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Appendix A – Cornell Local Roads Program Gravel Road Material Specifications

June 2002

Gravel: Local Road Material Specification

Cornell Local Roads Program Tech Tips

The following specification is for gravel materials used on local roads. It is the material portion only of a larger specification (Section 667) in the New York State Department of Transportation Specification.

LOCAL ROAD GRAVEL SURFACE, BASE, AND SUBBASE COURSES

Description

General

The work consists of furnishing, placing and compacting gravel surface, base and subbase courses in conformity with the lines, grades, thicknesses and typical sections shown on the plans, or as determined by field conditions and ordered in writing by the municipality.

Material Types

Provide materials as specified by the following options.

- **Type A**. Surface quality material with a maximum particle size of 25 mm (1 inch)
- **Type B**. Base quality material with a maximum particle size of 50 mm (2 inches)
- **Type C**. Subbase quality material with a maximum particle size of 75 mm (3 inches)

Materials

Test and Control Methods

All tests shall be performed by laboratories accredited under the AASHTO accreditation program. Materials tests and quality control methods pertaining to the work of this section will be performed in conformance with the procedures contained in the appropriate New York State Department of Transportation (NYSDOT) and/or American Association of State Highway and Transportation Officials (AASHTO) publications which are current on the date of advertisement of bids.

Materials Requirements

Provide materials for local road gravel surface, base, and subbase courses that consist of Sand and Gravel, approved Blast Furnace Slag or Stone that meet the requirements

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contained herein. Provide materials well graded from coarse to fine, and free from organic or other deleterious materials. Any gravel material will be rejected if it is determined to contain any unsound or deleterious materials.

Gradation

Perform sieve analysis in accordance with the AASHTO procedures T 27, T 88 or T 311. Report the following sieves for all tests: 75µm, 425µm, 6.3 mm, 12.5 mm, 19.0 mm, 25.0 mm, 37.5 mm, 50 mm, 75 mm.

Provide material meeting the gradation limits from Table 1.

Soundness

Material for local road gravel surface, base, and subbase courses will be accepted on the basis of Magnesium Sulfate Soundness Loss after four (4) cycles performed according to NYSDOT procedures and Table 2.

Table 1: Percent passing by weight of gravel materials

	Option Type		
Sieve (U.S. sieve)	**A (Surface)**	**B (Base)**	**C (Subbase)**
75 mm (3")			100
50 mm (2")		100	-
37.5 mm (1.5")		85-100	70-100
25.0 mm (1")	100	-	-
19.0 mm (3/4")	85-100	-	-
6.3 mm (1/4")	50-75	30-50	30-55
425 µm (#40)	15-35	5-20	5-25
75 µm (#200)	8-15	0-5	0-8

Plasticity

Determine plasticity using either of the following methods:

- **Plasticity Index**. The Plasticity Index of the material passing the #40 mesh sieve shall meet the values in Table 2. Determine plasticity using AASHTO tests T 89 and T 90.
- **Sand Equivalent**. The sand equivalence of the granular material shall meet the values in Table 2. Determine sand equivalence using AASHTO test T 176.

Table 2: Test and control limits of gravel materials

	Material Type		
Material Properties	**A (Surface)**	**B (Base)**	**C (Subbase)**
Maximum Soundness loss (%)	20	20	25
Plasticity Index	2-9	0-5	0-8
Sand Equivalent	25-40	>40	>35

Elongated Particles

Not more than 30 percent, by weight, of the particles retained on a 12.5 mm sieve shall consist of flat or elongated particles. A flat or elongated particle is defined herein as one which has its greatest dimension more than 3 times its least dimension. Acceptance for this requirement will normally be based on a visual inspection. When the municipality elects to test for this requirement, material with a percentage greater than 30 will be rejected.

Fractured Faces

When the municipality elects to test for this requirement, Type A material shall have at least two fractured faces on 50 percent of the stone particles larger than 12.5 mm or at least one fractured face on 75 percent of the particles larger than 12.5 mm. Type B material shall have at least one fractured face on 50 percent of the stone particles larger than 12.5 mm.

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Appendix C – Geotechnical Investigations

Quality Geo Engineering, P.C.

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GEOTECHNICAL ENGINEERING REPORT
KILLEARN ROAD REHABILITATION
KILLEARN ROAD
TOWN OF WASHINGTON, DUTCHESS COUNTY, NEW YORK

PREPARED FOR:
Colliers Engineering and Design
18 Computer Drive East, Suite 203
Albany, NY 12205

PREPARED BY:
Quality Geo Engineering, P.C.
877 Route 4S
Schuylerville, New York 12871
on behalf of QC/QA Laboratories, Inc.

October 25, 2022
Project No. SE22-030

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1.0 INTRODUCTION

This report presents the results of a subsurface exploration program and geotechnical engineering evaluation completed by Quality Geo Engineering, P.C. on behalf of QC/QA Laboratories, Inc., for the Killearn Road Rehabilitation project in the Town of Washington, Dutchess County, New York. The subsurface exploration was completed by QC/QA Laboratories, Inc. (QCQA Labs), and the geotechnical engineering evaluation was performed by Quality Geo Engineering, P.C., on behalf of QCQA Labs.

Based on the information provided by Colliers Engineering and Design, we understand the project will consist of reconstructing the existing gravel road with either a new gravel section or a new asphalt pavement section. The approximate location of the site is shown on the attached Figure No. 1.

2.0 SUBSURFACE EXPLORATION

The subsurface exploration program consisted of a total of fifteen (15) test borings along Killearn Road. The test borings were drilled by QCQA Labs on September 27th, and 28th, 2022. The test borings were designated as B-1 through B-15. The approximate locations of the test borings are shown on the attached Figures No. 2 through 14.

The test borings were made with a Central Mine Equipment (CME) model 45 truck-mounted drill rig, using a split-spoon sampler and hollow stem augers. The test borings were advanced to a depth of 4 feet or auger refusal.

The test boring logs were prepared by a geotechnical engineer based on visual observation of the recovered soil samples and review of the driller's field notes. The soil samples were described based on a visual/manual estimation of the grain size distribution, along with characteristics such as color, relative density, consistency, moisture, etc. The test boring logs are presented in Appendix B, along with general information and a key of terms and symbols used to prepare the logs.

3.0 LABORATORY TESTING

The laboratory testing was performed by QCQA Labs on samples of the gravel wearing course and underlying subgrade soil samples recovered from the test borings. Laboratory testing included natural water content and sieve analysis. Natural water content and sieve analysis testing was performed on a total of twenty-six (26) samples.

Natural water content testing was conducted in general accordance with ASTM D-2216 *"Standard Test Methods for Laboratory Determination of Water (Moisture) Contents of Soil and Rock by Mass."* Sieve analysis testing was conducted in general accordance with ASTM C-117 *"Standard Test Method for Materials Finer Than 75-um (No. 200) Sieve in Mineral Aggregates by Washing"*, and ASTM C-136 *"Standard Test Method for Sieve*

Analysis of Fine and Coarse Aggregates." The laboratory test results are presented in Appendix B.

4.0 SUBSURFACE CONDITIONS

The existing road surface consisted of a "gravel" wearing course extending to depths ranging from approximately 8 to 30 inches. The "gravel" wearing course generally consisted of brown to brown-gray gravel with intermixed sand and silt, and brown, brown-gray, and gray sand with varying amounts of intermixed gravel and silt, with the exception of test boring B-11. The "gravel" wearing course at test boring B-11 consisted of gray rock fragments with intermixed silt. The silt content of the sand and gravel wearing course generally ranged from approximately 12 to 22 percent by weight based on the laboratory sieve analysis testing. The thicknesses of the "gravel" wearing course encountered in the test borings are presented in the table below.

GRAVEL WEARING COURSE THICKNESS	
Test Boring No.	Gravel Wearing Course Thickness (inches)
B-1	19
B-2	30
B-3	18
B-4	20
B-5	24
B-6	24
B-7	18
B-8	24
B-9	24
B-10	24
B-11	18
B-12	17
B-13	8
B-14	24
B-15	24

The "gravel" wearing course was underlain by subgrade soils in test borings B-1, B-4, B-6 through B-10, and B-12 through B-14. The subgrade soils consisted of brown to brown-gray sand with varying amounts of gravel, silt, and/or rock fragments, and brown silt with varying amounts of intermixed sand and gravel. Gray highly weathered rock fragments were recovered near the boring termination depth of 4 feet in test boring B-13.

Auger refusal was encountered in test borings B-2, B-3, B-5, B-11 and B-15 at depths ranging from 1.5 to 3.0 feet. The "gravel" wearing course generally extended to the auger

refusal depths at these locations. Rock coring was not performed to verify whether the refusal material encountered in the test borings consisted of bedrock or large cobbles or boulders. The auger refusal depths encountered in the test borings are presented in the table below.

AUGER REFUSAL DEPTHS	
Test Boring No.	Auger Refusal Depth (feet)
B-1	NA
B-2	3.0
B-3	1.5
B-4	NA
B-5	2.0
B-6	NA
B-7	NA
B-8	NA
B-9	NA
B-10	NA
B-11	2.0
B-12	NA
B-13	NA
B-14	NA
B-15	2.5

Standard penetration test (SPT) "N" values obtained in the cohesionless gravel wearing course ranged from 27 to greater than 100 indicating the relative density of these soils varied from "firm" to "very compact". SPT "N" values obtained in the cohesionless subgrade soils below the gravel wearing course ranged from 9 to greater than 100 indicating the relative density of these soils varied from "loose" to "very compact".

Free standing water was not present in any of the test borings at the time of drilling. It is possible that perched and/or trapped groundwater conditions could be encountered at relatively shallow depths in some areas where relatively low permeability silty subgrade soils are present, particularly following periods of wet weather conditions. It should be expected that groundwater conditions will vary with changes in prevailing weather conditions.

5.0 GEOTECHNICAL RECOMMENDATIONS

We understand consideration is being given to rehabilitating Killearn Road with either a new gravel road surface or a new asphalt pavement road surface. Recommendations are provided below for both options.

1) New Gravel Road Surface: In our opinion, a new gravel wearing course could be placed over the existing gravel surface. We recommend the new gravel road surface be constructed with a crown or cross slope of at least 4 percent. The existing gravel surface must be shaped to match the surface crown or cross slope prior to placing the new gravel wearing course layer. The existing gravel road surface must be evaluated for stability by proofrolling as discussed below. We also recommend that drainage ditches or edge drains be provided as discussed below.

2) New Asphalt Pavement Road Surface: A new asphalt pavement road section could be constructed over the existing soil subgrade. We recommend a new asphalt section consist of a layer of Subbase Stone, which is placed over the existing soil subgrade after excavation to the design subgrade elevation, and is overlain with layers of Base, Binder, and Top Course asphalt pavement. We recommend the pavement surface (and underlying Subbase Stone and soil subgrade surfaces) be constructed with a crown or cross slope of at least 2 percent. The exposed soil subgrade surface must be evaluated for stability by proofrolling as discussed below. We also recommend that drainage ditches or edge drains be provided as discussed below.

For both options discussed above, the exposed soil subgrade must be evaluated after excavating to the design subgrade elevation. The exposed subgrade soils should be proofrolled using a loaded tandem-axle dump truck. Any areas which appear wet, loose, soft, unstable, or otherwise unsuitable during proof-rolling, should be undercut as directed by the geotechnical engineer. Undercut excavations should be backfilled with compacted Subbase Stone, which is placed over a layer of woven geotextile stabilization fabric, such as Mirafi 160N. Recommendations for Subbase Stone material, along with placement and compaction requirements, are presented in Appendix C.

We recommend drainage ditches or edge drains be constructed along the shoulders of the road. Edge drains, if used, should consist of a trench with a 4-inch diameter perforated underdrain pipe placed at the bottom and backfilled with clean crushed stone, such as NYSDOT Table 703-4 No. 1 Stone. The drain pipes must discharge to daylight.

The road sections recommended below are based on the assumption that the subgrades will be prepared in accordance with our recommendations.

<u>New Gravel Road Section:</u>

- 6 inches – Gravel Wearing Course
- Existing Gravel Wearing Course

<u>New Asphalt Pavement and Subbase:</u>

- 1.5 inches – Top Course
- 2.0 inches – Binder Course
- 3.0 inches – Base Course

- 8.0 inches – Subbase Course
- Woven geotextile stabilization fabric

Material requirements for the above pavement structure components are presented in Appendix C.

Adjacent geotextile panels should have an overlap of at least 18 inches. Construction of the asphaltic concrete courses (i.e., binder and top) should be performed in accordance with NYSDOT Standard Specifications Section 400. The binder and top courses should be compacted to at least 92 percent of the maximum theoretical density.

It should be understood that both the gravel and asphalt pavement road sections will experience seasonal frost heaving. Seasonal frost heaving is typically more pronounced in areas with poor drainage. Gravel road sections can also be particularly impacted by loss of support in the spring as frost leaves the ground. As the soil thaws from the top down, water gets trapped above the frozen soil zone and causes the thawed soil above to become super-saturated and thus creates loss of support and rutting of the road surface. Frost heaving, and loss of soil support during the spring thaw, can be eliminated by placing non-frost susceptible materials (such as clean crushed stone) beneath the road section extending below the frost depth. This would require placing non-frost susceptible material to a depth of at least 4 feet below the road surface, which we anticipate is not a feasible option.

Auger refusal was encountered in some of the test borings at depths ranging from 1.5 to 3.0 feet. It is possible that the refusal material encountered in the test borings consisted of bedrock. It is possible that bedrock could be encountered in excavations to the design soil subgrade elevation in some areas. If bedrock is encountered above the design soil subgrade elevation, options include raising the road surface elevation to allow for placement of the design section, removing the rock using an excavator equipped with a hydraulic hammer (ho-ram), or reducing the thickness of the new road section. We recommend that QCQA Labs be consulted if bedrock is encountered above the design soil subgrade elevation to provide additional recommendations on a case-by-case basis.

6.0 CONCLUDING REMARKS

This report was prepared to assist in planning the design and construction of the Killearn Road Rehabilitation project in the Town of Washington, Dutchess County, New York. The recommendations were prepared based on our understanding of the proposed project, as described herein, and through the application of generally accepted soils and foundation engineering practices. No warranties, expressed or implied, are made by the conclusions, opinions, recommendations, or services provided.

Important information regarding the use and interpretation of this report is presented in Appendix D.

Respectfully Submitted:
Quality Geo Engineering, P.C.

Tod Kobik

Tod M. Kobik, P.E.
President

APPENDIX C

FILL MATERIAL AND PLACEMENT RECOMMENDATIONS

FILL MATERIAL AND PLACEMENT RECOMMENDATIONS

I. Fill Material Recommendations

A. Gravel Wearing Course for New Gravel Road Section

The Gravel Wearing Course material should consist of a crusher run stone or crushed gravel which is free of expansive shale, organics and friable or deleterious particles, and meets the following gradation requirements:

Sieve Size	Percent Finer by Weight
1"	100
No. 4	45-70
No. 8	25-55
No. 40	10-30
No. 200	3.0 – 15.0*

*The liquid limit of the material passing the No. 200 sieve must be 25 or less and the plasticity index of the material passing the No. 200 sieve must be 10 or less.

B. Subbase Stone Beneath Gravel Wearing Course/New Asphalt Pavement Section

Imported Subbase Stone should consist of a crusher-run stone or crushed gravel meeting the material and gradation requirements of New York State Department of Transportation (NYSDOT), Standard Specifications, Item 304.12 – Type 2 or Item 304.14 Type 4 Subbase Course.

II. Fill Placement and Compaction Recommendations

The Gravel Wearing Course and Subbase Stone materials should be compacted to a minimum of 95 percent of the maximum dry density as measured by the modified Proctor test (ASTM D1557), or as directed by the geotechnical engineer.

Placement of fill materials should not exceed a maximum loose lift thickness of 12 inches and should be reduced in conjunction with the compaction equipment used so that the required density is attained.

Fill should have a moisture content within 2 percent of the optimum moisture content prior to compaction. Subgrades should be properly drained and protected from moisture and frost. Placement of fill on frozen subgrades, and placement of frozen fill materials, is not acceptable. It is recommended that all fill placement and compaction be monitored and tested by qualified geotechnical personnel.

III. Quality Assurance Testing

The following minimum laboratory and field quality assurance testing frequencies are recommended to confirm fill material quality and post placement and compaction conditions. These minimum frequencies are based on generally uniform material properties

and placement conditions. Should material properties vary or conditions at the time of placement vary (i.e. moisture content, placement and compaction, procedures or equipment, etc.), then additional testing is recommended. Additional testing, if required, should be determined by qualified geotechnical personnel based on evaluation of the actual fill material and construction conditions.

A. Laboratory Testing of Material Properties

- Moisture content (ASTM D-2216) - 1 test per 4000 cubic yards or no less than 2 tests per each material type.
- Grain Size Analysis (ASTM D-422) - 1 test per 4000 cubic yards or no less than 2 tests per each material type.
- Modified Proctor Moisture Density Relationship (ASTM D-1557) 1 test per 4000 cubic yards or no less than 1 test per each material type.

B. Field In-Place Moisture/Density Testing (ASTM D-6938)

- Compaction testing - 1 test per 100 lineal feet per lift.

APPENDIX D

INFORMATION REGARDING THIS GEOTECHNICAL ENGINEERING REPORT

IMPORTANT INFORMATION REGARDING THIS GEOTECHNICAL ENGINEERING REPORT

Quality Geo Engineering, P.C. (Quality Geo), has endeavored to prepare this report in accordance with generally accepted geotechnical engineering principles and practices on behalf of QC/QA Laboratories, Inc. (QCQA Labs). Geotechnical engineering analyses and evaluations are based partly on judgment and opinion, and are therefore far less exact than other engineering disciplines. Accordingly, Quality Geo believes that providing the report user with information regarding the preparation and limitations of this report will aid in the proper interpretation and implementation of the conclusions and recommendations presented in this report. The following information is provided in an effort to reduce potential geotechnical-related delays, cost over-runs and other problems that can develop during the design and construction process.

SCOPE OF SERVICES: The scope of this report is limited to the specific items identified in QCQA Labs' Proposal for services for this project. The scope of services is limited to a geotechnical engineering evaluation of the conditions disclosed by the subsurface exploration and does not include any geoenvironmental assessment or investigation for the presence, absence or prevention of any hazardous or toxic materials or conditions (or mold) in the soil, groundwater or surface water within or beyond the project site. Unanticipated environmental problems can lead to significant project cost over-runs and QCQA Labs recommends that the Owner retain a geoenvironmental consultant to discuss risk management guidance.

PROJECT-SPECIFIC FACTORS: The conclusions and recommendations presented in this report were prepared based on project-specific factors described in the report, such as the size, loading, type of construction and intended use of the structure; the location of the structure on the site; planned structure elevation(s) and site grading; other planned or existing site improvements, such as access roads, parking lots, underground utilities; and any other pertinent project information. Changes to the project details may alter the factors considered in development of the report conclusions and recommendations. As such, neither Quality Geo nor QCQA Labs shall be responsible nor liable for problems that may develop if we are not consulted regarding any changes to the project-specific factors that were assumed during preparation of the report.

SUBSURFACE CONDITIONS: The subsurface exploration program for this project consisted of sampling only at discrete test locations. Quality Geo has used judgment to infer the subsurface conditions between the discrete test locations. The conclusions and recommendations presented in this report were based on the subsurface conditions disclosed/inferred at and between the discrete test locations at the time the subsurface exploration program was performed. We point out that surface and subsurface conditions at the site are subject to change subsequent to preparation of this report. Such changes may include floods, earthquakes, groundwater fluctuations, and construction activities at the site and/or adjoining properties. It should be understood that the actual subsurface conditions could vary from the conditions inferred by Quality Geo between and away from the discrete test locations, which could be revealed during construction. As such, QCQA Labs should be retained during construction to confirm that the subsurface conditions are consistent with the conditions disclosed by the subsurface exploration program, and to refine our conclusions and recommendations in the event that the subsurface conditions differ from those disclosed by the subsurface exploration program.

USE OF THIS GEOTECHNICAL ENGINEERING REPORT: This report has been prepared for the exclusive use of our client, and any other parties specifically identified in the report, for specific application to the site and project-specific conditions described in the report. This report should not be applied to any other site or project, or for any uses other than those originally intended without our consent.

MISINTERPRETATION OF THIS REPORT: The conclusions and recommendations presented in this report are subject to misinterpretation by the design team and contractors, which can result in costly problems. The risk of misinterpretation by the design team can be reduced by having appropriate members of the design team confer with QCQA Labs regarding the conclusions and recommendations presented in this report prior to completing the plans and specifications. In addition, QCQA Labs should be retained to review pertinent elements of the design team's final plans and specifications prior to bidding to confirm that the recommendations presented in this report have been properly interpreted and applied. The risk of misinterpretation by contractors can be reduced by retaining QCQA Labs to attend prebid and preconstruction conferences, and to provide construction observation.

COMPONENTS OF THIS REPORT: Subsurface exploration logs, figures, tables and any other report components are subject to misinterpretation if they are separated from this report. This may occur if copies of the boring logs or other report components are given to the contractors during the bid preparation process. To minimize this risk, report components should not be separated from the report and only complete copies of this report should be distributed as appropriate.

ALTERATION OF THIS REPORT: It is a violation of Section 7209 Subdivision 2 of the New York State Education Law for any person to alter this report in any way, except under the direction of a licensed professional engineer. Neither QCQA Labs nor Quality Geo shall be liable for any alterations that are made to this report without our knowledge and written consent.

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Appendix D – Utility Mark-out Sketch

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Memorandum

To: Town of Washington

From: Joseph King,

Date: November 8, 2022

Subject: Killearn Rd Utility Investigation

Project No.: 21003140G

I am pleased to submit this summary on behalf of Colliers Engineering & Design (CED) following the underground utility designation and mark-out along Killearn Road. The project procedures and results are presented below.

Data Collection Methodology and Results

The underground utility investigation was conducted at the project site October 12, 2022. Michael Micholas, CED representative, conducted the utility designation and mark-out along Killearn Road.

CED used electromagnetic utility designating equipment and Ground Penetrating Radar technology to identify the locations of existing underground utilities. Underground electric, cable, and telephone lines were identified and designated throughout the project limits. All of these lines are shallow, less than four feet below grade. The approximate locations of all utilities marked out are shown on the attached field sketch. Due to the dense nature of the underground utility network here, extreme caution (likely including hand digging) must be exercised when excavating.

These services are conducted with due diligence and in a manner consistent with standards of the subsurface utility mapping industry. Every reasonable effort was made to locate underground utilities within the project limits. CED cannot guarantee that all existing underground utility infrastructure was detected. The targeting of subsurface utilities, although highly reliable, is expressly understood to represent an approximate location of the target facility as marked on the ground surface. The accuracy of utility designating is subject to certain factors beyond our control such as standard equipment limitations and field conditions that may include, but are not limited to: depth of utility, electrical conductivity of utility, site conditions and access. In areas deemed critical, the owner/engineer is encouraged to use empirical means such as vacuum excavation to validate the exact location of identified or unidentified subsurface targets.

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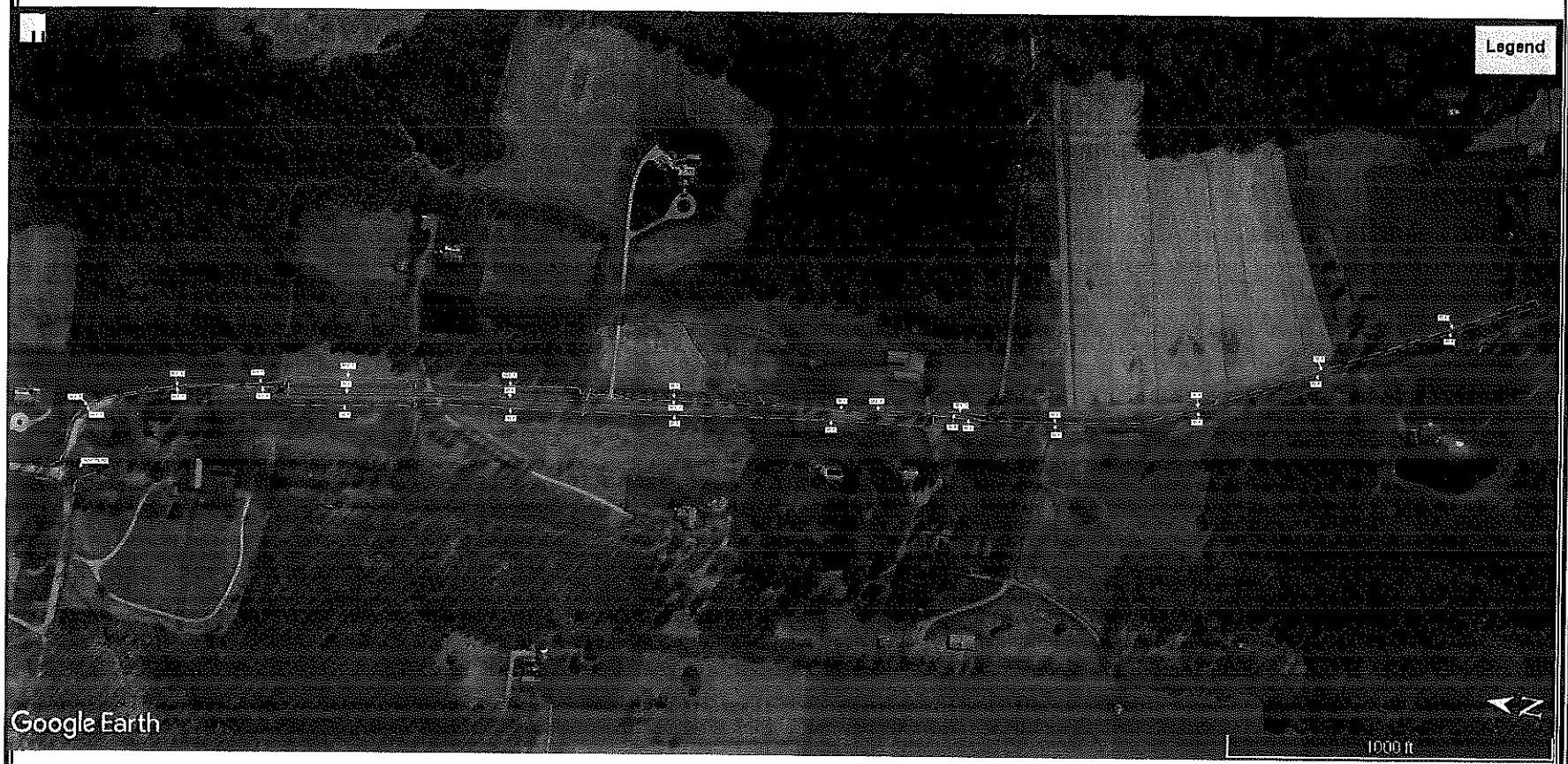
Sincerely,

Colliers Engineering & Design CT, P.C.
(DBA Maser Consulting)

Joseph King,
Department Manager

Attachment: Field sketch



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- Gas Quality Level B
- Water Quality Level B
- Waste Water Quality Level B
- Storm Sewer Quality Level B
- Unknown Quality Level B

Quality level line styles will be adjusted once dwgs

Meter		Cleanout	
Vent		Fire Hydrant	
Transformer		Manhole	
Vault		Light Pole	
Cabinet		Utility Pole	
Valve		Handhole	
Air Release Valve		Test Hole	
Test Station		Utility Marker	
Well		Control Line	
Pedestal		OL Delineation	
Tele-Pedestal		End of Information	EOI
Elec-Pedestal		Designated End Point	X
TV-Pedestal		Storm Drain Inlet	

Symbols will be adjusted to their respective APWA styles

Scale: Date: 10/10/22 Drawn By: MM Checked By:

Project Number: 21003140G

Drawing Name: UMO SKETCH

Sheet Title: 21003140G - Kilbarn Road

Sheet Number:

of