

July 3, 2018



McClure Engineering Company
1740 Lininger Lane
North Liberty, Iowa 52317

Attn: Mr. Bhooshan Karnik

Re: Report of Expected Geotechnical Conditions
Manufacturing Drive/Bluff Blvd Improvements
Clinton, Iowa
Terracon Project No. 07185067

Dear Mr. Karnik:

We are pleased to present this Report of Expected Geotechnical Conditions for the proposed roadway improvements referenced above. Our report includes:

Exhibit A	Project Understanding
Exhibit B	Scope of Services and Limitations
Exhibit C	Information Sources
Exhibit D	Confidence Estimate
Exhibit E	Expected Subsurface Conditions
Exhibit F	Expected Foundation Design Parameters
Exhibit G	Expected Construction Considerations

This report references a web-based, GIS portal that has been developed specific for this project using Terracon's proprietary GIS platform providing you with dynamic access to the information compiled for this project. Access to this information can be gained by using this link:

https://portal.gis.terracon.com/Login/?project=McClureEngineeringCompany_07185067

Exhibit B provides important details about the preliminary nature of these opinions. We appreciate the opportunity to be of service to you on this phase of your project, and look forward to performing a field exploration and provide additional geotechnical engineering services. If you have any questions, or if we may be of further service, please contact us.

Sincerely,
Terracon Consultants, Inc.

Zach A. Bonzer, P.E.
Project Engineer

Sara J. Somsy, P.E.
Geotechnical Department Manager

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EXHIBIT A PROJECT INFORMATION

McClure Engineering Company (McClure) is currently evaluating the feasibility of roadway improvements planned along Manufacturing Drive, South Bluff Boulevard, and North Bluff Boulevard, extending from the intersection of Lincoln Highway and Manufacturing Drive to the intersection of 7th Avenue North and North Bluff Boulevard.

Our understanding of the project was developed from information provided McClure. The purpose of our services for this phase of the project is to assess the surface and subsurface soil and rock conditions based on publicly available information regarding soils, geologic settings, topography, depth to subsurface water, and other site-specific data in conjunction with a review of Terracon’s historic geotechnical data in the area for use in rendering an opinion of the expected subsurface conditions anticipated for the proposed roadway improvements.

Item	Description									
Project Description	Improvements to the approximately 4¼-mile long roadway section will include: <ul style="list-style-type: none"> ■ Reconstruction of the pavement section ■ Replacement of 2 existing bridges along Manufacturing Drive: <ul style="list-style-type: none"> ○ The southern bridge, located on Manufacturing Drive about 1,850 feet southwest of South 21st Street, is approximately 120 feet long. ○ The northern bridge, located on Manufacturing Drive about 950 feet southwest of South 21st Street, is approximately 200 feet long. ■ Construct sidewalks and a bike path on the south side of the roadways 									
Project Location	The approximate latitude and longitude locations for the site are as follows: <table border="1" data-bbox="505 1308 1427 1440"> <thead> <tr> <th data-bbox="505 1308 812 1352">Point ID</th> <th data-bbox="815 1308 1122 1352">Latitude:</th> <th data-bbox="1125 1308 1427 1352">Longitude:</th> </tr> </thead> <tbody> <tr> <td data-bbox="505 1356 812 1400">Southern Limit</td> <td data-bbox="815 1356 1122 1400">41.8155°</td> <td data-bbox="1125 1356 1427 1400">-90.2466°</td> </tr> <tr> <td data-bbox="505 1404 812 1449">Northern Limit</td> <td data-bbox="815 1404 1122 1449">41.8522°</td> <td data-bbox="1125 1404 1427 1449">-90.1956°</td> </tr> </tbody> </table> <p data-bbox="505 1453 1427 1556">Refer to the site map presented as Figure 1 below. This project location was provided by McClure and used to generate a kmz file defining the project boundary.</p>	Point ID	Latitude:	Longitude:	Southern Limit	41.8155°	-90.2466°	Northern Limit	41.8522°	-90.1956°
Point ID	Latitude:	Longitude:								
Southern Limit	41.8155°	-90.2466°								
Northern Limit	41.8522°	-90.1956°								
Planned Construction	<ul style="list-style-type: none"> ■ Cut/fill along the alignment is expected to be minimal. We anticipate the roadway pavements will consist of either portland cement concrete or asphalt cement concrete surface. ■ The new bridge structures are expected to be a single or double-span bridge supported on deep foundations 									
Expected Foundations	Foundation loads for the bridges were not provided however, based on our experience, deep foundations such as driven piles or drilled shafts would be required.									

Item	Description
Traffic	Traffic volumes and types were not available at the time of this report. We anticipate traffic to consist of personal lightweight vehicles and trucks (garbage, delivery, semi-tractor trailers, etc.)

Figure 1:

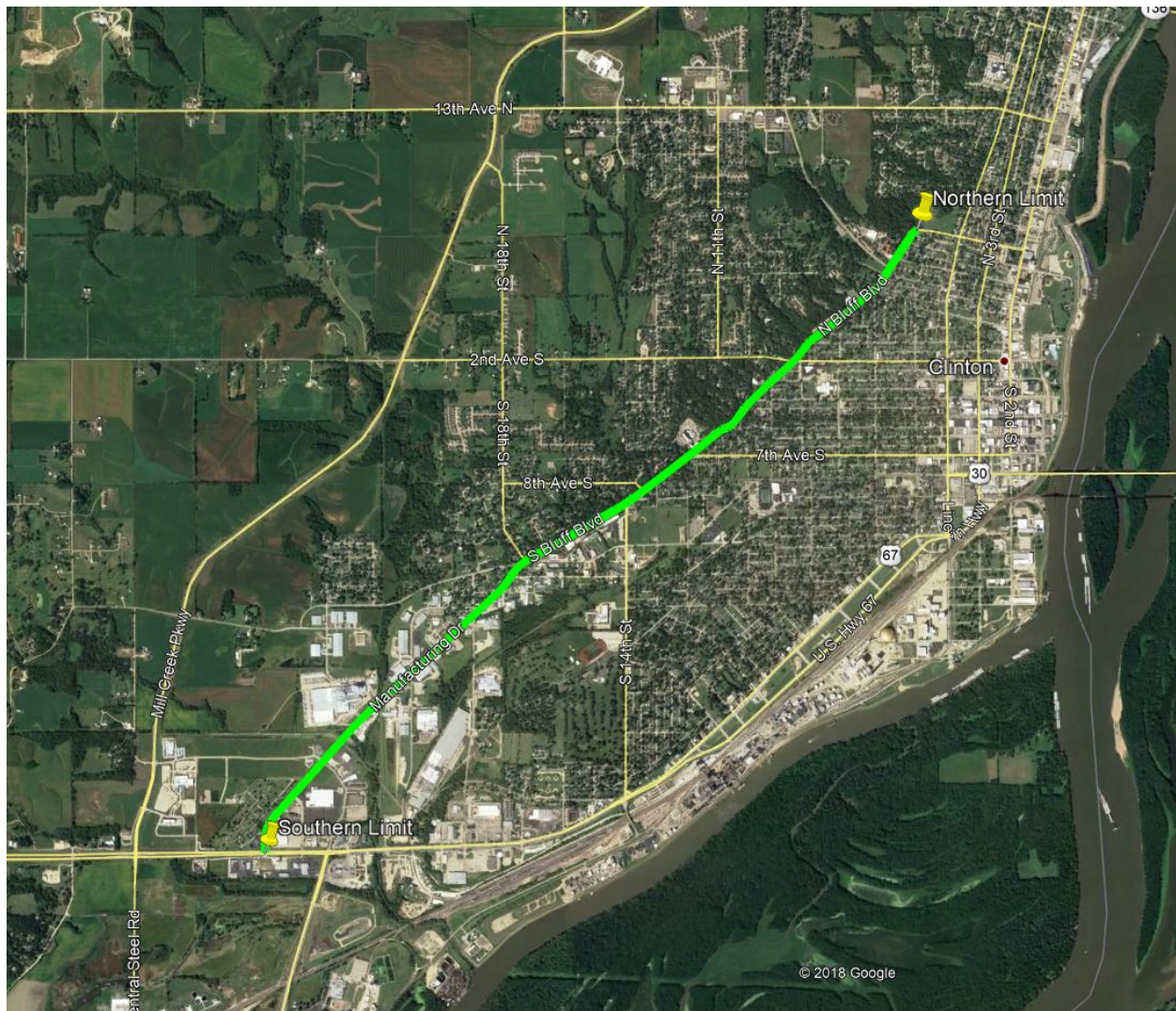


EXHIBIT B

SCOPE OF SERVICES AND LIMITATIONS

Scope of Services

This Report of Expected Geotechnical Conditions (REGC) provides an expectation of subsurface properties from a geotechnical engineering perspective. It is intended to assist in considering preliminary concepts for site development and foundation options for the project described in **Exhibit A**. It is also intended to provide a basis for a subsequent exploration program to confirm the expected conditions as necessary to develop plans for site preparation and foundation construction.

This REGC utilizes the following information:

- Relevant, publicly-available, spatial data for use with GIS delivery platforms,
- Terracon's database of historic documents from geotechnical investigations conducted in the vicinity of the project site using our proprietary GIS-based information retrieval system.

This information is displayed on a proprietary, web-based map sequence developed for this project. The information can be accessed through this web page:

https://portal.gis.terracon.com/Login/?project=McClureEngineeringCompany_07185067.

A geotechnical engineer with local experience in the area of the planned project has formed an opinion of expected geotechnical conditions by reviewing the information as provided on the webpage and our historic data in the vicinity of the project. The opinion rendered by the geotechnical engineer also includes an estimate of the confidence in that opinion. Finally, based upon the planned project, the information available and the confidence in the estimation of expected geotechnical conditions, the engineer has developed a general plan for exploration that will be necessary to confirm the expectations and to finalize the REGC.

Limitations

The data and opinions provided are estimates of geotechnical parameters. They are preliminary in nature and not for design purposes. Any opinions regarding the subsurface conditions for this project may not represent actual conditions encountered during project exploration or construction. In no case should the information or opinions provided in the REGC be utilized for final design.

Confirmation of opinions stated in this document is essential. Confirmation should include the conduct of a site-specific geotechnical investigation consisting of exploratory soil borings and/or

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related exploration methods consistent with the guidelines set forth in **Exhibit E**. Terracon should develop a specific scope of work that would be necessary to confirm these preliminary findings to the extent necessary to provide adequate geotechnical site characterization for the planned construction.

The scope of services for this project addresses a preliminary, unverified opinion of geotechnical conditions only. The scope does not include either specifically or by implication any environmental assessment of the site or identification or prevention of pollutants, hazardous materials or conditions.

This report has been prepared for the exclusive use of McClure to represent a preliminary opinion of geotechnical conditions for specific application to the project described in **Exhibit A** and in accordance with generally accepted geotechnical engineering practices. No warranties, either express or implied, are intended or made.

Furthermore, given the limitations described above based on the preliminary nature of this report, all parties are advised that any decisions or actions taken by any party based on the information contained herein, including decisions with financial implications are done solely at the risk of that party. By providing this information in this preliminary form, Terracon expressly disclaims any duties or obligations associated with the usage of this information for decision-making purposes.

In the event that changes in the nature, design, or location of the project as outlined in this report are planned, the preliminary conclusions and recommendations contained in this report shall not be considered valid unless Terracon reviews the changes and either verifies or modifies the conclusions of this report in writing. In the event the project moves into the design phase, Terracon should be retained to develop and complete a scope of work that includes site specific explorations to confirm or to modify this preliminary opinion of geotechnical conditions.

Terracon and McClure recognize that we have entered into an agreement that may contain certain confidential or non-disclosure obligations relating to our services. McClure recognizes however that while Terracon will not violate any such terms or obligations, none of these obligations create an exclusivity obligation to Terracon relating to the service or data in question and that Terracon has the unfettered ability to provide similar services to any other party and use any public or previously available data or information for the service of others even if included as part of this report.

EXHIBIT C

INFORMATION SOURCES

Public Data Sources Reviewed

The web-map series that can be reviewed at:
https://portal.gis.terracon.com/Login/?project=McClureEngineeringCompany_07185067
 and includes the following sources of public information.

Category	Source
Topographic Overview	USGS National Map web mapping service provided by ESRI
Aerial Imagery Overview	USDA FSA imagery provider, data source NAIP
USGS Geology	USGS Preliminary Integrated Geologic Map Database for the United States
Karst Geology	US Karst Areas web mapping service provided by ESRI
Slope of Terrain	USGS National Elevation Dataset provided by ESRI
Soil and Surficial Materials	NRCS Soil Survey Geographic (SSURGO) Databases for the United States
Depth to Shallow Bedrock	NRCS Soil Survey Geographic (SSURGO) Databases for the United States
Depth to Shallow Water Table	NRCS Soil Survey Geographic (SSURGO) Databases for the United States
Soil Hydrologic Groups	USGS Preliminary Integrated Geologic Map Database for the United States
Flooding Frequency	NRCS Soil Survey Geographic (SSURGO) Databases for the United States

Terracon Historic Records in Project Vicinity

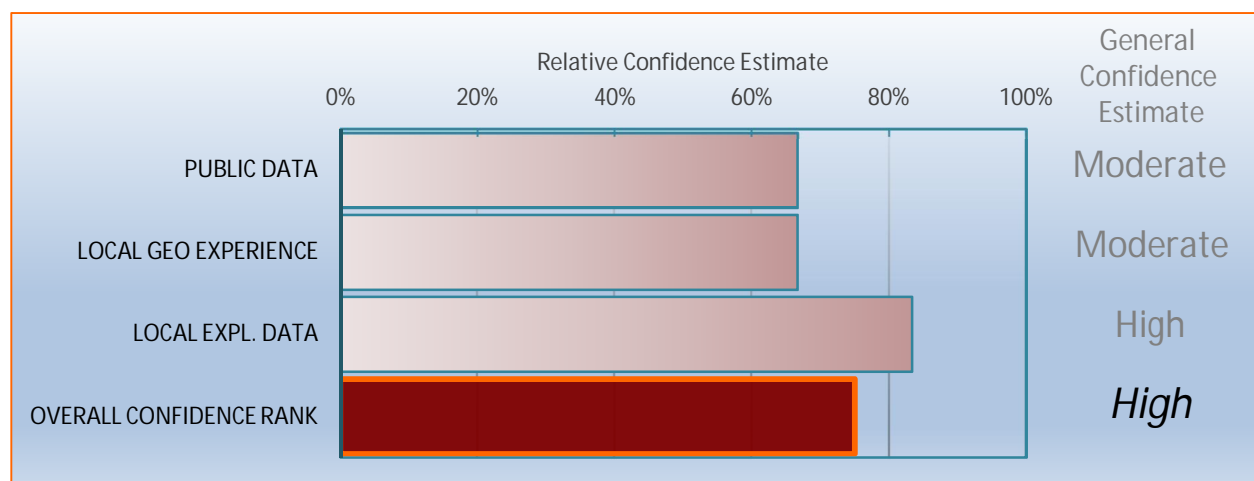
Our research of Terracon’s proprietary database of historic soil, subsurface water, and rock conditions in the vicinity of the site indicated 214 relevant projects within one mile of the project alignment. The project locations are illustrated on the web-based map sequence.

EXHIBIT D - CONFIDENCE ESTIMATE

The project geotechnical engineer has assigned confidence estimates for the data sets based upon the engineer's local practice in the vicinity of the sites. The results of this confidence ranking are presented in the chart below and is expressed as **Low**, **Moderate** or **High**. Using a weighted averaging approach, we derive an overall confidence interval for all of the combined information sources.

Low confidence implies that the level of data availability and/or consistency is such that little confidence can be placed in the Expected Geotechnical Conditions. Conversely, a high confidence ranking implies that sufficient data and consistency exists to derive a high confidence in the statement of expected conditions.

Regardless of the confidence ranking, the expected conditions must be confirmed with site-specific exploration data, and significant variations from the expected conditions are possible. (See **Exhibit B** for more details regarding the limitations of this report.) The confidence ranking process is valuable in guiding the plan for exploration of the site to confirm the geotechnical conditions as necessary for design.



As the chart above illustrates, using our weighted average confidence estimator we have assigned a confidence estimate of “**High**” for this project.

Using the publicly available data, Terracon’s proprietary database of soils information from projects near the proposed project, and our knowledge of general soil and bedrock conditions within the various geologic settings, we developed anticipated soil stratigraphy to a depth of 30 feet for the listed geologic settings at the project area.

EXHIBIT E - EXPECTED SUBSURFACE CONDITIONS

In the southwest area of the project between Lincoln Way and Valley West Drive, we anticipate the near surface soils to consist of clayey sands and silty sands extending to varying depths of 5 to 10 feet. These sands are expected to be underlain by cleaner sands. Bedrock can be anticipated at depths as shallow as 10 to 15 feet near the intersection of Manufacturing Drive and Lincoln Way.

Terracon has previously performed borings for the existing bridges located at both stream crossing on Manufacturing Drive. The southwest bridge generally encountered existing fill materials, which consisted of cohesive soils, to depths of approximately 5 to 15½ feet. Native alluvial soils extended to depths of 9 to 36 feet below boring surface elevations. These alluvial soils generally consisted of sandy lean clays, lean clays, and fat clays, though thin layers of sands were encountered in a majority of the borings. The bottom elevation of the alluvial soils appears to trend upward traveling from the southwest to the northeast. Below the alluvial soils, glacial till was encountered to varying depths. Limestone bedrock was encountered in a majority of the borings below the alluvial and glacial soils. The southwest side of the bridge encountered the bedrock at depths of 51½ to 54 feet, and the northeast side of the bridge encountered bedrock at depths of 20½ to 32 feet.

The northeast bridge encountered existing fill in a majority of the borings to depths of 5 to 10 feet; the existing fill materials consisted of cohesive soils. Below the fill material, native soils consisting of lean clays, sandy lean clays, and sands was encountered. Glacial soils were encountered in some of the borings extending to varying depths. Limestone bedrock was encountered in the borings at depths ranging from 8 to 16 feet. One boring encountered residual soils at depths of 19 to 52½ feet and terminated on limestone bedrock.

We anticipate existing fill and sands will be encountered along the portion of the alignment located northeast of the existing bridges, along the existing bluff. The depth to bedrock in this portion of the alignment may be as shallow as 5 to 10 feet below existing grades.

Depths to subsurface water on the order of 5 to 15 feet below grade are expected based on borings and water well information in the area. Based on information provided from the NRCS Soil Survey, depths to seasonal shallow water can vary from about 4 feet below the ground surface to more than 6 feet below the ground surface. The NRCS Soil Survey also notes the onsite soils are predominately clay soils, with isolated areas of sands, and are typically moderately permeable soils with some areas having low permeability. NRCS soils expected across the site are summarized in the following table.

Soil Type	Parent Material	Depth to Seasonal Shallow Water
Anthropotic Udorthents	Fill material	4 to 6 feet
Raddle Silt Loam	Silty Alluvium	Greater than 6 feet
Fayette Silt Loam	Loess	Greater than 6 feet
Finchford Loamy Sand	Sandy and Gravel Alluvium	Greater than 6 feet
Sawmill Silty Clay Loam	Silty Alluvium	Greater than 6 feet

EXHIBIT F - EXPECTED BRIDGE FOUNDATION DESIGN CONSIDERATIONS

We anticipate both bridges will be supported on deep foundation systems consisting of either driven steel piles or drilled shafts extending into bedrock.

Due to the shallow depth of bedrock expected at the northeast bridge, driven steel piles may not be feasible since the piles bearing on bedrock at a shallower depth may not be able to provide sufficient lateral resistance. Therefore, drilled shafts may be a more feasible option for the northeast bridge. Groundwater was encountered at depths of about 16 to 30 feet at the southwest bridge and at 10 to 19 feet at the northeast bridge during our previous exploration. The use of temporary casing and/or slurry drilling techniques may be required to prevent the collapse of side walls and to control seepage into drilled shaft excavations, particularly if excavations encounter water bearing sands at this site. A tremie method should also be used for concrete placement if water accumulates at the base of drilled shafts and cannot be satisfactorily removed.

Glacial soils were encountered in the borings and these soils can often contain gravel layers, boulders, and cobbles. Special drilling techniques may be required to penetrate potential gravel, cobble, and boulder zones that could be encountered in the underlying glacial soil deposits.

If drilled shafts are used to support the bridges, we anticipate the foundations will extend to bedrock. Extending drilled shaft excavations into bedrock will require the use of heavier duty rock augers or coring tools.

If driven piles are used, consideration should be given to the use of driving points due to the possibility of boulders and cobbles that may be encountered in the glacial soils. We anticipate the piles would bear in the limestone bedrock, with anticipated penetration depths into the rock of 2 to 3 feet.

EXHIBIT G - EXPECTED CONSTRUCTION CONSIDERATIONS

Existing Fill - Portions of the near surface soils encountered below the existing pavements are likely to consist of existing fill materials. If documentation exists for placement of the existing fill materials, this information should be provided to the geotechnical engineer for review during the geotechnical exploration phase of the project. Where exposed at subgrade level, existing fill material should be proofrolled to help delineate soft, disturbed, or low-density fill zones within the existing roadway subgrade. Proofrolling should be accomplished using a fully loaded, tandem axle dump truck or other equipment where cohesive materials are exposed, and with a heavy steel drum roller where granular materials are exposed. The subgrade should be carefully observed during proofrolling.

Moderate to high plasticity clay soils - The near surface site soils encountered in the borings exhibit variable plasticity, some of which consist of moderate to high plasticity clays (e.g., lean to fat clay and fat clay). These higher plasticity clays have potential for swelling or shrinking with changes in soil moisture contents that can occur during and after construction. Pavement sections are subject to other sources of subgrade movement (e.g., wetting-drying cycles and freeze-thaw cycles), and as such, support of pavements above moderate to high plasticity soils is generally considered tolerable with the understanding that increased pavement maintenance may result.

Subgrade Stabilization - Near surface soils encountered on the site may be susceptible to disturbance upon initial exposure. Additionally, unstable subgrade conditions could develop during general construction operations, particularly if the soils are wetted from precipitation, and/or subjected to repetitive construction traffic. Heavy equipment traffic directly on bearing surfaces should be avoided. The use of track-mounted equipment, such as a backhoe or dozer, would be beneficial to perform excavations and reduce subgrade disturbance.

Improvement methods to remedy unstable subgrade conditions are influenced by schedule, weather, the size of disturbed area, and the nature of the disturbance. Improvement methods include, but are not limited to:

- n **Scarification and Compaction** - Soils can be scarified, moisture conditioned (i.e., dried or moistened), and compacted. The success of this procedure depends primarily upon favorable weather and sufficient time to manipulate the soils. Even with adequate time and favorable weather, stable subgrades may not be achieved if the thickness of the unstable material is greater than about 1 to 1½ feet.
- n **Undercutting and Replacement with Crushed Stone/Aggregate** - The use of crushed stone, crushed concrete, and/or gravel could be given consideration for this project to improve subgrade stability. To limit depths of potential undercuts, the use of a geogrid could also be considered after underground work, such as utility construction, is

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completed. The specifications of the reinforcement product manufacturer should be verified prior to material purchase/delivery and placement at the site.

- n **Chemical Treatment** - Unstable or clay soils with high moisture contents can be chemically treated with hydrated lime, portland cement, or Class C fly ash. These treatments will require a contractor with experience in chemically treating clay soils. The treatment rates and incorporation process should be evaluated in the laboratory prior to construction, and Terracon can provide suggested specifications for chemical treatment of unstable subgrades. In addition, Terracon should be notified prior to selection of a chemical stabilization agent to allow time for a review the material's laboratory data sheet.

Chemically treated subgrades will require protection to limit disturbance from weather and construction activities. The use of chemical agents can impact the operation of adjacent facilities (e.g., windblown dust), and this should be considered by the designer and contractor. Equipment which limits fugitive dust should also be considered to limit the hazards associated with chemicals blowing across the site and onto adjacent properties.