WINN970905C Wetland - Bouska Site

Geotechnical Engineering Report

Calmar Township, Winneshiek County, Iowa

April 25, 2025 | Terracon Project No. 13245113

Prepared for:

Shive Hattery, Inc. Architecture & Engineering
4125 Westown Parkway, Suite 100
West Des Moines, Iowa 50266

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.

__________________________ April 25, 2025__

Theresa Stromberg-Murphy, P.E. Date
My license renewal date is December 31, 2025.

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April 25, 2025

Shive Hattery, Inc. Architecture & Engineering
4125 Westown Parkway, Suite 100
West Des Moines, Iowa 50266

Attn: Daniel Jensen, P.E.
P: (515) 223-8104
E: djensen@shive-hattery.com

Re: Geotechnical Engineering Report
WINN970905C Wetland - Bouska Site
Conover Road
Calmar Township, Winneshiek County, Iowa
Terracon Project No. 13245113

Dear Mr. Jensen:

We have completed the scope of Geotechnical Engineering services for the above referenced project in general accordance with Terracon Proposal No. P13245113 dated January 28, 2025. This report presents the findings of the subsurface exploration and provides geotechnical recommendations concerning earthwork, soil parameters for use in sheet pile design, and geotechnical discussion regarding use of borrow area soils in an embankment 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.

Terracon

Kurt A. Drilling
Senior Staff Geologist

Theresa Stromberg-Murphy, P.E.
Senior Engineer

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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 Terracon 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 Wetland WINN970905C located north of Conover Road and west of 270th Street in Calmar Township, Winneshiek County, Iowa. The purpose of these services was to provide information and geotechnical engineering recommendations related to:

- Subsurface soil conditions
- Groundwater conditions
- Borrow for embankment construction
- Soil parameters for sheet pile design

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 Site 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 and Laboratory Results section.

Project Description

Item	Description
Proposed Construction	A 5.89 acres wetland site is planned. The wetland conceptual plan includes a sheet pile weir in the southeast corner of the wetland, about 120 feet north of Conover Road. The sheet pile weir is planned to have a width of about 76 feet. A drop height of 6.5 feet and a maximum water depth of about 5 feet are planned for the weir and permanent pool. The borrow source is planned in the pool area of the site.

Site Conditions

Item	Description
Parcel Information	The project is located north of Conover Road and west of 270th Avenue in Calmar Township, Winneshiek County, Iowa. Latitude/Longitude 43.2417, -91.9423 See Site Location

Item	Description
Existing Improvements	None known
Current Ground Cover	Various vegetation
Existing Topography	Based on the topographic site plan provided, surface elevations range from about 1,160 feet in the east and west sides of the proposed wetland area to 1,150 feet near the proposed weir.

Geotechnical Characterization

We have developed a general characterization of the subsurface conditions based on 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 evaluation of the site. Conditions observed at the boring locations are indicated on logs in the Exploration and Laboratory Results. The GeoModel can be found in the Figures of this report.

As part of our evaluation, we identified the following model layers within the subsurface profile.

Model Layer	Layer Name	General Description
1	Surface	▪ Topsoil / root zone
2	Glacial Drift	▪ Sandy Lean Clay, with clayey sand layers, stiff
3	Alluvial	▪ Clayey Sand, fine to medium grained, loose ▪ Sand, with silt, trace clay, fine to medium grained, loose ▪ Clayey Sand, with limestone gravel, fine to coarse grained, loose
4	Bedrock	▪ Limestone, highly weathered and broken, with occasional silt and clay layers

Groundwater Observations

Groundwater was not observed in borings while and after sampling. Groundwater observations made in cohesive soils require a relatively long period for a groundwater level to develop and stabilize in a borehole. While groundwater level observations made within granular soils are usually a reliable indication of the current groundwater conditions. Long-term observations in piezometers or groundwater observation wells, sealed from the influence of surface water, would be required to provide a better evaluation of groundwater levels in materials of this type. Groundwater level fluctuations should be anticipated during the life of the structure due to variations in the amount of precipitation, and other potential factors not evident at the time the borings were performed.

A review of the Winneshiek County, Iowa Soil Survey provided online on the 'Web Soil Survey' by the United States Department of Agriculture/Soil Conservation Service mapped the Marlean Loam (512D2), Rockton Loam (814C), and Lawon-Ossian Complex (1489B) at the site. The information in the following table for groundwater, drainage class, and flooding frequency was indicated on the Web Soil Survey.

Map Unit Name	Seasonally High Groundwater Depths (feet)	Drainage Class	Flooding Frequency
Marlean Loam (512D2)	>6	Well drained	None
Rockton Loam (814C)	>6	Well drained	None
Lawson-Ossian Complex (1489B)	12	Somewhat poorly drained	None

Geologic Hazards

Based on the site plan provided, and the Iowa Department of Natural Resources (IDNR) Geological Survey maps of known sinkholes, karst areas, and potential karst areas in the State of Iowa, and USDA/SCS Soil Survey mapping of the site, we are not aware that a sinkhole has been mapped within the area. The IDNR indicates that the site is located in a ‘potential karst area’. Based on the conditions encountered in the borings, certain evidence of a karst condition that poses an immediate threat of a sinkhole or significant subsidence developing was not apparent. It is important to note however, that the boreholes explored an insignificant portion of the site overall. The following paragraphs provide discussion of karst for the owner and a design philosophy associated with construction at karst sites. We would be pleased to provide additional consultation regarding our experience with karst in the vicinity of this site upon request.

Karst topography results from the solution and weathering of a bedrock formation (e.g., limestone) in which a porous media (cavities) and/or conveying channels are created in the bedrock over a relatively long period. A resulting surface subsidence can occur following an advanced state of soil erosion or raveling of overburden (soil) in which soil particles migrate into the underlying porous media or cavities under the influence of a hydraulic gradient. This process results in a gradual loss of overburden that may be recognized as a “sinkhole”. In some instances, voids are filled with overburden because the erosional process is not complete.

The risk associated with constructing wetlands would include the loss of ground and loss of water detention. The risk associated with karst can initially by controlled by the identification of the karst feature and further controlled by detailed evaluation of the subsurface conditions and the development and implementation of a design concept and construction quality assurance practices that meet the expectations of functionality and the design life of the wetland proposed. The risk that karst would affect a structure can be further evaluated, and hence reduced, by performing additional borings and/or geophysical evaluation. Greater reduction of risk would involve the implementation of a rigorous grouting program in an attempt to fill the majority of voids in the karst feature and improve support conditions.

Geotechnical Overview

Based on the project information and the results of the subsurface exploration, laboratory testing, and our limited evaluation, geotechnical considerations for this project include:

- The presence of relatively thick layers of partly organic soils
- The presence of granular soils
- The presence of relatively shallow and potentially karstic bedrock

Materials encountered in the proposed outlet area, Borings 1 and 2, consisted of topsoil over partly organic clay to depths of about 3.5 to 4 feet. Below the partly organic clay, Boring 1 encountered sandy lean clay to a depth of about 9 feet below existing grade. Boring 3, within the pool area, encountered about 2.3 feet of topsoil over granular soils to the boring's termination depth of about 10.5 feet. Based on the provided information and the results of the subsurface exploration and laboratory testing, it does not appear that a significant source of non-organic clay is present in the proposed borrow areas. Zones of unsuitable, partly organic soil, sand, and clayey sand are present at the project site. Where encountered in a borrow area, thorough mixing of the material with lean clay or sandy lean clay, or wasting of the material, will be necessary for a suitable borrow source for embankment fill.

Construction of a relatively uniform embankment will require proper fill placement and compaction operations. Fill placement and compaction operations ultimately affect whether the in-place strength and hydraulic conductivity meet the project design requirements. Control of fill moisture content and thorough discing and mixing will be required during construction. The moisture content of each previous lift must be maintained prior to placement of each subsequent lift of fill. This will require that watering, moisture conditioning, and protection of working subgrades be provided throughout construction. The sizes of the fill material pieces, or clod sizes, affects the hydraulic conductivity of the compacted element. Discing, pulverizing, or tining will therefore be required during construction. The contractor must select appropriate equipment with sufficient weight or force capable of breaking each lift of fill into an acceptable clod size prior to and during moisture conditioning. Each lift of fill should be placed and compacted under strict moisture and compaction/density control and each lift of fill should be tested. In addition to in-place moisture and compaction testing, undisturbed samples of in-place fill should be obtained and tested for hydraulic conductivity throughout embankment construction.

Although groundwater was not encountered at the site, based on the results of the subsurface exploration, it appears that groundwater could be encountered. The amount of groundwater requiring removal to facilitate construction will depend on the actual extent of granular seams and layers, prevailing weather conditions during construction, and depths and method of borrow removal. The use of ditches or "french drains" to intercept and convey water may be a satisfactory means to drain borrow and excavation areas. Where extensive areas of water-bearing granular deposits are present, or if it is not possible to gravity drain an area, it would be necessary to utilize sump pits and pumps or well points to maintain groundwater levels below the working construction grade.

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

Site Preparation and Subgrade Evaluations

The subgrade for the embankment and any berms should be evaluated by Terracon personnel. Unstable, soft, or disturbed subgrade areas for the embankment and berms should be undercut or improved in-place prior to fill placement. Excessively wet or dry material should also be undercut or scarified, moisture conditioned, and compacted. Prior to the placement of each lift of fill, the surface should be scarified/disced to a depth of about 4 inches.

We recommend that lifts of fill be placed on slopes no steeper than 5H:1V. The excavation of a maximum 5H:1V slope will help provide a positive bond between the fill and existing soils/materials and reduce the possibility of failure along the interface of existing soil/material and new fill. Faces of slopes should be compacted as construction proceeds. Consideration should be given to overfilling new fill slopes and subsequently cutting the slope to the plan section.

Fill Material Types

For the purposes of this report, fill required to construct the embankment and any berms is referred to as structural fill. Requirements for structural fill material types follow.

Reuse of On-Site Soil: Excavated on-site soil may be selectively reused as fill. Due to the presence of partly organic material, sorting of suitable and unsuitable materials should be expected. Some moisture conditioning (e.g., drying) should also be expected to achieve compaction requirements for on-site, fine-grained materials used for the embankment and berm fill. It should be noted that clayey and silty soils (CL, ML, SC, and SM) can be difficult to compact during cool or cold weather, in relatively small areas, and over lower strength/density and marginally stable subgrades.

Borrow Materials: Based on the subsurface conditions encountered below the topsoil and near the site surface in Borings 1 and 2, it appears that suitable clay borrow is present in limited quantities at the site. However, Borings 1 and 2 encountered zones of clayey sand at depths of about 6 to 9 feet below existing grade and should be selectively sorted.

Material Property Requirements: Material property requirements for soil/material used as fill to construct the embankment and any berms are presented in the following table.

Fill Type[1]	USCS Classification	Acceptable Locations for Placement
Imported, Low to Medium Plasticity, Fine-grained Soil	CL, CL/CH, CH 15 < PI < 30 LL <60	Embankment, berms, and general site grading
Imported or On-site, Granular[2]	SP, SW, SC, SM, GP, GW, GM, ML	General site grading
On-site, Fine-grained Soil[3]	CL 15 < PI < 30, LL <60	Embankment, berms, and general site grading

1. Based on the results of the subsurface exploration and laboratory testing. By our definition, low plasticity material would have a liquid limit (LL) of 45 or less, and a plasticity index (PI) of 23 or less. Low plasticity fill should be used in areas where movements related to shrinking and swelling may adversely impact an improvement. Actual material suitability should be evaluated during construction.
2. Interlayering of fine-grained and coarse-grained materials should be avoided.
3. Based on the construction planned and the results of the borings and laboratory testing, it appears that the non-organic, on-site, fine-grained soils could be reused. Moisture conditioning should be expected to achieve compaction requirements.

Fill Placement and Compaction Requirements

Construction of a relatively uniform embankment will require proper fill placement and compaction operations. Fill placement and compaction operations ultimately affect whether the in-place strength and hydraulic conductivity meet the project design requirements. Control of fill moisture content and thorough discing and mixing will be required during construction. The moisture content of each previous lift must be maintained prior to placement of each subsequent lift of fill. This will require that watering, moisture conditioning, and protection of working subgrades be provided throughout construction. The sizes of the fill material pieces, or clod sizes, affects the hydraulic conductivity of the compacted element. Discing, pulverizing, or tining will therefore be required during construction. The contractor must select appropriate equipment with sufficient weight or force capable of breaking each lift of fill into an acceptable clod size prior to and during moisture conditioning. Each lift of fill should be placed and compacted under strict moisture and compaction/density control and each lift of fill should be tested. In addition to in-place moisture and compaction testing, undisturbed samples of in-place fill should be obtained and tested for hydraulic conductivity throughout embankment construction.

Structural fill should be placed and compacted in accordance with the following requirements.

Item	Requirement	
Maximum Lift Thickness	■ 9 inches in loose thickness when heavy, self-propelled compaction equipment is used ■ 4 inches in loose thickness when hand-guided equipment (i.e., jumping jack or plate compactor) is used	
Minimum Compaction Requirements [1, 2]	■ Granular material: ■ Fine-grained material:	95% 95%
Water Content Range from Optimum [1, 3]	■ Fine-grained/Cohesive material: ■ Granular material:	0% to +4% -3% to +3%

1. The minimum compaction requirements are in reference to the maximum dry density value and optimum water content determined by the 'standard Proctor' test (ASTM D698). Should the results of the in-place density tests indicate the specified water content or compaction limits have not been met, the area represented by the test should be reworked and retested, as required, until the specified water content and compaction requirements are achieved.
2. If the granular material is a coarse sand or gravel, or of a uniform size, or has a low fines content, compaction comparison to relative density may be more appropriate. In this case, granular materials should be compacted to at least 70% relative density (ASTM D4253 and D4254).
3. The gradation of a granular material affects its stability and the water content required for proper compaction. The water content of granular material should be maintained at levels satisfactory for compaction to be achieved without the granular material bulking during placement or pumping when proofrolled.

General Earthwork Considerations

The on-site, fine-grained soils are frost-susceptible and will be sensitive to changes in moisture conditions. Upon completion of filling and grading, care should be taken to maintain the subgrade water content. Construction traffic over completed subgrades should be avoided. If the subgrade freezes or becomes desiccated, saturated, or disturbed, the affected material should be removed, or the materials should be scarified, moisture conditioned, and recompacted.

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. 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 responsibility for construction site safety, or the contractor's activities; such responsibility shall neither be implied nor inferred.

Sheet Pile Design Parameters

The following soil parameters were estimated based on the results of the subsurface exploration and laboratory testing and may be used in the sheet pile design. Please note that recommendations for design and construction of the embankment and sheet pile are beyond our scope of services for this project.

Recommended Sheet Pile Parameters			
Soil Classification	Topsoil	Model Layer 2 Glacial Drift	Model Layer 3 Alluvial Soil
Total ‘Saturated’ Density (pcf)	105	120	120
Submerged Density (pcf)	40	55	55
Effective friction angle (degrees)	18	22	30
Cohesion (psf)	0	1,500	0
Steel-soil interface friction angle	---	---	14
Active Pressure coefficient (K_a)	0.53	0.46	0.33
Passive Pressure coefficient (K_p)	1.89	2.19	3.00

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.

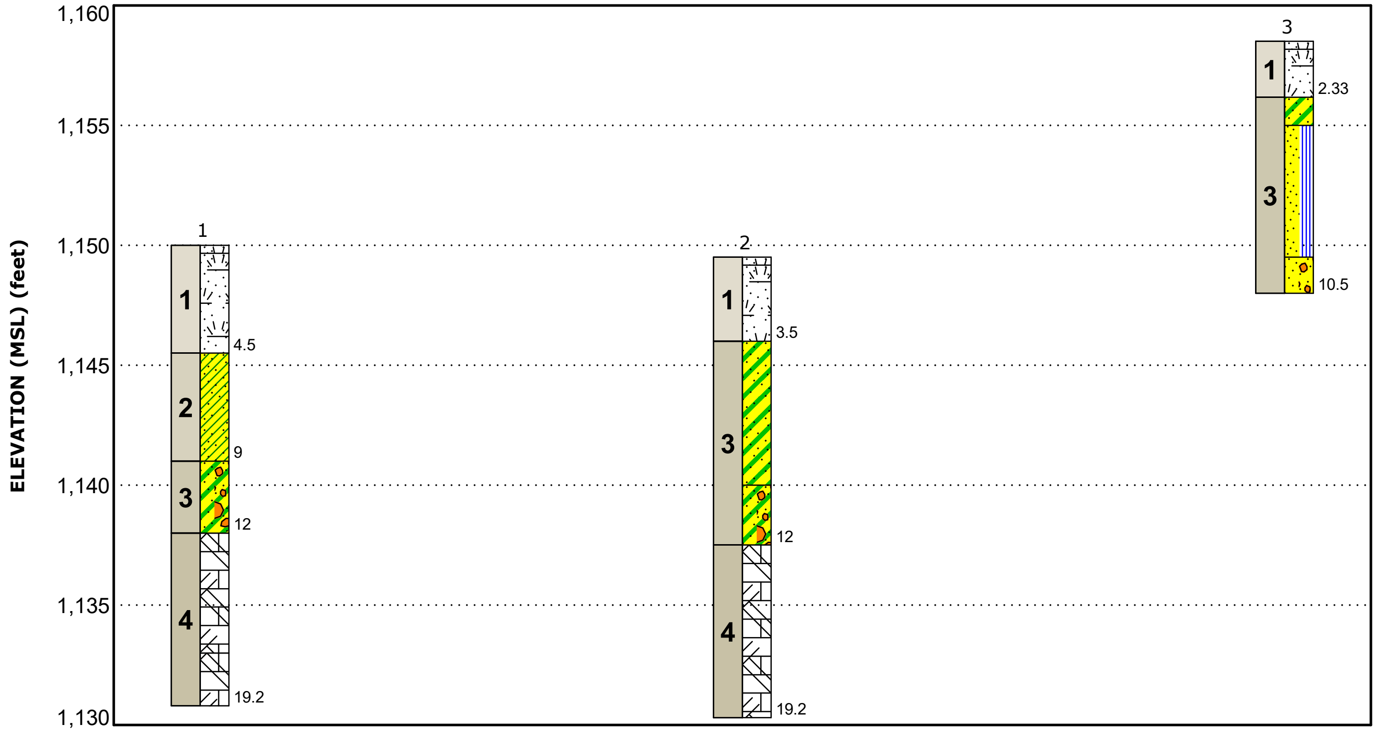
Site characteristics as provided are for design purposes and not to estimate excavation cost. Any use of our report in that regard is done at the sole risk of the excavating cost estimator as there may be variations on the site that are not apparent in the data that could significantly effect excavation 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 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.

Figures

Contents:

Terracon
3105 Capital Way, Ste 5
Cedar Falls, IA

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	**Surface**	Topsoil / root zone
2	**Glacial Drift**	Sandy Lean Clay, with clayey sand layers, stiff
3	**Alluvial**	Clayey Sand, fine to medium grained, loose Sand, with silt, trace clay, fine to medium grained, loose Clayey Sand, with limestone gravel, fine to coarse grained, loose
4	**Bedrock**	Limestone, highly weathered and broken, with occasional silt and clay layers

Legend

- Topsoil
- Sandy Lean Clay
- Clayey Sand with Gravel
- Weathered Limestone
- Clayey Sand
- Poorly-graded Sand with Silt
- Poorly-graded Sand with Gravel

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.

Attachments

Exploration and Testing Procedures

Field Exploration

Number of Borings	Approximate Boring Depth (feet)	Location
2	19.2	Sheet Pile Weir
1	10.5	Borrow Area

Boring Layout and Elevations: Shive-Hattery personnel determined the boring locations and staked the locations in the field. Approximate elevations were also determined by Shive-Hattery personnel. The surface elevations on the boring logs were rounded to the nearest ½-foot. The locations and elevations of the borings should be considered accurate to the degree implied by the methods used to define them.

Subsurface Exploration Procedures: We advanced the borings with an ATV-mounted, rotary drill rig using continuous flight, solid-stem augers. Soil sampling was performed using thin-wall tube and split-barrel sampling procedures. In the split-barrel sampling procedure, the number of blows required to advance a standard 2-inch O.D. split barrel sampler the last 12 inches of the typical total 18-inch penetration by means of a hammer with a free fall of 30 inches, is the standard penetration resistance value (N). A CME automatic SPT hammer was used to estimate the relative density of granular soils, and to a lesser extent, the consistency of fine-grained soils. 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.

Our exploration team prepared field boring logs as part of the drilling operations. These field logs include visual classifications of the materials encountered during drilling and the exploration team's interpretation of the subsurface conditions between samples. The sampling interval depths, penetration resistances, recoveries, and other sampling information are recorded on the field boring logs. The samples were containerized and transported to our laboratory for further testing and classification.

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 Unit Weight
- Unconfined Compression

- Grain size analysis
- Atterberg limits

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

Site Location and Exploration Plans

Contents:

Note: All attachments are one page unless noted above.

Site Location

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY MICROSOFT BING MAPS

Exploration Plan

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

MAP PROVIDED BY SHIVE HATTERY.

Exploration and Laboratory Results

Contents:

Note: All attachments are one page unless noted above.

Boring Log No. 1

Location: See Exploration Plan

Latitude: 43.2418° Longitude: -91.9421°

Depth (Ft.) Elevation: 1150.0 (Ft.)

Model Layer	Depth (Ft.)	Description	Elevation (Ft.)
1	0.3	**ROOT ZONE**	1149.67
	4.5	**TOPSOIL**	1145.5
2	9.0	**SANDY LEAN CLAY (CL)**, with clayey sand layers, brown and dark brown, stiff	1141
3	12.0	**CLAYEY SAND (SC)**, with limestone gravel, fine to coarse grained, brown, loose	1138
4	17.0	**LIMESTONE**, highly weathered and broken, with clay layers, light brown	1133
	19.2	**LIMESTONE**, highly weathered, light brown	1130.8
		Practical Auger Refusal at 19.2 Feet	

Recovery (In.)	Field Test Results	HP (psf)	Strength Test: Test Type	Compressive Strength (psf)	Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
18	8-6-4 N=10	2000				27.4			
17	3000 (HP)					15.3	111	30-14-16	
16	2-4-4 N=8	3500				15.7			
15	2-4-4 N=8					13.6			
11						11.4			
	50/2"					8.4			

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.

Classification of rock estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Notes

Water Level Observations
None observed while drilling
None observed after drilling

Advancement Method
Solid Stem Auger

Abandonment Method
Boring backfilled with soil cuttings upon completion.

Drill Rig
589

Hammer Type
Automatic

Driller
CL

Logged by
CR

Boring Started
02-27-2025

Boring Completed
02-27-2025

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Boring Log No. 2

Location: See Exploration Plan

Latitude: 43.2417° Longitude: -91.9423°

Depth (Ft.) Elevation: 1149.5 (Ft.)

Model Layer	Depth (Ft.)	Material Description	Elevation (Ft.)	Sample Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (psf)	Test Type	Compressive Strength (psf)	Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1	0.3	**TOPSOIL**	1149.17													
1	3.5	**TOPSOIL**	1146			X	12	5-2-3 N=5					30.4			
3	9.5	**CLAYEY SAND (SC)**, fine to medium grained, brown, loose	1140	5		X	12	3-2-3 N=5					6.9			15.2
						X	13	4-4-5 N=9					17.0			
3	12.0	**CLAYEY SAND (SC)**, with limestone gravel, fine to coarse grained, brown, loose	1137.5	10		X	13	3-3-5 N=8					13.3 13.0			
4	19.2	**LIMESTONE**, highly weathered and broken, with occasional silt layers, light brown	1130.3	15		X	13	3-8-11 N=19					11.8			
						X	2	50/2"					11.2			

Practical Auger Refusal at 19.2 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.

Classification of rock estimated from disturbed samples. Core samples and petrographic analysis may reveal other rock types.

Water Level Observations
None observed while drilling

Drill Rig
589

Hammer Type
Automatic

Driller
CL

Notes

Advancement Method
Solid Stem Auger

Abandonment Method
Boring backfilled with soil cuttings upon completion.

Logged by
CR

Boring Started
02-27-2025

Boring Completed
02-27-2025

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Boring Log No. 3

Location: See Exploration Plan

Latitude: 43.2428° Longitude: -91.9417°

Depth (Ft.) Elevation: 1158.5 (Ft.)

Model Layer	Depth (Ft.)	Description	Elevation	Sample Depth (Ft.)	Water Level Observations	Sample Type	Recovery (In.)	Field Test Results	HP (psf)	Strength Test: Test Type	Strength Test: Compressive Strength (psf)	Strength Test: Strain (%)	Water Content (%)	Dry Unit Weight (pcf)	Atterberg Limits LL-PL-PI	Percent Fines
1	0.3	**ROOT ZONE**	1158.17													
1	2.3	**TOPSOIL**	1156.17			Split spoon	14	6-4-4 N=8	2500				16.5			
3	3.5	**CLAYEY SAND (SC)**, fine to medium grained, dark brown to brown, loose	1155													
3	9.0	**SAND (SP-SM)**, with silt, trace clay, fine to medium grained, brown, loose	1149.5	5		Split spoon	11	4-4-4 N=8					4.7			
						Split spoon	12	2-3-3 N=6					6.6			
3	10.5	**SAND (SP)**, with limestone gravel, fine to medium grained, brown, medium dense	1148	10		Split spoon	14	8-11-12 N=23					7.5			

Boring Terminated at 10.5 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.

Water Level Observations

Drill Rig
589

Hammer Type
Automatic

Driller
CL

Notes

Advancement Method
Solid Stem Auger

Abandonment Method

Logged by
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Boring Started
02-27-2025

Boring Completed
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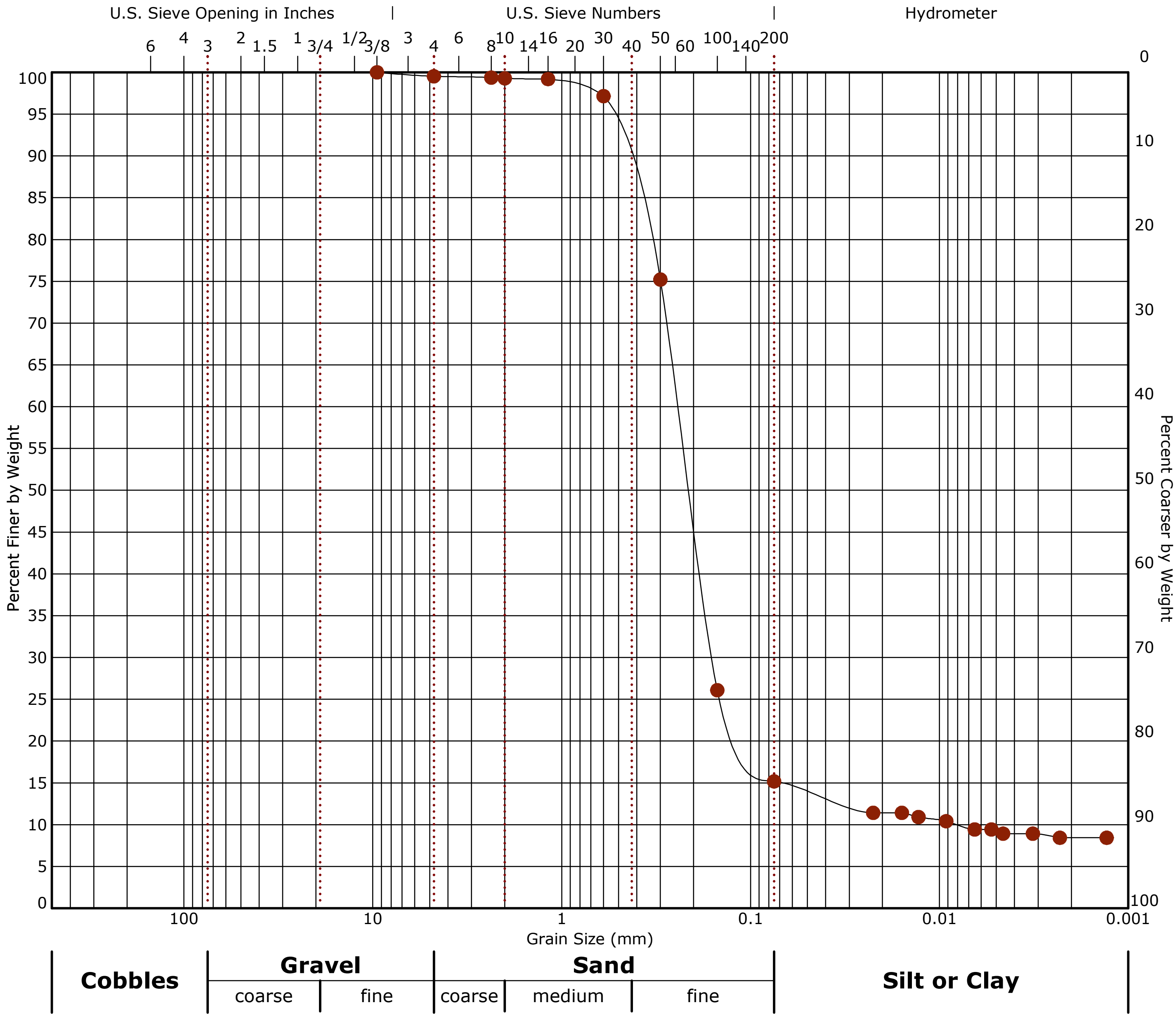
Grain Size Distribution

ASTM D422 / ASTM C136 / AASHTO T27



	Boring ID	Depth	% Cobbles	% Gravel	% Sand	% Fines	% Silt	% Clay	USCS
●	**2**	4 - 5.5	0.0	0.5	84.4		5.9	9.2	SC

	Description
●	CLAYEY SAND, fine to medium grained, brown

	Remarks
●	

● Sieve	● % Finer	Sieve	% Finer	Sieve	% Finer
3/8"	100.0				
#4	99.53				
#8	99.38				
#10	99.28				
#16	99.19				
#30	97.16				
#50	75.21				
#100	26.09				
#200	15.17				

Grain Size

	●		
D_{60}	0.242		
D_{10}	0.008		

Coefficients

	●		
C_c	13.04		
C_u	30.41		

Supporting Information

Contents:

Note: All attachments are one page unless noted above.

Terracon
3105 Capital Way, Ste 5
Cedar Falls, IA

General Notes

Sampling	Water Level	Field Tests
Shelby Tube; Split Spoon	Water Initially Encountered Water Level After a Specified Period of Time Water Level After a Specified Period of Time Cave In Encountered 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.	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 (psi)**	**Standard Penetration or N-Value (Blows/Ft.)**
Very Loose	0 - 3	Very Soft	less than 3.50	0 - 1
Loose	4 - 9	Soft	3.5 to 7.0	2 - 4
Medium Dense	10 - 29	Medium Stiff	7.0 to 14.0	4 - 8
Dense	30 - 50	Stiff	14.0 to 28.0	8 - 15
Very Dense	> 50	Very Stiff	28.0 to 55.5	15 - 30
		Hard	> 55.5	> 30

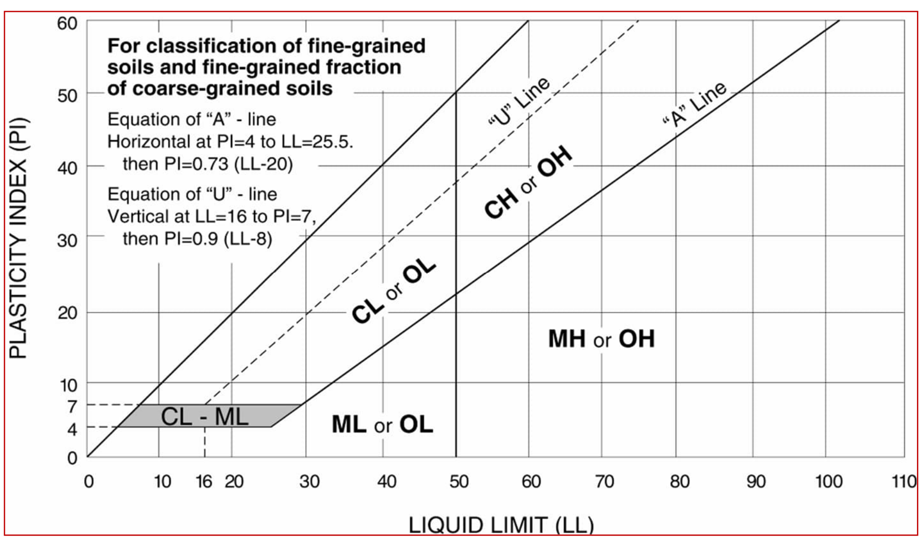
Relevance of Exploration and Laboratory Test Results

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:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	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:	$\frac{LL\ oven\ dried}{LL\ not\ dried} < 0.75$	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	Peat

[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] $Cu = D_{60}/D_{10} \qquad Cc = \frac{(D_{30})^2}{D_{10} \times D_{60}}$
[F] If soil contains ≥ 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 ≥ 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 ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.
[M] If soil contains ≥ 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.



General Notes – Sedimentary Rock Classification

DESCRIPTIVE ROCK CLASSIFICATION:

Sedimentary rocks are composed of cemented clay, silt and sand sized particles. The most common minerals are clay, quartz and calcite. Rock composed primarily of calcite is called limestone; rock of sand size grains is called sandstone, and rock of clay and silt size grains is called mudstone or claystone, siltstone, or shale. Modifiers such as shaly, sandy, dolomitic, calcareous, carbonaceous, etc. are used to describe various constituents. Examples: sandy shale; calcareous sandstone.

LIMESTONE	Light to dark colored, crystalline to fine-grained texture, composed of CaCo3, reacts readily with HCI.
DOLOMITE	Light to dark colored, crystalline to fine-grained texture, composed of $CaMg(CO3)2$, harder than limestone, reacts with HCI when powdered.
CHERT	Light to dark colored, very fine-grained texture, composed of micro-crystalline quartz (SiO2), brittle, breaks into angular fragments, will scratch glass.
SHALE	Very fine-grained texture, composed of consolidated silt or clay, bedded in thin layers. The unlaminated equivalent is frequently referred to as siltstone, claystone or mudstone.
SANDSTONE	Usually light colored, coarse to fine texture, composed of cemented sand size grains of quartz, feldspar, etc. Cement usually is silica but may be such minerals as calcite, iron-oxide, or some other carbonate.
CONGLOMERATE	Rounded rock fragments of variable mineralogy varying in size from near sand to boulder size but usually pebble to cobble size (1/2 inch to 6 inches). Cemented together with various cementing agents. Breccia is similar but composed of angular, fractured rock particles cemented together.

DEGREE OF WEATHERING:

SLIGHT	Slight decomposition of parent material on joints. May be color change.
MODERATE	Some decomposition and color change throughout.
HIGH	Rock highly decomposed, may be extremely broken.

Classification of rock materials has been estimated from disturbed samples.
Core samples and petrographic analysis may reveal other rock types.