

**GREENE STREET WATER MAIN REPLACEMENT
WALKER, IOWA**

CONTRACTOR'S BID DATE: Monday, March 13, 2023 @ 10:00 A.M.

PLACE FOR CONTRACTORS
TO SUBMIT BIDS:

City of Walker
City Hall
204 Greene Street
Walker, Iowa 52352

ADDENDUM NO.1

March 10, 2023

TO ALL PLANHOLDERS:

The following changes, clarifications, additions, and/or deletions are hereby made a part of the contract documents for the above-referenced project, as fully and completely as if the same were fully set forth therein. All Bidders submitting a Bid on the above Contract shall carefully read this Addendum and give it consideration in the preparation of their Bid.

This Addendum No. 1 consists of the following:

- Addendum No. 1 pages ADN1-1 through ADN1-2.
- Geotechnical Engineering Report – Terracon – 32 pages

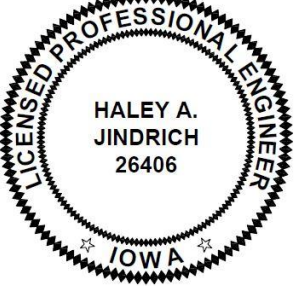
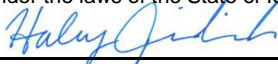
CLARIFICATIONS:

1. Refer to attached geotechnical engineering report for information on existing pavement.
2. Bid Items 20-22 (Driveway, Paved, PCC 6"; Driveway, Paved, HMA, 6"; and Driveway, Granular, 6") include removal of the existing pavement/gravel, and pavement/gravel placement, as well as the items listed under 7030-H in SUDAS (excavation, subgrade preparation, etc.). Subbase is not required under driveways.
3. Bid Item 23, Full Depth Patch, HMA – new HMA pavement thickness shall be equal to the existing HMA thickness plus 1 inch (does not include thickness of existing chip seal). Item shall also include 4 inches of modified subbase below HMA pavement, in addition to items A and B listed under Bid Item 23.
4. Bid item 24, Granular Resurfacing, includes resurfacing gravel areas along the paved road that are disturbed due to construction activities. Granular resurfacing areas are identified on Plans with specific hatching.

SPECIFICATIONS:

1. **ADD** – Geotechnical Engineering Report – Terracon issued with this Addendum

All bidders shall acknowledge receipt and acceptance of Addendum No. 1 by signing in the space provided on the Bid Form. Bids submitted without Addendum No. 1 being acknowledged will be considered non-responsive.

| | | |
|---|---|---------------|
|  | I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa. | |
| |  | Date: 3/10/23 |
| | HALEY ANNE JINDRICH, P.E. | |
| | License No. 26406 | |
| | My renewal date is December 31, 2023 | |
| | Pages or sheets covered by this seal: | |
| | Addendum #1 | |

HALEY JINDRICH, PE
HR GREEN, INC.
8710 EARHART LANE
CEDAR RAPIDS, IOWA 52404
PHONE: (319) 841-4000

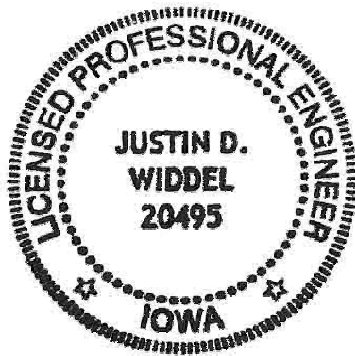
END OF ADDENDUM #1

Greene Street Reconstruction

Geotechnical Engineering Report

Prepared for:

HR Green, Inc.
8710 Earhart Lane SW
Cedar Rapids, Iowa 52404



I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under the laws of the State of Iowa.

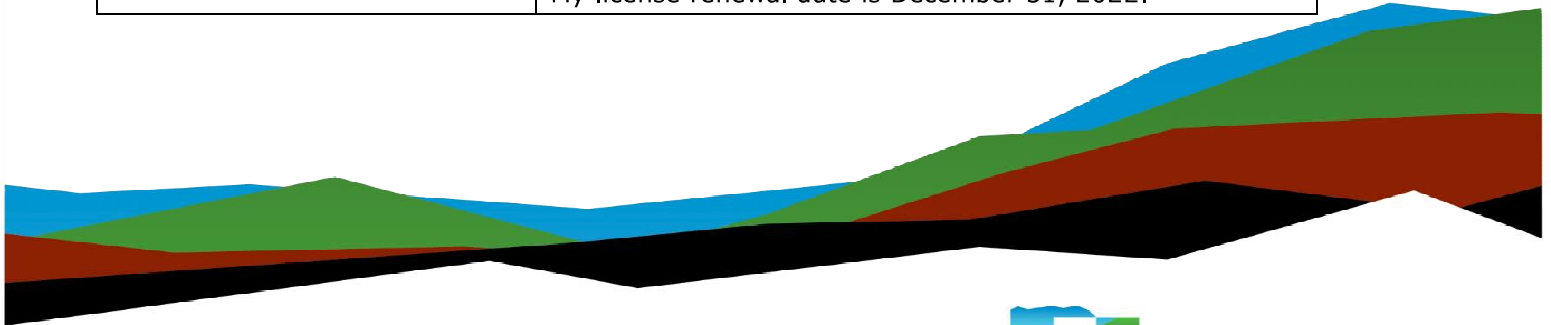
A handwritten signature of Justin D. Widdel in black ink.

December 16, 2022

Justin D. Widdel, P.E.

Date

My license renewal date is December 31, 2022.



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2640 12th Street SW
Cedar Rapids, Iowa 52404
P (319) 366-8321
Terracon.com

December 16, 2022

HR Green, Inc.
8710 Earhart Lane SW
Cedar Rapids, Iowa 52404

Attn: Tim Cutsforth
P: 319-841-4363
E: tcutsforth@hrgreen.com

Re: Geotechnical Engineering Report
Greene Street Reconstruction
Dows Street to Rowley Street
Walker, Iowa
Terracon Project No. 06225147.01

Dear Mr. Cutsforth:

We have completed the scope of Geotechnical Engineering services for the above referenced project in general accordance with Terracon Proposal No. P06225147 dated September 26, 2022. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork and the design and construction of pavements for the proposed project.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report or if we may be of further service, please contact us.

Sincerely,

Terracon

A handwritten signature in black ink that reads "Thomas W. Sherman".

Thomas W. Sherman, P.E. (WI)

Geotechnical Engineer

A handwritten signature in black ink that reads "Justin D. Widdel".

Justin D. Widdel, P.E.

Iowa No. 20495

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Site Location and Exploration Plans
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Geotechnical Engineering Report

Greene Street Reconstruction | Walker, Iowa

December 16, 2022 | Terracon Project No. 06225147.01



Note: This report was originally delivered in a web-based format. **Blue Bold** text in the report indicates a referenced section heading. The PDF version also includes hyperlinks which direct the reader to that section and clicking on the  logo will bring you back to this page. For more interactive features, please view your project online at client.terracon.com.

Refer to each individual Attachment for a listing of contents.

Introduction

This report presents the results of our subsurface exploration and Geotechnical Engineering services performed for the proposed Greene Street Reconstruction to be located from Dows Street to Rowley Street in Walker, Iowa. The purpose of these services was to provide information and geotechnical engineering recommendations relative to:

- Subsurface soil conditions
- Groundwater conditions
- Site preparation and earthwork
- Pavement design and construction

The geotechnical engineering Scope of Services for this project included the advancement of test borings, laboratory testing, engineering analysis, and preparation of this report.

Drawings showing the site and boring locations are shown on the [Alignment Location](#) and [Exploration Plan](#), respectively. The results of the laboratory testing performed on soil samples obtained from the site during our field exploration are included on the boring logs in the [Exploration Results](#) section.

Project Description

Our initial understanding of the project was provided in our proposal and was discussed during project planning. Our understanding of the project conditions at the time of this report is tabulated below.

| Item | Description |
|-------------------------------|---|
| Information Provided | Email from Mr. Timothy Cutsforth of HRG that included the number and depth of soil borings |
| Project Description | Water main replacement along Greene Street from Grant Street to Linn Street in Walker, Iowa <ul style="list-style-type: none">■ Greene Street is 2-lane, 2-way with parking on both sides Street reconstruction from Dows Street to Rowley Street |
| Grading | Grade changes of less than 0.5 foot are anticipated |
| Below-Grade Structures | Potential for water main access manhole(s) |

| Item | Description |
|------------------|---|
| Pavements | <p>New pavements will be constructed in accordance with SUDAS Standards/Specifications</p> <p>Design traffic, including annual average daily traffic (AADT), percent trucks, and design life not provided</p> |

Terracon should be notified if any of the above information is inconsistent with the planned construction, as modifications to our recommendations may be necessary.

Site Conditions

The following description of conditions along the alignment is derived from our site visit in association with the field exploration and our review of publicly available topographic information.

| Item | Description |
|------------------------------|---|
| Project Location | <p>The project is located along Greene Street from Grant Street to Linn Street with pavement reconstruction from Dows Street to Rowley Street in Walker, Iowa.</p> <p>Latitude/Longitude</p> <ul style="list-style-type: none"> ■ South end of street reconstruction: 42.2853° N, 91.7809° W ■ North end of street reconstruction: 42.2867° N, 91.7809° W <p>See Alignment Location</p> |
| Existing Improvements | <p>Subsurface utilities</p> <p>Overhead electrical lines (OHE) along portions of both sides of the street</p> |
| Current Ground Cover | Asphaltic cement concrete over chip seal |
| Existing Topography | From the IDNR LiDAR Tool, the street slopes upwards to the north, with surface elevations ranging from about 888 feet to 897 feet |

Geotechnical Characterization

We have developed a general characterization of the subsurface conditions based upon our review of the subsurface exploration, laboratory data, geologic setting, and our

understanding of the project. This characterization, termed GeoModel, forms the basis of our geotechnical calculations and evaluation of the site. Conditions observed at each exploration point are indicated on the individual logs. The individual logs can be found in the [Exploration Results](#) and the GeoModel can be found in the [Figures](#) attachment of this report.

As part of our analyses, we identified the following model layers within the subsurface profile. For a more detailed view of the model layer depths at each boring location, refer to the GeoModel.

| Model Layer | Layer Name | General Description |
|-------------|---------------------------|---|
| 1 | Surficial | Hot-Mix Asphalt over Chip Seal |
| 2 | Sandy Eolian Deposits | Silty Sand (SM) |
| 3 | Interbedded Clay and Sand | Sandy Lean Clay (CL), Lean to Fat Clay (CL/CH), Clayey Sand (SC), and Poorly Graded Sand (SP) |
| 4 | Glacial Till | Sandy Lean Clay (CL) |

The borings were advanced in the dry using continuous flight augers that allow short term groundwater observations to be made while drilling. Groundwater was not encountered within the maximum drilling depth of Boring B-1 at the time of our field exploration, while it was observed at a depth of about 7 feet in Boring B-2.

Groundwater conditions may be different at the time of construction. Mapping by the Natural Resources Conservation Service (NRCS) indicates a seasonal high groundwater level more than 6 feet below the ground surface for the alignment. Groundwater conditions may change because of seasonal variations in rainfall, runoff, and other conditions not apparent at the time of drilling. Long-term groundwater monitoring was outside the scope of services for this project, and would be required for better evaluation of groundwater conditions along the alignment.

Geotechnical Overview

General Design and Construction Considerations

Unless noted otherwise in this report, design of the project should be in accordance with the current Iowa Statewide Urban Design and Specifications (SUDAS).

Recommendations for the construction of the roadway reconstruction and associated subsurface utilities are provided in the [Earthwork](#) and [Pavements](#) sections.

Terracon should be retained during the construction phase of the project to observe earthwork and to perform necessary tests and observations during subgrade preparation, pavement construction, and fill placement.

Easily Disturbed Subgrade Soils

The soils encountered along the alignment are susceptible to disturbance from construction activities, particularly if the soils are wetted by surface water or seepage.

During earthwork operations, the soils may require stabilization to create a working platform or a stable surface for the pavement base course. If grading is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist. Stabilization options are provided in the [Earthwork](#) section, including moisture conditioning and recompaction, undercuts and replacement with crushed limestone, and chemical stabilization.

Pavement Design

Our opinion of pavement section thickness design has been developed based on our understanding of the intended use, assumed traffic, and subgrade preparation recommended herein using methodology contained in SUDAS [Section 5F-1 - Pavement Thickness Design](#). The [Pavements](#) section includes minimum pavement component thicknesses.

Report Qualifications

The recommendations contained in this report are based upon the results of field and laboratory testing (presented in the [Exploration Results](#)), engineering analyses, and our current understanding of the proposed project. The [General Comments](#) section provides an understanding of the report limitations.

Earthwork

Earthwork is anticipated to include demolition of the existing pavement, construction of new and repair of existing utilities, subdrain placement, new fill placement (if grades are changed), pavement subgrade preparation, and base course placement. The following sections provide recommendations for use in the preparation of specifications for the work. Recommendations include critical quality criteria, as necessary, to render the site in the state considered in our geotechnical engineering evaluation for pavements.

Alignment Preparation

Existing pavement and base course sections, utilities to be abandoned, topsoil, vegetation, near-surface soils with organic contents greater than 5 percent, and any otherwise unsuitable materials should be removed from the pavement reconstruction areas. Excessively wet or dry material should either be removed, or moisture conditioned and compacted. Soft and/or low-density soil should be removed or compacted in place prior to placing new fill. Subgrade conditions should be observed by Terracon during construction.

While not anticipated, if moderate to high plasticity clay soils are encountered within 2 feet of finished subgrade elevation, Terracon should be consulted to provide supplemental recommendations. Similarly, if existing fill is present along the alignment, Terracon should be retained to evaluate the material and provide supplement recommendations.

Pavement Subgrade Evaluation and Stabilization

The alignment soils could become unstable with typical earthwork and construction traffic, especially after precipitation events. Effective surface drainage should be completed early in the construction sequence and maintained after construction to avoid potential strength and/or stability issues. If possible, earthwork should be performed during the warmer and drier time of the year. If earthwork is performed during the winter months, an increased risk for possible undercutting and replacement of unstable subgrade will persist.

After rough grade has been established, the exposed subgrade should be proofrolled by the contractor and evaluated by Terracon. Obviously unstable subgrades should not be proofrolled to reduce disturbance of the subgrade soils, until after these soils have been stabilized. Proofrolling of sands should be performed with a vibratory roller with a gross weight of at least 10 tons, while if clayey textured subgrades are present, proofrolling could be accomplished by using heavy, rubber-tired construction equipment or a tandem-axle dump truck (loaded to a gross weight of about 25 tons). This surficial proofroll would help to provide a stable base for the compaction of new structural fill, and delineate low density, soft, or disturbed areas that may exist below subgrade level. Soft, low density, and disturbed areas should be scarified, moisture conditioned, and recompacted or replaced with approved structural fill.

Corrective measures may be required to increase subgrade stability during subgrade preparation. HRG and the City should budget for additional costs to provide the required corrective measures. Based on our experience in soils of these types, crushed stone working mat on the order of 1 to 2 feet thick could be required to stabilize subgrade soils. A geotextile stabilization material could also be placed below the crushed stone to help stabilize the subgrade soils. As an alternative, inorganic portions of the unstable

subgrade soils could be undercut, scarified in-situ, and compacted with moisture and density control in maximum 9-inch loose lifts up to final subgrade elevation to provide a uniform thickness of well-compacted material.

Incorporation of hydrated lime, portland cement, or Class C fly ash could be considered for chemical stabilization of the unstable soils. Chemical modification should be performed by a pre-qualified contractor having experience with successfully stabilizing subgrades in the project area on similar sized projects with similar soil conditions. Results of chemical analysis of the additive materials should be provided to the geotechnical engineer prior to use. Equipment which limits fugitive dust should also be used to limit the hazards associated with chemicals blowing onto adjacent property. Additional testing would be needed for us to develop specific recommendations to improve subgrade stability by blending chemicals with the soils. However, on a preliminary basis, 14 to 16 percent by soil weight of Class C fly ash and 4 to 6 percent by soil weight of hydrated lime or portland cement could be used for budgeting purposes. Additional testing could include, but not be limited to, determining the most suitable stabilizing agent, the optimum amounts required, the potential for sulfate induced heave, and freeze-thaw durability of the subgrade.

Upon completion of filling and grading, care should be taken to maintain the subgrade moisture content prior to construction of the pavement. Construction traffic over the completed subgrade should be avoided to the extent practical. The alignment should also be graded to prevent ponding of surface water on the prepared subgrades or in excavations. If the subgrade should become frozen, desiccated, saturated, or disturbed, the affected material should be removed, or these materials should be scarified, moisture conditioned, and recompacted prior to placement of pavement base courses and pavement sections.

Dewatering Considerations

Dewatering during construction may be required for undercuts, subdrain installation, and utility excavations. We expect that sump pits and pumps would generally be adequate for dewatering shallow excavations in clay soils. More extensive dewatering measures, such as well points and sheeting, are anticipated to be required if excavations encounter water bearing sand soils.

Pipe Bedding and Backfill

Care should be taken so that the subgrade at the base of the utility excavations is not disturbed during construction. Disturbed or unstable materials should be removed before placing any granular bedding material. Groundwater, lower strength soils, and unstable conditions should be anticipated along the trench excavation alignments.

If very soft to soft clay soils, very loose to loose sand soils, and/or otherwise unsuitable materials are present, overexcavation of lower strength soils and backfilling with crushed stone in these areas will likely be required to create a stable surface for placement of the pipe bedding. Pipe bedding should be placed in accordance with SUDAS specifications.

Fill Material Types

Structural fill for pavement subgrades and utility trench backfill should meet the requirements of SUDAS Standard Specifications, Division 2 – Earthwork, Division 3 – Trench Excavation and Backfill, and general practice requirements; summarized below.

Fill placed in pavement areas should be low plasticity cohesive soil or granular materials. Fill placed in confined excavations should consist of relatively clean and well-graded granular material. This should provide for greater ease of placement and compaction in confined areas where larger compaction equipment cannot be operated.

The inorganic (i.e., less than 5 percent loss on ignition), silty sand soils (GeoModel Layer 2) and lower plasticity, sandy lean clay, and clayey sand soils (GeoModel Layer 3) encountered in the borings are considered suitable for use/reuse as mass grading fill, and based on our testing, meet the requirements of SUDAS Section 2010 2.03 as “*Suitable Embankment Material*”. Significant quantities of soils that meet the requirements for SUDAS Section 2010 2.04 “*Select Subgrade Material*” are not anticipated to be excavated.

Moisture conditioning (e.g., drying of soils) should be anticipated if existing subgrade soils are used as fill. However, we anticipate that drying requirements would be reduced if the soils were chemically modified.

Compacted structural fill should meet the following material property requirements tabulated below.

| Fill Type ¹ | USCS Classification | Acceptable Location for Placement |
|---|----------------------------------|--|
| Low plasticity cohesive ^{2, 4} | CL-ML, CL | General grading fill |
| High plasticity cohesive | CL/CH, CH | Green (non-structural) locations |
| Granular ^{3, 4} | GW, GP, GM, GC SW, SP, SM, SC | General grading fill |
| Unsuitable | MH, CL-OL, OL, CH-OH, OH, PT | Green (non-structural) locations |
| On-site soils | SM, CL, SC, SP, CL/CH | Per the USCS classifications noted in this table |

| Fill Type ¹ | USCS Classification | Acceptable Location for Placement |
|--|---------------------|-----------------------------------|
| <ol style="list-style-type: none"> 1. Structural fill should consist of approved materials that are free of organic matter and debris. Frozen material should not be used, and fill should not be placed on a frozen subgrade. A sample of each material type should be submitted to Terracon for evaluation prior to use on this project. 2. By our definition, suitable cohesive soils should have a liquid limit less than or equal to 45 and a plasticity index less than or equal to 23 (differs from SUDAS Section 2010 2.03). As per SUDAS, cohesive Select Subgrade Materials should have 45% or less silt size fractions, density of 110 pcf or greater according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density), plasticity index greater than 10, and be AASHTO A-6 or A-7-6 soils of glacial origin. 3. As per SUDAS, granular Select Subgrade Materials should have density of 110 pcf or greater according to ASTM D 698 or AASHTO T 99 (Standard Proctor Density), 15% or less silt and clay, plasticity index of 3 or less, and be AASHTO A 1, A-2, or A-3 (0) soil. 4. As per SUDAS, the Engineer (as defined in SUDAS Standard Specification, Division 1) may authorize a change in select subgrade materials subject to locally available materials at the time of construction. | | |

Appropriate laboratory tests, including Atterberg Limits for cohesive soils, organic content tests for dark colored soils and/or those that exhibit a noticeable odor, and standard Proctor (ASTM D698) moisture-density relationship tests should be performed on proposed fill materials prior to their use as structural fill. Further evaluation of any on-site soils or off-site fill materials should be performed by Terracon prior to their use in compacted fill sections.

Fill Placement and Compaction Requirements

Structural fill should meet the following compaction requirements.

| Item | Description |
|------------------------------------|---|
| Maximum Fill Lift Thickness | <ul style="list-style-type: none"> ■ Two 6-inch lifts of uniform composition within 12 inches below top of subgrade under new paving or subbase, plus 2 feet laterally to each side ■ 8 inches or less in loose thickness when heavy, self-propelled compaction equipment is used ■ 4 inches in loose thickness when hand-guided equipment (e.g., jumping jack or plate compactor) is used |

| Item | Description |
|---|--|
| Minimum Compaction Requirements ¹ | <ul style="list-style-type: none"> ■ Per maximum standard Proctor dry density (cohesive soil and granular soils with more than 5% fines) <ul style="list-style-type: none"> ○ 98% in the top 1 foot of subgrade ² ○ 95% below the top 1 foot of subgrade ■ 70% of maximum relative density (granular soils with 5% or fewer fines) |
| Moisture Content Range | <ul style="list-style-type: none"> ■ Low plasticity cohesive: 0% to +4% ■ Granular: typically at -3% to +3%; sufficient to achieve compaction without pumping when proofrolled ² |

1. As determined by the Standard Proctor test (ASTM D698) or Maximum and Minimum Index Density test (ASTM D4253 and D4254).
2. Differs from Section 2010.3.09 of SUDAS Standard Specifications, Division 2 – Earthwork.

Grading and Drainage

All grades should provide effective drainage during and after construction, and also need to be maintained throughout the life of the pavement. Water retained on pavement subgrades can result in soil movements greater than those discussed in this report. These greater movements can result in unacceptable differential pavement movement and pavement distress.

Earthwork Considerations

As a minimum, excavations should be performed in accordance with OSHA 29 CFR, Part 1926, Subpart P, “Excavations” and its appendices, and in accordance with any applicable local, and/or state regulations.

Where granular soils are encountered, excavations will likely require shoring or bracing to maintain stability and reduce the lateral extent of the excavations. Sloped excavations could be considered if the lateral extent would not impact adjacent utilities, pavements, or structures. If poorly compacted variable fill materials are encountered, flatter slopes than those required by OSHA could be required to maintain the stability of the excavation(s). The stability of the excavation slopes should be reviewed continuously by qualified personnel.

Construction site safety is the sole responsibility of the contractor who controls the means, methods, and sequencing of construction operations. Under no circumstances

shall the information provided herein be interpreted to mean Terracon is assuming any responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Construction Observation and Testing

Earthwork should be observed and tested by Terracon, including stripping, fill placement, compaction, and pavement subgrade preparation. Sewer trench bottom soils should be evaluated by Terracon. In addition to the documentation of the essential parameters necessary for construction, the continuation of Terracon into the construction phase of the project provides the continuity to maintain our evaluation of geotechnical conditions, including assessing variations and associated design changes.

Pavements

General Pavement Comments

Pavement subgrades should be prepared in accordance with the recommendations presented in the **Earthwork** section of this report.

Pavement Subgrade Preparation

There is often a time lapse between the end of grading operations and commencement of paving. Subgrades prepared early in the construction process can become disturbed by construction traffic, weather, and other factors. Non-uniform subgrades often result in poor pavement performance and local failures relatively soon after pavements are constructed. Depending on the contractor's use of paving equipment, measures may be required to improve subgrade strength for support of heavily loaded ready-mix concrete or hot mix asphalt trucks.

Before paving, and where recommended by Terracon, pavement subgrades should be evaluated by proofrolling in the presence of a Terracon representative using rubber tire equipment with a gross weight of about 25 tons, such as a partially loaded tandem axle dump truck, prior to commencement of actual paving operations. Proofrolling helps in delineating soft or disturbed areas that may exist at or near the exposed subgrade level. Areas exhibiting excessive deflection and/or rutting should be corrected as recommended in the **Earthwork** section.

Minimum Pavement Thicknesses

Traffic data was not available as noted in the [Project Description](#) section. Our thickness recommendations assume that 18-kip equivalent single axle loads (18-kip ESALs) for asphaltic cement concrete (ACC) and portland cement concrete (PCC) for up to a 50-year design life are less than 300,000 (i.e., SUDAS classification as *Local Roads*). We can provide revised thickness recommendation for higher design traffic upon request.

Based on the relatively high silt content of the silty sand encountered in Boring B-1, as well as the possibility of clay subgrades, we recommend a CBR of 3 be used for pavement design.

To promote drainage of water to the recommended subdrains, we recommend a minimum base course thickness of 6 inches.

The recommended minimum pavement thicknesses are based on SUDAS Table 5F-1.13: *Recommended Thickness for Rigid Pavement – Local Roads* and SUDAS Table 5F-1.16: *Recommended Thickness for Flexible Pavement – Local Roads*.

Based on our recommendations for the pavement having subdrains, and the minimums discussed above, our recommended minimum pavement section is:

- 6.5 inches ACC over;
- 6 inches granular base course;

Or

- 6 inches PCC over;
- 6 inches granular base course.

These minimum thicknesses consider:

- All materials should meet the current Iowa Department of Transportation (IDOT) Standard Specifications for Highway and Bridge Construction.
- The granular base course should be placed on a stable subgrade and compacted to at least 98 percent of the materials standard Proctor maximum dry density.

All concrete for rigid pavements should have a minimum 28-day compressive strength of 4,000 psi. Proper joint spacing will also be required to prevent excessive slab curling and shrinkage cracking. All joints should be sealed to prevent entry of foreign material and dowelled where necessary for load transfer.

Pavement Design Considerations

Long term pavement performance will be dependent upon several factors, including pavement and subgrade thicknesses, maintaining subgrade moisture levels, and providing for preventive maintenance. The following recommendations should be considered the minimum:

- Final grade adjacent to paved areas should slope down from the edges at a minimum 2 percent
- The subgrade and pavement surface should have a minimum 2 percent slope to promote proper surface drainage
- Install below pavement drainage systems in surrounding areas anticipated for frequent wetting
- Install joint sealant and seal cracks immediately
- Seal all landscaped areas in or adjacent to pavements to reduce moisture migration to subgrade soils
- Place compacted, low permeability backfill against the exterior side of curb and gutter.

Longitudinal Subdrains / Pavement Subdrains

Due to frost susceptible nature of the site soils, and the potential for shallow groundwater/perched groundwater, and in order to prolong the service life of the pavement, we recommend that longitudinal shoulder subdrains be provided along the roadway. A permeable base will help prevent infiltrated surface water from ponding beneath pavement and softening the pavement subgrade. Longitudinal subdrains should drain the permeable base and help increase the overall pavement stability and decrease the potential for frost heave.

Longitudinal drains should be constructed in accordance with **Section 4040 – Subdrains and Footing Drain Collectors** of SUDAS Standard Specifications, Division 4 – Sewers and Drains. The drains should be hydraulically connected with the permeable base and sloped to provide positive gravity drainage to a reliable discharge point.

Pavement Maintenance

The pavement section provided in this report represents minimum recommended thickness and, as such, periodic maintenance should be anticipated. Therefore, preventive maintenance should be planned and provided for through an on-going pavement management program. Maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment. Maintenance consists of both localized maintenance (e.g., crack and joint sealing and patching) and global maintenance (e.g., surface sealing). Preventive maintenance is usually the first priority

when implementing a pavement maintenance program. Additional engineering observation is recommended to determine the type and extent of a cost-effective program. Even with periodic maintenance, some movements and related cracking may still occur, and repairs may be required.

General Comments

Our analysis and opinions are based upon our understanding of the project, the geotechnical conditions in the area, and the data obtained from our site exploration. Variations will occur between exploration point locations or due to the modifying effects of construction or weather. The nature and extent of such variations may not become evident until during or after construction. Terracon should be retained as the Geotechnical Engineer, where noted in this report, to provide observation and testing services during pertinent construction phases. If variations appear, we can provide further evaluation and supplemental recommendations. If variations are noted in the absence of our observation and testing services on-site, we should be immediately notified so that we can provide evaluation and supplemental recommendations.

Our Scope of Services does not include either specifically or by implication any environmental or biological (e.g., mold, fungi, bacteria) assessment of the site or identification or prevention of pollutants, hazardous materials, or conditions. If the owner is concerned about the potential for such contamination or pollution, other studies should be undertaken.

Our services and any correspondence are intended for the sole benefit and exclusive use of our client for specific application to the project discussed and are accomplished in accordance with generally accepted geotechnical engineering practices with no third-party beneficiaries intended. Any third-party access to services or correspondence is solely for information purposes to support the services provided by Terracon to our client. Reliance upon the services and any work product is limited to our client and is not intended for third parties. Any use or reliance of the provided information by third parties is done solely at their own risk. No warranties, either express or implied, are intended or made.

Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly affect excavation cost. Any parties charged with estimating excavation costs should seek their own site characterization for specific purposes to obtain the specific level of detail necessary for costing. Site safety and cost estimating including excavation support and dewatering requirements/design are the responsibility of others. Construction and site development have the potential to affect adjacent properties. Such impacts can include damages due to vibration, modification of groundwater/surface

Geotechnical Engineering Report

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water flow during construction, foundation movement due to undermining or subsidence from excavation, as well as noise or air quality concerns. Evaluation of these items on nearby properties are commonly associated with contractor means and methods and are not addressed in this report. The owner and contractor should consider a preconstruction/precondition survey of surrounding development. If changes in the nature, design, or location of the project are planned, our conclusions and recommendations shall not be considered valid unless we review the changes and either verify or modify our conclusions in writing.

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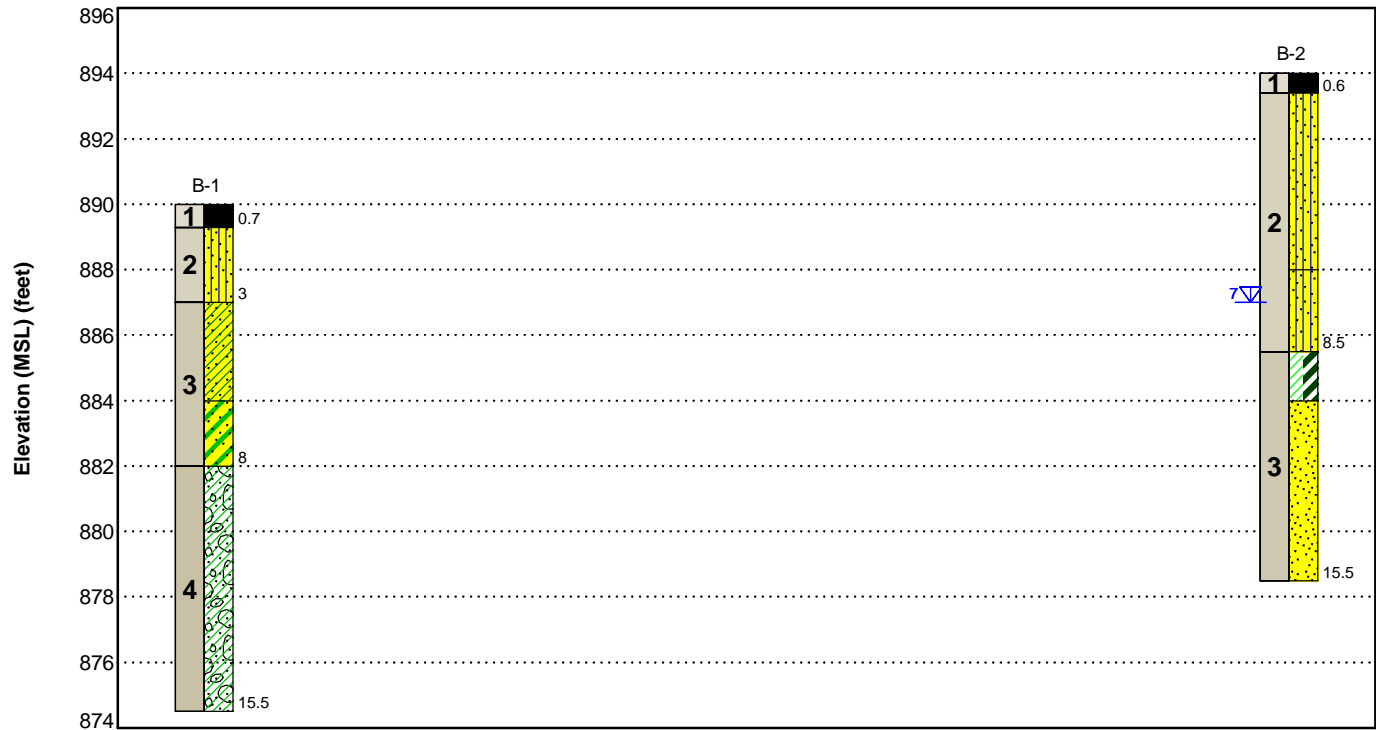


Figures

Contents:

GeoModel

GeoModel



This is not a cross section. This is intended to display the Geotechnical Model only. See individual logs for more detailed conditions.

| Model Layer | Layer Name | General Description |
|-------------|---------------------------|---|
| 1 | Surficial | Hot-Mix Asphalt over Chip Seal |
| 2 | Sandy Eolian Deposits | Silty Sand (SM) |
| 3 | Interbedded Clay and Sand | Sandy Lean Clay (CL), Lean to Fat Clay (CL/CH), Clayey Sand (SC), and Poorly Graded Sand (SP) |
| 4 | Glacial Till | Sandy Lean Clay (CL) |

LEGEND

- Asphalt
- Clayey Sand
- Poorly-graded Sand
- Silty Sand
- Glacial Till
- Sandy Lean Clay
- Lean Clay/Fat Clay

- First Water Observation
- Second Water Observation

The groundwater levels shown are representative of the date and time of our exploration. Significant changes are possible over time. Water levels shown are as measured during and/or after drilling. In some cases, boring advancement methods mask the presence/absence of groundwater. See individual logs for details.

NOTES:
Layering shown on this figure has been developed by the geotechnical engineer for purposes of modeling the subsurface conditions as required for the subsequent geotechnical engineering for this project.
Numbers adjacent to soil column indicate depth below ground surface.

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Attachments

Exploration and Testing Procedures

Field Exploration

| Number of Borings | Approximate Boring Depth (feet) | Location |
|-------------------|---------------------------------|----------------------|
| 2 | 15.5 | pavement / utilities |

Boring Layout and Elevations: One boring per block of the project alignment was requested by HRG. Terracon personnel selected the boring locations and provided the boring layout using handheld GPS equipment (estimated horizontal accuracy of about ± 10 feet) and referencing existing site features. Approximate ground surface elevations (rounded to the nearest foot on the boring logs) were obtained by plotting the boring coordinates in the IDNR LiDAR Tool. The coordinates and elevations of the borings should be considered as accurate as the means and methods used to develop them.

Subsurface Exploration Procedures: We advanced the borings with an ATV-mounted rotary drill rig using continuous flight augers. Four samples were obtained in the upper 10 feet of each boring and at intervals of 5 feet thereafter. In the thin-walled tube sampling procedure, a thin-walled, seamless steel tube with a sharp cutting edge was pushed hydraulically into the soil to obtain a relatively undisturbed sample. In the split-barrel sampling procedure, a standard 2-inch outer diameter split-barrel sampling spoon was driven into the ground by a 140-pound automatic hammer falling a distance of 30 inches. The number of blows required to advance the sampling spoon the last 12 inches of a normal 18-inch penetration is recorded as the Standard Penetration Test (SPT) resistance value. The SPT resistance values, also referred to as N-values, are indicated on the boring logs at the test depths. For safety purposes, the borings were backfilled with auger cuttings after their completion. Pavements were patched with cold-mix asphalt.

We also observed the boreholes while drilling and at the completion of drilling for the presence of groundwater. The groundwater levels or absence of groundwater in the borings are shown on the attached boring logs.

Our exploration team prepared field boring logs as part of the drilling operations. The sampling depths, penetration resistances, and other sampling information were recorded on the field boring logs. These field logs included visual classifications of the materials observed during drilling and our exploration team's interpretation of the subsurface conditions between samples.

Laboratory Testing

The project engineer reviewed the field data and assigned laboratory tests. The laboratory testing program included the following types of tests:

- Moisture Content
- Dry density
- Unconfined compressive strength
- Percent passing the U.S. No. 200 sieve

The laboratory testing program included examination of soil samples by a geotechnical engineer. Based on the results of our field and laboratory programs, we described and classified the soil samples in accordance with the Unified Soil Classification System.

Computer generated boring logs were prepared from the field logs. These boring logs represent the Geotechnical Engineer's interpretation of the field logs and include modifications based on observations and tests of the samples in our laboratory.

Alignment Location and Exploration Plans

Contents:

Alignment Location Plan

Exploration Plan

Note: All attachments are one page unless noted above.

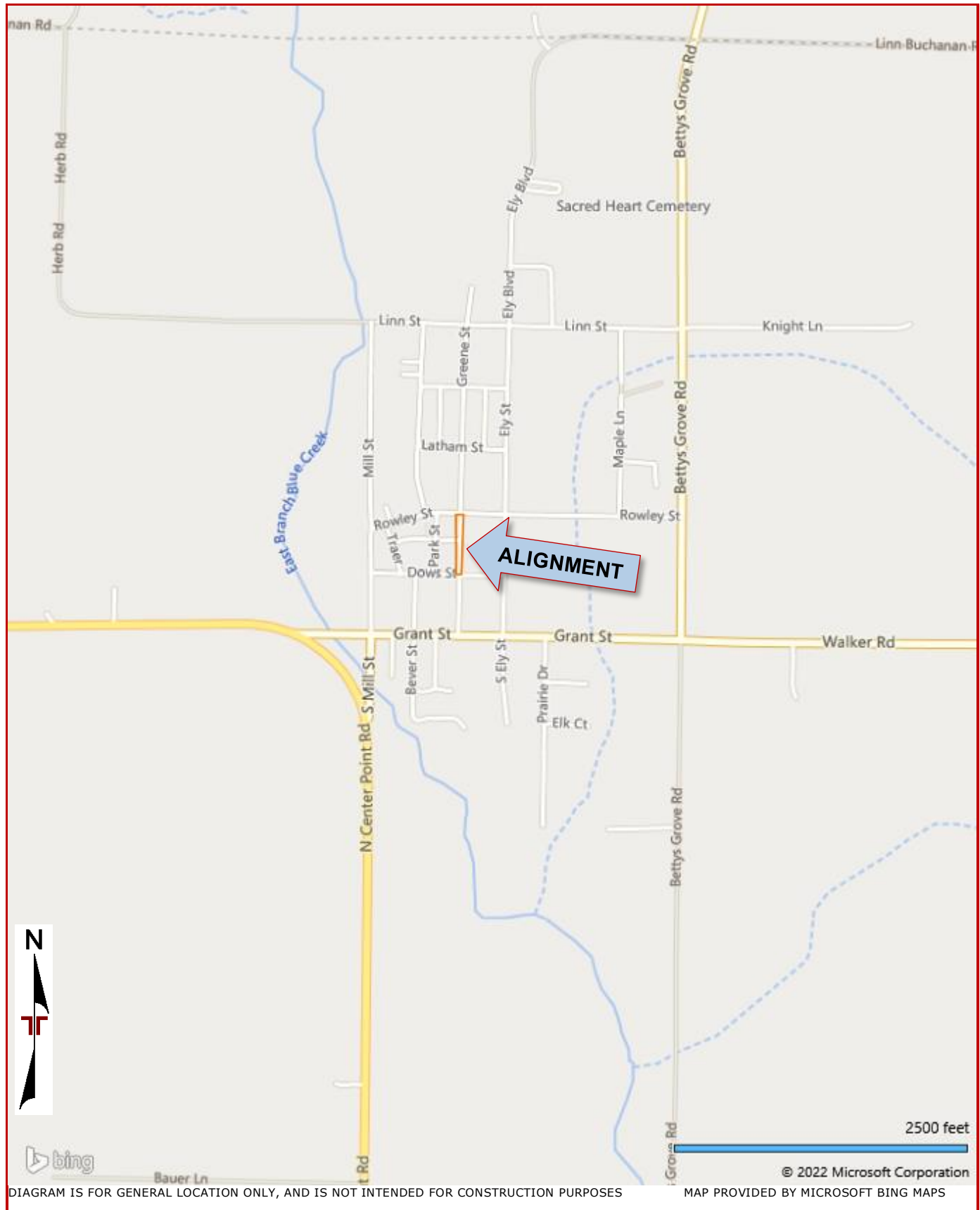
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Alignment Location



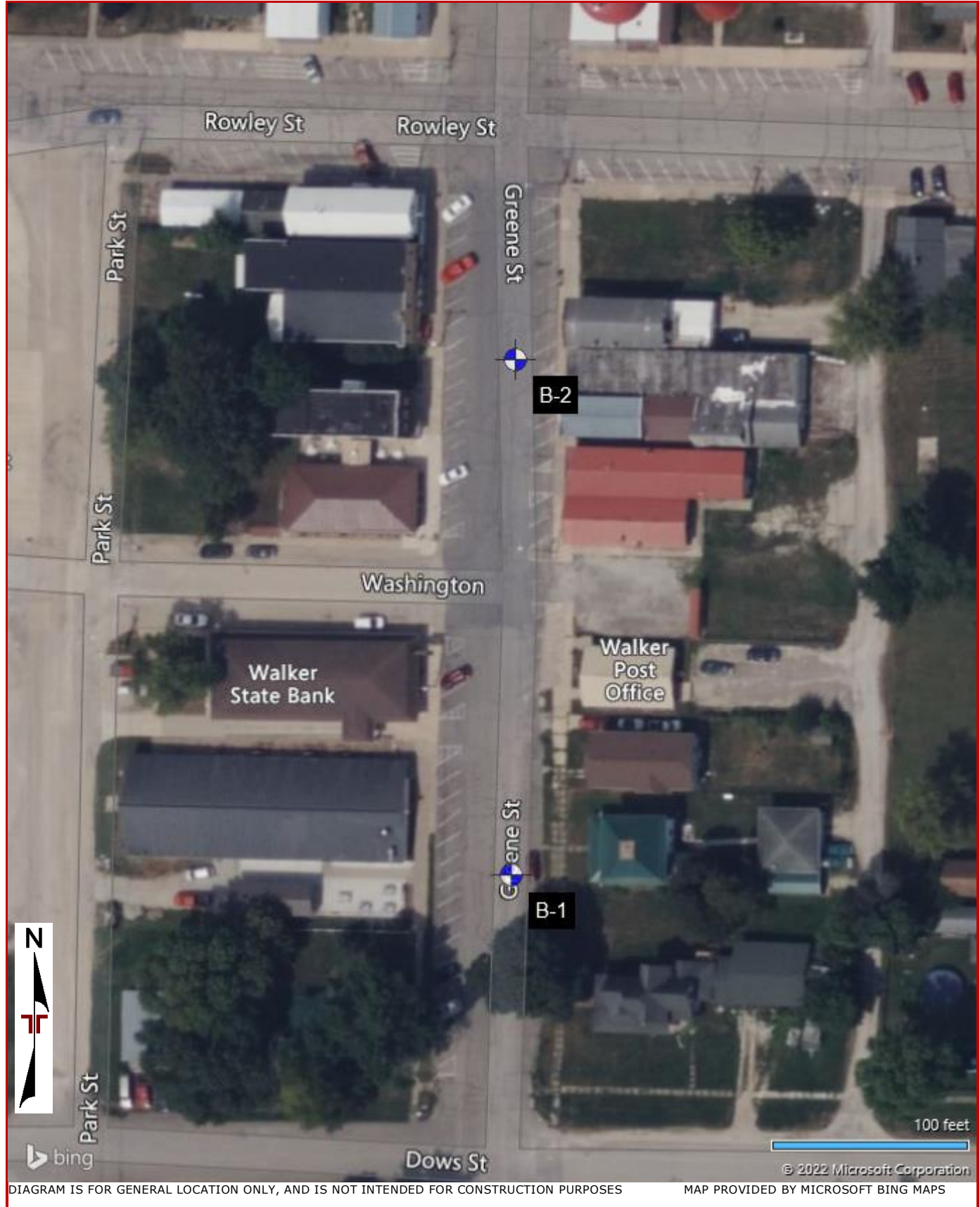
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Exploration Plan



Exploration and Laboratory Results

Contents:

Boring Logs (B-1 and B-2)

Note: All attachments are one page unless noted above.

Boring Log No. B-1

| Model Layer | Graphic Log | Location: Offset: 7' W Latitude: 42.2857° Longitude: -91.7808° Depth (Ft.) Elevation: 890 (Ft.) +/- | Depth (Ft.) | Water Level Observations | Sample Type | Recovery (In.) | Field Test Results | HP (tsf) | Strength Test | | | Water Content (%) | Dry Unit Weight (pcf) | Percent Fines |
|-------------|-------------|---|-------------|--------------------------|-------------|----------------|--------------------|-----------|---------------|----------------------------|------------|-------------------|-----------------------|---------------|
| | | | | | | | | | Test Type | Compressive Strength (tsf) | Strain (%) | | | |
| 1 | | 5" Hot-Mix Asphalt over 3" Chip Seal 0.7 889.3 | | | | | | | | | | | | |
| 2 | | SILTY SAND (SM) , fine to medium grained, dark brown, loose 3.0 887 | | | | 12 | 3-3-2 N=5 | | | | | 14.7 | | 40 |
| 3 | | SANDY LEAN CLAY (CL) , brown, gray, and dark brown, very stiff 6.0 884 | 5 | | | 5 | | 2.5 (HP) | UC | 2.59 | 7.9 | 12.5 | 119 | |
| | | CLAYEY SAND (SC) , fine to medium grained, brown and gray, loose 8.0 882 | | | | 18 | 2-2-2 N=4 | | | | | 18.2 | | |
| | | SANDY LEAN CLAY (CL) , trace gravel, occasional sand seams, brown and dark gray, stiff 10 | 10 | | | 10 | | 1.75 (HP) | UC | 1.91 | 15 | 14.6 | 118 | |
| 4 | | very stiff to hard below about 14 feet 15.5 874.5 | 15 | | | 18 | 5-9-11 N=20 | 4.5+ (HP) | | | | 11.3 | | |
| | | Boring Terminated at 15.5 Feet | | | | | | | | | | | | |

See [Exploration and Testing Procedures](#) for a description of field and laboratory procedures used and additional data (If any).

See [Supporting Information](#) for explanation of symbols and abbreviations.

Notes

Elevation Reference: Elevation obtained using IDNR LiDAR Data Elevation Tool

Water Level Observations

No water encountered during drilling/sampling

No water observed after boring

Advancement Method

Power Auger

Abandonment Method

Boring backfilled with auger cuttings upon completion.
Pavement patched.

Drill Rig

719 - CME 550X

Hammer Type

CME Automatic

Driller

DL

Logged by

ZS

Boring Started

11-10-2022

Boring Completed

11-10-2022

Supporting Information







Contents:

General Notes

Unified Soil Classification System

Note: All attachments are one page unless noted above.

General Notes

| Sampling | Water Level | Field Tests |
|---|--|---|
|  Shelby Tube  Standard Penetration Test |  Water Initially Encountered  Water Level After a Specified Period of Time  Water Level After a Specified Period of Time  Cave In Encountered <p>Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.</p> | N Standard Penetration Test Resistance (Blows/Ft.) (HP) Hand Penetrometer (T) Torvane (DCP) Dynamic Cone Penetrometer UC Unconfined Compressive Strength (PID) Photo-Ionization Detector (OVA) Organic Vapor Analyzer |

Descriptive Soil Classification

Soil classification as noted on the soil boring logs is based Unified Soil Classification System. Where sufficient laboratory data exist to classify the soils consistent with ASTM D2487 "Classification of Soils for Engineering Purposes" this procedure is used. ASTM D2488 "Description and Identification of Soils (Visual-Manual Procedure)" is also used to classify the soils, particularly where insufficient laboratory data exist to classify the soils in accordance with ASTM D2487. In addition to USCS classification, coarse grained soils are classified on the basis of their in-place relative density, and fine-grained soils are classified on the basis of their consistency. See "Strength Terms" table below for details. The ASTM standards noted above are for reference to methodology in general. In some cases, variations to methods are applied as a result of local practice or professional judgment.

Location And Elevation Notes

Exploration point locations as shown on the Exploration Plan and as noted on the soil boring logs in the form of Latitude and Longitude are approximate. See Exploration and Testing Procedures in the report for the methods used to locate the exploration points for this project. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

Strength Terms

| Relative Density of Coarse-Grained Soils (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance | | Consistency of Fine-Grained Soils (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance | | |
|---|---|---|--|---|
| Relative Density | Standard Penetration or N-Value (Blows/Ft.) | Consistency | Unconfined Compressive Strength Qu (tsf) | Standard Penetration or N-Value (Blows/Ft.) |
| Very Loose | 0 - 3 | Very Soft | less than 0.25 | 0 - 1 |
| Loose | 4 - 9 | Soft | 0.25 to 0.50 | 2 - 4 |
| Medium Dense | 10 - 29 | Medium Stiff | 0.50 to 1.00 | 4 - 8 |
| Dense | 30 - 50 | Stiff | 1.00 to 2.00 | 8 - 15 |
| Very Dense | > 50 | Very Stiff | 2.00 to 4.00 | 15 - 30 |
| | | Hard | > 4.00 | > 30 |

Relevance of Exploration and Laboratory Test Results

Exploration/field results and/or laboratory test data contained within this document are intended for application to the project as described in this document. Use of such exploration/field results and/or laboratory test data should not be used independently of this document.

Unified Soil Classification System

| Criteria for Assigning Group Symbols and Group Names Using Laboratory Tests ^A | | | | Soil Classification | |
|--|--|---|---|---------------------|--|
| | | | | Group Symbol | Group Name ^B |
| Coarse-Grained Soils: More than 50% retained on No. 200 sieve | Gravels: More than 50% of coarse fraction retained on No. 4 sieve | Clean Gravels: Less than 5% fines ^C | Cu≥4 and 1≤Cc≤3 ^E | GW | Well-graded gravel ^F |
| | | | Cu<4 and/or [Cc<1 or Cc>3.0] ^E | GP | Poorly graded gravel ^F |
| | | Gravels with Fines: More than 12% fines ^C | Fines classify as ML or MH | GM | Silty gravel ^{F, G, H} |
| | | | Fines classify as CL or CH | GC | Clayey gravel ^{F, G, H} |
| | Sands: 50% or more of coarse fraction passes No. 4 sieve | Clean Sands: Less than 5% fines ^D | Cu≥6 and 1≤Cc≤3 ^E | SW | Well-graded sand ^I |
| | | | Cu<6 and/or [Cc<1 or Cc>3.0] ^E | SP | Poorly graded sand ^I |
| | | Sands with Fines: More than 12% fines ^D | Fines classify as ML or MH | SM | Silty sand ^{G, H, I} |
| | | | Fines classify as CL or CH | SC | Clayey sand ^{G, H, I} |
| Fine-Grained Soils: 50% or more passes the No. 200 sieve | Silts and Clays: Liquid limit less than 50 | Inorganic: | PI > 7 and plots above “A” line ^J | CL | Lean clay ^{K, L, M} |
| | | | PI < 4 or plots below “A” line ^J | ML | Silt ^{K, L, M} |
| | | Organic: | $\frac{LL\text{ oven dried}}{LL\text{ not dried}} < 0.75$ | OL | Organic clay ^{K, L, M, N} Organic silt ^{K, L, M, O} |
| | Silts and Clays: Liquid limit 50 or more | Inorganic: | PI plots on or above “A” line | CH | Fat clay ^{K, L, M} |
| | | | PI plots below “A” line | MH | Elastic silt ^{K, L, M} |
| | | Organic: | $\frac{LL\text{ oven dried}}{LL\text{ not dried}} < 0.75$ | OH | Organic clay ^{K, L, M, P} Organic silt ^{K, L, M, Q} |
| | | | | | |
| | Highly organic soils: | Primarily organic matter, dark in color, and organic odor | | | PT |

^A Based on the material passing the 3-inch (75-mm) sieve.

^B If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.

^C Gravels with 5 to 12% fines require dual symbols: GW-GM well-graded gravel with silt, GW-GC well-graded gravel with clay, GP-GM poorly graded gravel with silt, GP-GC poorly graded gravel with clay.

^D Sands with 5 to 12% fines require dual symbols: SW-SM well-graded sand with silt, SW-SC well-graded sand with clay, SP-SM poorly graded sand with silt, SP-SC poorly graded sand with clay.

$$^E \quad Cu = D_{60}/D_{10} \quad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$$

^F If soil contains $\geq 15\%$ sand, add "with sand" to group name.

^G If fines classify as CL-ML, use dual symbol GC-GM, or SC-SM.

^H If fines are organic, add "with organic fines" to group name.

^I If soil contains $\geq 15\%$ gravel, add "with gravel" to group name.

^J If Atterberg limits plot in shaded area, soil is a CL-ML, silty clay.

^K If soil contains 15 to 29% plus No. 200, add "with sand" or "with gravel," whichever is predominant.

^L If soil contains $\geq 30\%$ plus No. 200 predominantly sand, add "sandy" to group name.

^M If soil contains $\geq 30\%$ plus No. 200, predominantly gravel, add "gravelly" to group name.

^N PI ≥ 4 and plots on or above "A" line.

^O PI < 4 or plots below "A" line.

^P PI plots on or above "A" line.

^Q PI plots below "A" line.

