No. Depth Interval (Ft) Recovery (in)	Blow Count	Moisture Content (%)	Unconfined Compressive Strength (TSF)	Notes & Test Results
	0.0		Approximately 4" of Asphalt Pavement Approximately 13" of Sand and Gravel (SP-GP FILL)					Unconfined compressive strength of soil samples estimated using a calibrated penetrometer.
	1.0		Sandy Clay, Trace Gravel, gray, stiff to hard (CL)	SS-1 1.0' - 2.5' 10" Recovery	4 5 6	- 15.0	- 3.0	
	2.0							
	3.0							
	4.0			SS-2 3.5' - 5.0' 17" Recovery	3 3 6	18.4	1.25	
	5.0							
	6.0							
	7.0		Saturated	SS-3 6.0' - 7.5' 11" Recovery	3 3 4	27.7	1.0	
	8.0							
	9.0			SS-4 8.5' - 10.0' 18" Recovery	3 9 12	14.5	4.5+	
	10.0		END of BORING at 10 Feet					
	11.0							
	12.0							
	13.0							
	14.0							
	15.0							
	16.0							
	17.0							
	18.0							
	19.0							
	20.0							

Drilling Contractor: CGMT, Inc.
Drilling Method: 3¼" O.D. H.S.A. Split Spoon Sampling
Drilling Equipment: CME-45C Truck Mounted Drill Rig
REVIEWED BY: NPW

Water Level (Ft.)
During Drilling: None
Immediately After Drilling: None

Soil Boring Log

Construction & Geotechnical Material Testing, Inc.
60 Martin Lane, Elk Grove Village, Illinois 60007
Telephone (630) 595-1111 ♦ Fax (630) 595-1110

Boring No.: **B-04/C-4**
Date: Wednesday, April 14, 2021
Project: Proposed Utility Improvements
Oak Grove Drive
Long Grove, Illinois 60047
Project No.: 21G0190
Boring Location: See Boring Location Diagram
Logged By: L.S.H.
Ground Elevation:

Soil Boring Prepared for:
Mr. Patrick J. Glenn, P.E., CFM
Gewalt Hamilton Associates, Inc.
625 Forest Edge Drive
Vernon Hills, Illinois 60061

Sheet 1 of 1

Elevation	Depth	Strata	Soil / Rock Description	Sample Type & No. Depth Interval (Ft) Recovery (in)	Blow Count	Moisture Content (%)	Unconfined Compressive Strength (TSF)	Notes & Test Results
	0.0		Approximately 6" of Asphalt Pavement Approximately 9" of Aggregate Base Course (Apparent IDOT CA06)					Unconfined compressive strength of soil samples estimated using a calibrated penetrometer.
	1.0–2.5		Silty Clay, Trace Sand and Gravel, gray, stiff to very stiff (CL FILL)	SS-1 1.0' - 2.5' 14" Recovery	2 3 5	- 22.6	- 1.5	
	3.0							Dry Density: 1.0' - 2.5' = 100.3 lbs/ft^3
	3.5–5.0			SS-2 3.5' - 5.0' 14" Recovery	4 5 7	23.7	3.5	Dry Density: 3.5' - 5.0' = 99.3 lbs/ft^3
	6.0–7.5		Silty Clay, Trace Sand and Gravel, brown, very stiff (CL)	SS-3 6.0' - 7.5' 12" Recovery	3 3 5	17.0	2.0	
	8.5–10.0			SS-4 8.5' - 10.0' 8" Recovery	52 11 7	18.2	3.75	
	10.0		END of BORING at 10 Feet					
	11.0–20.0							

Drilling Contractor: CGMT, Inc.
Drilling Method: 3¼" O.D. H.S.A. Split Spoon Sampling
Drilling Equipment: CME-45C Truck Mounted Drill Rig
REVIEWED BY: NPW

Water Level (Ft.)
During Drilling: None
Immediately After Drilling: 9 feet

Soil Boring Log

Construction & Geotechnical Material Testing, Inc.
60 Martin Lane, Elk Grove Village, Illinois 60007
Telephone (630) 595-1111 ♦ Fax (630) 595-1110

Soil Boring Prepared for:
Mr. Patrick J. Glenn, P.E., CFM
Gewalt Hamilton Associates, Inc.
625 Forest Edge Drive
Vernon Hills, Illinois 60061

Boring No.: B-5/C-5
Date: Wednesday, April 14, 2021
Project: Proposed Utility Improvements
Hilltop Road
Long Grove, Illinois 60047
Project No.: 21G0190
Boring Location: See Boring Location Diagram
Logged By: L.S.H.
Ground Elevation:

Elevation	Depth	Strata	Soil / Rock Description	Sample Type & No. Depth Interval (Ft) Recovery (in)	Blow Count	Moisture Content (%)	Unconfined Compressive Strength (TSF)	Notes & Test Results
	0.0		Approximately 7 1/2" of Asphalt Pavement					Unconfined compressive strength of soil samples estimated using a calibrated penetrometer.
	1.0		Silty Clay, Trace Sand and Gravel, brown, hard (CL)	SS-1 1.0' - 2.5' 18" Recovery	4 5 8	16.9	4.5+	
	2.0							
	3.0							
	4.0			SS-2 3.5' - 5.0' 16" Recovery	5 6 11	14.6	4.5+	
	5.0							
	6.0		Silty Clay, Trace Sand and Gravel, gray, very stiff (CL)	SS-3 6.0' - 7.5' 18" Recovery	4 4 8	14.4	3.5	
	7.0							
	8.0							
	9.0		Sand, Trace Gravel, brown, medium dense (SP)	SS-4 8.5' - 10.0' 8" Recovery	5 6 7	11.1	-	
	10.0		END of BORING at 10 Feet					
	11.0							
	12.0							
	13.0							
	14.0							
	15.0							
	16.0							
	17.0							
	18.0							
	19.0							
	20.0							

Drilling Contractor:	CGMT, Inc.	**Water Level (Ft.)**	
Drilling Method:	3¼" O.D. H.S.A. Split Spoon Sampling	**During Drilling:**	None
Drilling Equipment:	CME-45C Truck Mounted Drill Rig	**Immediately After Drilling:**	None
	REVIEWED BY: NPW		

Soil Boring Log

Construction & Geotechnical Material Testing, Inc.
60 Martin Lane, Elk Grove Village, Illinois 60007
Telephone (630) 595-1111 ♦ Fax (630) 595-1110

Soil Boring Prepared for:
Mr. Patrick J. Glenn, P.E., CFM
Gewalt Hamilton Associates, Inc.
625 Forest Edge Drive
Vernon Hills, Illinois 60061

Boring No.:	**B-06/C-6**
Date:	Wednesday, April 14, 2021
Project:	Proposed Utility Improvements Catalpa Drive Round Lake, Illinois 60073
Project No.:	21G0190
Boring Location:	See Boring Location Diagram
Logged By:	L.S.H.
Ground Elevation:	

Sheet 1 of 1

Elevation	Depth	Strata	Soil / Rock Description	Sample Type & No. Depth Interval (Ft) Recovery (in)	Blow Count	Moisture Content (%)	Unconfined Compressive Strength (TSF)	Notes & Test Results
	0.0		Approximately 11 1/2" of Asphalt Pavement					Unconfined compressive strength of soil samples estimated using a calibrated penetrometer.
	1.0		Approx. 5" of Aggregate Base Course (CA06)	SS-1	3	-	-	
			Silty Clay, Trace Sand and Gravel, gray, very soft to stiff (CL FILL)	1.0' - 2.5'	4	21.6	1.25	
	2.0			11" Recovery	5			
	3.0							Dry Density:
				SS-2	1			1.0' - 2.5' = 105.9 lbs/ft^3
	4.0		Saturated	3.5' - 5.0'	1	27.2	<0.25	
				12" Recovery	2			
	5.0							
	6.0		Silty Clay, Trace Sand and Gravel, gray, very stiff (CL)	SS-3	2			
				6.0' - 7.5'	4	19.0	2.5	
	7.0			17" Recovery	5			
	8.0							
				SS-4	3			
	9.0			8.5' - 10.0'	5	17.2	2.5	
				14" Recovery	6			
	10.0		END of BORING at 10 Feet					
	11.0							
	12.0							
	13.0							
	14.0							
	15.0							
	16.0							
	17.0							
	18.0							
	19.0							
	20.0							

Drilling Contractor:	CGMT, Inc.	**Water Level (Ft.)**	
Drilling Method:	3¼" O.D. H.S.A. Split Spoon Sampling	**During Drilling:**	7 feet
Drilling Equipment:	CME-45C Truck Mounted Drill Rig	**Immediately After Drilling:**	7 feet
	REVIEWED BY: NPW		

Soil Boring Log

Construction & Geotechnical Material Testing, Inc.
60 Martin Lane, Elk Grove Village, Illinois 60007
Telephone (630) 595-1111 ♦ Fax (630) 595-1110

Soil Boring Prepared for:
Mr. Patrick J. Glenn, P.E., CFM
Gewalt Hamilton Associates, Inc.
625 Forest Edge Drive
Vernon Hills, Illinois 60061

Boring No.: B-07
Date: Wednesday, April 14, 2021
Project: Proposed Utility Improvements
Catalpa Drive
Round Lake, Illinois 60073
Project No.: 21G0190
Boring Location: See Boring Location Diagram
Logged By: L.S.H.
Ground Elevation:

Sheet 1 of 1

Elevation	Depth	Strata	Soil / Rock Description	Sample Type & No. Depth Interval (Ft) Recovery (in)	Blow Count	Moisture Content (%)	Unconfined Compressive Strength (TSF)	Notes & Test Results
	0.0		Approximately 9" of Topsoil					Unconfined compressive strength of soil samples estimated using a calibrated penetrometer.
	1.0		Silty Clay, Trace Sand and Gravel, dark brown, stiff (CL FILL)	SS-1 1.0' - 2.5' 6" Recovery	2 3 3	20.9	1.0	
	2.0							
	3.0							
	4.0		Silty Clay, Trace Sand and Gravel, brown and gray, hard (CL)	SS-2 3.5' - 5.0' 13" Recovery	3 4 6	18.2	4.0	
	5.0							
	6.0			SS-3 6.0' - 7.5' 17" Recovery	4 6 12	15.3	4.5+	
	7.0							
	8.0							
	9.0		Silty Clay, Trace Sand and Gravel, gray, hard (CL)	SS-4 8.5' - 10.0' 13" Recovery	6 8 10	15.1	4.5+	
	10.0		END of BORING at 10 Feet					
	11.0							
	12.0							
	13.0							
	14.0							
	15.0							
	16.0							
	17.0							
	18.0							
	19.0							
	20.0							

Drilling Contractor: CGMT, Inc.
Drilling Method: 3¼" O.D. H.S.A. Split Spoon Sampling
Drilling Equipment: CME-45C Truck Mounted Drill Rig
REVIEWED BY: NPW

Water Level (Ft.)
During Drilling: None
Immediately After Drilling: None

Soil Boring Log

Construction & Geotechnical Material Testing, Inc.
60 Martin Lane, Elk Grove Village, Illinois 60007
Telephone (630) 595-1111 ♦ Fax (630) 595-1110

Soil Boring Prepared for:
Mr. Patrick J. Glenn, P.E., CFM
Gewalt Hamilton Associates, Inc.
625 Forest Edge Drive
Vernon Hills, Illinois 60061

Boring No.: B-08
Date: Wednesday, April 14, 2021
Project: Proposed Utility Improvements
Midland Drive
Round Lake, Illinois 60073
Project No.: 21G0190
Boring Location: See Boring Location Diagram
Logged By: L.S.H.
Ground Elevation:

Sheet 1 of 1

Elevation	Depth	Strata	Soil / Rock Description	Sample Type & No. Depth Interval (Ft) Recovery (in)	Blow Count	Moisture Content (%)	Unconfined Compressive Strength (TSF)	Notes & Test Results
	0.0		Approximately 6" of Topsoil					Unconfined compressive strength of soil samples estimated using a calibrated penetrometer.
	1.0		Sandy Clay, Trace Gravel, brown, very stiff (CL)	SS-1 1.0' - 2.5' 11" Recovery	3 4 5	15.4	2.5	
	2.0							
	3.0							
	4.0			SS-2 3.5' - 5.0' 7" Recovery	3 3 4	17.9	2.5	
	5.0							
	6.0		Silty Clay, Trace Sand and Gravel, brown and gray, hard (CL)	SS-3 6.0' - 7.5' 14" Recovery	3 4 6	16.5	4.5+	
	7.0							
	8.0							
	9.0			SS-4 8.5' - 10.0' 14" Recovery	4 6 10	17.0	4.5+	
	10.0		END of BORING at 10 Feet					
	11.0							
	12.0							
	13.0							
	14.0							
	15.0							
	16.0							
	17.0							
	18.0							
	19.0							
	20.0							

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Drilling Method: 3¼" O.D. H.S.A. Split Spoon Sampling
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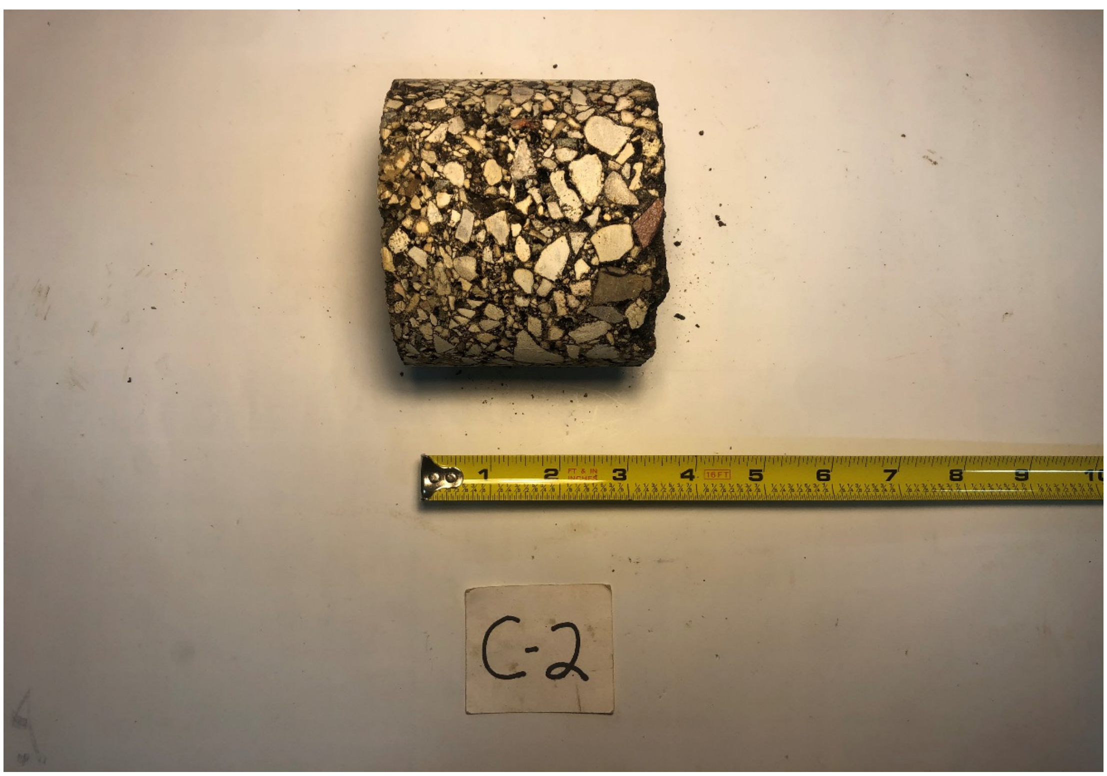
REVIEWED BY: NPW

Water Level (Ft.)
During Drilling: None
Immediately After Drilling: None

Pavement Core C-1: W. Columbia Bay Road



Pavement Core C-2: W. Columbia Bay Road

Pavement Core C-3: W. Columbia Bay Road

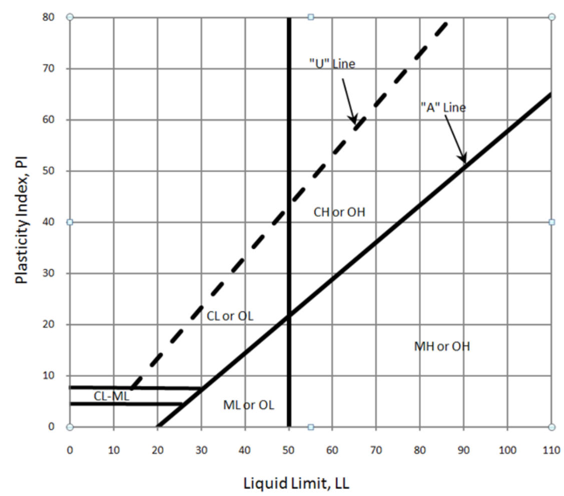
Pavement Core C-4: Oak Grove Drive

Pavement Core C-5: Hilltop Road

Pavement Core C-6: Catalpa Drive

UNITED SOIL CLASSIFICATION SYSTEM
(ASTM D-2487)

Major Division		Group Symbol	Typical Names		Classification Criteria
Coarse-grained soils More than 50% retained on No. 200 sieve	Gravels More than 50% of coarse fraction retained on No. 4 sieve	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines: Less than 5% pass No. 200 sieve: GW, GP, SW, SP; More than 12% pass No. 200 sieve: GM, GC, SM, SC; 5% to 12% pass No. 200 sieve: Borderline classification requiring use of dual symbol	$C_u = D_{60}/D_{10}$ greater than 4 $C_z = (D_{30})^2/(D_{10}XD_{60})$ between 1 & 3
		GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW
		GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4
		GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits plot above "A" line and plasticity index greater than 7
	Sands More than 50% of coarse fraction passes No. 4 sieve	SW	Well-graded sands and gravelly sands, little or no fines		$C_u = D_{60}/D_{10}$ greater than 6 $C_z = (D_{30})^2/(D_{10}XD_{60})$ between 1 & 3
		SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW
		SM	Silty sands, sand-silt mixtures		Atterberg limits plot below "A" line or plasticity index less than 4
		SC	Clayey sands, sand-clay mixtures		Atterberg limits plot above "A" line and plasticity index greater than 7
Fine-grained soils 50% or more passing No. 200 sieve	Silts and Clays Liquid limit 50% or less	ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands		Note: U-line represents approximate upper limit of LL and PI combinations natural soils (empirically determined). ASTM D-2487
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays		
		OL	Organic silts and organic silty clays of low plasticity		
	Silts and Clays Liquid limit greater than 50%	MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts		
		CH	Inorganic clays of high plasticity, fat clays		
		OH	Organic clays of medium to high plasticity		
Highly organic soils		Pt	Peat, muck and other highly organic soils		Fibrous organic matter; will char, burn or glow



Plasticity chart for the classification of fine-grained soils. Tests made on fraction finer than No. 40 sieve

Borderline classifications, used for soils possessing characteristics of two groups, are designated by combinations of group symbols. For example: GW-GC, well-graded gravel-sand mixture with clay binder

UNIFIED SOIL CLASSIFICATION SYSTEM

REFERENCE NOTES FOR BORING LOGS

I. Drilling and Sampling Symbols:

SS – Split Spoon Sampler	RB – Rock Bit Drilling
ST – Shelby Tube Sampler	BS – Bulk Sample of Drilling
RC – Rock Core: NX, BX, AX	PA – Power Auger (no sample)
PM – Pressuremeter	HSA – Hollow Stem Auger
DC – Dutch Cone Penetrometer	WS – Wash Sample

Standard Penetration (Blows/Ft) refers to the blows per foot of a 140 lb. hammer falling 30 inches on a 2 inch O.D. split spoon sampler, as specified in ASTM D-1586. The blow count is commonly referred to as the N-value.

II. Correlation of Penetration Resistances to Soil Properties:

Relative Density-Sands, Silts

SPT – N	Relative Density
0 – 3	Very Loose
4 – 9	Loose
10 – 29	Medium Dense
30 – 49	Dense
50 – 80	Very Dense

Consistency of Cohesive Soils

Unconfined Compressive Strength, Qp, tsf	Consistency
under 0.25	Very Soft
0.25 – 0.49	Soft
0.50 – 0.99	Firm
1.00 – 1.99	Stiff
2.00 – 3.99	Very Stiff
4.00 – 8.00	Hard
over 8.00	Very Hard

III Unified Soil Classification Symbols:

GP – Poorly Graded Gravel	ML – Low Plasticity Silt
GW – Well Graded Gravel	MH – High Plasticity Silt
GM – Silty Gravel	CL – Low Plasticity Clay
GC – Clayey Gravel	CH – High Plasticity Clay
SP – Poorly Graded Sand	OL – Low Plasticity Organic
SW – Well Graded Sand	OH – High Plasticity Organic
SM – Silty Sand	CL-ML – Dual Classification (Typical)
SC – Clayey Sand	

IV. Water Level Measurement Symbol:

WL – Water Level	BCR – Before Casing Removal
WS – While Sampling	ACR – After Casing Removal
WD – While Drilling	WCI – Wet Cave In
	DCI – Dry Cave In

The water levels are those water levels actually measured in the borehole at the times indicated by the symbol. The measurements are relatively reliable when augering, without adding fluids, in a granular soil. In clays and plastic silts, the accurate determination of water levels may require several days for the water level to stabilize. In such cases, additional methods of measurement are generally applied.