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Attachment D

Geotech Report

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Longspur conducted an additional geotechnical survey in response to changes in the Wind Project layout during the fourth quarter of 2025. As noted in the application, the resulting report is being submitted to the North Dakota Public Service Commission.

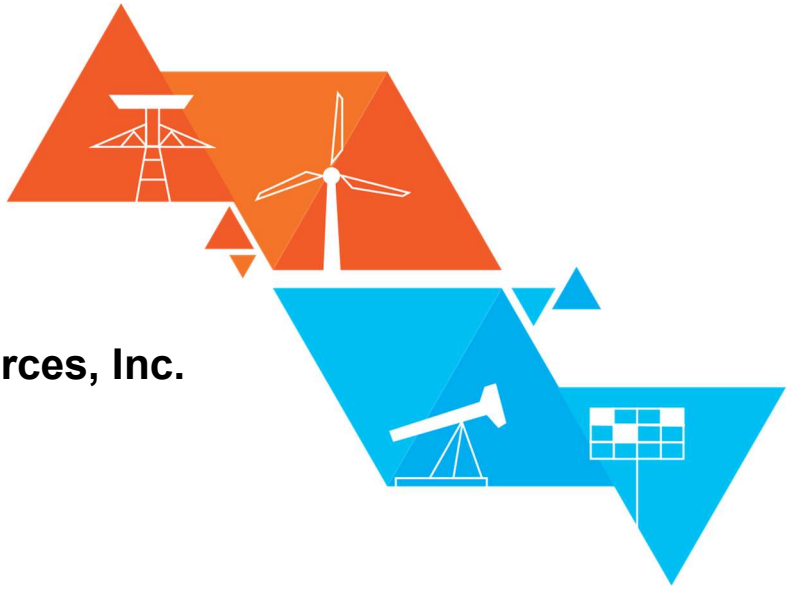
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CONFIDENTIAL

Geotechnical Report

Longspur Wind Project

Mercer and Morton Counties,
North Dakota



PREPARED FOR

Minnesota Power
c/o Allete Renewable Resources, Inc.

Prepared By:

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RRC Project No. GE2503026
April 22, 2026

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April 22, 2026

Minnesota Power
c/o Allete Renewable Resources, Inc.
30 Superior Street
Duluth, MN 55802

Attn: Mitchell Bettenhausen

Re: Geotechnical Report
Longspur Wind Project
Mercer and Morton Counties, North Dakota
RRC Project No. GE2503026

RRC Power & Energy, LLC (RRC) has completed the authorized subsurface exploration and geotechnical engineering evaluation for the proposed Longspur Wind Project. The purpose of this geotechnical engineering study was to explore and evaluate the subsurface conditions at various locations on the site and develop geotechnical design and construction recommendations for the project. The attached report contains:

- A description of our findings from the field exploration and laboratory-testing program;
- Our engineering interpretation of the results with respect to the project characteristics; and
- Geotechnical engineering parameters for the design of foundation systems and access roadways.

Should you have any questions concerning this Geotechnical Report, please do not hesitate to contact us. Your business is always appreciated.

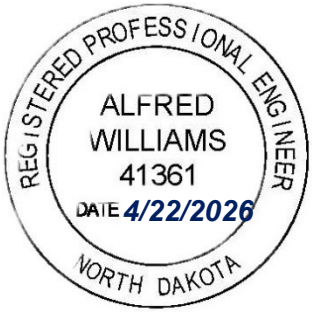
Sincerely,

RRC Power & Energy, LLC

Manoj Keerthipati, P.E.
Geotechnical Engineer

REVISION HISTORY

Revision	Description	Performed by	Reviewed by	Issued Date
0	Draft Geotechnical Report	Manoj Keerthipati	Alfred Williams	6/19/2025
0	Final Geotechnical Report	Manoj Keerthipati	Alfred Williams	9/19/2025
1	Final Geotechnical Report	Manoj Keerthipati	Alfred Williams	4/22/2026



Prepared and Submitted by

Manoj Keerthipati, P.E.
Geotechnical Engineer

Reviewed by

Alfred Williams, P.E.
Director of Geotechnical Engineering

FIRM REGISTRATION NO. ND 1788PE

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GEOTECHNICAL REPORT

1.0 INTRODUCTION

RRC Power and Energy LLC (RRC) has completed the authorized subsurface exploration and geotechnical engineering evaluation for the proposed Longspur Wind Project. This Report includes subsurface information and geotechnical design recommendations. The site is located 5 miles north of the City of Glen Ullin, in Mercer and Morton Counties, North Dakota. The approximate boundaries of the project site are shown on Figure 1, Site Location Map.

The purpose of this geotechnical investigation and report was to:

- Explore subsurface soil, bedrock, and groundwater conditions;
- Conduct field and laboratory tests to characterize the subsurface soil and bedrock properties at selected locations across the site; and
- Provide geotechnical engineering parameters for the design of foundation systems and access roadways.

2.0 PROPOSED CONSTRUCTION

It is understood that the Longspur Wind project will consist of 45 wind turbine generators (WTG). The WTGs will be comprised of Vestas 4.5 MW, 163-meter rotor diameter models with a hub height of 113 meters. The project team anticipates WTGs will be supported on gravity foundation systems with an embedment depth of about thirteen (13) feet below finished grade. RRC assumes finished turbine pad grade is at or slightly above current existing site grade.

3.0 SITE EXPLORATION

Facilities associated with the project are anticipated to include electrical collection lines, overhead transmission lines, MET tower, Permanent Meteorological Mast (PMM), substation, operations and maintenance (OM) building, and access roadways. Private-access roadways will most likely be surfaced with imported road-base materials from nearby quarry pits.

The exploration was conducted based on turbine array L015_01.13.26, which includes a total 57 turbines, primary and alternates. This an update from the previous array, L011_04.26.25, which included 67 turbines. Laboratory and geophysical data completed as part of the initial investigation is included within the appendices of this report.

RRC's complete subsurface exploration program consisted of:

- Drilled 73 borings at WTG locations;
- Drilled 10 borings and 14 Hand Auger borings at the substation;
- Drilled 18 borings along the Transmission Line;
- Drilled 1 borings at the MET tower location;

- Drilled 3 borings at Permanent Meteorological Mast (PMM) locations;
- Drilled one boring at ADLS Tower location;
- Drilled one boring at the O&M Building;
- Installed 5 temporary piezometers at select WTG locations and 1 temporary piezometer within the substation;
- Obtained bulk samples at 14 locations for laboratory thermal resistivity (TR) testing;
- Obtained bulk samples at 2 locations for California Bearing Ratio (CBR) testing;
- Completed 18 Electrical Resistivity (ER) surveys; and
- Completed six Multi-Channel-Analysis-of-Surface-Waves (MASW) surveys.

Figures 1 to 13 in Appendix A consist of maps for the various borings relative to sample, geophysical survey and thermal resistivity test locations, site geology, and soil survey and groundwater data. A summary of subsurface exploration is provided within Table A2 within Appendix A.

3.1 Field Exploration and Testing

RRC geologists staked the boring locations using GPS coordinates provided by Allette Renewable Resources, Inc. Drill crews under RRC's direction drilled the borings within 15 feet of each staked location.

The borings were advanced with truck and track mounted drill rigs utilizing continuous flight hollow stem augers. During the field operations, the drill crew observed for groundwater levels. Following the completion of the drilling operations, the drillers backfilled each bore with soil cuttings in accordance with state regulations. At some locations, we added bentonite chips to supplement the soil cuttings.

Standard Penetration Test (SPT) samplers obtain disturbed soil samples. RRC documented each penetration resistance value in accordance with *ASTM D1586: Standard Test Method for Standard Penetration Test (SPT) and Split-Barrel Sampling of Soils*. This test consists of driving the sampler into the ground with a 140-pound hammer free-falling 30 inches. The number of blows required to advance the SPT sampler 18 inches is counted and recorded, with the sum of the blows to drive the last 12 inches referred to as the standard penetration resistance value (N-value). Results of the field tests are shown on the logs of boring under the "Field Data" column and are preceded by the letter "N." Each soil sample from the SPT samplers collected in the field were visually classified, placed in plastic bags to preserve moisture content, and labeled as to location and depth. All SPT samples were arranged in core boxes and transported to our laboratory facility in Round Rock, Texas for further analysis.

RRC's field geologist directed sampling of cohesive soils at selected depths using Shelby tube samplers. These are 3-inch (OD) diameter stainless steel, thin-walled tubes in accordance with ASTM D1587: Standard Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes. The intent of this sampling technique is to obtain relatively undisturbed samples. Soil

samples obtained using Shelby tubes were tested for consistency utilizing a pocket-sized penetrometer, with the reading included on the log of boring, as identified by the preceded letter "P." Readings in excess of 4.5 tons per square feet (tsf), if any, indicate that the capacity of the device has been exceeded. Note that the penetrometer reading is only an approximation of general cohesion. Pocket penetrometers are not a measurement for either shear strength, unconfined compressive strength, or bearing capacity.

Modified California (MC) split-spoon samplers were used to obtain relatively undisturbed samples of both cohesive and non-cohesive soils. RRC's field geologist and/or field engineer directed drill crews to obtain these samples at intermittent locations. The Modified California sampler is similar to the SPT sampler except that the Modified California sampler obtains 2.5-inch diameter samples in a steel sleeve. The Modified California sampler is driven like the SPT sampler and the blow counts are counted and recorded similarly. Results of the field tests are also shown on the Logs of Boring under the "Field Data" column and are preceded by the letter "N". When conducting an analysis of the stratum, a correlation is needed to convert the Modified California N-value to an SPT N-value. For 3-inch outside diameter MC sampler, conversion factor is in the range of 0.45 (Lacroix and Horn, 1773 method) to 0.65 (Burmister, 1948 method). Based on the experience, RRC uses a conversion factor of 0.5 when performing soil density analysis of N-values for the Modified California sampler. A plastic cap was placed on each end of the Modified California sample to seal the sample's moisture. The sample was labeled as to location and depth. All Modified California samples were arranged in core boxes and transported to our laboratory facility in Round Rock, Texas for further analysis.

RRC classifies soils in general accordance with the Unified Soil Classification System (USCS); *ASTM D2488: Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. The soil and bedrock classification symbols appear on the logs of boring and are briefly described in Appendix A. Bedrock materials were classified in general accordance with the general notes for rock classification included as part of *ASTM D5878: Standard Guides for Using Rock-Mass Classification Systems for Engineering Purposes*.

RRC's field geologist prepared field logs for each boring. The logs of boring contain classification of the materials encountered during drilling as well as interpolation of the subsurface conditions between samples.

The project engineer/geologist reviewed all the field logs, soil samples, and lab test data to make appropriate modifications to the logs of boring, as necessary. Final Logs of Boring and laboratory testing completed to date are provided in Appendix A. The logs of boring describe the strata encountered, their approximate thickness, SPT results, soil and rock classifications, the various depths at which the samples were obtained, as well as the presence of groundwater.

Temporary piezometers were installed at five locations to allow for subsequent groundwater measurements. We installed the piezometers to an approximate depth of 18-feet below the ground surface. Each piezometer consisted of either 1 or 2-inch diameter schedule 40 PVC pipe. We situated the piezometers an offset distance of about 5 to 10 feet from the boring location. The

piezometers include a bottom screen/slotted section that is 5-feet long and backfilled with sand that extends about one-foot above the screened section. The remainder of the piezometer is 15-feet of PVC that extends two-feet above ground. We used bentonite to backfill the upper portion of the piezometer. Groundwater levels measured to date within the temporary piezometers are discussed in Section 4.4 of this report. At locations where piezometers were not installed the borings were backfilled with soil cuttings in accordance with the state of North Dakota regulations. The temporary piezometer locations are mapped on Figure 13 in Appendix A.

3.2 Laboratory Tests

The soil samples were returned to the laboratory, examined by the project engineer/geologist, and applicable laboratory testing was assigned on selected soil samples. Laboratory testing was performed in general accordance with ASTM and locally accepted practices. The following laboratory methods of analyses were generally utilized, where sample quality allowed:

- Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System): ASTM D2487;
- Standard Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass: ASTM D2216;
- Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils: ASTM D4318;
- Standard Test Methods for Amount of Material in Soils Finer than No. 200 (75-µm) Sieve: ASTM D1140;
- Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort: ASTM D698;
- Standard Test Methods for Unconfined Compressive Strength of Cohesive Soils: ASTM D2166;
- Standard Test Methods for CBR (California Bearing Ratio) of Laboratory-Compacted Soils: ASTM D1883;
- Standard Test Method for Measurement of Soil Resistivity using the Two-Electrode Soil Box Method: ASTM G187;
- Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing: ASTM G51; and
- Sulfate and Chlorides Content: EPA 300/300.1.

4.0 SUBSURFACE CONDITIONS

4.1 Geology

The geologic interpretations contained herein are based on available geological maps and literature, and review of the logs of excavation as part of this study. The Longspur Wind project site is located within the Missouri Plateau Section of the Great Plains Province, which includes western Northern Dakota, western South Dakota, northeastern Wyoming, and Montana. It is an area characterized by generally low relief with gentle slopes interrupted by low buttes and ridges.

The northern half of the site is glaciated, while the lower half of the site is unglaciated. (Reference 1).

At the project site, bedrock includes thick beds of Tertiary aged sandstone (Reference 2). The bedrock is covered by thin surficial unconsolidated sediments composed mostly of silt, clay, and sand. These are river, lake, and swamp deposits that range from 10 to 30 feet in thickness (Reference 2).

The Geologic map of North Dakota: U.S. Geological Survey, scale 1:500,000 (Reference 2) indicates the bedrock materials of the site consist of the following geologic units of the listed geologic time periods.

Quaternary Period

- **Oahe Formation River Sediment** (Qor): This unit consists of river and stream sediments made of dark clay and silt. The sediments are bedded and overlies crossbedded sand. It is on the plains of modern streams. The thickness of this unit ranges from 10 to 30 feet.

Tertiary Period

- **Golden Valley Formation** (Tg): The upper part of the unit contains yellowish brown micaceous sandstone and fluvial sediments consisting of sand, silt, and clay. The lower part of the unit consists of white or yellow clay, silt, and sand. This unit is about 265 feet.

- **Sentinel Butte Formation** (Ts): This unit consists of river, lake, and swamp sediments containing grayish brown silt, sand, clay, sandstone, and lignite. This unit is 600 feet thick.

- **Bullion Creek Formation** (Tb): This unit consists of river, lake, and swamp sediments containing yellowish brown silt, sand, clay, sandstone, and lignite. This unit is 600 feet thick.

Figure 6 and Figure 7 in Appendix A shows the geologic units within the project site.

4.2 Subsurface Stratigraphy

As indicated on the logs of boring, the soil stratigraphy at the site generally consisted of topsoil underlain by either clay or sand layers.

The soil layers can generally be described as:

- Soft to hard, Lean and Fat Clay soils with varying amounts of sand and gravel.
- Medium stiff to hard, Silt soils with varying amounts of sand and gravel.
- Dense sands with varying amounts of silt, clay and gravel.

Bedrock where encountered, consisted of sandstone, shale, and mudstone.

Lignite seams/layers were also noted in some of the borings. Approximate thickness and consistency of these seams/layers are noted on the logs of boring within Appendix A.

Detailed Logs of Boring present detailed stratum descriptions, soil classifications, types of sampling used, laboratory test data, and additional field data. Bore logs are presented in Appendix A. The lines separating stratum types on the Logs of Boring do not necessarily represent distinct lines of demarcation because transitions can be gradual. The Boring Log Key, defining the terms and descriptive symbols used on each log of boring, is also presented in Appendix A

4.3 Laboratory Test Results

RRC obtained the service of Beyond Engineering & Testing, LLC to conduct laboratory tests. Lab test results completed to date are presented below and discussed in subsequent sections.

Laboratory test results indicate the native soils possess in-situ moisture contents in the range from about 2 to 55%, with an average of 19%.

The native soils have Plasticity Indices (PI) ranging from non-plastic to 48%. Clay soils with a PI less than 15 are generally considered to exhibit a low expansive potential provided their moisture contents are stable. High plasticity clay soils with a PI greater than 25 are generally considered to exhibit a high expansive potential if their moisture contents undergo a significant moisture change

We performed 14 moisture/density relationships (proctors) to determine the maximum dry unit weight and optimum moisture content in accordance with ASTM D698 (standard method). We also conducted Atterberg Limits on these samples to assess the soil type. A summary of the test results is presented below.

Table 4.3.1 Summary of Proctors and Atterberg Test Results

Sample Location	Depth (feet)	Material Type	Liquid Limit (%)	Plasticity Index (%)	Maximum Dry Unit Weight (pcf)	Optimum Moisture Content (%)
GEO-01	2 to 4	CH	63	41	99.5	22.2
GEO-08	2 to 4	CH	57	38	107.0	18.2
GEO-10	2 to 4	CH	71	47	92.4	27.6
GEO-19	2 to 4	CL	30	12	111.8	16.3
GEO-22	2 to 4	SC-SM	22	6	115.6	12.7
GEO-33	2 to 4	CH	61	42	100.4	20.8
GEO-46	2 to 4	CL	41	23	112.1	15.4
GEO-48	2 to 4	CH	71	48	99.1	20.7
GEO-53	2 to 4	CH	54	35	103.1	19.5
GEO-59	2 to 4	CH	54	34	104.8	20.2
GEO-62	2 to 4	SC	26	8	113.9	12.3
GEO-67	2 to 4	CL	43	22	105.9	18.1
GEO-70	2 to 4	CH	61	41	100.6	20.8

Sample Location	Depth (feet)	Material Type	Liquid Limit (%)	Plasticity Index (%)	Maximum Dry Unit Weight (pcf)	Optimum Moisture Content (%)
SUB-2	2 to 4	CL	37	23	116.1	13.7

Notes: pcf = pounds per cubic foot; CL = Lean Clay; CH = Fat Clay; SC = Clayey Sand, SM = Silty Sand;

Results of Unconsolidated-Undrained Triaxial (UU) Compression testing are presented in Table 4.3.2. These tests are performed in accordance with ASTM D2166 on relatively undisturbed samples.

Table 4.3.2 Summary of UU Triaxial Test Results

Sample Location	Depth (feet)	Material Type	Confining Pressure (psi)	In-situ Dry Unit Weight (pcf)	Undrained Shear Strength, s_u (psf)
GEO-04	12	CL	10.0	103.0	1,960
GEO-07	12	CL	10.0	99.0	6,920
GEO-46	12	CL	10.0	104.0	6,210
GEO-62	12	CL	10.0	105.0	4,510
GEO-66	12	SC	10.0	104.0	6,240
GEO-77	12	CL	10.0	112.3	6,420
SUB-3	4	CL	3.0	108.0	1,620
O&M-1	7	SC	5.5	100.0	320

Notes: pcf = pounds per cubic foot; psf = pounds per square foot; CL = Lean Clay; SC = Clayey Sand.

Results of Unconfined Compressive Strength (UC) tests are presented in Table 4.3.3. These tests are performed in accordance with ASTM D2166 on relatively undisturbed samples.

Table 4.3.3 Summary of Unconfined Compressive Strength Test Results

Sample Location	Sample Type	Depth (feet)	Material Type	In-situ Dry Unit Weight (pcf)	In-situ Moisture Content (%)	Undrained Shear Strength, s_u (psf)
GEO-01	MC	14	CL	111.2	20.2	5,280
GEO-04	ST	19	CL	102.3	22.1	2,600
GEO-33	MC	17	CL	111.3	16.6	9,450
GEO-36	ST	17	CL	92.9	29.9	940
GEO-37	ST	12	CL	65.1	47.0	2,660
GEO-69	ST	12	CL	95.1	24.8	4,600

Notes: pcf = pounds per cubic foot; psf = pounds per square foot; MC = Modified California; ST = Shelby tube; CL = Lean Clay.

Results of swell test performed in accordance with ASTM D4546 are presented in Table 4.3.4.

Table 4.3.4 Summary of Swell/ Collapse Test Results

Sample Location	Depth (feet)	Material Type	Dry Density (pcf)	Moisture Content (%)	Surcharge Load (psf)	Collapse Strain (%)
SUB-6	4	SM	101.2	18.8	500	-0.8

Notes: pcf = pounds per cubic foot; SM = Silty Sand.

We performed two California Bearing Ratio (CBR) tests on select samples. The test specimens soaked for 96 hours prior to the CBR load test. A summary of the CBR test results is presented in Table 4.3.5. Design CBR values represent strength at 95% compaction relative to the maximum dry density as determined by ASTM D698. CBR increases with increased density.

Table 4.3.5 Summary of CBR Test Results

Sample Location	Depth (feet)	Material Type	Design Dry Unit Weight (pcf)	Design CBR (%)
GEO-48	1 to 4	CH	94.1	0.8
GEO-62	1 to 4	SC	108.2	8.2

Notes: pcf = pounds per cubic foot; CH = Fat Clay; SC = Clayey Sand.

Results of water-soluble sulfate and chloride testing performed on shallow soil samples are presented in Table 4.3.6.

Table 4.3.6 Summary of Sulfate and Chloride Contents

Sample Location	Depth (feet)	Material Type	Chloride Contents (% by weight)	Sulfate Contents (% by weight)
GEO-04	1 to 13	CL	0.0080	0.2220
GEO-10	1 to 13	CH	0.0080	0.0672
GEO-25	1 to 13	CL	0.0059	0.2600
GEO-50	1 to 13	CL/CH	0.0079	0.4390
GEO-64	1 to 13	CL	0.0076	0.2740
SUB-3	1 to 4	CL	0.0305	0.0240

Notes: CL = Lean Clay; CH = Fat Clay.

Results of Minimum Soil Box Resistivity and pH tests performed on shallow soil samples are summarized in Table 4.3.7.

Table 4.3.7 Summary of Minimum Soil Box Resistivity and pH Tests

Sample Location	Depth (feet)	Material Type	Minimum Resistivity (ohm-cm)	pH
GEO-04	1 to 13	CL	589	7.1
GEO-10	1 to 13	CH	746	6.6
GEO-25	1 to 13	CL	455	7.5
GEO-50	1 to 13	CL/CH	408	7.6
GEO-64	1 to 13	CL	294	7.3
SUB-3	1 to 4	CL	805	9.1

Notes: CL = Lean Clay; CH = Fat Clay.

A summary of laboratory tests is presented in Appendix B.

4.4 Groundwater Conditions

Based upon information obtained from the borings drilled to date and historical water data for the region, it is RRC's opinion static groundwater level will affect the construction and design of shallow gravity foundation systems at select locations. Groundwater was encountered at the time

of drilling at depths in the range of about 7 to 49 feet below site grade in 37 of the 115 borings completed as part of this study. Groundwater observations for each WTG location are presented on Table A1 in Appendix A.

Temporary piezometers were installed within the foundation footprint of four select turbine sites and within the substation area to facilitate additional groundwater level measurements. Based on water measurements collected to date, the groundwater table (GWT) in the piezometers was found to be at depths in the range of about 1 foot to 12 feet below existing site grade. Groundwater level measurements in the piezometers were recorded immediately after installation, and approximately 24 to 72 hours after installation. A summary of the groundwater levels measured in the piezometers are presented in Table A4 within Appendix A.

RRC reviewed published water well logs for Mercer and Morton Counties, North Dakota that were available from the North Dakota Department of Water Resources. Historical water well logs surrounding the project site reported ground water levels between 1.4 and 278.8 feet below the ground surface. The shallowest groundwater level was recorded in the year 2020 at about 1.4 feet below the ground surface at Well Report No. 9006.

It is important to note that water well records may not accurately represent seasonal fluctuations in static groundwater level or perched groundwater conditions, which should be considered during WTG foundation design.

It is also imperative to note that short-term groundwater level observations presented in this study are not an accurate evaluation of the variable groundwater conditions that may be present at each of the turbine locations. This Report is not to be interpreted as a comprehensive groundwater study. Groundwater levels are highly dependent on climatic and hydrologic conditions before and after construction, and site development including irrigation demands, drainage and other factors. As such, the presence of water during construction may vary relative to this report. It is understood that the presence of groundwater may influence certain construction activities and long-term performance of foundations and pavements; if a detailed groundwater study is desired, a groundwater hydrologist should be retained to perform these services.

RRC recommends implementing a groundwater level monitoring program to assess the impact of shallow groundwater levels on foundation design and construction.

4.5 Geohazard Assessment

The following subject items represent geologic or physical hazards to the project. Within each subject, we address the level of risk associated with the particular hazard to the project.

4.5.1 Flood Hazard

The Federal Emergency Management Agency (FEMA) has not completed a study to determine the flood hazard for Mercer and Morton Counties, North Dakota.

The project civil engineer should review the structure locations within the project site, especially for those located near drainage features to verify if additional studies are needed. The design of

flood-proofing as well as the need for scour/erosion protection is the responsibility of the project Civil Engineer or Hydrology Engineer.

4.5.2 Expansive Soils

Based upon review of the logs of boring, laboratory testing results, available geological maps and literature, expansive soils are anticipated to be encountered across the project site. Expansive soils have a potential to shrink or swell when the moisture content is allowed to change significantly. WTG foundations are anticipated to have an embedment depth of approximately 13 feet, which is likely beyond the depth of moisture variations for this project site. It is our opinion that expansive soil will not cause significant movement for WTG foundation systems. The potential of expansive soils negatively impacting WTG foundations can be considered as a low risk. It is imperative that the exposed subgrade is not allowed to dry out significantly prior to concrete seal slab placement.

4.5.3 Soil Collapse Due to Windblown Soils

The project site can be classified as having a low susceptibility risk of collapse prone soils. Soil collapse is a geological feature associated with windblown soils. Windblown soil particles can be angular and when deposited lightly, they can form with high void ratios. Windblown soil is also quickly deposited and may become partially cemented. Both of these factors tend to preserve the high void ratio. When wetted and loaded, these soils can then collapse. Typically, we can identify these soils by low SPT N values and low dry densities.

Based on the log of borings and publicly available geological mapping within the project area, the potential for soil collapse is considered low.

4.5.4 Frost Penetration Depth

Based on Reference 3, the average frost penetration depth for Morton County is approximately 48 inches. Therefore, we recommend that the spread or strip footings at the site should have a minimum embedment of 48 inches below finished site grade for confinement and frost penetration.

4.5.5 Corrosion Potential

Published maps indicate that surficial soils within the project site have a low to high risk for concrete corrosion. Figure 10 in Appendix A is a map that attempts to indicate concrete corrosion risk boundaries. RRC cautions that this published map only estimates the boundaries based on soil types and cannot be precise. Based on the lab testing completed, the soils within the upper 12 feet exhibit, the risk for concrete corrosion is low to moderate..

Published maps indicate that the project site has a low to high risk for steel corrosion. Refer to Figure 11 for approximate steel corrosion risk boundaries. Again, we caution that this map is not precise and are only generalizations based on soil types. Based on the lab testing completed, the soils within the upper 12 feet exhibit “Very Corrosive” electrical characteristics with regards to galvanic corrosion of steel.

Section 5.4 discusses in greater detail laboratory test results for concrete and steel corrosion.

4.5.6 Karst Potential

Water soluble rocks located near or exposed at the surface have potential for development of karst and dissolution features. Rocks or mineral deposits, such as limestone, dolomite, gypsum/anhydrite, and salt are all susceptible to dissolution when in contact with circulating water. These soluble deposits pose the greatest risk when located within 20 feet of the ground surface, and a moderate risk when located within 20 to 100 feet of the surface Based upon review of geologic maps and literature, bedrock formations of this project area predominately consist of sandstone, shale and mudstone, which are typically not subject to karst and dissolution features.

Based upon review of the logs of boring, available geological maps and literature, karst potential can be considered low.

4.5.7 Slope Stability

Within the project area, the site consists of broader flat to gently rolling plains. Where most of the site exhibits gradual to moderate slopes, occasional steeper slopes may exist near drainage features. For native slopes greater than 2.5:1 (horizontal:vertical), RRC recommends that the turbines are offset one foundation diameter or more from the slope crest; otherwise, it is recommended that a detailed slope stability analysis be performed. Based on current existing site topography and RRC's observations during the geotechnical field exploration, slope stability is not anticipated to be a major concern for this project site, assuming minimum site grading occurs during construction phase.

4.5.8 Seismicity Hazards

North Dakota is generally a region of relatively low seismicity. At the project area, the site modified peak ground acceleration (PGA_m) was computed to be 0.039 g for Site Class D. This is based on the *Hazards Program*, a web-based program developed by the ASCE Hazard Tool (Reference 5) in accordance with ASCE 7-16. Based on the 2021 IBC (Reference 4), the Seismic Design Category for the site is anticipated to be category "A". Therefore, the seismic hazard risk is considered very low at the project site.

4.6 Geophysical Properties

RRC performed One-Dimensional Multi-Channel Analysis of Subsurface Waves (MASW) surveys at 6 WTG locations. The purpose of MASW surveys is to obtain shear wave velocity (V_s) profiles. The MASW survey locations are mapped on Figure 5 in Appendix A. The MASW survey methodologies and results are discussed in Section 4.6.1.

RRC also completed Earth Electrical Resistivity (ER) surveys at 18 locations across the site, including five surveys within the substation area. The test locations are mapped on Figure 5 in Appendix A. RRC conducted these surveys using the Wenner four-pin method. The electrical resistivity survey methodologies are presented in Section 4.6.2.

4.6.1 MASW Survey

The Multi-Channel-Analysis-of-Surface-Waves (MASW) method is a non-intrusive/non-destructive technique which uses Rayleigh waves to evaluate the stiffness of subsurface strata. Rayleigh waves of different wavelengths (or frequencies) travel at different velocities as they

propagate through different soils. The waves also bounce along the surface of different layers, called dispersion. MASW reports are presented in Appendix C.

For a 1-D MASW survey, twenty-four geophones with a 5-foot spacing are laid out in a linear array. The total length of the array is approximately 115 feet. A 16-pound sledgehammer striking a metal plate is employed as the seismic source located 10, 25 and 40 feet away from the first geophone. RRC uses SurfSeis 4.04 software to collect and process the seismic data.

The shear wave velocities are used to determine certain soil and bedrock characteristics based on simple equations. For example, the soil/bedrock shear modulus can be calculated using the following equation:

$$G = \rho V_S^2$$

Where: G = Shear Modulus (psf);
ρ = Mass density (pcf/(ft/sec.^{2})); and
V_s = Shear wave velocity (ft/sec.)

Young's Modulus, E, can also be calculated from the shear wave velocity data using the following equation:

$$E = 2G(1 + v)$$

Where: E = Young's Modulus (psf);
G = Shear Modulus (psf); and
v = Poisson's Ratio.

The weighted average is calculated based on the following formula based on the 2021 International Building Code (IBC) (reference 4):

$$\overline{V_S} = \frac{\sum_i^n d_i}{\sum_i^n \frac{d_i}{V_{si}}}$$

Where: d_i = Thickness of any layer between 0 and 100 feet; and
V_{si} = Shear wave velocity of a layer.

Note the measured shear wave velocity using MASW may not be available down to a depth of 100 feet. In the case where measured shear wave velocity is less than 100 feet, the weighted shear wave velocity is calculated based on available depths.

To determine the rotational stiffness of the underlying soil and bedrock, the parameters outlined in Table 4.6.1.1 can be used to compute the elastic and shear moduli. These values are generic values from published sources and typical for the respective soil type.

Table 4.6.1.1 Recommended Soil Parameters for Rotational Stiffness

Soil/ Material Type	Poisson's Ratio [1]	Average Total Unit Weight (pcf) [1,2]
Saturated Clay and Silt Soils	0.45	115
Unsaturated Clay and Silt Soils	0.35	105
Loose to Medium Dense Sand Soils	0.35	115
Medium Dense to Dense Sand Soils	0.30	120
Structural Fill	0.30	120
Bedrock	0.30	165

Note: (1) Based on Reference 6 (see page 123 for Poisson's ratio and page 163 for unit weight).
(2) Based on laboratory measurements (see Section 4.3).

Computed parameters from the MASW surveys represent soil behavior at small strain. The foundation designer should incorporate appropriate reduction factors to determine the rotational stiffness of the foundation system. The MASW survey results completed to date are included in Appendix C.

4.6.2 Earth Electrical Resistivity Surveys

RRC performed a total of 18 field electrical resistivity (ER) surveys using the Wenner 4-pin array method. The electrical resistivity surveys were completed at 13 WTG locations and 5 surveys within the substation. The electrical resistivity survey locations are mapped on Figure 5 included in Appendix A. Each survey consists of two perpendicular arrays, both centered at the same location. Results of electrical resistivity surveys are presented in Appendix C.

Interpretation of the electrical resistivity surveys is beyond the scope of this study and should be performed by the electrical design team.

4.6.3 Thermal Resistivity of Soils

RRC obtained bulk soil samples at 14 locations to conduct laboratory thermal resistivity (TR) tests. The samples consist of subsurface soils collected at depths of 2 to 4 feet below existing site grade. RRC obtained the services of Beyond Engineering & Testing to conduct laboratory thermal resistivity (TR) tests in accordance with IEEE 442 Method. The test locations are mapped on Figure 5 in Appendix A.

The thermal resistivity tests were performed on remolded samples targeting 92% compaction of the maximum dry density as determined by ASTM D698 at the "as-received" moisture content. Thermal resistivity samples were then tested at a series of moisture contents from "as-received" moisture content to 0% moisture content. The result is a thermal resistivity dry-out curve. Thermal resistivity test results are included in Appendix C.

Interpretation of the thermal resistivity tests results is beyond the scope of this study and should be performed by the design team.

5.0 GEOTECHNICAL RECOMMENDATIONS

It is understood the Longspur Wind Project will consist of the construction of 45 WTGs and associated facilities, including a substation, transmission line, PMM structure, MET tower and O&M building. We assume WTGs will be supported on gravity foundation systems and will bear on native soils with an embedment depth of about 13 feet below finished grade. RRC received the proposed grade changes from Client and has incorporated these into our recommendations.

The extent and location of site grading is also unknown. RRC should be retained to review the civil drawings and cross-sections for each turbine location and other critical areas along the proposed roadways. This will allow us to evaluate the need for additional studies such as slope stability analyses. If current site grade is changed at a WTG location, we can assess whether our original recommendations apply.

RRC's geotechnical recommendations presented in this report should be verified when information on the foundation design and site grading become available.

5.1 General Turbine Foundation Expectations

RRC performed bearing capacity and settlement calculations in general accordance with methodologies outlined in the 2nd Edition of *Guidelines for Design of Wind Turbines* (Reference 7). We also used generally accepted standard of care and practice along with experience with similar soil conditions in this type of geological setting. Detailed discussions of bearing capacity and settlement for WTG bearing on native soils are outlined in the following subsections. A summary of anticipated conditions that will require particular attention in the design and construction is presented below:

- RRC based our design parameters and construction recommendations to allow for foundations to bear at depths outlined in Table A1 below the existing ground surface for an allowable end bearing capacity of 2,500 psf, with a total settlement of 2.5-inches and a maximum differential settlement or tilt potential of 0.15 degree across the foundation. Table A1, *Summary of Foundation Design Net Allowable Bearing Pressure and Design Groundwater Recommendation*s in Appendix A provides net allowable end bearing capacity for each turbine site. Some locations are not capable of supporting a net allowable bearing capacity of 2,500 psf. Alternate foundation designs may be required. Otherwise, remediation of the foundation supporting soils is necessary.

- The depths of remediation required to obtain the bearing capacity and/or settlement values listed above are provided in Table A1. RRC assumes an embedment depth of 13 feet or greater. Should an embedment depth of less than 13 feet be used, RRC should be consulted to determine if additional locations require soil improvement to achieve the bearing capacity and/or settlement values listed above. These depths to remediation are based relative to naturally existing grade and foundations bearing about nine feet below grade. If final

elevations result in the foundation bearing at a different depth, then adjustments should be made to the depth of remediation.

- Over-excavation and replacement with structural fill materials may be considered for soil improvement depths up to about 16 feet below existing ground surface, if feasible. For soil improvements greater than 16 feet below existing ground surface, the cost for performing over-excavation and replacement will likely be excessive; therefore, deep soil improvement measures such as Rammed Aggregate Piers (RAP), compaction grouting or other equivalent ground improvement techniques are appropriate.

- It is anticipated excavations may be advanced with conventional earth moving equipment where native soils extend below foundation bearing elevations.

- Excavation contractors and/or underground utility installers should consider performing test pits or probing tests to evaluate proper means and methods for advancing excavations. Potential caving/sloughing within narrow and shallow utility trenches may require sidewalls of trenches to be sloped in order to install utilities. Excavated trench bottoms should be thoroughly cleaned prior to cable placement and backfilling.

- It is crucial to maintain a uniform foundation subgrade support below the turbine foundation to reduce the potential of excessive differential foundation settlement. If compacted structural fill is used below the turbine foundation, the thickness of structural fill below the turbine foundation shall be a minimum of 6 inches; the structural fill thickness shall be kept as uniform as possible with no abrupt thickness change, with an overall thickness difference of 2 feet or less across the turbine foundation footprint. Either the bedrock portion of the foundation subgrade may be excavated, or the lower portion of the soil subgrade excavation may be filled with lean concrete so that the structural fill thickness difference can be kept at 2 feet or less across the foundation width.

- Turbine foundations located adjacent to natural or man-made slopes should be setback laterally from the top of the slope. The minimum setback distance should be 25 feet or one turbine foundation diameter, whichever is larger, away from the edge of foundation to the crest of any natural or man-made slopes. Proper drainage measures should be taken to reduce impacts to man-made cut and fill slopes as well as all undisturbed natural slopes.

It is imperative that a professional geotechnical engineer, or their representative, observe each foundation excavation to verify that the exposed foundation soil bearing conditions meet the intent of this Report. This observation allows the geotechnical engineer to assess the need and limits of removal and replacement. Detailed construction recommendations and/or specifications are outlined in Section 6 of this report.

5.1.1 Bearing Capacity and Settlement of Gravity Foundation System

A net allowable bearing pressure of 2,500 psf can be used for the structural design for turbine foundations bearing directly on undisturbed native soils. The allowable bearing values are based

on a safety factor of three for general shear failure. These net allowable bearing pressure values may be increased by 25% when considering short duration loading conditions such as extreme wind and seismic forces. Some locations will require remedial measures outlined in Section 6 in order to achieve the full allowable bearing pressure.

The estimated total turbine foundation settlement is expected to be about 1.5 to 2.5 inches under normal operating loading conditions at the center of the foundation. The estimated differential settlement or tilt across the foundation diameter is less than 0.15 degrees under both dead load and normal operating loading conditions.

Table 5.1.1.1 Geotechnical Design Parameters for Gravity Foundation

Parameters/Soil Type*	Recommended Values
Min. Undrained Shear Strength / Very Stiff Clay	1,500 (psf)
Min. Internal Friction Angle / Sand	30 (deg.)
Min. Net Allowable Bearing Capacity (Normal Operating Load, Fs=3.0)	2,500 (psf)
Poisson's Ratio	0.35

Table 5.1.1.2 presents a summary of Modulus of Subgrade Reaction for different soil, bedrock, and structural fill materials.

Table 5.1.1.2 Recommended Soil and Structural Fill Design Parameters

Soil/ Material Type	Friction Coefficient[(1)]	Modulus of Subgrade Reaction, k_s(pci)
Firm Clay Soils	0.35	75
Stiff to Hard Clay Soils	0.35	100
Medium Dense Sand Soils	0.35	150
Dense to Very Dense Sand Soils	0.45	200
Structural Fill Materials (Min. 1-foot thick)	0.45	225

Note: [(1)] If necessary, lateral passive earth pressures can be considered to develop additional resistance. The coefficient of base friction should be reduced to 0.30 when used in conjunction with passive pressure.

To determine the rotational stiffness of the underlying soils/bedrock, the foundation designer should reference the results of the MASW testing performed as part of this study. The results of these surveys completed as part of this study are presented in Appendix C.

5.1.2 Overburden Backfill on Turbine Foundation

The use of native soil/rock as backfill materials placed above and against the side of turbine foundations is acceptable. RRC recommends the backfill materials placed over the turbine foundations be compacted to dry densities of at least 95% of the maximum dry density as determined by ASTM D698. This compaction is necessary to support a crane pad, reduce erosion and deter settlement. RRC recommends using an average long-term moisture content of 10% for native soils used as overburden. Contractor should place overburden backfill material in accordance with specifications outlined in Section 6.4.4 of this report.

Using the Standard Proctor tests listed in Table 4.3.1, the recommended overburden backfill unit weight values for turbine foundation design are presented in Table 5.1.2.1 below.

Table 5.1.2.1 Overburden Backfill Density Range Requirement

Soil/ Material Type	Dry Backfill Unit Weight Range, γ_d (pcf)	Moist Backfill Unit Weight Range, γ_{total} (pcf)
Native Soils	88-116	118-134

Note: pcf= pounds per cubic foot;

It should be noted that some turbine sites have shallow surficial soils which are classified as fat clay soils. In areas where fat clay soils are encountered within the foundation excavation zone, increased compaction efforts or mixing with heavier soil may be required to achieve the proposed turbine foundation backfill requirements.

5.2 Substation, O&M Building, MET Tower and ADLS Tower Shallow Foundation Systems

Final grade elevations for the Substation, O&M Building, ADLS, and PMM were not available. RRC has assumed the finished grade will be near or slightly above the existing ground surface. Surficial soils at these locations predominantly comprise lean and fat clay soils with varying amounts of sand. These clay soils range from medium stiff to very stiff in terms of consistency.

Shallow foundations shall bear a minimum of 48 inches below the ground surface. 48 inches was selected based on the *Building and Design Criteria* for Morton County, North Dakota. We recommend that continuous footings have a minimum width of 18-inches to allow cleaning, inspection, and placement of rebar.

Shallow foundations embedded 48 inches below the ground surface at the substation, O&M Building, ADLS, and PMM can use a net allowable bearing pressures shown in the tables below. These net allowable bearing capacities include a factor of safety of 3 for general shear failure.

For reinforced concrete slabs bearing at finished grade, we recommend over-excavation of foundation subgrade soils to a minimum of four feet below the finished grade and replacement with non-frost susceptible structural fill material or flowable fill (controlled low strength material) having compressive strength of at least 150 psi. The non-frost susceptible materials should meet the requirements of Section 6.2. The excavation should extend at least four feet beyond the perimeter of the foundation.

Table 5.2.1 Soil Parameters for Substation

Parameter	Design Value
Design Groundwater Level below ground surface (ft)	7
Average Total Unit Weight (pcf)	115
Modulus of Subgrade Reaction of Select Fill Pad (pci)	70*

Parameter	Design Value
Friction Coefficient at Foundation Base (Native Soils)	0.35
Friction Coefficient at Foundation Base (Structural Fill)	0.45
Net Allowable bearing pressure for Strip or Continuous Footings (psf) bearing 4-feet below ground surface (psf) with 0.5-inch settlement	1,500
Net Allowable bearing pressure for Strip or Continuous Footings (psf) bearing 4-feet below ground surface (psf) with 1-inch settlemment	2,000
Net Allowable Bearing Pressure for Continuous and Spread Footings (psf) bearing 4-feet below ground surface (psf) with 0.5-inch settlement	1,500
Net Allowable Bearing Pressure for Continuous and Spread Footings (psf) bearing 4-feet below ground surface (psf) with 1-inch settlement	2,000
Net Allowable bearing pressure for Mat Foundations on earthen pad to 4-feet below ground surface (psf) with 0.5-inch settlement	1,350
Net Allowable bearing pressure for Mat Foundations on earthen pad to 4-feet below ground surface (psf) with 1-inch settlement	1,800

Notes: pcf = pounds per cubic foot; psf = pounds per square foot; pci = pounds per cubic inch.
* For a 1 ft. x 1 ft. Plate.

Table 5.2.2 Soil Parameters for O&M Building

Parameter	Design Value
Design Groundwater Level below ground surface (ft)	18
Average Total Unit Weight, pcf	115
Modulus of Subgrade Reaction of Select Fill Pad, pci	70*
Friction Coefficient at Foundation Base (Native Soils)	0.35
Friction Coefficient at Foundation Base (Structural Fill)	0.45
Net Allowable bearing pressure for Strip or Continuous Footings (psf) bearing 4-feet below ground surface (psf)	2,000
Net Allowable Bearing Pressure for Continuous and Spread Footings (psf) bearing 4-feet below ground surface (psf)	2,000
Net Allowable bearing pressure for Mat Foundations on earthen pad to 4-feet below ground surface (psf)	1,500

Notes: pcf = pounds per cubic foot; psf = pounds per square foot; pci = pounds per cubic inch.
* For a 1 ft. x 1 ft. Plate.

Table 5.2.3 Soil Parameters for ADLS Locations

Parameter	Design Value
Design Groundwater Level below ground surface (ft)	20
Average Total Unit Weight, pcf	115
Modulus of Subgrade Reaction of Select Fill Pad, pci	70*
Friction Coefficient at Foundation Base (Native Soils)	0.35
Friction Coefficient at Foundation Base (Structural Fill)	0.45
Net Allowable bearing pressure for Strip or Continuous Footings (psf) bearing 4-feet below ground surface (psf)	2,500
Net Allowable Bearing Pressure for Continuous and Spread Footings (psf) bearing 4-feet below ground surface (psf)	3,000

Parameter	Design Value
Net Allowable bearing pressure for Mat Foundations on earthen pad to 4-feet below ground surface (psf)	2,500

Notes: pcf = pounds per cubic foot; psf = pounds per square foot; pci = pounds per cubic inch.
* For a 1 ft. x 1 ft. Plate.

Table 5.2.4 Soil Parameters for PMM Locations

Parameter	Design Value
Design Groundwater Level below ground surface (ft)	20
Average Total Unit Weight, pcf	115
Modulus of Subgrade Reaction of Select Fill Pad, pci	70*
Friction Coefficient at Foundation Base (Native Soils)	0.35
Friction Coefficient at Foundation Base (Structural Fill)	0.45
Net Allowable bearing pressure for Strip or Continuous Footings (psf) bearing 4-feet below ground surface (psf)	2,000
Net Allowable Bearing Pressure for Continuous and Spread Footings (psf) bearing 4-feet below ground surface (psf)	2,500
Net Allowable bearing pressure for Mat Foundations on earthen pad to 4-feet below ground surface (psf)	2,000

Notes: pcf = pounds per cubic foot; psf = pounds per square foot; pci = pounds per cubic inch.
* For a 1 ft. x 1 ft. Plate.

Site grading should ensure positive drainage away from the structures. This will prevent pooling of water near the foundations which could result in significant moisture changes of the soils beneath the foundations. Poorly graded sand (classified as SP) and gravel are highly permeable and allow water entry. These soils make poor overburden backfill. If the backfilled material around the structures consists of SP or Gravel, RRC recommends adding a 12-inch-thick clay cap. This clay cap should extend at least five feet beyond the foundation excavation.

5.3 Substation, Transmission Line, MET Tower and ADLS Tower Deep Foundation Systems

Structure elements with heavy axial loads and/or large overturning moments may utilize drilled pier foundations. Pier lengths will likely be dictated by overturning resistance. Allowable end bearing pressures and allowable skin friction values for the substation, transmission line and MET/ADLS tower structures are presented in Appendix D. Allowable end bearing pressures and allowable skin frictions utilize a factor of safety of 3 and 2.5, respectively.

Skin friction values should be reduced by 25% when calculating pull-out resistance, where applicable. Settlement associated with drilled piers is anticipated to be about ½ to 1 inch. For proper installation of steel rebar and to monitor cleanliness, drilled shafts should have a minimum diameter of 1½ feet. The structural engineer should determine the length of the drilled piers to satisfy axial, uplift, and lateral loading.

Lateral load analysis may be performed using the LPILE computer program. LPILE uses a p-y curve finite difference technique for predicting the soil-structure interaction and response. RRC provides detailed LPILE parameters within Appendix D to evaluate drilled piers under lateral loads.

Vertical steel reinforcement to resist tensile loads caused by uplift forces should extend the full length of the pier shaft. Additional reinforcement required by structural demands for axial compressive loads, lateral loads, or minimum reinforcement required by design codes should also be satisfied.

Transmission line pole foundation systems may consist of directly embedded pre-stressed concrete pole foundation systems and would likely be designed using EPRI's MFAD computer software. Compacted granular backfill material in the annulus can be assumed to exhibit the following parameters outlined in Table 5.3.1. These values assume backfill to be compacted to a relative density of 65% of greater.

Table 5.3.1 Parameters for Compacted Anulus Backfill

Parameter	Compacted Granular Aggregate
Total Unit Weight (pcf)	125
Internal Angle of Friction (degree)	35
Horizontal Modulus of Elasticity (ksi)	1.6

5.4 Corrosivity of Soils

Water-soluble sulfate and chloride test results are presented in Table. 4.3.6. The test results indicate the soils in the upper 12 feet possess a "Negligible" to "Moderate" risk for sulfate exposure and corrosion potential to concrete. Published maps indicate that in general, the area has low to moderate risk for corrosion to concrete. Foundation concrete should be designed in accordance with *ACI 318: Building Code Requirements for Structural Concrete and Commentary*.

Minimum Soil Box Electrical Resistivity and pH testing results are presented in Table 4.3.7 of this report. Soil Box Electrical Resistivity results indicate soils within the upper 12 feet exhibit "Very Corrosive" electrical characteristics with regards to galvanic corrosion of steel. Cathodic protection for buried metal pipe should be designed by a qualified corrosion engineer.

Table 5.4.1 Effect of Soil Box Electrical Resistivity on Corrosion

Aggressiveness	Resistivity in ohm-cm
Very Corrosive	< 700
Corrosive	700 – 2,000
Moderately Corrosive	2,000 – 5,000
Mildly Corrosive	5,000 – 10,000
Non-Corrosive	> 10,000

5.5 Lateral Earth Pressures

Lateral earth pressures will apply in soil strata. The WTG foundations will be designed to resist all lateral movements; therefore, the “at rest” lateral earth pressure will apply. The following “at rest” equivalent fluid pressures are recommended in Table 5.5.1. The lightweight range is more conservative and necessary for the “at rest” and “passive” condition. The heavier weights are more conservative for the “active” condition.

RRC applied unit weights listed in Table 5.2.1.3 for overburden backfill soils with minimal compaction and low moisture content. The lightweight range is more conservative and necessary for the “at rest” and “passive” condition. The heavier weights are more conservative for the “active” condition.

Table 5.5.1 Equivalent Fluid Pressures

Soil Type	Condition	Equivalent Fluid Pressure (psf/ft)
Clay Soils ϕ=20, γ_t=97 to 136 pcf	At Rest, k_o= 0.65	63 to 88
	Active, k_a= 0.49	68
	Passive, k_p= 2.0	195
Sand Soils ϕ=34, γ_t=103 to 132 pcf	At Rest, k_o= 0.44	41 to 53
	Active, k_a= 0.28	40
	Passive, k_p= 3.5	365

We note that for clay soils, the angle of internal friction is adjusted to correct for shear versus a lower friction angle. Theoretical correlations for the at-rest coefficient of clays are a property of Plasticity Index. For large variations in clay plasticity, RRC can provide alternate k_o coefficients. Because we expect that there will only be one foundation design, we expect that the lateral earth pressure will be dictated by the sandy condition.

Passive and active earth pressure resistance will only mobilize after significant movement of the foundation. The passive case occurs where a structural element tends to move into the soil mass. The active case occurs when the element tends to move away from the soil mass. Both cases are applicable for unrestrained foundation elements.

The above earth pressure values do not include safety factors. We recommend a minimum safety factor of 2.0 be applied when using passive earth pressure for lateral load resistance. Surcharge loads should also be considered where appropriate. The values apply only to cases where the ground surface is level. We should be contacted to provide suitable values for cases where the ground surface is sloped. Similarly, if a structure is submerged below water, then the earth pressures change dramatically and require a different analysis.

5.6 Seismic Design

RRC provides seismic design using 2021 International Building Code (IBC) (reference 4). Based on Logs of Boring, we recommend using a Site Class D for stiff soils. The Mapped Spectral

Response Acceleration for the 1 second (S_1) and short periods (S_S) were computed using the ASCE Hazard Tool, which is a web-based application program (reference 5). The table below summarizes recommended seismic parameters to be used in the design.

Table 5.6.1 Recommended Seismic Parameters

Parameter	Recommended Value
S_S – Mapped Spectral Response Acceleration at Short Period (0.2-Second)	0.053 g
S_1 – Mapped Spectral Response Acceleration at 1-Second Period	0.023 g
F_a (Site Coefficient) – Site Class D	1.6
F_v (Site Coefficient) – Site Class D	2.4
Site Modified Peak Ground Acceleration	0.039 g
Seismic Design Category	A

6.0 FOUNDATION CONSTRUCTION CRITERIA

6.1 Site Preparation

Prior to construction, we recommend adequate positive drainage be provided to maintain a relatively dry condition in the area of proposed construction. This will be very important if any work is attempted during periods of prolonged rainfall or heavy snow fall followed by warmer days. Ponding of water in the areas of construction should be avoided. Winter conditions can also impact the construction process. Newly placed fill should not be placed on frozen subgrade and frozen material should not be used for fill.

During excavation of the turbine foundations, every effort should be made to avoid disturbing subgrade materials at the planned foundation bearing elevation. When the subgrade is disturbed, the resulting surface should be re-compacted to achieve a minimum compaction of 98% of the maximum dry density as determined by ASTM D698 and moisture conditioned within 2% of optimum moisture content or drier. Soft lignite layers encountered at or near foundation bearing elevation shall be removed and replaced with suitable on-site soils or structural fill. A qualified representative of the geotechnical engineer should verify the stability of the subgrade prior to foundation installation.

6.2 Structural Fill Specifications

Structural fill material beneath foundations, where required, should consist of a non-expansive, well-graded material with sufficient binder for compaction purposes and should be in general accordance with the meets *North Dakota Department of Transportation, Section 816, Aggregate Class 5,* or better. RRC's intent is to make Structural Fill interchangeable with road base.

Structural fill should be compacted to a minimum of 95% of ASTM D1557. The structural fill should be moisture conditioned within 2% of optimum moisture content. Typically, 9-inch lifts are a

maximum, but if a contractor can complete thicker lifts and it can be verified that full densification occurs throughout the lift, then lifts to 12-inches are possible.

6.3 Native Soils as Select Fill below Foundations

RRC understands the importance of using native soils whenever feasible. The following specifications allow reasonable native soil reuse while maintaining structural requirements for end bearing capacity and settlement. Modification of unsuitable foundation soils shall consist of over-excavation and replacement with any of the following materials:

All soils that possess the following properties qualify as Select Fill that may be used under foundations: maximum plasticity index of 15 and a maximum liquid limit of 40, and classify as SC-SM, SC, Sandy CL, well-graded GC, and well-graded GS.

Select Fill placement under turbines should be limited to two-feet thick. Deeper replacement must be approved by the Geotechnical Engineer in order to assess settlement potentials for that specific location. Otherwise, use Structural Fill.

When dealing with subgrade pumping, rutting, or moisture, and the remediation has a maximum thickness of 12-inches, then the excavated soils may be scarified and reused to complete the remediation. Deeper remediation requires either Select Fill or Structural Fill.

All reused and Select Fill soils used under foundations shall be compacted to a minimum of 98% of the maximum dry density as determined by ASTM D698 and shall be moisture conditioned within 3% of optimum moisture content.

6.4 Turbine Earthwork Requirements

RRC reviewed each log of boring for the presence of soft to medium stiff clays, loose sand layer(s) and/or non-competent materials below and near the anticipated foundation bearing elevation. In *Table A1, Summary of Foundation Design Net Allowable Bearing Pressure and Design Groundwater Recommendations* within Appendix A, we list locations that we expect will require remediation. Following are various options and methods to remediate subsurface soils to support the intended gravity foundations. We also present other earthwork requirements related to the turbines, such as overburden backfill and crane pads on overburden fill.

6.4.1 Verification of Turbine Foundation Subgrade

Prior to placing a mud mat and rebar, the bearing surface should be verified for stability. This verification applies under all soil, fill, or rock conditions. There is a preference to perform a proof-roll test using a fully loaded water truck, or similar equipment. Conduct the proof-roll test in at least two directions with a minimum of two passes per area. Proof-roll tests should not exceed 1-inch of deflection, rutting, or pumping. Areas that fail this proof-roll shall be excavated and the removed soils be recompacted or replaced.

Where the foundation design allows for relatively soft soils with a bearing capacity below 3,000 psf, or where shallow groundwater deters the proof-roll, then the Geotechnical Engineer shall consider alternate verification methods. Alternates might consist of Dynamic Cone Penetrometer for sandy/gravelly soils or Static Cone Penetrometer for clay with low sand content.

6.4.2 Subgrade Remediation Methods

A representative of the Geotechnical Engineer should observe and verify over-excavations. In some cases, additional over-excavation may be necessary. In some cases, less excavation is sufficient.

In order to disperse the foundation load over a larger area, structural fill pads should be larger than the foundation. Deeper remediation also requires a wider distance. The over-excavated areas should extend laterally a distance such that the edge is at least a distance equal to the pad thickness. Foundation stresses extend downward and outward at a 45-degree angle through the structural fill. For example, a 3-foot thick remediation will require a pad that is 3-feet beyond the edge of the foundation.

If compacted structural fill or select fill is used below the turbine foundation, the fill thickness shall be kept uniform with a maximum thickness difference of two feet across the foundation footprint. This uniform thickness is to deter differential settlement. Where subgrade is a combination of bedrock and soil, then either excavate the rock or replace the soil with lean concrete or structural fill.

It is possible to encounter suitable soils at shallower depths. It is also feasible to verify that suspect soils are suitable to support the foundation design intent. If Table A1 recommends excavation to a depth, it is because this is the anticipated bottom of the suspect stratum. Contractor may choose to conduct additional tests to verify whether the suspect soils meet strength requirements. These tests should extend through the suspect layer. For the stiff and dense soils at this site, RRC can recommend Dynamic Cone Penetrometer (DCP) tests to conduct this verification. Once a foundation design is complete, the geotechnical team can work with the quality assurance team to devise a suitable DCP test procedure and minimum DCP test values.

The stability of the subgrade at foundation bearing elevation may be affected by the proximity to shallow groundwater levels and/or “Perched” Groundwater conditions. In areas where bearing capacity and settlement are not the concern, such as a thin layer of mud, the contractor may establish a stable platform using the following options:

- Dewater the site. Means and methods for dewatering are the responsibility of the contractor.
- Use geogrid/geotextile in combination with structural fill to create a stable surface. Obtain design input from the product manufacturer.

- Use coarse rip rap to bridge wet soils. Compact rip rap to bed the aggregate within the wet soils. Cap the rip rap with compacted structural fill then verify overall stability using a proof-roll method.

It is crucial to maintain a uniform foundation subgrade support below the turbine foundation to reduce differential foundation settlement. In areas where a combination of soil and bedrock are exposed at the foundation bearing elevation, the soil portion should be over-excavated to competent bedrock and replaced with either compacted structural fill or lean concrete having a 28-day compressive strength of 1,000 psi or higher. Do not use select fill or native soils. Alternatively, the entire foundation footprint can be over-excavated for a depth of 2 feet below the foundation bearing elevation and replaced with compacted structural fill.

Should boulders be exposed at foundation bearing elevation during excavation, remove the boulder and replace with structural fill. Foundations bearing on exposed boulders have the potential to create point loads at the bottom of the foundations. This increases differential foundation stress.

6.4.3 Excavated Materials as Overburden Backfill

The use of native clay and sand soils is acceptable as overburden backfill materials placed above and against the sides of turbine foundations. All backfill should be free of significant organics, roots, and deleterious materials and should be properly processed and compacted. See specifications below.

Overburden Backfill Placement:

- The backfill materials should be placed in loose lifts not exceeding 12 inches.

- Each lift of backfill should be moisture conditioned, compacted, and tested to meet the minimum and maximum dry and moist unit weight values specified in the foundation design drawings. If not on the drawings, refer to Section 5.1.2 of this report for target overburden weights.

- Each lift of backfill materials over turbine foundations should be compacted to dry densities of at least 95% of the maximum dry density as determined by ASTM D698. Even if this level of compaction is greater than the minimum target weights from item 2 above. This compaction reduces fill settlement, erosion, and provides support for the transformer and crane pad.

Poorly graded sand (classified as SP) and gravel is highly permeable and allow water entry. These soils make poor overburden backfill. If overburden material consists of SP or Gravel, then RRC recommends adding a 12-inch thick clay cap. This clay cap should extend at least five feet beyond the turbine foundation excavation. Alternately, the contractor can consider mixing clayey soils into the overburden backfill materials in order to create a less permeable mixture. The Geotechnical Engineer should be allowed to review such mixtures.

The top surface of the backfill should have a minimum 2% drainage slope away from the turbine to allow surface water runoff.

6.4.4 Crane Pads on Overburden

In areas where crane pads extend over the overburden backfill zone, then the crane operator's bearing capacity requirements also must apply. As a general guideline, RRC suggests a minimum three feet (in thickness) of the overburden backfill below crane pads be compacted to a minimum of 98% of the maximum dry density as determined by ASTM D698 and moisture conditioned within 2% of optimum moisture content. Refer to Section 7.2 of this Report for additional recommendations related to crane pads.

6.5 Substation, Transmission Line, MET Tower, PMM, ADLS and O&M Building Structures

This section provides construction recommendations and specifications related to shallow and deep foundations for structures not consisting of turbines. This section is intended to apply for all electrical substation, switchyard, and transmission line structures. If future, more specific geotechnical studies for those facilities are conducted, then disregard this section and refer to the recommendations in those more specific studies.

6.5.1 Shallow Foundation Construction

The following construction criteria and general guidance should be observed during foundation construction:

- All foundation excavations should be observed by the engineer's qualified representative to assess proper bearing materials are present at foundation bearing elevation in accordance with the recommendations given herein, and to assess the need for densification of the subgrade materials.

- Care should be taken to protect the exposed soils from being disturbed, freezing or desiccation.

- The foundation excavation should be sloped sufficiently to create internal sumps for runoff collection and removal. Foundation excavations subject to rainfall and possible deterioration from accumulated water should be protected using a protective "mud-slab" (lean concrete). If surface runoff water or groundwater seepage accumulates at the bottom of the foundation excavation, it should be collected and removed and not allowed to adversely affect the quality of the bearing surface.

- The foundation excavations should be checked for size and cleaned prior to the placement of reinforcing steel. Take precautions during the placement of reinforcement and concrete to prevent the loose material from falling into the excavation.

6.5.2 Drilled Shaft Foundation Construction

The following items are important for the successful completion of drilled shaft foundations:

- The engineer's representative should observe all drilled shaft excavations. This inspection is to verify proper depth, bearing stratum, cleanliness, verticality (plumbness) and to record other observations regarding the drilled shaft construction.

- If water is present within the shaft, it is imperative that the contractor use proper construction methods to account for the water. Either the water must be removed, or the contractor must use tremies or pumps to allow concrete placement under water.

- Prompt placement of concrete in the excavation as it is completed, cleaned, and inspected is strongly recommended. Under no circumstances should a shaft be drilled, that cannot be filled with concrete before the end of the workday.

- The reinforcement steel cage placed in the shaft should be designed to be stable and centered during the placement of concrete.

- Varying subsurface soil conditions may be encountered. A Geotechnical Engineer or his representative should observe subsurface conditions during installation of any drilled piers to verify subsurface conditions match the design criteria.

- Drilled shaft construction should follow applicable industry standard. Means and methods of construction shall be determined by the contractor.

6.5.3 Directly Embedded Pole Construction

The following items are important for the successful completion of directly embedded foundations:

- The Geotechnical Engineer or their representative should observe all excavations. Directly embedded pole construction observations are recommended to observe proper depth, bearing stratum and to record other observations regarding the construction.

- Excavations should be checked for size, and to determine all loose material and free water has been removed prior to the placement of the poles and annulus with crushed rock. Precautions should be taken during the placement of the poles and annulus materials to prevent loose excavated material from falling into the excavation.

- Prompt placement of the pole and annulus material in the excavation as it is completed, cleaned, and inspected is strongly recommended. Under no circumstances should a shaft excavation be drilled that cannot be filled with the pole and annulus material before the end of the workday.

- The pole placed in the shaft excavation should be designed to be stable and centered during the placement of the annulus backfill materials.

- Varying subsurface soil conditions may be encountered. A Geotechnical Engineer or his representative should observe subsurface conditions during installation of any drilled piers to verify subsurface conditions match the design criteria.

6.6 Open Excavations

With all excavations in soils, sloped excavations and trench shields are required for excavations greater than four feet in depth. The contractor's "Competent Person" (as defined by OSHA) must inspect each trench wall to determine the type of bench or slope that is required. With all excavations, only a "Competent Person" shall determine whether sloped, benched, or trench shields can be used. OSHA and applicable state and local standards should be observed and followed. Site safety is the responsibility of the contractor. For general planning purposes, RRC offers the following:

- The surficial cohesive clay soils across this site are generally stiff. This soil type classifies as an OSHA Type A material that requires the excavation's sidewall be sloped at 3/4H:1V (or flatter).

- The sandy soils at the site possess low to zero cohesion. This soil type classifies as an OSHA Type B material that requires the excavation's sidewall be sloped at a 1H:1V slope (or flatter). The silt content may give the appearance of cohesion when first excavated, but this is not correct.

- The presence of water within any excavation automatically creates a Type C classification. All Type C class excavations require a 1.5H:1V slope or bench.

- Stable Rock is a natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed, such as Limestone or Sandstone.

Protect construction slopes and permanent embankment slopes from surface runoff water. Design site grading to deter surface water from flowing down unprotected slopes. The contractor should avoid surcharge loads, either static or dynamic, adjacent to an excavation slope. Prevent construction equipment from traveling along or near the top of the excavation slope. The contractor's "Competent Person" must monitor temporary slopes, trenches, and dewatering during construction in order to detect early warnings of movement. Site safety is the responsibility of the contractor.

6.7 Drainage and Construction Dewatering

Proper drainage should be provided away from the foundation elements during all phases of construction and post-construction grading. Proper drainage is essential to the long-term stability

of the structures. Ponding of water near the foundation elements from improper drainage should not be permitted.

Based on the available groundwater information, shallow groundwater may be encountered and is considered a concern at some WTG foundation excavations. If rain causes perched water conditions, we anticipate the groundwater re-charge rate should be slow enough to conduct excavation dewatering with conventional sumps and pumps.

7.0 ACCESS ROADWAYS AND CRANE PADS

Private access roadways will be built for construction and maintenance purposes. Traffic volumes during construction are anticipated to be frequent with heavy equipment utilizing the access roadways. Following the construction period, the traffic volumes will be light and vehicles accessing the roadways will generally consist of pickup trucks and occasional single and multi-axle truck traffic. The section thickness design should be based upon the methodology outlined by the American Association of State Highways and Transportation Officials (AASHTO) for design of aggregate-surfaced roadways (reference 8).

Crane pads require sufficient bearing capacity to support the large cranes used to lift the turbine sections. The design intent for these crane pads is not related to regular traffic.

7.1 Pavement Section Thickness Recommendations

Based on the field exploration, lean clay, fat clay and clayey sand soils were encountered at the ground surface across the site. Clay soils are considered to be poor subgrades for roadways. The Contractor and the Civil Engineer should coordinate on traffic expectations for different roadways such as to value engineer road design for different areas of the facility.

Soaked CBR tests are compacted to 95% of the maximum dry density at optimum moisture content as determined by ASTM D698. Soaked CBR values of native soils ranged from 0.8% to 8.2%. RRC used a design CBR value of 2.0 %, which is correlated to a subgrade resilient modulus (M_R) value of 3,980 psi. It is important to understand that these CBR values are for soils without topsoil. Leaving topsoil within the road subgrade will significantly reduce the CBR values, thus negating the recommendations below.

RRC anticipates that the project team will use crushed stone for the roadways. RRC recommends using crushed limestone that meets *North Dakota Department of Transportation, Section 816, Aggregate Class 5,* or better. Aggregate base materials should be compacted to a minimum of 95% of ASTM D1557. The thickness of the crushed stone base course is dependent on the traffic loads, traffic frequency, duration, and performance expectations. Crushed stone ‘pavement’ is not an engineered pavement and can be expected to require regular maintenance regardless of thickness. This is especially true if traffic is allowed onto it when saturated.

The following section provides a summary of design recommendations for aggregate base course roadways based on the 1993 AASHTO Design Manual. We used AASHTO’s design chart for low-

volume aggregate base surface roads, which designs based on acceptable rutting. Traffic 18-kip Equivalent Single-Axle Loads (ESAL) were estimated based upon our experience with similar type projects. For this project we estimate 1,000 ESAL for each turbine. AASHTO's 1993 nomograph from low-volume aggregate pavement design was utilized to calculate the required aggregate base layer thickness for the corresponding ESAL traffic load, with the following design parameters: 30,000 psi for the Modulus of Aggregate Base Layer (E_{BS}), 3,980 psi for the Resilient Modulus (M_R), and 2.0 and 3.0 inches for an Allowable Rut Depth. A summary of design parameters and recommended aggregate base course thickness are presented in Table 7.1.1.

Table 7.1.1 Summary of Aggregate Base Course Thickness

Number of WTG Sites per Private Access Roadway	ESAL	Aggregate Base Thickness (in.) - 2.0-inch Allowable Rutting	Aggregate Base Thickness (in.) - 3.0-inch Allowable Rutting
3 or less	3,000	5.0	4.0
5	5,000	5.5	4.5
10	10,000	7.5	5.5

RRC cautions that a 3-inch rut is essentially a failure for a roadway. Trucking and turbine providers typically reject this amount of rutting. We provide these values because it is part of the AASHTO method, and it provides the team with comparisons for the performance of different pavement cross-sections.

Strip and remove topsoil and vegetation prior to the placement of the aggregate base materials. Topsoil and organics could be up to about 8 inches or more in thickness in some areas and should not be allowed for use in structural areas or along roadway alignments. The exposed subgrade should then be compacted, and proof rolled to assess the presence of soft areas and the need for remedial measures, if any. Proof-roll test with at least two passes using a fully loaded water truck or similar. Maximum deflection or pumping should be less than one inch. In areas where excessive pumping of the subgrade is observed, removal unsuitable soils and re-compaction and/or replacement with road base. Aggregate base materials should be compacted to a minimum of 95% of ASTM D1557 where moisture content is not a pass/fail criteria.
As an alternative, consider placing geogrid (Tensar Biaxial Type 2 or equivalent) on top of geotextile (Mirafi HP 570 or equivalent) in areas where excessive pumping is observed. Consideration could also be given to performing a cement or lime mix design to stabilize the subgrade soils supporting pavement structures as an alternative. A formal cement or lime mix design should be performed prior to construction to determine design CBR values and aggregate base thicknesses.

7.2 Crane Pads Design and Construction Recommendations

This Section 7.2 works in conjunction with Section 6.4.3 within the turbine earthwork requirements. That previous section defines earthwork requirements for the overburden backfill. In areas where the crane pad does not overlap with the overburden backfill, then follow the subgrade requirements below.

The crane pad should extend at least two feet beyond the footprint of the crane tracks. Strip and remove topsoil, vegetation, and other deleterious materials. When the subgrade consists of soils, scarify and rework the resulting subgrade to a depth of 12 inches. Compact the reworked soils to a minimum of 98% of the maximum dry density per ASTM D698. Also, the contractor's use of mats can affect the necessary compaction requirement.

After verifying subgrade density, perform a proof-roll test using a fully loaded water truck, or similar equipment. Conduct the proof-roll in two directions and perform at least two passes per location. Maximum allowable deflection under the proof-roll is 1-inch. If higher deflections are observed, the subgrade soil should be over-excavated to suitable material and replaced with either Select Fill or Structural Fill, defined in Section 6.

Once a suitable subgrade condition has been achieved, use flexible road base aggregate materials (structural fill) to construct the crane pad. The pad should be at least 9-inches thick. The aggregate base should conform to the requirements of Section 6.2 of this report. Compact to a minimum of 95% of the maximum dry density as determined in accordance with ASTM D1557. Moisture is not a test criteria.

These recommendations are expected to provide an ultimate bearing capacity of 5,000 psf at the finished surface. This value assumes a crane track width of six feet, treated as a mat bearing on the ground surface.

For cranes that impart loads more than that provided above, alternate designs will be necessary. The crane operators can consider load distribution mats, such as timber mats or composite mats. If crane mats are to be used, RRC should be retained to review the design of the crane mats to check that bearing capacities are met. Otherwise, an alternate crane pad cross section may be necessary.

8.0 LIMITATIONS

Recommendations contained in this report are based on our field observations and subsurface explorations, limited laboratory tests, and our present knowledge of the proposed construction. It is likely soil conditions will vary between or beyond the points explored. If soil conditions are encountered during construction that differ from those described herein, we should be notified immediately in order to provide supplemental recommendations (if needed). If the scope of the proposed construction, including the proposed loads or structural locations, changes from those described in this report, our data should also be reviewed.

We have prepared this report in substantial accordance with the generally accepted geotechnical engineering practice as it exists in the site area at the time of our study. No warranty is expressed or implied. The recommendations provided in this report assume RRC will conduct an adequate

program of tests and observations during the construction phase in order to evaluate compliance with our recommendations.

This report may be used only by the client and only for the purposes stated, within three years from its issuance. Land use, site conditions (both on site and off site) or other factors may change over time, and additional work may be required with the passage of time. Any party other than the client, or the client's design team members for this project, who wishes to use this report shall notify RRC of such intended use. Based on the intended use of the report, RRC may require that additional work be performed and that an updated report be issued. Non-compliance with any of these requirements by the client or anyone else will release RRC from any liability resulting from the use of this report by any unauthorized party.

Other standards or documents referenced in any given standard cited in this report, or otherwise relied upon by the authors of this report, are only mentioned in the given standard; they are not incorporated into it or "included by reference," as that latter term is used relative to contracts or other matters of law.

9.0 REFERENCES

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APPENDIX A

Table A1 - Summary of Foundation Design Net Allowable Bearing Pressure and Design Groundwater Recommendations

Boring No.	Latitude	Longitude	Turbine/Boring ID (L015_01.13.26)	Groundwater During Drilling (ft,begs)	Groundwater Immediately After Drilling (ft,begs)	Minimum Piezometer Groundwater Level (ft,begs)	Estimated Design Groundwater Depth (begs,ft)	Anticipated Grade Change (ft)	Anticipated Foundation Embedment Depth (ft, begs)	Net Allowable Bearing Capacity (qnet all) Under Normal Operating Load Conditions Based on Anticipated Foundation Bearing Elevation (psf)	Required Soil Improvement Depth Below Existing Ground Surface (ft,begs)	Recommended Soil Improvement to Achieve a Net Allowble Bearing Capacity of 2,500 psf (ft,begs)	Remarks
GEO-001	46.928605	-101.860052	T01	30.0	52.0	--	20.0	1.8	11.2	2,250		14	Over-excavation and Replacement w/ Structural Fill
GEO-002	46.936340	-101.861568		NE	NE	--	20.0		13.0	3,500			
GEO-003	46.939368	-101.854080	T03	NE	NE	--	20.0	-4.4	17.4	3,500			
GEO-004	46.937945	-101.847728		NE	NE	--	20.0		13.0	3,500	25		Deep Soil Improvement
GEO-005	46.935278	-101.841595	T05	34.0	48.0	--	20.0	-1.1	14.1	3,500			
GEO-006	46.930996	-101.826168	T06	NE	NE	--	20.0	0.0	13.0	3,500			
GEO-007	46.913460	-101.838517	T07	NE	NE	--	35.0	-15.1	28.1	3,500			
GEO-008	46.916400	-101.834600	T08	NE	NE	--	20.0	-0.4	13.4	3,500			
GEO-009	46.921153	-101.828370		NE	NE	--	20.0		13.0	3,500			
GEO-010	46.921172	-101.821962	T10	NE	NE	--	20.0	0.2	12.8	3,500			
GEO-011	46.921497	-101.813248		NE	NE	--	20.0		13.0	3,250			
GEO-012	46.921525	-101.806480	T12	19.0	44.0	12.0	11.0	-0.1	13.1	3,500			
GEO-013	46.900807	-101.826790	T13	NE	NE	--	20.0	-1.4	14.4	3,500			
GEO-014	46.900966	-101.819722		34.0	48.0	--	20.0		13.0	3,500			
GEO-015	46.900394	-101.810586	T15	NE	NE	--	20.0	-2.3	15.3	3,500			
GEO-016	46.904707	-101.805945	T16	NE	NE	--	20.0	-1.4	14.4	3,000			
GEO-017	46.886948	-101.814793	T17	49.0	52.0	--	20.0	0.1	12.9	3,500			
GEO-018	46.885050	-101.808962	T18	44.0	44.0	--	20.0	0.0	13.0	3,500			
GEO-019	46.886566	-101.800295	T19	NE	NE	--	20.0	-2.9	15.9	3,500			
GEO-020	46.976011	-101.763598	T20	NE	NE	--	20.0	-0.6	13.6	3,500			
GEO-021	46.973311	-101.752139	T21	39.0	23.0	--	20.0	2.5	10.5	3,500			
GEO-022	46.973116	-101.745499	T22	NE	NE	--	20.0	1.2	11.8	3,500			
GEO-023	46.975381	-101.721823	T23	NE	NE	--	20.0	-0.5	13.5	3,500			
GEO-024	46.968427	-101.723739	T24	NE	NE	--	20.0	-1.9	14.9	3,500			
GEO-025	46.959730	-101.706249	T25	NE	NE	--	20.0	0.0	13.0	3,500			
GEO-026	46.961450	-101.700128	T26	39.0	50.0	--	20.0	0.6	12.4	3,500			
GEO-027	46.961464	-101.693477	T27	NE	NE	--	20.0	0.2	12.8	3,500			
GEO-028	46.953950	-101.786611	T28	35.0	52.0	--	20.0	0.0	13.0	3,500			
GEO-029	46.959220	-101.764704	T29	9.0	55.0	12.0	11.0	0.0	13.0	3,500			
GEO-030	46.951333	-101.765145				--	--		13.0	--			Not Investigated
GEO-031	46.954390	-101.753974	T31	49.0	49.0	--	20.0	0.5	12.5	3,250			
GEO-032	46.955296	-101.743890				--	--		13.0	--			Not Investigated
GEO-033	46.954002	-101.730960	T33	NE	NE	--	20.0	-0.2	13.2	3,500	18		Deep soil improvement
GEO-034	46.954983	-101.724356	T34	NE	NE	--	20.0	0.0	13.0	3,500			
GEO-035	46.944218	-101.753027		30.0	NE	--	20.0	1.2	11.8	3,500			
GEO-036	46.941605	-101.746654	T36	12.0	47.0	0.5	0.0	0.0	13.0	3,500	20		Deep soil improvement
GEO-037	46.942772	-101.740419	T37	NE	NE	--	20.0	0.0	13.0	3,500	15		Over-Excavation and Replacement w/ Structural Fill
GEO-038	46.940588	-101.731712		NE	NE	--	20.0	0.0	13.0	3,000			
GEO-039	46.945336	-101.725459	T39	49.0	54.0	--	20.0	0.0	13.0	3,500			
GEO-040	46.939113	-101.709620	T40	NE	NE	--	20.0	-2.2	15.2	3,500			
GEO-041	46.938437	-101.721078				--	--		13.0	--			Not Investigated
GEO-042	46.940888	-101.695081		30.0	54.0	--	20.0	0.0	13.0	3,500			
GEO-043	46.939567	-101.785665	T43	NE	NE	--	20.0	-5.8	18.8	3,500			
GEO-044	46.937839	-101.767572		NE	NE	--	20.0	0.9	12.1	2,500			
GEO-045	46.935204	-101.795228	T45	NE	NE	--	20.0	-2.3	15.3	3,500			
GEO-046	46.932590	-101.787606	T46	NE	NE	--	20.0	-0.7	13.7	3,500			
GEO-047	46.932651	-101.777749	T47	45.0	48.0	--	20.0	0.2	12.8	3,500			
GEO-048	46.922343	-101.767967		NE	NA	--	20.0	0.0	13.0	3,500			
GEO-049	46.926427	-101.762739		NE	NE	--	20.0	0.0	13.0	2,500			
GEO-050	46.923447	-101.751849	T50	NE	NE	--	20.0	0.1	12.9	3,500			
GEO-051	46.922422	-101.730508	T51	NE	NE	--	20.0	0.0	13.0	3,500			
GEO-052	46.923094	-101.724068	T52	NE	NE	--	20.0	-1.1	14.1	3,500			
GEO-053	46.922764	-101.713804	T53	NE	NE	--	20.0	-4.2	17.2	2,500			
GEO-054	46.922576	-101.705791		NE	NE	--	20.0	-3.9	16.9	3,000			
GEO-055	46.930926	-101.689845				--	--		13.0	--			Not Investigated
GEO-056	46.907994	-101.725116		NE	NE	--	20.0	-2.3	15.3	3,500			
GEO-057	46.910611	-101.712133	T57	NE	NE	--	20.0	0.0	13.0	3,500			
GEO-058	46.915340	-101.703733	T58	NE	NE	--	20.0	0.5	12.5	3,500			
GEO-059	46.911737	-101.695736	T59	34.0	NA	--	20.0	-0.5	13.5	3,500			
GEO-060	46.918971	-101.692605		NE	NE	16.0	15.0	0.1	12.9	3,500			
GEO-061	46.909107	-101.683665	T61	24.0	NE	2.3	1.3	0.6	12.4	3,500			
GEO-062	46.908347	-101.677053	T62	34.0	52.0	--	20.0	-0.5	13.5	3,500			
GEO-063	46.903391	-101.708698	T63	NE	NE	--	20.0	-0.2	13.2	3,500			
GEO-064	46.903570	-101.686788	T64	NE	NE	--	20.0	0.0	13.0	3,500			
GEO-065	46.897699	-101.696096	T65	NE	NE	--	20.0	-3.7	16.7	3,500			
GEO-066	46.896434	-101.676574	T66	NE	NE	--	20.0	0.4	12.6	3,000			
GEO-067	46.897586	-101.664957	T67	45.0	NA	--	20.0	0.2	12.8	3,500			
GEO-068	46.896070	-101.651180		NE	NE	--	20.0	0.6	12.4	3,000			
GEO-069	46.890090	-101.683948	T69	NE	NE	--	20.0	-2.5	15.5	3,500			

Updated on ***4/22/2026***

Table A1 - Summary of Foundation Design Net Allowable Bearing Pressure and Design Groundwater Recommendations

Boring No.	Latitude	Longitude	Turbine/Boring ID (L015_01.13.26)	Groundwater During Drilling (ft,begs)	Groundwater Immediately After Drilling (ft,begs)	Minimum Piezometer Groundwater Level (ft,begs)	Estimated Design Groundwater Depth (begs,ft)	Anticipated Grade Change (ft)	Anticipated Foundation Embedment Depth (ft, begs)	Net Allowable Bearing Capacity (qnet all) Under Normal Operating Load Conditions Based on Anticipated Foundation Bearing Elevation (psf)	Required Soil Improvement Depth Below Existing Ground Surface (ft,begs)	Recommended Soil Improvement to Achieve a Net Allowble Bearing Capacity of 2,500 psf (ft,begs)	Remarks
GEO-070	46.881269	-101.690206	T70	NE	NE	--	20.0	-3.1	16.1	3,500			
GEO-071	46.951278	-101.767572		25.0	NE	--	20.0	0.0	13.0	3,500			
GEO-072	46.951464	-101.767567	T30	19.0	6.0	NE	20.0	0.9	12.1	3,500			
GEO-073	46.940581	-101.732158	T38	NE	NE	--	20.0	1.1	11.9	2,500			
GEO-074	46.937832	-101.766825	T44	NE	NA	--	20.0	-3.9	16.9	3,500			
GEO-075	46.923032	-101.767480	T48	NE	NE	--	20.0	-0.8	13.8	2,750			
GEO-076	46.907995	-101.724410	T56	NE	NE	--	20.0	0.0	13.0	3,250			
GEO-077	46.895876	-101.651185	T68	NE	NE	--	20.0	0.1	12.9	3,500			

NE = Not Encountered; begs = Below Existing Ground Surface

Table A2 - Summary of Subsurface Exploration and Geographic Coordinates

Boring No.	Latitude	Longitude	Turbine/Boring ID (L015_01.13.26)	Latitude (L015_01.13.26)	Longitude (L015_01.13.26)	Turbine/Boring ID (L011_04.26.25)	Turbine/Boring ID (L009_03.19.25)	MASW Survey	Electrical Resistivity Testing	Thermal Resistivity Samples	Piezometer Location	Piezometer Installation Date	Test/ Drilling Date	Auger (ft)	Total Depth (ft)	Groundwater During Drilling (ft.)	Groundwater Immediately After Drilling (ft.)	Groundwater 24-Hours After Drilling (ft.)	Remarks
GEO-001	46.928605	-101.860052	T01	46.928598	-101.860041	T01	T01		05/14/25	04/25/25			04/25/25	55.5	55.5	30	52	NA	
GEO-002	46.936340	-101.861568				T02	T02						04/25/25	55.0	55.0	NE	NE	NA	**Removed from L015**
GEO-003	46.939368	-101.854080	T03	46.939360	-101.854069	T03	T03						04/24/25 - 04/25/25	55.5	55.5	NE	NE	NA	
GEO-004	46.937945	-101.847728				T04	T04	05/10/25					04/25/25	55.0	55.0	NE	NE	NA	**Removed from L015**
GEO-005	46.935278	-101.841595	T05	46.935271	-101.841461	T05	T05						04/26/25	55.5	55.5	34	48	NA	**L015 relocated ~35 ft.**
GEO-006	46.930996	-101.826168	T06	46.930989	-101.826157	T06	T06						04/23/25	55.5	55.5	NE	NE	NA	
GEO-007	46.913460	-101.838517	T07	46.913388	-101.838660	T07	T07						04/23/25	55.5	55.5	NE	NE	NA	**L015 relocated ~45 ft.**
GEO-008	46.916400	-101.834600	T08	46.916479	-101.834460	T08	T08		05/14/25	04/23/25			04/23/25	55.5	55.5	NE	NE	NA	**L015 relocated ~45 ft.**
GEO-009	46.921153	-101.828370				T09	T09						05/07/25	55.5	55.5	NE	NE	NA	**Removed from L015**
GEO-010	46.921172	-101.821962	T10	46.921164	-101.821952	T10	T10		05/14/25	04/24/25			04/23/25 - 04/24/25	55.0	55.0	NE	NE	NA	
GEO-011	46.921497	-101.813248				T11	T11						04/24/25	55.5	55.5	NE	NE	NA	**Removed from L015**
GEO-012	46.921525	-101.806480	T12	46.921517	-101.806469	T12	T12				X	04/24/25	04/24/25	55.5	55.5	19	44	NA	
GEO-013	46.900807	-101.826790	T13	46.900880	-101.826716	T13	T13						04/22/25	55.5	55.5	NE	NE	NA	**L015 relocated ~30 ft.**
GEO-014	46.900966	-101.819722				T14	T14	05/10/25					04/22/25	55.5	55.5	34	48	NA	**Removed from L015**
GEO-015	46.900394	-101.810586	T15	46.900386	-101.810575	T15	T15						04/22/25	55.5	55.5	NE	NE	NA	
GEO-016	46.904707	-101.805945	T16	46.904696	-101.806135	T16	T16						04/21/25 - 04/22/25	55.5	55.5	NE	NE	NA	**L015 relocated ~45 ft.**
GEO-017	46.886948	-101.814793	T17	46.886940	-101.814783	T17	T17						04/21/25	55.5	55.5	49	52	NA	
GEO-018	46.885050	-101.808962	T18	46.885043	-101.808952	T18	T18	05/10/25					04/21/25	55.5	55.5	44	44	NA	
GEO-019	46.886566	-101.800295	T19	46.886559	-101.800285	T19	T19		05/17/25	04/21/25			04/21/25	55.5	55.5	NE	NE	NA	
GEO-020	46.976011	-101.763598	T20	46.976003	-101.763752	T20	T20						04/30/25	55.5	55.5	NE	NE	NA	**L015 relocated ~45 ft.**
GEO-021	46.973311	-101.752139	T21	46.973304	-101.752129	T21	T21						05/11/25	54.5	54.5	39	23	NA	
GEO-022	46.973116	-101.745499	T22	46.973109	-101.745488	T22	T22		05/06/25	05/09/25			05/09/25	55.5	55.5	NE	NE	NA	
GEO-023	46.975381	-101.721823	T23	46.975373	-101.721813	T23	T23						05/09/25	55.5	55.5	NE	NE	NA	
GEO-024	46.968427	-101.723739	T24	46.968420	-101.723729	T24	T24						05/09/25	55.5	55.5	NE	NE	NA	
GEO-025	46.959730	-101.706249	T25	46.959723	-101.706238	T25	T25						05/08/25	55.5	55.5	NE	NE	NA	
GEO-026	46.961450	-101.700128	T26	46.961443	-101.700118	T26	T26						05/08/25	55.5	55.5	39	50	NA	
GEO-027	46.961464	-101.693477	T27	46.961457	-101.693467	T27	T27						05/09/25	55.0	55.0	NE	NE	NA	
GEO-028	46.953950	-101.786611	T28	46.953943	-101.786601	T28	T28						04/26/25	55.5	55.5	35	52	NA	
GEO-029	46.959220	-101.764704	T29	46.959212	-101.764736	T29	T29	05/10/25			X	04/29/25	04/29/25	55.5	55.5	9	55	NA	
GEO-030	46.951333	-101.765145					T30												**Relocated ~ 600 ft. from L011, See GEO-071;**
GEO-031	46.954390	-101.753974	T31	46.954383	-101.753964	T31	T31						05/02/25	55.5	55.5	49	49	NA	
GEO-032	46.955296	-101.743890					T32												**Removed From L011**
GEO-033	46.954002	-101.730960	T33	46.953995	-101.730950	T33	T33	05/09/25	05/18/25	05/03/25			05/03/25	55.5	55.5	NE	NE	NA	
GEO-034	46.954983	-101.724356	T34	46.954976	-101.724345	T34	T34						05/04/25	55.0	55.0	NE	NE	NA	
GEO-035	46.944218	-101.753027				T35	T35						04/03/25	55.5	55.5	30	NE	NA	**Removed from L015**
GEO-036	46.941605	-101.746654	T36	46.941598	-101.746644	T36	T36				X	05/05/25	05/05/25	55.5	55.5	12	47	NA	
GEO-037	46.942772	-101.740419	T37	46.942764	-101.740409	T37	T37						05/04/25 - 04/05/25	54.5	54.5	NE	NE	NA	
GEO-038	46.940588	-101.731712				T38	T38						05/01/25	42.5	42.5	NE	NE	NA	**Relocated ~93 ft. See GEO-073**
GEO-039	46.945336	-101.725459	T39	46.945329	-101.725449	T39	T39						05/04/25	55.5	55.5	49	54	NA	
GEO-040	46.939113	-101.709620	T40	46.939105	-101.709609	T40	T40						04/27/25	55.0	55.0	NE	NE	NA	
GEO-041	46.938437	-101.721078				T41	T41												**Non Participating Landowner per email 04.04.25**
GEO-042	46.940888	-101.695081				T42	T42						05/10/25	55.5	55.5	30	54	NA	**Removed from L015**
GEO-043	46.939567	-101.785665	T43	46.939560	-101.785655	T43	T43						05/07/25	55.5	55.5	NE	NE	NA	
GEO-044	46.937839	-101.767572				T44	T44						04/27/25	55.5	55.5	NE	NE	NA	**Relocated ~160 ft. from L015, See GEO-074**
GEO-045	46.935204	-101.795228	T45	46.935196	-101.795217	T45	T45						04/27/25	55.5	55.5	NE	NE	NA	
GEO-046	46.932590	-101.787606	T46	46.932583	-101.787596	T46	T46		05/13/25	04/26/25			04/26/25	55.0	55.0	NE	NE	NA	
GEO-047	46.932651	-101.777749	T47	46.932644	-101.777739	T47	T47						04/27/25	55.5	55.5	45	48	NA	
GEO-048	46.922343	-101.767967				T48	T48		05/18/25	05/05/25			05/05/25	52.5	52.5	NE	NA	NA	**Relocated ~245 ft. from L015, See GEO-075**
GEO-049	46.926427	-101.762739				T49	T49						05/06/25	55.5	55.5	NE	NE	NA	**Removed from L015**
GEO-050	46.923447	-101.751849	T50	46.923440	-101.751839	T50	T50						05/08/25	55.5	55.5	NE	NE	NA	
GEO-051	46.922422	-101.730508	T51	46.922415	-101.730497	T51	T51						05/10/25	55.0	55.0	NE	NE	NA	
GEO-052	46.923094	-101.724068	T52	46.923086	-101.724057	T52	T52						05/08/25 - 05/09/25	55.5	55.5	NE	NE	NA	
GEO-053	46.922764	-101.713804	T53	46.922757	-101.713794	T53	T53		05/18/25	05/06/25			05/06/25	55.5	55.5	NE	NE	NA	
GEO-054	46.922576	-101.705791				T54	T54						04/27/25	55.5	55.5	NE	NE	NA	**Removed from L015**
GEO-055	46.930926	-101.689845					T55												**Removed From L011**
GEO-056	46.907994	-101.725116				T56	T56						05/08/25	55.5	55.5	NE	NE	NA	**Relocated ~160 ft. from L015, See GEO-076**
GEO-057	46.910611	-101.712133	T57	46.910604	-101.712123	T57	T57						05/07/25	55.5	55.5	NE	NE	NA	
GEO-058	46.915340	-101.703733	T58	46.915332	-101.703722	T58	T58						04/27/25 - 05/07/25	55.5	55.5	NE	NE	NA	
GEO-059	46.911737	-101.695736	T59	46.911730	-101.695726	T59	T59		05/17/25	04/26/25			04/26/25	55.5	55.5	34	NA	NA	
GEO-060	46.918971	-101.692605				T60	T60						04/25/25 - 04/26/25	55.5	55.5	NE	NE	NA	**Removed From L011**
GEO-061	46.909107	-101.683665	T61	46.909100	-101.683654	T61	T61				X	04/25/25	04/25/25	55.5	55.5	24	NE	NA	
GEO-062	46.908347	-101.677053	T62	46.908339	-101.677043	T62	T62		05/17/25	05/07/25			05/06/25	55.5	55.5	34	52	NA	
GEO-063	46.903391	-101.708698	T63	46.903383	-101.708687	T63	T63						05/07/25	55.5	55.5	NE	NE	NA	
GEO-064	46.903570	-101.686788	T64	46.903563	-101.686778	T64	T64	05/09/25					04/24/25	55.5	55.5	NE	NE	NA	
GEO-065	46.897699	-101.696096	T65	46.897692	-101.696086	T65	T65						05/08/25	55.5	55.5	NE	NE	NA	
GEO-066	46.896434	-101.676574	T66	46.896426	-101.676563	T66	T66						04/23/25	55.5	55.5	NE	NE	NA	
GEO-067	46.897586	-101.664957	T67	46.897578	-101.664946	T67	T67		05/17/25	04/26/25			04/25/25	55.5	55.5	45	NA	NA	
GEO-068	46.896070	-101.651180				T68	T68						04/23/25	54.5	54.5	NE	NE	NA	**Relocated ~63 ft. from L015, See GEO-077**
GEO-069	46.890090	-101.683948	T69	46.890082	-101.683937	T69	T69						04/24/25	55.5	55.5	NE	NE	NA	
GEO-070	46.881269	-101.690206	T70	46.881261	-101.690195	T70	T70		05/11/25	04/24/25			04/24/25	55.5	55.5	NE	NE	NA	
GEO-071	46.951278	-101.767572				T30							05/03/25	55.5	55.5	25	NE	NA	**Relocated from L015; Moved 60 ft., see GEO-072**
GEO-072	46.951464	-101.767567	T30	46.951464	-101.767567						X	03/18/26	03/18/26	55.5	55.5	19	6	NA	
GEO-073	46.940581	-101.732158	T38	46.940581	-101.732158								03/18/26	55.5	55.5	NE	NE	NA	
GEO-074	46.937832	-101.766825	T44	46.937832	-101.766825								01/30/26	54.5	54.5	NE	NA	NA	
GEO-075	46.923032	-101.767480	T48	46.923032	-101.767480								03/17/26	55.5	55.5	NE	NE	NA	
GEO-076	46.907995	-101.724410	T56	46.907995	-101.724410								03/17/26	55.5	55.5	NE	NE	NA	
GEO-077	46.895876	-101.651185	T68	46.895876	-101.651185								01/29/26	55.5	55.5	NE	NE	NA	
TL-01	46.986205	-101.766771											04/29/25	50.5	50.5	NE	NE	NA	
TL-02	46.984606	-101.766776											04/29/25	30.5	30.5	NE	NE	NA	
TL-03	46.982158	-101.766783											04/29/25	30.5	30.5	NE	NE	NA	
TL-04	46.980259	-101.766789											04/29/25	50.5	50.5	NE	NE	NA	

Table A2 - Summary of Subsurface Exploration and Geographic Coordinates

Boring No.	Latitude	Longitude	Turbine/Boring ID (L015_01.13.26)	Latitude (L015_01.13.26)	Longitude (L015_01.13.26)	Turbine/Boring ID (L011_04.26.25)	Turbine/Boring ID (L009_03.19.25)	MASW Survey	Electrical Resistivity Testing	Thermal Resistivity Samples	Piezometer Location	Piezometer Installation Date	Test/ Drilling Date	Auger (ft)	Total Depth (ft)	Groundwater During Drilling (ft.)	Groundwater Immediately After Drilling (ft.)	Groundwater 24-Hours After Drilling (ft.)	Remarks
TL-05	46.980257	-101.763791											04/29/25	30.5	30.5	NE	NE	NA	
TL-06	46.980255	-101.760946											04/30/25	50.5	50.5	NE	NE	NA	
TL-07	46.978169	-101.760927											04/30/25	30.5	30.5	NE	NE	NA	
TL-08	46.976028	-101.760909											04/30/25	30.5	30.5	NE	NE	NA	
TL-09	46.973915	-101.760890											05/01/25	30.5	30.5	NE	NE	NA	
TL-10	46.971640	-101.760870											05/01/25	30.5	30.5	24	24	NA	
TL-11	46.969358	-101.760850											05/01/25	30.5	30.5	29	28	NA	
TL-12	46.967150	-101.760831											05/02/25	30.5	30.5	7	6.5	NA	
TL-13	46.964992	-101.760811											05/02/25	50.5	50.5	NE	NE	NA	
TL-14	46.964315	-101.761887											05/02/25	50.5	50.5	NE	NE	NA	
TL-15	46.962040	-101.761888											05/06/25	30.5	30.5	24	NA	NA	
TL-16	46.960133	-101.761890											04/29/25	30.5	30.5	25	27	NA	
TL-17	46.958219	-101.761891											04/29/25	30.5	30.5	12	54	NA	
TL-18	46.956549	-101.761892											04/29/25	50.5	50.5	10	47	NA	
MET-01	46.975132	-101.747075																	**Relocated to PMM borings**
MET-02	46.937508	-101.754410																	**Relocated to PMM borings**
MET-03	46.894016	-101.661035											04/23/25	34.5	34.5	NE	NE	NA	**Relocated to PMM borings**
PMM1	46.976921	-101.747421											05/11/25	35.5	35.5	NE	NE	NA	
PMM2	46.938197	-101.755101											05/05/25	35.5	35.5	NE	NE	NA	**Moved ~120 ft. to avoid transmission line**
PMM3	46.894397	-101.662007											05/07/25	34.5	34.5	NE	NE	NA	
ADLS-01	46.927989	-101.795361																	
ADLS-02	46.927981	-101.795351											05/07/25	35.5	35.5	NE	NE	NA	
DSR-1	46.955511	-101.761935							05/12/25				05/12/25						
DSR-2	46.957204	-101.763285							05/12/25				05/12/25						
TSR-1	46.954950	-101.762055							05/13/25				05/13/25						
TSR-2	46.955006	-101.760905							05/13/25				05/13/25						
TSR-3	46.955567	-101.760980							05/12/25				05/12/25						
HA-1	46.955771	-101.762488											04/30/25	5.0	5.0	NE	NE	NA	
HA-2	46.955782	-101.761487											04/30/25	5.0	5.0	NE	NE	NA	
HA-3	46.955793	-101.760486											04/30/25	5.0	5.0	NE	NE	NA	
HA-4	46.955223	-101.762475											04/30/25	5.0	5.0	NE	NE	NA	
HA-5	46.955234	-101.761474											04/30/25	5.0	5.0	NE	NE	NA	
HA-6	46.955245	-101.760473											04/30/25	5.0	5.0	NE	NE	NA	
HA-7	46.954675	-101.762462											04/30/25	5.0	5.0	NE	NE	NA	
HA-8	46.954686	-101.761461											04/30/25	5.0	5.0	NE	NE	NA	
HA-9	46.954697	-101.760460											04/30/25	5.0	5.0	NE	NE	NA	
HA-10	46.954106	-101.761659											05/01/25	5.0	5.0	NE	NE	NA	
HA-11	46.954113	-101.760954											05/01/25	5.0	5.0	NE	NE	NA	
HA-12	46.953608	-101.761295											05/01/25	5.0	5.0	NE	NE	NA	
HA-13	46.953102	-101.761635											05/01/25	5.0	5.0	NE	NE	NA	
HA-14	46.953110	-101.760931											05/01/25	5.0	5.0	NE	NE	NA	
SB-1	46.955712	-101.761785											05/01/25	40.5	40.5	19.8	33	NA	
SB-2	46.955535	-101.762072								05/06/25			05/01/25	40.5	40.5	14	35	NA	
SB-3	46.955049	-101.762273									X	05/01/25	04/30/25	40.5	40.5	14	35	NA	
SB-4	46.955054	-101.761848											04/30/25	40.5	40.5	12	33	NA	
SB-5	46.954784	-101.761958											04/29/25	40.5	40.5	12.5	30	NA	
SB-6	46.955549	-101.760791											05/01/25	40.5	40.5	19	29	NA	
SB-7	46.955058	-101.761344											04/30/25	40.5	40.5	13	34	NA	
SB-8	46.954797	-101.760801											04/30/25	40.5	40.5	19	35	NA	
SB-9	46.953917	-101.761302											05/01/25	15.5	15.5	NE	NE	NA	
SB-10	46.953298	-101.761288											05/01/25	15.5	15.5	NE	NE	NA	
O&M -1	46.950414	-101.762334											05/03/25	35.0	35.0	18	25	NA	

NE = Not Encounter, NA = Not Available

Table A3: Well Log Information Obtained from the North Dakota Department of Water Resources

Well Report No. (NDDWR)	**Latitude**	**Longitude**	**Well Depth** (feet below land surface)	**Water Level Record** (feet below land surface)	**Date of Record** (YYYY/MM/DD)
9060	46.944751	-101.785024	890	278.8	1978/07/24
20703	46.944751	-101.785024	400	225.9	1977/10/12
9064	46.935761	-101.896039	380	13.4	1978/07/07
9066	46.899611	-101.845919	400	42.7	1993/12/07
8467	46.982237	-101.897894	380	27.7	1978/06/30
9056	46.954666	-101.699212	N/D	20.0	1967/06/20
9046	46.94992	-101.577623	N/D	10.0	1967/05/15
9049	46.954421	-101.542125	154.0	84.0	1967/06/04
9006	46.863352	-101.932869	380.0	1.4	2020/05/29
9009	46.861534	-101.930243	N/D	1.9	1973/10/24
8985	46.846777	-101.635774	360.0	104.3	1994/05/04
8988	46.878104	-101.827556	N/D	39.7	1975/08/05
8989	46.848936	-101.779908	360.0	42.6	1973/08/24

N/D = No Data Available

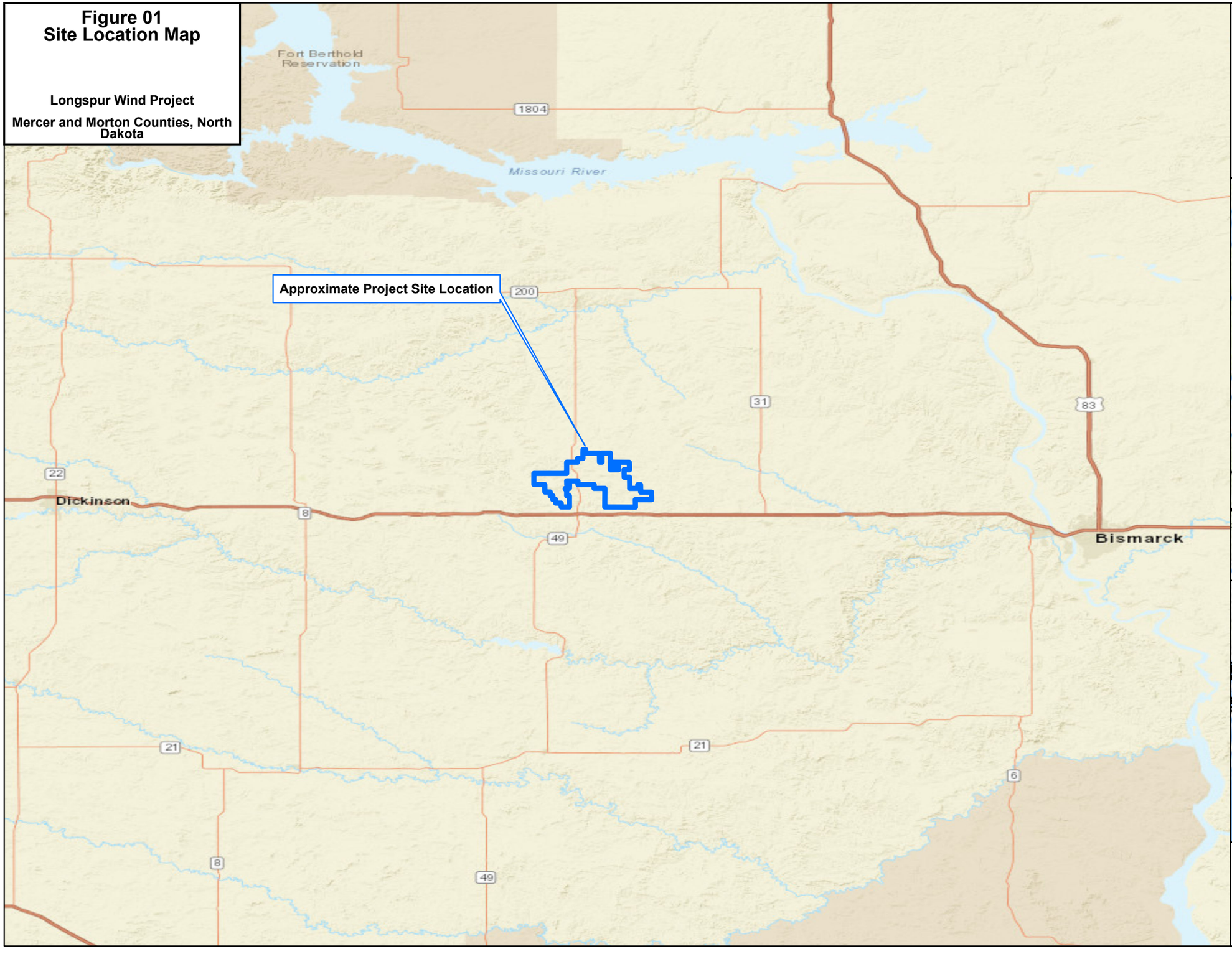
Table A4 - Summary of Measured Groundwater Levels in Temporary Piezometers Installed at Selected WTG Sites

Temp Piezometer No.	Latitude	Longitude	Date Installed	Total Depth of Temporary Piezometer (ft.) Below Existing Ground Surface	Height of Temp Piezometer Stick-up (ft.) Above Existing Site Grade	GWL (ft.) After Installation	GWL (ft.) 24 hrs after Installation	GWL (ft.) 48 hrs after Installation	GWL (ft.) 72 hrs after Installation	GWL (ft.) (05/18/25)	GWL (ft.) (10/06/25)	GWL (ft.) (03/18/26)	Minimum GWL (ft.)
GEO-012	46.921525	-101.806480	04/24/2025	18.00	2.00	NE	15.25	15.42	14.00	12.00	12.92		12.00
GEO-029	46.959220	-101.764704	04/29/2025	18.00	2.00	15.80	14.20	13.70	13.00	12.00	12.92	12.00	12.00
GEO-036	46.941605	-101.746654	05/05/2025	18.00	2.00	3.50	1.25	1.92	2.00	2.00	2.50	0.50	0.50
GEO-061	46.909107	-101.683665	04/25/2025	18.00	2.00	7.30		2.33		3.00	3.00	2.75	2.33
GEO-072	46.951494	-101.767567	03/18/2026	13.00	2.00	NE							NE
SB-4	46.955049	-101.762273	05/01/2025	18.00	2.00	7.00	7.50	9.33	9.42	7.00	8.50	7.50	7.00

Figure 01
Site Location Map

Longspur Wind Project

Mercer and Morton Counties, North Dakota

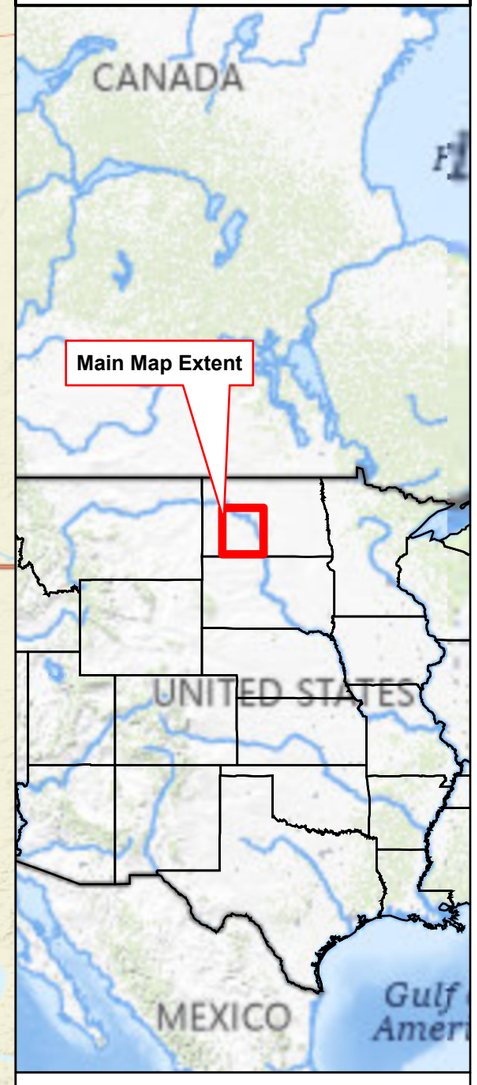


0 5 10 15 20 25 Miles

N

Legend

Project Boundary



RRC Power & Energy, LLC

810 Hesters Crossing Rd
Suite 120
Round Rock, TX 78681

Figure 02
WTG Boring Locations on a Topographic Map

Longspur Wind Project

Mercer and Morton Counties, North Dakota

0 0.5 1 1.5 2 Miles

N

Legend

- Turbine Locations- L015
- Turbine Locations Removed from L015
- Project Boundary

GEO-001, GEO-002, GEO-003, GEO-004, GEO-005, GEO-006, GEO-007, GEO-008, GEO-009, GEO-010, GEO-011, GEO-012, GEO-013, GEO-014, GEO-015, GEO-016, GEO-017, GEO-018, GEO-019, GEO-020, GEO-021, GEO-022, GEO-023, GEO-024, GEO-025, GEO-026, GEO-027, GEO-028, GEO-029, GEO-030, GEO-031, GEO-032, GEO-033, GEO-034, GEO-035, GEO-036, GEO-037, GEO-038, GEO-039, GEO-040, GEO-041, GEO-042, GEO-043, GEO-044, GEO-045, GEO-046, GEO-047, GEO-048, GEO-049, GEO-050, GEO-051, GEO-052, GEO-053, GEO-054, GEO-055, GEO-056, GEO-057, GEO-058, GEO-059, GEO-060, GEO-061, GEO-062, GEO-063, GEO-064, GEO-065, GEO-066, GEO-067, GEO-068, GEO-069, GEO-070, GEO-071, GEO-072, GEO-073, GEO-074, GEO-075, GEO-076, GEO-077

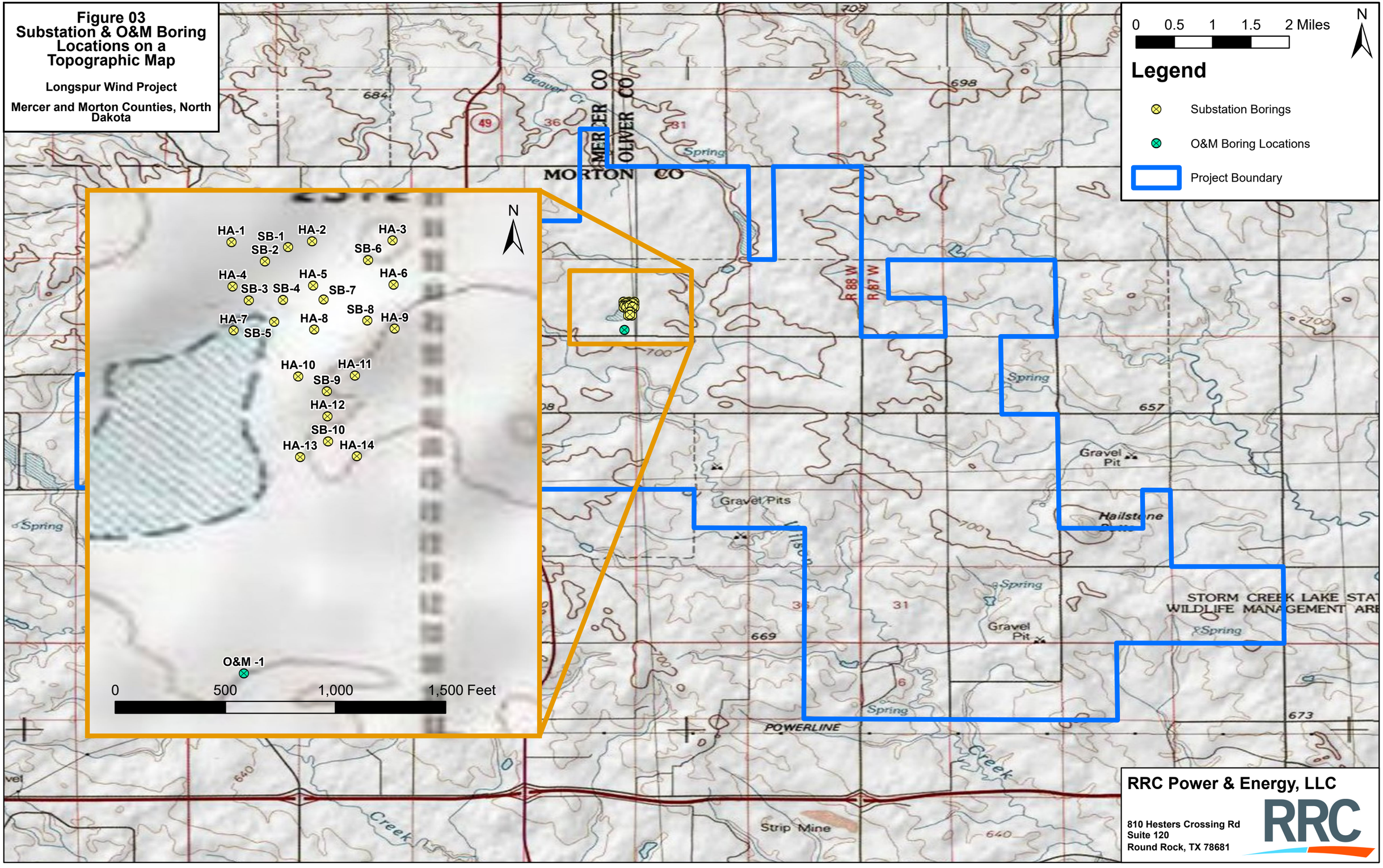
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Suite 120
Round Rock, TX 78681

Figure 03
Substation & O&M Boring Locations on a Topographic Map

Longspur Wind Project

Mercer and Morton Counties, North Dakota



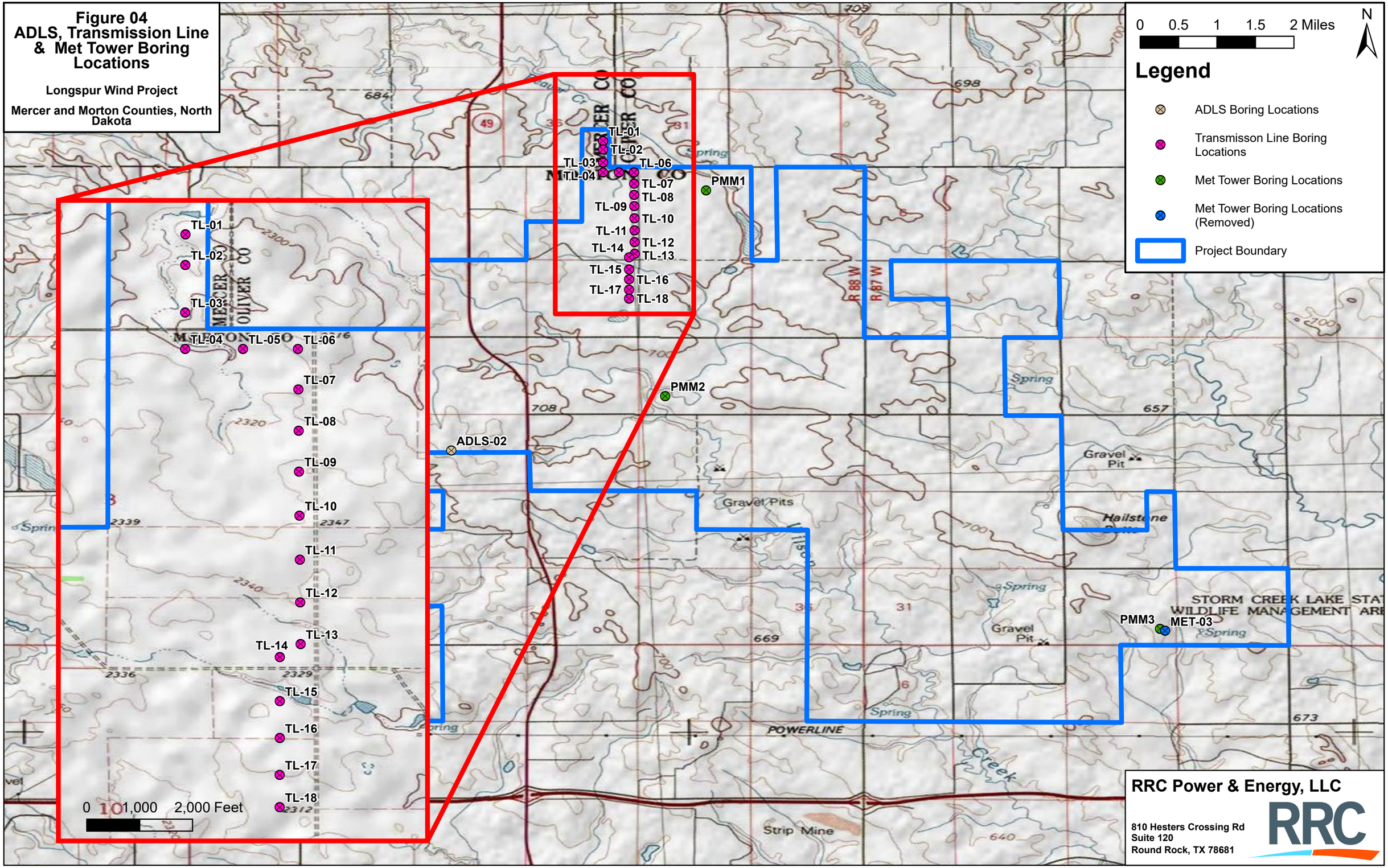
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Figure 04
ADLS, Transmission Line & Met Tower Boring Locations

Longspur Wind Project

Mercer and Morton Counties, North Dakota



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Figure 05
MASW, Electrical Resistivity (ER) and Thermal Resistivity (TR) Testing Locations Map

Longspur Wind Project

Mercer and Morton Counties, North Dakota

0 0.5 1 1.5 2 Miles

N

Legend

- ER Survey Locations
- TR Survey Locations
- MASW Survey Locations
- TR & ER Survey Locations
- MASW, TR, & ER Survey Locations
- Project Boundary

0 500 1,000 Feet

GEO-029
DSR-2
SB-2
TSR-3
TSR-2
TSR-1
GEO-021
GEO-029
GEO-033
GEO-004
GEO-001
GEO-046
GEO-009
GEO-007
GEO-048
GEO-053
GEO-059
GEO-062
GEO-064
GEO-014
GEO-067
GEO-018
GEO-070

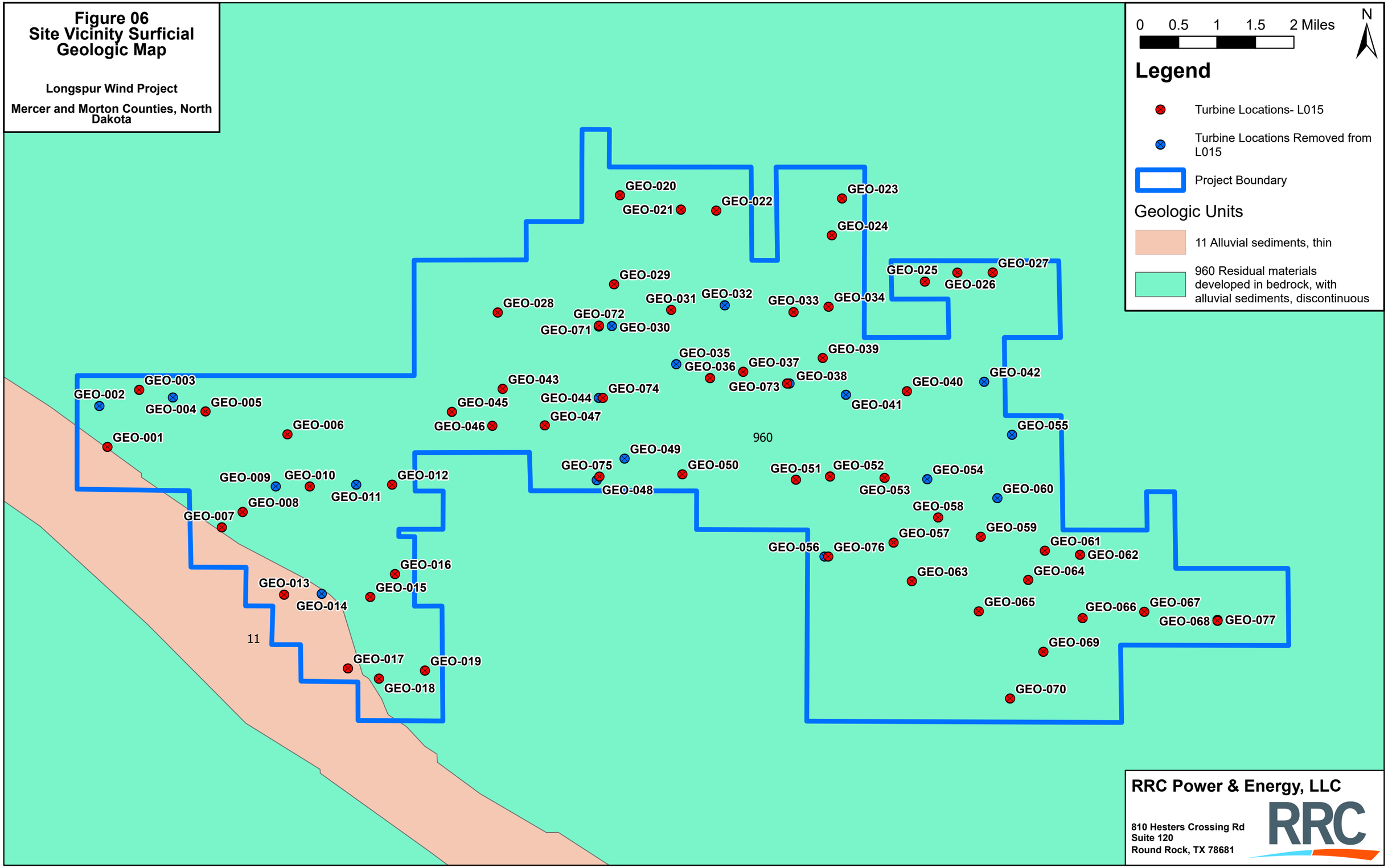
Mercer
Morton
62nd Ave
49
Highway 49
94

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810 Hesters Crossing Rd
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Round Rock, TX 78681

Figure 06
Site Vicinity Surficial Geologic Map

Longspur Wind Project

Mercer and Morton Counties, North Dakota



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Figure 07
Site Vicinity Bedrock Geologic Map

Longspur Wind Project

Mercer and Morton Counties, North Dakota

0 0.5 1 1.5 2 Miles

N

Legend

- Turbine Locations- L015
- Turbine Locations Removed from L015
- Project Boundary

Geologic Units

- Tg Golden Valley Formation
- Ts Sentinel Butte Formation
- Tb Bullion Creek Formation

GEO-001
GEO-002
GEO-003
GEO-004
GEO-005
GEO-006
GEO-007
GEO-008
GEO-009
GEO-010
GEO-011
GEO-012
GEO-013
GEO-014
GEO-015
GEO-016
GEO-017
GEO-018
GEO-019
GEO-020
GEO-021
GEO-022
GEO-023
GEO-024
GEO-025
GEO-026
GEO-027
GEO-028
GEO-029
GEO-030
GEO-031
GEO-032
GEO-033
GEO-034
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GEO-041
GEO-042
GEO-043
GEO-044
GEO-045
GEO-046
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GEO-050
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GEO-052
GEO-053
GEO-054
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GEO-061
GEO-062
GEO-063
GEO-064
GEO-065
GEO-066
GEO-067
GEO-068
GEO-069
GEO-070
GEO-071
GEO-072
GEO-073
GEO-074
GEO-075
GEO-076
GEO-077

Tb
Ts
Tg

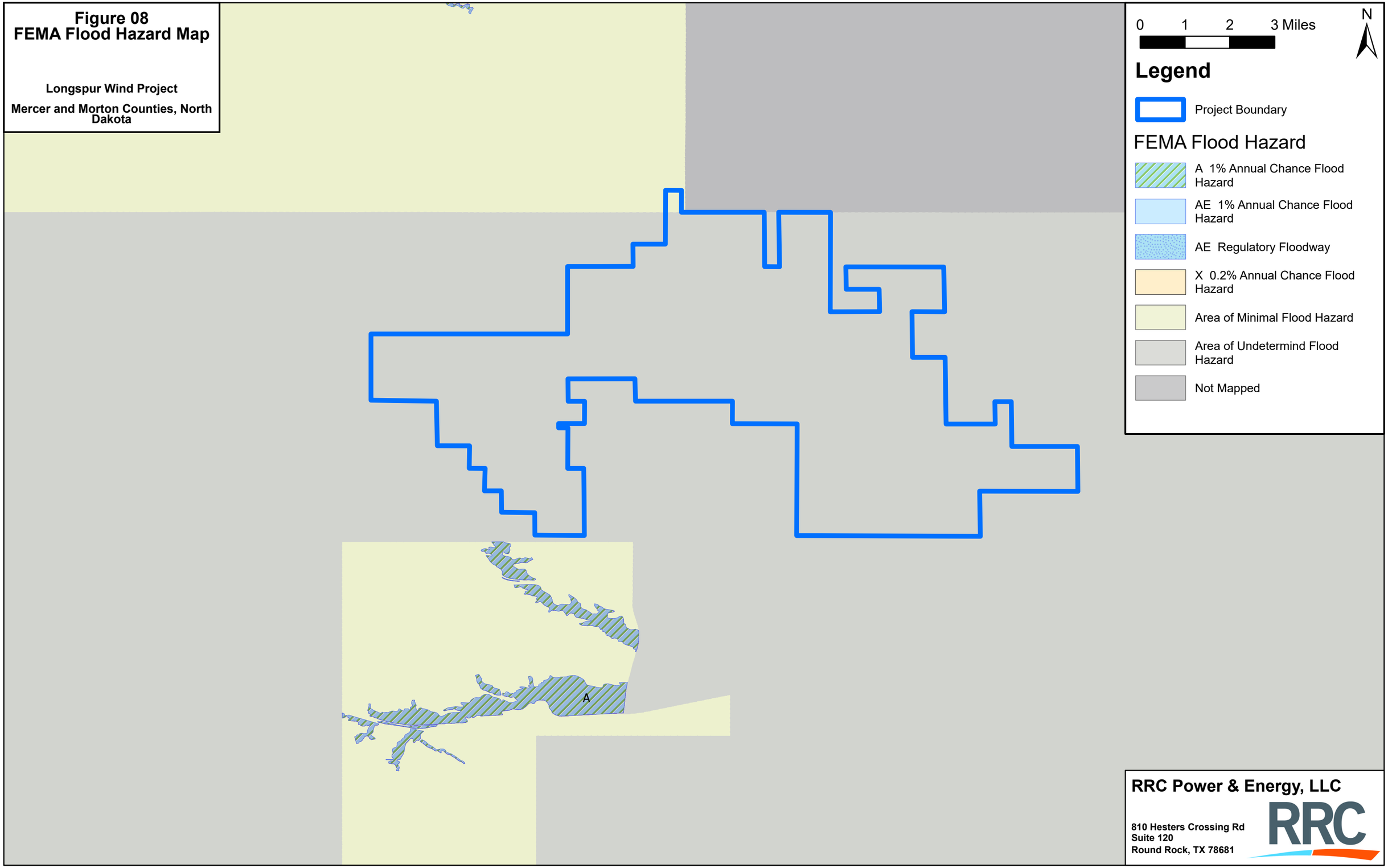
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Figure 08
FEMA Flood Hazard Map

Longspur Wind Project

Mercer and Morton Counties, North Dakota



0 1 2 3 Miles

N

Legend

- Project Boundary

FEMA Flood Hazard

- A 1% Annual Chance Flood Hazard
- AE 1% Annual Chance Flood Hazard
- AE Regulatory Floodway
- X 0.2% Annual Chance Flood Hazard
- Area of Minimal Flood Hazard
- Area of Undetermind Flood Hazard
- Not Mapped

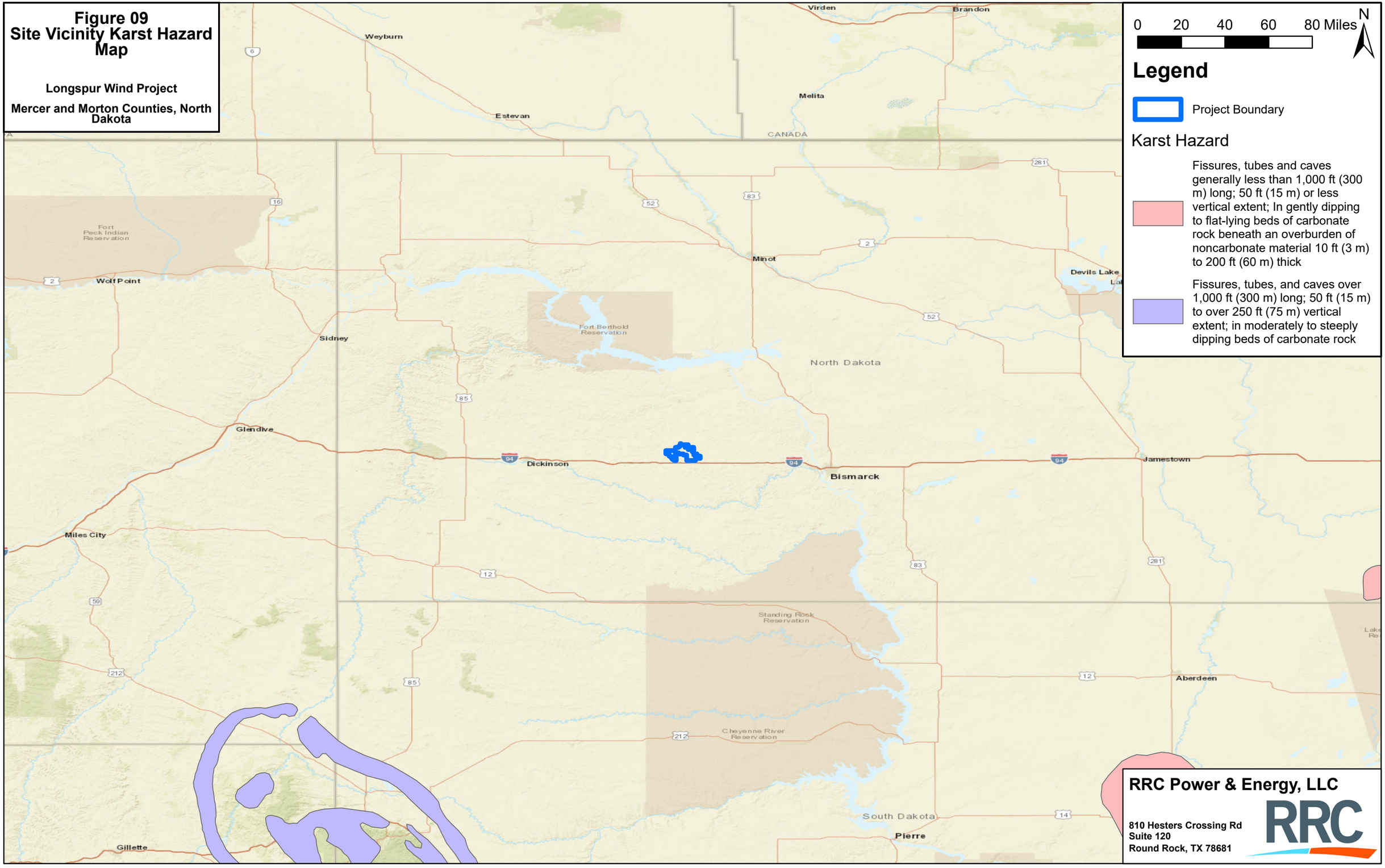
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Figure 09
Site Vicinity Karst Hazard Map

Longspur Wind Project

Mercer and Morton Counties, North Dakota



RRC Power & Energy, LLC

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Round Rock, TX 78681

Figure 10
Soil Corrosion of Concrete Map

Longspur Wind Project

Mercer and Morton Counties, North Dakota

0 0.5 1 1.5 2 Miles

N

Legend

- Turbine Locations- L015
- Turbine Locations Removed from L015
- Project Boundary

Corrosion Ratings

- Low
- Moderate
- High

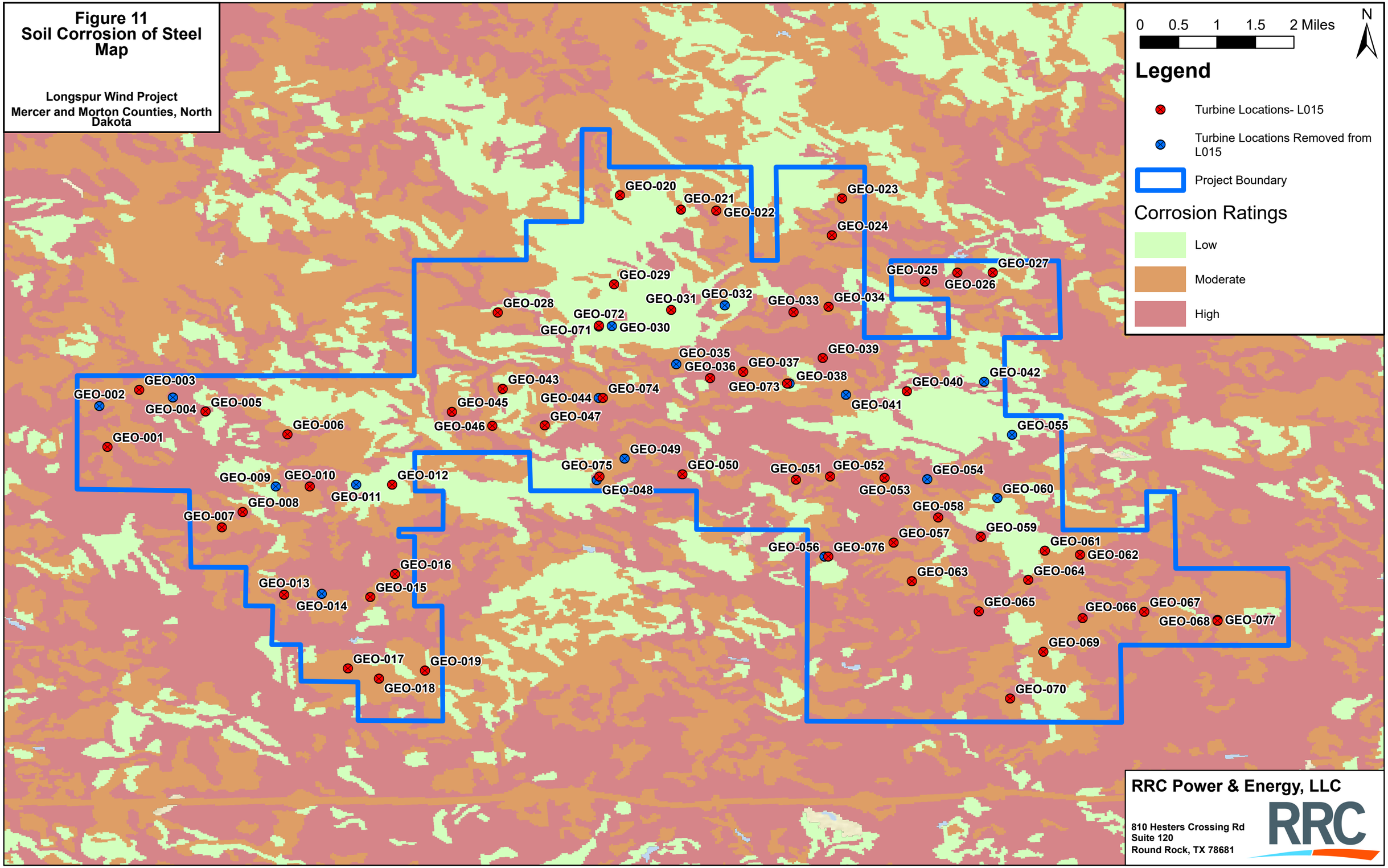
GEO-001 GEO-002 GEO-003 GEO-004 GEO-005 GEO-006 GEO-007 GEO-008 GEO-009 GEO-010 GEO-011 GEO-012 GEO-013 GEO-014 GEO-015 GEO-016 GEO-017 GEO-018 GEO-019 GEO-020 GEO-021 GEO-022 GEO-023 GEO-024 GEO-025 GEO-026 GEO-027 GEO-028 GEO-029 GEO-030 GEO-031 GEO-032 GEO-033 GEO-034 GEO-035 GEO-036 GEO-037 GEO-038 GEO-039 GEO-040 GEO-041 GEO-042 GEO-043 GEO-044 GEO-045 GEO-046 GEO-047 GEO-048 GEO-049 GEO-050 GEO-051 GEO-052 GEO-053 GEO-054 GEO-055 GEO-056 GEO-057 GEO-058 GEO-059 GEO-060 GEO-061 GEO-062 GEO-063 GEO-064 GEO-065 GEO-066 GEO-067 GEO-068 GEO-069 GEO-070 GEO-071 GEO-072 GEO-073 GEO-074 GEO-075 GEO-076 GEO-077

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Figure 11
Soil Corrosion of Steel Map

Longspur Wind Project
Mercer and Morton Counties, North Dakota



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Round Rock, TX 78681

Figure 12
Water Well Locations Obtained from the North Dakota Water Development Board

Longspur Wind Project
Mercer and Morton Counties, North Dakota

0 1 2 3 4 Miles

N

Legend

- Project Boundary
- Local Well
- 00 Water Level Record

8467
27.7

9064
13.4

9060
20703
225.9
278.8

9056
20

9046
10

9049
84

9066
42.7

8988
39.73

9006
1.4

9009
1.9

8989
42.57

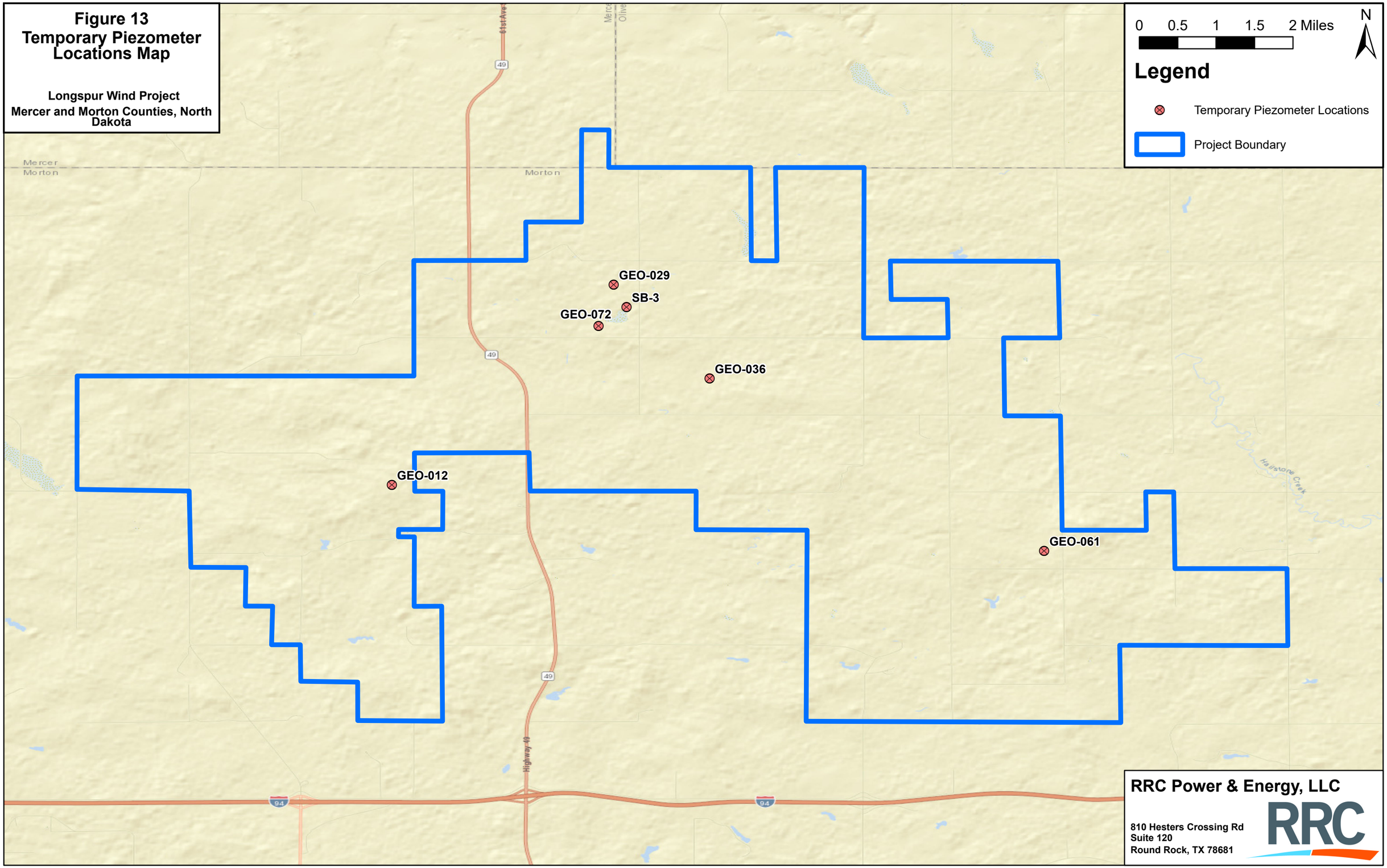
8985
104.3

Mercer
Morton
Oliver
61st Ave SW
49
94
County Road 88
63rd Ave
Glen Ullin

RRC Power & Energy, LLC
810 Hesters Crossing Rd
Suite 120
Round Rock, TX 78681
RRC

Figure 13
Temporary Piezometer Locations Map

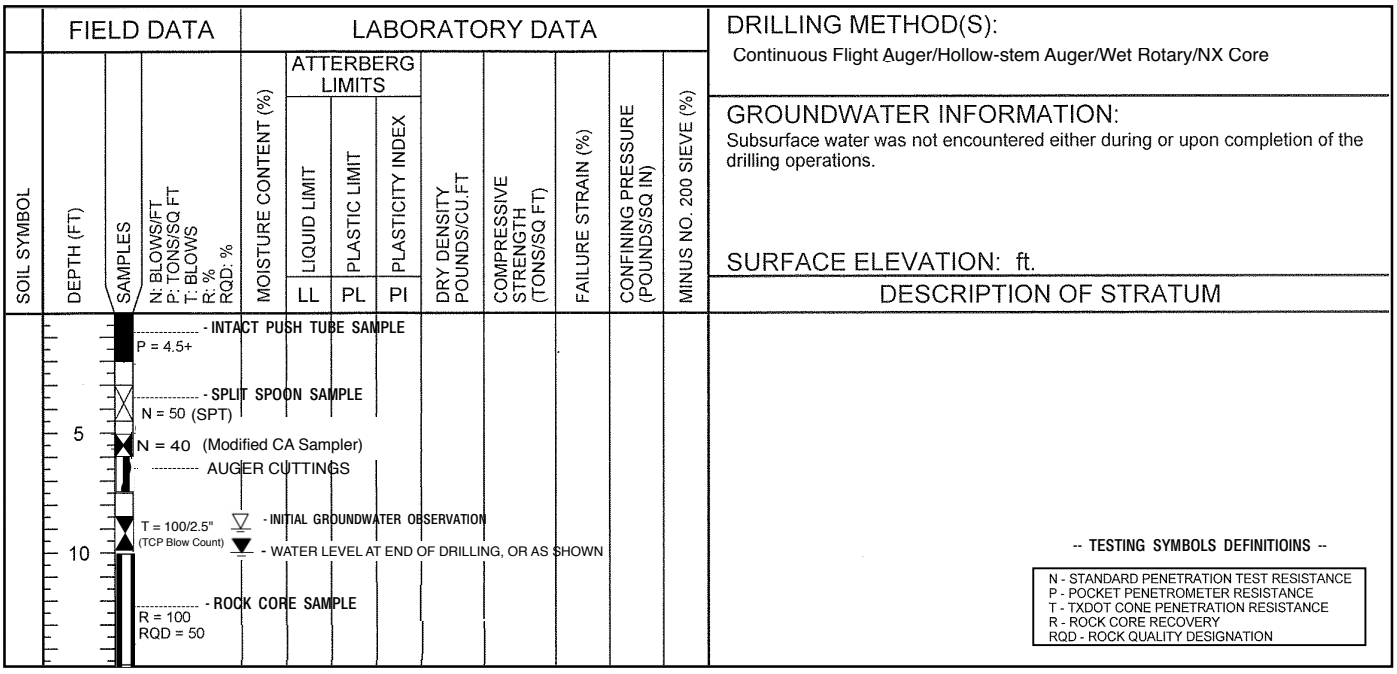
Longspur Wind Project
Mercer and Morton Counties, North Dakota



RRC Power & Energy, LLC

810 Hesters Crossing Rd
Suite 120
Round Rock, TX 78681

BORING LOG KEY



TYPICAL SOIL AND ROCK SYMBOLS (USCS CLASSIFICATION)

- Lean Clay (CL)
- Fat Clay (CH)
- Silt (ML)
- Elastic Silt (MH)
- Silty Sand (SM)
- Clayey Sand (SC)
- Silty, Clayey Sand (SC-SM)
- Poorly-Graded Sand (SP)
- Well-Graded Sand (SW)
- Poorly-Graded Gravel (GP)
- Well-Graded Gravel (GW)
- Clayey Gravel (GC)
- Silty Gravel (GM)
- Silty Clay (CL-ML)
- Claystone
- BASALT
- Limestone
- Sandstone
- Siltstone
- Fill Material
- Shale

DEGREE OF WEATHERING

1) Unweathered: No evidence of any chemical or mechanical alteration.
2) Slightly weathered: Slight discoloration on surface, slight alteration along discontinuities, less than 10% of the rock volume altered.
3) Moderately weathered: Discoloring evident, surface pitted and altered with alteration penetrating well below rock surfaces, weathering "halos" evident, 10% to 50% of the rock volume altered.
4) Highly weathered: Entire mass discolored, alteration pervading nearly all of the rock with some pockets of slightly weathered rock noticeable, some minerals leached away.
5) Decomposed: rock reduced to a soil with relicit rock texture, generally molded and crumbled by hand.

SOIL STRUCTURE

Calcareous..... Containing calcium carbonate

Slickensided..... The presence of planes of weakness having a slick and glossy appearance

Interbedded..... Alternating layers of varying material

LOG OF BORING GEO-01

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/25/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 30 ft. during drilling and measured at 52 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 12	23									4 in. Topsoil
				24	63	22	41					100	FAT CLAY (CH), trace Sand, brown to light gray, stiff to hard, moist
	5		N = 16	19									
			N = 15	28									Grading light brown, iron stained
	10		N = 30	29									Grading dark brown to brown, with organics
			N = 9	47									Grading with Lignite
	15		N = 50	20	52	20	32	111	5.28	7.3	0.0	81	Grading with Sand Grading brown to gray
	20		N = 35										CLAYEY SAND (SC), light gray to gray, dense, dry to moist, fine grained
	25		N = 16										LEAN CLAY (CL), trace Sand, dark gray to gray, very stiff to hard, dry to moist
	30		N = 32										Grading trace Lignite and organics Grading wet
	35		N = 32										
	40		N = 50/3"										SHALE, dark brown, hard to very hard, moist to wet, with Lignite
	45		N = 50/6"										
	50		N = 64										Grading gray
	55		N = 42										MUDSTONE, light gray to gray, medium hard, moist to wet, trace organics Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.928605, Long. -101.860051

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:49 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING GEO-02

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/25/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 10	18									SANDY LEAN CLAY (CL), gray, stiff to very stiff, moist, calcareous
	5		N = 16	22									
			N = 21	20									CLAYEY SAND (SC), light brown to gray, medium dense, moist, fine grained, iron stained, trace organics
	10		N = 30	19									
			N = 22	22									
	15		N = 32										LEAN CLAY (CL), with Sand, gray, hard, dry to moist, trace Lignite
	20		N = 50/3"										
	25		N = 47										
	30		N = 36										Grading trace Sand
	35		N = 46										
	40		N = 67										
	45		N = 81/11"										SILTSTONE, gray to light brown, very hard, dry to moist, with Shale interbeddings, trace Lignite
	50		N = 50/6"										Shale interbedding grades out
	55		N = 50/6"										
													Total Depth = 55 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.936340, Long. -101.861568

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:49 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING GEO-03

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/24/2025 - 4/25/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 24	11									LEAN CLAY (CL), trace Sand, brown, very stiff, dry to moist, calcareous
	5		N = 15	16									SANDY LEAN CLAY (CL), brown, stiff to very stiff, moist, iron stained
			N = 19	16									Grading trace organics
	10		N = 15	19									Grading dark brown, trace Lignite
			N = 38	16				96					
	15		N = 42										LEAN CLAY (CL), trace Sand, dark brown, hard, dry to moist, iron stained, calcareous
	20		N = 62										
	25		N = 36										Grading trace organics
	30		N = 27										LIGNITE, black, very stiff, dry to moist
	35		N = 79										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist
	40		N = 43										
	45		N = 49										
	50		N = 50/3"										LIGNITE, black, hard, dry to moist
	55		N = 92										SANDSTONE, gray, very hard, dry to moist, fine grained
													Total Depth = 55.5 ft.

FIELD DATA / LABORATORY DATA

DESCRIPTION OF STRATUM

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.939368, Long. -101.854080

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LOG OF BORING GEO-04

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/25/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													4 in. Topsoil
			N = 15	14									LEAN CLAY (CL), with Sand, light brown, soft to very stiff, dry to moist, calcareous
	5		N = 9	19									
			N = 5	23 22									
	10		N = 4	23									
			P = 2.5	23	47	18	29	103	1.96	14.8	10.0	85	
	15		N = 5										
	20		P = 2.5	22				102	2.59	7.8	0.0		
	25		N = 13										
	30		N = 10										SANDY LEAN CLAY (CL), light brown, stiff, dry to moist, calcareous
	35		N = 29										SILTY SAND (SM), light brown to gray, medium dense to dense, dry to moist, fine grained
	40		N = 35										
	45		N = 50/6"										SANDSTONE, light brown to gray, very hard, dry to moist, fine grained
	50		N = 50/5"										
	55		N = 50/6"										
													Total Depth = 55 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.937945, Long. -101.847728

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LOG OF BORING GEO-05

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/26/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 34 ft. during drilling and measured at 48 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 21	16									CLAYEY SAND (SC), brown, medium dense to dense, dry to moist, fine grained, iron stained
	5		N = 27	15									
			N = 25	17									Grading trace organics
	10		N = 28	19									
			N = 34	17									
	15		N = 32										
	20		N = 33										
	25		N = 46										
	30		N = 42										
	35		N = 42										Grading wet
	40		N = 32										LIGNITE, dark brown, hard, moist to wet
	45		N = 38										SILT (ML), trace Sand, gray, hard, moist to wet
	50		N = 60										LEAN CLAY (CL), with Sand, gray, hard, moist, trace organics
	55		N = 82										Grading gray to brown
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.935278, Long. -101.841595

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LOG OF BORING GEO-06

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/23/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 11	14									LEAN CLAY (CL), with Sand, brown, stiff to hard, dry to moist, calcareous
	5		N = 9	30									Grading iron stained, trace organics
			N = 13	27									Grading trace Sand, gray
	10		N = 11	30									Grading with Lignite interbeddings
			N = 33										
	15		N = 31										
	20		N = 39										
	25		N = 51										
	30		N = 41										
	35		N = 44										POORLY-GRADED SAND (SP), light brown to gray, dense, dry to moist, fine grained
	40		N = 57										LEAN CLAY (CL), trace Sand, gray to brown, hard, dry to moist
	45		N = 83										
	50		N = 59										
	55		N = 75										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.930996, Long. -101.826168

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LOG OF BORING GEO-07

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/23/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 11	25									4 in. Topsoil SANDY LEAN CLAY (CL), light brown, stiff, moist, iron stained, calcareous
	5		N = 14	22									FAT CLAY (CL), with Sand, light brown, stiff to hard, dry to moist, trace organics
			N = 14	26									Grading trace Sand, gray
	10		N = 18	27									
			N = 28	27	64	23	41	99	6.92	6.3	10.0	100	
	15		N = 20										
	20		N = 45										
	25		N = 50/1"										Grading with Gravel
	30		N = 36										
	35		N = 27										Organic grades out; grading gray
	40		N = 41										
	45		N = 38										
	50		N = 77										LIGNITE, dark gray to dark brown, hard, dry to moist
	55		N = 84										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.913460, Long. -101.838517

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LOG OF BORING GEO-08

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/23/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 9	25									FAT CLAY (CH), trace Sand, light brown to brown, stiff to very stiff, dry to moist, trace roots
				22	57	19	38					99	
	5		N = 15	22									Grading brown, iron stained
			N = 19	24									
	10		N = 22	23									
			N = 38										
	15		N = 27										CLAYEY SAND (SC), light brown to brown, medium dense, dry to moist, fine grained
	20		N = 26										LEAN CLAY (CL), trace Sand, gray to bluish gray, very stiff to hard, dry to moist
	25		N = 37										
	30		N = 27										
	35		N = 50/4"										LIGNITE, black, hard, dry to moist
	40		N = 37										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist
	45		N = 41										SILT (ML), trace Sand, gray to dark gray, hard, dry to moist
	50		N = 64										LIGNITE, black, hard, dry to moist
	55		N = 43										SILT (ML), trace Sand, gray to light gray, hard, dry to moist
													Total Depth = 55.5 ft.

FIELD DATA | LABORATORY DATA | DESCRIPTION OF STRATUM

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.916400, Long. -101.834600

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LOG OF BORING GEO-09

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/7/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													8 in. Topsoil
			N = 9	16									LEAN CLAY (CL), with Sand, light brown, stiff to hard, dry to moist
	5		N = 17	23									Grading light brown, iron stained
			N = 20	25									Grading trace Sand
	10												
			N = 50/6"										
	15		N = 26										Grading dark gray to gray
	20		N = 28										
	25		N = 35										Iron stain grades out
	30		N = 50/6"										Grading dark brown to brown
	35		N = 38										SANDY LEAN CLAY (CL), light gray to dark gray, hard, dry to moist, trace Lignite
	40		N = 50/6"										LIGNITE, dark brown to black, hard, dry to moist
	45		N = 56										LEAN CLAY (CL), with Sand, light gray to gray, hard, dry to moist, with Lignite
	50		N = 52										Lignite grades out
	55		N = 71										Grading trace Sand
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.921153, Long. -101.828369

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LOG OF BORING GEO-10

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/23/2025 - 4/24/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 21	14									FAT CLAY (CH), trace Sand, light brown to brown, very stiff to hard, moist
				16	71	24	47					91	
	5		N = 40	15									Grading with Sand, yellowish brown to brown, calcareous, trace roots
			N = 26	17 16									
	10		N = 26	17									Grading trace Sand, dark gray to gray, iron stained
			N = 32	41									Grading with Lignite interbeddings
	15		N = 50/6"										LIGNITE, black, hard, dry to moist
	20		N = 38										LEAN CLAY (CL), trace Sand, light gray to dark brown, hard, dry to moist
	25		N = 40										Grading trace Lignite
	30		N = 40										
	35		N = 73										Grading with Sand, light gray to brown
	40		N = 50/6"										SANDY LEAN CLAY (CL), light brown to light gray, hard, dry to moist
	45		N = 88/9"										CLAYEY SAND (SC), light brown to gray, very dense, dry to moist, fine grained
	50		N = 50/6"										
	55		N = 50/6"										
													Total Depth = 55 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.921172, Long. -101.821962

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LOG OF BORING GEO-11

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/24/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 5	13									LEAN CLAY (CL), with Sand, light brown, medium stiff, moist, trace roots
	5		N = 12	12									CLAYEY SAND (SC), light brown, medium dense to very dense, dry to moist, fine to medium grained
			N = 18	7									Grading light gray
	10		N = 50/4"	4									Grading light brown to gray
			N = 35	13									
	15		N = 13										LEAN CLAY (CL), trace Sand, light brown, stiff to very stiff, dry to moist, calcareous
	20		N = 37										Grading trace organics
	25		N = 37										SANDY LEAN CLAY (CL), light brown to gray, hard, dry to moist, iron stained
	30		N = 31										CLAYEY SAND (SC), dark gray to light gray, dense to very dense, dry to moist, fine grained, trace organics
	35		N = 51										Organic grades out; grading brown, iron stained
	40		N = 46										LEAN CLAY (CL), with Sand, gray, hard, dry to moist, with Lignite interbeddings
	45		N = 34										Lignite interbedding grades out; grading Lignite beddings
	50		N = 50/1"										SILTSTONE, gray, very hard, dry to moist, calcareous
	55		N = 35										SANDY CLAYSTONE, light gray, medium hard, dry to moist
													Total Depth = 55.5 ft.

FIELD DATA | LABORATORY DATA

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.921497, Long. -101.813248

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LOG OF BORING GEO-12

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/24/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 19 ft. during drilling and measured at 44 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 4	12									SANDY LEAN CLAY (CL), dark brown, soft, dry to moist
	5		N = 9	11									CLAYEY SAND (SC), trace Gravel, dark brown to gray, loose to medium dense, dry to moist, fine to coarse grained, calcareous
			N = 11	9									Calcareous feature grades out
	10		N = 29	16									Grading iron stained
			N = 37	16									SILTY SAND (SM), gray to brown, dense, dry to moist, fine grained
	15		N = 40										
	20		N = 37										Grading trace Gravel, wet, fine to coarse grained
	25		N = 29										LEAN CLAY (CL), with Sand, gray to brown, very stiff to hard, moist to wet
	30		N = 33										Grading calcareous
	35		N = 60/9"										Grading iron stained, with Lignite interbeddings
	40		N = 50/3"										LIGNITE, black, hard, moist
	45		N = 40										LEAN CLAY (CL), trace Sand, gray, hard, moist
	50		N = 36										
	55		N = 59										POORLY-GRADED SAND (SP), gray, very dense, moist, fine to medium grained
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.921525, Long. -101.806480

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LOG OF BORING GEO-13

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/22/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 4	20									SANDY LEAN CLAY (CL), light brown, soft, moist
	5		N = 8	26									CLAYEY SAND (SC), light brown, loose, moist, fine grained, iron stained
			N = 15	21									LEAN CLAY (CL), trace Sand, light brown, stiff to hard, dry to moist, iron stained
	10		N = 17	24									Grading with Sand, trace organics
			N = 18	30									Grading trace Sand, gray to dark brown
	15		N = 30										
	20		N = 42										Grading light brown
	25		N = 35										SANDY LEAN CLAY (CL), light brown to brown, hard, dry to moist
	30		N = 58										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist, iron stained
	35		N = 48										Grading brown, trace organics
	40		N = 66										Grading light gray
	45		N = 58										Grading gray to dark gray
	50		N = 81										SILTSTONE, light gray to gray, very hard, dry to moist
	55		N = 90/11"										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.900807, Long. -101.826790

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LOG OF BORING GEO-14

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/22/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 34 ft. during drilling and measured at 48 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 6	19									LEAN CLAY (CL), trace Sand, light brown, medium stiff to very stiff, moist
	5		N = 20	22									
			N = 21	23									Grading with Sand, light brown to gray, calcareous, trace organics
	10		N = 23	22									Organic grades out
			N = 28	18									SANDY LEAN CLAY (CL), light gray, very stiff, moist
	15		N = 21										CLAYEY SAND (SC), light gray, medium dense, dry to moist, fine grained
	20		N = 16										LEAN CLAY (CL), trace Sand, dark brown, very stiff to hard, dry to moist, with Lignite interbeddings
	25		N = 42										Grading with Sand, brown to light brown, iron stained, trace organics
	30		N = 50										Grading trace Sand, light gray
	35		N = 49										Grading with Sand, wet
	40		N = 34										Grading gray to dark gray
	45		N = 39										
	50		N = 37										
	55		N = 37										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.900966, Long. -101.819722

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LOG OF BORING GEO-15

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/22/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 22	7									4 in. Topsoil SILT (ML), trace Sand, light brown, very stiff, dry to moist, calcareous
	5		N = 52	11									LEAN CLAY (CL), trace Sand, light brown, stiff to hard, dry to moist
			N = 12	24									Grading light gray, with Lignite interbeddings
	10		N = 20	23									Grading calcareous, trace organics
			N = 36	19									Grading light brown to brown, iron stained
	15		N = 34										CLAYEY SAND (SC), light gray to brown, dense, dry to moist, fine grained
	20		N = 29										LEAN CLAY (CL), trace Sand, dark brown to black, very stiff to hard, dry to moist, with Lignite interbeddings, trace organics
	25		N = 72/11"										
	30		N = 48										CLAYEY SAND (SC), light gray to gray, dense, dry to moist, fine grained, trace organics
	35		N = 48										
	40		N = 35										LEAN CLAY (CL), with Sand, light brown to gray, very stiff to hard, dry to moist
	45		N = 28										
	50		N = 36										Grading calcareous
	55		N = 30										CLAYEY SAND (SC), dark gray to light gray, medium dense, dry to moist, fine grained
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.900394, Long. -101.810586

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LOG OF BORING GEO-16

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/21/2025 - 4/22/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 69	3									SILT (ML), trace Sand, light brown, hard, dry to moist, calcareous
	5		N = 12	36									CLAYEY SAND (SC), dark brown, medium dense, moist, fine grained, trace organics
			N = 28	23									Grading brown
	10		N = 31	23									SANDY ELASTIC SILT (MH), dark brown to brown, stiff to hard, dry to moist
			N = 12	31	76	46	30					56	Grading with Lignite interbeddings
	15		N = 23										Grading with Shale beddings, trace organics
	20		N = 78/10"										
	25		N = 47										LEAN CLAY (CL), with Sand, gray, hard, dry to moist
	30		N = 34										Grading light gray
	35		N = 38										
	40		N = 43										
	45		N = 69										CLAYSTONE, dark brown to black, hard, dry to moist, trace organics
	50		N = 89										SILTSTONE, light gray to gray, very hard, dry to moist
	55		N = 81/11"										
													Total Depth = 55.5 ft.

FIELD DATA | LABORATORY DATA

DESCRIPTION OF STRATUM

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.904707, Long. -101.805945

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LOG OF BORING GEO-17

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/21/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 49 ft. during drilling and measured at 52 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													4 in. Topsoil
			N = 11	13									SILT (ML), trace Sand, light brown, medium stiff to stiff, dry to moist, calcareous
	5		N = 7	12									Grading trace organics
			N = 4	14									LEAN CLAY (CL), trace Sand, dark brown, soft to hard, dry to moist, calcareous, trace organics
	10		P = +4.5										
			N = 16	17									Grading light brown
	15		N = 50/1"										Grading with Sand
	20		N = 37										Grading trace Sand
	25		N = 45										
	30		N = 42										Grading with Sand
	35		N = 33										
	40		N = 36										
	45		N = 36										
	50		N = 43										Grading trace Sand, gray, wet
	55		N = 37										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.886948, Long. -101.814793

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LOG OF BORING GEO-18

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/21/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 44 ft. during drilling and measured at 44 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 24	7									3 in. Topsoil CLAYEY SAND (SC), light brown to brown, medium dense to very dense, dry to moist, fine grained
	5		N = 39	9									
			N = 51	9									
	10		N = 72	10									
			N = 86	6									
	15		N = 39										
	20		N = 50/6"										
	25		N = 93/11"										
	30		N = 71										
	35		N = 56										SANDY LEAN CLAY (CL), dark brown to brown, hard, dry to moist, iron stained
	40		N = 36										Grading trace organics
	45		N = 45										CLAYEY SAND (SC), dark brown to brown, dense, wet, fine grained, iron stained
	50		N = 42										
	55		N = 32										LEAN CLAY (CL), with Sand, gray to brown, hard, moist
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.885050, Long. -101.808962

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LOG OF BORING GEO-19

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/21/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													4 in. Topsoil
			N = 30	8									LEAN CLAY (CL), trace Sand, light brown, very stiff, dry to moist
		C		6	30	18	12					97	
	5		N = 26	20									Grading with Sand, light brown to brown, iron stained
			N = 24	29									Grading trace Sand, gray to brown, with Lignite interbeddings
	10		N = 25	21									
			N = 36	19									SANDY LEAN CLAY (CL), light gray, very stiff to hard, dry to moist
	15		N = 25										
	20		N = 28										Grading iron stained, trace organics
	25		N = 24										LEAN CLAY (CL), trace Sand, gray to light gray, very stiff to hard, dry to moist, iron stained, trace organics
	30		N = 50/1"										Grading with Sand, brown, with occasional Sandstone fragments
	35		N = 37										Grading trace Sand, gray to brown
	40		N = 33										Grading dark brown to black
	45		N = 39										Organic grades out; grading light gray to gray
	50		N = 39										Grading dark brown to black, trace organics
	55		N = 50										Grading gray to light gray
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.886567, Long. -101.800295

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LOG OF BORING GEO-20

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 5	21									CLAYEY SAND (SC), light brown, loose, moist, fine grained
													SILT (ML), trace Sand, light brown, dry to moist
	5		N = 15	22									CLAYEY SAND (SC), light brown to brown, medium dense, moist, fine grained
			N = 20	22									LEAN CLAY (CL), with Sand, brown to gray, very stiff to hard, dry to moist, iron stained
	10		N = 21	22									
			P = +4.5										
	15		N = 29										
	20		N = 33										CLAYEY SAND (SC), gray, dense to very dense, dry to moist, fine grained
	25		N = 35										Grading light gray
	30		N = 41										
	35		N = 58										Grading fine to medium grained
	40		N = 40										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist
	45		N = 47										SILT (ML), trace Sand, gray, hard, dry to moist
	50		N = 55										
	55		N = 36										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist
													Total Depth = 55.5 ft.

FIELD DATA / LABORATORY DATA

DESCRIPTION OF STRATUM

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.976011, Long. -101.763598

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LOG OF BORING GEO-21

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/11/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 39 ft. during drilling and measured at 23 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 9	8									6 in. Topsoil SANDY LEAN CLAY (CL), brown, stiff, dry to moist, trace roots
	5		N = 10	7									CLAYEY SAND (SC), light brown to brown, loose, dry to moist, fine grained, iron stained
			N = 10	6									POORLY-GRADED SAND (SP), brown, loose to dense, dry to moist, fine to medium grained, iron stained
	10		N = 35	7									
			N = 65										
	15		N = 43										Grading light brown
	20		N = 47										CLAYEY SAND (SC), light brown to brown, dense to very dense, dry to moist, fine to medium grained, iron stained
													Grading wet
	25		N = 42										
	30		N = 50										
	35		N = 48										Grading gray to brown
	40		N = 64										Grading dark gray
	45		N = 58										Iron stain grades out; grading gray
	50		N = 79										
			N = 50/5"										Grading gray to brown, fine to coarse grained, trace organics Total Depth = 54.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.973311, Long. -101.752139

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:49 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING GEO-22

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/9/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 17	10									SILTY, CLAYEY SAND (SC-SM), light brown, medium dense, dry to moist, fine grained
				17	22	16	6					37	
	5		N = 17	23									Grading trace Sand, light gray, iron stained, calcareous
			N = 15	22									SANDY SILT (ML), light brown, medium dense, moist, calcareous
	10		N = 18	21									SANDY LEAN CLAY (CL), brown, very stiff, moist, iron stained
			N = 37										SILTY SAND (SM), light brown, medium dense, dry to moist, fine grained, iron stained, trace organics
	15		N = 30										LEAN CLAY (CL), trace Sand, brown, very stiff to hard, dry to moist, iron stained
	20		P = +4.5										
	25		N = 34										CLAYEY SAND (SC), brown, dense, dry to moist, fine grained, trace organics
	30		N = 50/3"										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist, calcareous, trace organics
	35		N = 36										Grading with Lignite beddings
	40		N = 44										SANDY SILT (ML), gray, dense, dry to moist
	45		N = 53										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist
	50		N = 55										Grading with Shale beddings
	55		N = 49										SANDY LEAN CLAY (CL), gray, hard, dry to moist, trace organics
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.973116, Long. -101.745499

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LOG OF BORING GEO-23

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/9/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 8	13									LEAN CLAY (CL), with Sand, light brown, medium stiff to hard, dry to moist, calcareous
	5		N = 9	21									
			N = 19	20									Grading trace Sand, yellowish brown, iron stained
	10		N = 23	21									Grading trace organics
			P = +4.5										
	15		N = 22										Grading with Sand, light brown
	20		N = 45										CLAYEY SAND (SC), light brown to brown, medium dense to very dense, dry to moist, fine grained, iron stained
	25		N = 79/9"										
	30		N = 37										LEAN CLAY (CL), trace Sand, gray to bluish gray, hard, dry to moist
	35		N = 78										
	40		N = 51										Grading gray to black, with Lignite interbeddings
	45		N = 75/8"										Grading light gray to gray
	50		N = 95/10"										Grading with Sand, calcareous
	55		N = 62										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.975381, Long. -101.721823

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LOG OF BORING GEO-24

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/9/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 9	21									SANDY LEAN CLAY (CL), light brown to gray, stiff to very stiff, moist
	5		N = 21	19									Grading iron stained
			N = 17	21									LEAN CLAY (CL), trace Sand, gray to brown, very stiff to hard, dry to moist, iron stained, trace organics
	10		N = 23	21									Grading light brown to yellowish brown, calcareous
			P = +4.5										Grading with Sand
	15		N = 28										Grading trace Sand, light brown to gray
	20		N = 22										Grading with Lignite
	25		N = 41										Grading dark brown
	30		N = 52										Grading gray to dark gray, with Lignite interbeddings
	35		N = 54										Organic grades out; grading light gray
	40		N = 61										SANDY LEAN CLAY (CL), light gray, hard, dry to moist
	45		N = 62										LEAN CLAY (CL), with Sand, dark gray, hard, dry to moist, trace organics
	50		N = 78/10"										CLAYEY SAND (SC), light gray to gray, very dense, dry to moist, fine grained
	55		N = 55										LEAN CLAY (CL), trace Sand, dark gray to gray, hard, dry to moist
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.968427, Long. -101.723739

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LOG OF BORING GEO-25

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/8/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 10	19									LEAN CLAY (CL), with Sand, light brown, stiff to hard, dry to moist, calcareous
	5		N = 14	21									Grading trace Sand, trace organics
			N = 15	16 20									Grading iron stained
	10		N = 19	21									
			P = +4.5										
	15		N = 33										
	20		N = 46										Organic grades out
	25		N = 56										SILT (ML), trace Sand, light brown, hard, dry to moist
	30		N = 43										LEAN CLAY (CL), trace Sand, brown to gray, hard, dry to moist, iron stained
	35		N = 48										SILT (ML), with Sand, light brown, hard, dry to moist, calcareous
	40		N = 43										LEAN CLAY (CL), trace Sand, dark brown, hard, dry to moist, trace organics
	45		N = 72/9"										
	50		N = 36										CLAYEY SAND (SC), gray, dense, dry to moist, fine grained
	55		N = 47										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.959730, Long. -101.706249

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LOG OF BORING GEO-26

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/8/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 39 ft. during drilling and measured at 50 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 13	18									LEAN CLAY (CL), with Sand, light brown, stiff, moist
	5		N = 22	16									SANDY LEAN CLAY (CL), light brown to brown, very stiff, moist, iron stained
			N = 16	18									LEAN CLAY (CL), trace Sand, light gray to brown, very stiff to hard, dry to moist, iron stained
	10		N = 20	21									Grading with Sand, trace organics
			N = 62										Grading trace Sand, gray to light gray
	15		N = 28										Grading with Sand, gray to brown, with Lignite interbeddings
	20		N = 55										CLAYEY SAND (SC), light gray, very dense, dry to moist, fine grained
	25		N = 50/1"										Grading light brown to gray, calcareous
	30		N = 82/11"										
	35		N = 78										Grading light brown to yellowish brown, with Lignite
	40		N = 58										LEAN CLAY (CL), trace Sand, dark brown to black, hard, wet, with Lignite interbeddings
	45		N = 75/9"										Grading dark gray to black
	50		N = 59										Grading light gray to black, trace organics
	55		N = 68										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.961450, Long. -101.700128

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LOG OF BORING GEO-27

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/9/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 11	16									LEAN CLAY (CL), with Sand, light brown, stiff, moist, calcareous
	5		N = 10	15									SANDY LEAN CLAY (CL), dark brown, stiff, moist, iron stained, trace organics
			N = 25	15									CLAYEY SAND (SC), light brown, medium dense to dense, moist, fine grained, trace organics
	10		N = 42	14									Grading light brown to brown, iron stained
			N = 33	15									Grading light brown to gray
	15		N = 32										LEAN CLAY (CL), trace Sand, brown, hard, dry to moist, iron stained, trace organics
	20		N = 39										
	25		N = 55										Grading dark brown, with Lignite
	30		N = 65										CLAYEY SAND (SC), gray, very dense, dry to moist, fine grained
	35		N = 74										
	40		N = 78										
	45		N = 50/6"										LIGNITE, black to dark brown, hard, dry to moist, trace organics
	50		N = 70										
	55		N = 50/6"										Total Depth = 55 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.961464, Long. -101.693477

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LOG OF BORING GEO-28

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/26/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 35 ft. during drilling and measured at 52 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 6	15									LEAN CLAY (CL), with Sand, light brown, medium stiff to hard, dry to moist
	5		N = 7	20									Grading iron stained, calcareous
			N = 10	22									Grading trace organics
	10		N = 32	20									
			N = 50/5"	7									
	15		N = 62										SANDY LEAN CLAY (CL), light brown to brown, hard, dry to moist, iron stained
	20		N = 41										CLAYEY SAND (SC), light gray to brown, dense, dry to moist, fine grained
	25		N = 35										Grading iron stained
	30		N = 40										Grading trace Lignite
	35		N = 43										Organic grade out; grading dark gray Grading wet
	40		N = 33										LEAN CLAY (CL), trace Sand, gray, hard, moist to wet
	45		N = 35										
	50		N = 47										Grading calcareous
	55		N = 73										SILTSTONE, gray to light gray, hard, moist
													Total Depth = 55.5 ft.

FIELD DATA | LABORATORY DATA

DESCRIPTION OF STRATUM

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.953950, Long. -101.786611

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:49 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING GEO-29

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/29/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 9 ft. during drilling and measured at 55 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													4 in. Topsoil
			N = 2	19									CLAYEY SAND (SC), light brown, very loose to dense, dry to moist, fine grained
	5		N = 2	21									
			P = 2.5										
	10		N = 31	19									Grading wet Grading brown to gray, iron stained
			N = 36	20									
	15		N = 42										Grading light brown to gray
	20		N = 34										Grading dark gray to gray
	25		N = 22										LEAN CLAY (CL), with Sand, light brown to gray, very stiff to hard, moist to wet
	30		N = 39										
	35		N = 50/6"										CLAYEY SAND (SC), gray to bluish gray, very dense, moist to wet, fine grained
	40		N = 35										LEAN CLAY (CL), trace Sand, dark gray to gray, hard, moist to wet
	45		N = 51										Grading with organics
	50		N = 45										Organic grades out
	55		N = 67/11"										Grading with Lignite interbeddings
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.959220, Long. -101.764704

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:49 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING GEO-31

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/2/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 49 ft. during drilling and measured at 49 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 8	7									CLAYEY SAND (SC), light brown to brown, loose to medium dense, dry to moist, fine grained
	5		N = 7	7									
			N = 21	7									
	10												Grading iron stained
			N = 15	15									LEAN CLAY (CL), trace Sand, gray to light brown, very stiff to hard, dry to moist
			P = 4.5										
	15		N = 20										
	20		P = +4.5										
	25		N = 31										Grading with Sand
	30		N = 32										
	35		N = 55										Grading trace Sand, dark gray
	40		N = 38										Grading gray
	45		N = 50/5"										Grading dark brown, trace organics
	50		N = 40										Grading gray, wet
	55		N = 41										SILT (ML), trace Sand, gray, hard, moist
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.954390, Long. -101.753974

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:49 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING GEO-33

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/3/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 14	14									FAT CLAY (CH), trace Sand, gray to brown, stiff to hard, moist, iron stained
				17	61	19	42					98	
	5		N = 14	25									Grading trace organics
			N = 16	21									
	10		N = 52/8"	23									
			N = 21	19									SANDY LEAN CLAY (CL), light brown, medium stiff to hard, dry to moist
	15		N = 6										Grading dark brown to black, with Lignite interbeddings and organics
			N = 80/9"	17				111	9.45	2.9	0.0		Grading brown to gray, iron stained
	20		N = 33										LEAN CLAY (CL), with Sand, light brown, hard, dry to moist
	25		N = 58										Grading trace Sand, brown, trace Lignite and organics
	30		N = 35										Grading with Sand, dark gray to gray
	35		N = 42										
	40		N = 82/11"										SANDSTONE, gray to dark gray, very hard, dry to moist, fine grained
	45		N = 50/5"										
	50		N = 93/8"										
	55		N = 50/6"										
													Total Depth = 55 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.954002, Long. -101.730960

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LOG OF BORING GEO-34

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/4/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 14	15									CLAYEY SAND (SC), light brown, medium dense, dry to moist, fine grained, calcareous
	5		N = 17	12									Grading brown, iron stained
			N = 11	32									LEAN CLAY (CL), trace Sand, light brown to gray, stiff, moist
	10		N = 23	22									CLAYEY SAND (SC), light brown to gray, medium dense, moist, fine grained
			N = 32	24									LEAN CLAY (CL), with Sand, brown, hard, moist, iron stained
	15		N = 33										CLAYEY SAND (SC), light brown to brown, dense, dry to moist, fine grained
	20		N = 23										LEAN CLAY (CL), trace Sand, dark brown to brown, very stiff, dry to moist, iron stained, trace organics
	25		N = 27										Grading light brown, with Lignite interbeddings
	30		N = 61										SILT (ML), trace Sand, gray to light gray, hard, dry to moist
	35		N = 78/9"										SHALE, dark brown to black, very hard, dry to moist, with Lignite interbeddings
	40		N = 56										SILTSTONE, dark brown, medium hard to hard, dry to moist, trace organics
	45		N = 48										Organic grades out; grading gray to light gray
	50		N = 90/8"										CLAYSTONE, dark gray to gray, very hard, dry to moist, trace Lignite
	55		N = 50/6"										Total Depth = 55 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.954983, Long. -101.724356

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LOG OF BORING GEO-35

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/3/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 30 ft. during drilling and not measured immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 5	30									LEAN CLAY (CL), trace Sand, dark brown, medium stiff, moist, trace organics
	5		N = 8	24									SANDY LEAN CLAY (CL), dark brown, medium stiff, moist, iron stained, trace organics
			N = 7	51									LEAN CLAY (CL), with Sand, brown, medium stiff to very stiff, dry to moist, iron stained, with Lignite interbeddings, trace organics
	10		N = 29	26									Grading gray
			N = 27	23									
	15		N = 24										
	20		N = 35										POORLY-GRADED SAND (SP), dark brown, dense, dry to moist, fine grained
	25		N = 44										Grading iron stained
	30		N = 21										LEAN CLAY (CL), trace Sand, gray, very stiff to hard, moist to wet, trace organics
	35		N = 26										
	40		N = 24										
	45		N = 46										
	50		N = 31										
	55		N = 37										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.944218, Long. -101.753027

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LOG OF BORING GEO-36

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/5/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 12 ft. during drilling and measured at 47 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 18	14									LEAN CLAY (CL), with Sand, brown to dark gray, very stiff, moist, iron stained, trace organics
	5		N = 6	16									CLAYEY SAND (SC), brown to gray, very loose to very dense, dry to moist, fine grained
			N = 9	21									
	10		N = 50/2"	6									
			N = 50/2"	10									Grading wet
	15		N = WOH										Grading trace organics
			P = 4.0	30	63	26	37	93	0.93	4.1	0.0	100	FAT CLAY (CH), trace Sand, gray, medium stiff to hard, moist to wet, trace organics
	20		N = 24										Grading with Sand, brown
	25		N = 21										
	30		N = 25										
	35		N = 21										
	40		N = 32										
	45		N = 35										Grading dark gray
	50		N = 29										Grading dark brown
	55		N = 34										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.941605, Long. -101.746654

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LOG OF BORING GEO-37

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/4/2025 - 5/5/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 13	21									LEAN CLAY (CL), trace Sand, light brown, stiff to very stiff, moist, iron stained
	5		N = 20	22									
			N = 17	24									
	10		N = 5	97									LIGNITE, black, medium stiff to very stiff, moist, trace organics
			N = 43	47				65	2.66	3.5	0.0		
	15		N = 17										LEAN CLAY (CL), trace Sand, gray, very stiff, dry to moist
	20		N = 49										
	25		N = 33										POORLY-GRADED SAND (SP), gray, dense, dry to moist, fine grained
	30		N = 50/6"										LIGNITE, black, hard, dry to moist
	35		N = 50/6"										
	40		N = 43										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist
	45		N = 43										SILT (ML), trace Sand, gray, hard, dry to moist
	50		N = 42										
			N = 50/2"										Total Depth = 54.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.942772, Long. -101.740419

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LOG OF BORING GEO-38

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/4/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 13	12									LEAN CLAY (CL), with Sand, light brown to brown, soft to hard, dry to moist, trace roots
	5		N = 5	15									Grading dark brown
			N = 4	23									Grading brown
	10		P = +4.5										Grading light brown
			N = 14	21	38	17	21					85	Grading trace Sand, brown, iron stained
	15		N = 26										Grading light brown to brown
	20		N = 22										CLAYEY SAND (SC), brown, medium dense to very dense, dry to moist, fine grained, iron stained
	25		N = 38										
	30		N = 53										
	35		N = 68/10"										
	40		N = 71/9"										SANDSTONE, gray, very hard, dry to moist, fine grained
			N = 50/2"										Total Depth = 42.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.940587, Long. -101.731712

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LOG OF BORING GEO-39

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/4/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 49 ft. during drilling and measured at 54 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 7	19									LEAN CLAY (CL), with Sand, dark brown to brown, medium stiff, moist
	5		N = 13	20									SILT (ML), trace Sand, light gray, stiff, moist
			N = 18	20									LEAN CLAY (CL), trace Sand, brown to light gray, very stiff to hard, dry to moist
	10		N = 19	21									
			N = 56										
	15		N = 25										Grading with Sand, dark brown to brown
	20		N = 46										CLAYEY SAND (SC), brown, dense to very dense, dry to moist, fine grained
	25		N = 67										Grading trace Gravel, fine to coarse grained
	30		N = 79/11"										SANDSTONE, brown to light brown, very hard, dry to moist, fine grained, iron stained
	35		N = 75/10"										Grading dark gray to brown
	40		N = 48										SANDY CLAYSTONE, gray, medium hard, dry to moist
													SANDSTONE, gray, medium hard to very hard, fine grained
	45		N = 81/8"										
	50		N = 68										Grading wet
	55		N = 79/8"										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.945336, Long. -101.725459

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LOG OF BORING GEO-40

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/27/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 9	9									6 in. Topsoil SANDY SILT (ML), light brown, loose, dry to moist
	5		N = 7	15									SILTY SAND (SM), light brown, dry to moist, fine grained LEAN CLAY (CL), with Sand, brown to light brown, medium stiff, moist
			N = 13	17									CLAYEY SAND (SC), brown, medium dense to dense, dry to moist, fine to medium grained, iron stained
	10		N = 17	16									
			N = 67										
	15		N = 49										
	20		N = 42										POORLY-GRADED SAND (SP), light brown to yellowish brown, dense to very dense, dry to moist, fine grained
	25		N = 57										
	30		N = 33										
	35		N = 50/6"										
	40		N = 95										
	45		N = 87										
	50		N = 50/6"										
	55		N = 50/5"										Total depth = 55 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.939113, Long. -101.709620

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LOG OF BORING GEO-42

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/10/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 30 ft. during drilling and measured at 54 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 12	18									5 in. Topsoil LEAN CLAY (CL), trace Sand, brown, stiff, moist, iron stained, calcareous
	5		N = 11	22									SANDY LEAN CLAY (CL), brown, stiff to hard, dry to moist, calcareous
			N = 17	22									Grading iron stained
	10		N = 21	21									
			P = +4.5										
	15		N = 23										
			N = 28										
	20		N = 38										CLAYEY SAND (SC), brown, dense to very dense, dry to moist, fine grained
	25		N = 37										
	30		N = 47										Grading gray, trace organics Grading wet
	35		N = 76/11"										
	40		N = 75/11"										
	45		N = 44										
	50		N = 46										
	55		N = 48										Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.940888, Long. -101.695081

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LOG OF BORING GEO-43

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/7/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 11	13									CLAYEY SAND (SC), light brown, medium dense to very dense, dry to moist, fine grained, calcareous
	5		N = 29	14									Grading brown, iron stained
			N = 33	13									
	10												
			N = 35	12									Grading gray to brown
	15		N = 80										
			N = 44										
	20		N = 52										Grading light brown to brown
	25		N = 69										
	30		N = 62										
	35		N = 92										
	40		N = 80										Grading gray to brown
	45		N = 85/10"										
	50		N = 81/10"										
	55		N = 71										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.939567, Long. -101.785665

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:49 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING GEO-44

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/27/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 14	15									LEAN CLAY (CL), with Sand, light brown, stiff to very stiff, moist, calcareous
	5		N = 19	22									Grading trace organics
			N = 93/9"	19									CLAYEY SAND (SC), brown, very dense, dry to moist, fine grained, iron stained
	10		N = 50/5"	2									
			N = 27	21									SANDY LEAN CLAY (CL), brown to gray, very stiff, dry to moist, iron stained, trace organics
	15		N = 23										
	20		N = 53										LEAN CLAY (CL), trace Sand, brown to light brown, hard, dry to moist
	25		N = 9										LIGNITE, black, stiff to hard, dry to moist
			N = 80/11"										
	30		N = 29										SILT (ML), trace Sand, gray, stiff to hard, dry to moist, trace Lignite
	35		N = 35										
	40		N = 34										
	45		N = 34										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist
	50		N = 64										Grading with Sand
	55		N = 83										Grading Lignite beddings
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.937839, Long. -101.767572

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LOG OF BORING GEO-45

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/27/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 20	16									CLAYEY SAND (SC), light brown, medium dense, moist, fine grained, calcareous
	5		N = 22	20									SANDY LEAN CLAY (CL), light brown to brown, very stiff, moist, iron stained, calcareous, trace organics
			N = 17	23									LEAN CLAY (CL), trace Sand, light brown, very stiff, moist, iron stained, calcareous, trace organics
	10		N = 18	18									SANDY LEAN CLAY (CL), light brown to gray, very stiff to hard, dry to moist, iron stained
			N = 38										
	15		N = 34										CLAYEY SAND (SC), gray to brown, dense, dry to moist, fine grained, iron stained
	20		N = 23										LEAN CLAY (CL), trace Sand, brown, very stiff to hard, dry to moist, iron stained, trace organics
	25		N = 59										Grading gray
	30		N = 56										
	35		N = 58										
	40		N = 83/11"										SANDSTONE, light brown, very hard, dry to moist, fine grained
	45		N = 84/9"										
	50		N = 93/10"										
	55		N = 88/10"										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.935204, Long. -101.795228

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LOG OF BORING GEO-46

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/26/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 14	12									LEAN CLAY (CL), with Sand, light brown, stiff to very stiff, moist, trace Lignite
				16	41	18	23					84	
	5		N = 29	19									Grading light brown to brown, iron stained
			N = 15	31									Grading trace Sand, gray to brown, trace organics
	10		N = 17	19									
			N = 34	23	69	18	51	104	6.21	10.1	10.0	82	FAT CLAY (CH), with Sand, gray to brown, hard, moist
	15		N = 30										SANDY LEAN CLAY (CL), light gray to brown, very stiff, dry to moist
	20		N = 18										LEAN CLAY (CL), trace Sand, light gray to dark brown, very stiff to hard, dry to moist, trace organics
	25		N = 38										Grading with Sand
	30		N = 47										SANDY LEAN CLAY (CL), light brown to brown, hard, dry to moist, iron stained
	35		N = 65										Grading light gray
	40		N = 78/10"										SANDY CLAYSTONE, light gray to brown, very hard, dry to moist
	45		N = 50/5"										SANDSTONE, light gray to brown, very hard, dry to moist, fine to medium grained, weakly cemented
	50		N = 50/6"										
	55		N = 50/4"										
													Total Depth = 55 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.93259, Long. -101.787606

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LOG OF BORING GEO-47

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/27/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 45 ft. during drilling and measured at 48 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													2 in. Topsoil
			N = 18	8									CLAYEY SAND (SC), light brown, medium dense to very dense, dry to moist, fine grained, calcareous
	5		N = 74	7									
			N = 58	11									SANDY LEAN CLAY (CL), light brown, hard, dry to moist
	10		N = 51	14									
			N = 49	13									CLAYEY SAND (SC), light brown, dense, dry to moist, fine grained
	15		N = 39										SANDY LEAN CLAY (CL), light brown, hard, dry to moist
	20		N = 50										CLAYEY SAND (SC), light brown, dense to very dense, dry to moist, fine grained
	25		N = 52										Grading gray
	30		N = 47										
	35		N = 45										
	40		N = 58										
	45		N = 56										Grading wet
	50		N = 66										LIGNITE, dark brown, hard, moist
	55		N = 36										LEAN CLAY (CL), with Sand, gray, hard, moist, calcareous
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.932651, Long. -101.777749

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LOG OF BORING GEO-48

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/5/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 13	20									FAT CLAY (CH), trace Sand, brown to gray, stiff to hard, moist
		M		23	71	23	48					96	
	5		N = 15	22									Grading with Sand, iron stained
			N = 19	22									
	10		N = 31	17									CLAYEY SAND (SC), brown to gray, dense, dry to moist, fine grained, iron stained
			N = 37	19									Grading yellowish brown
	15		N = 42										
	20		N = 55										LEAN CLAY (CL), trace Sand, brown to dark brown, hard, dry to moist, with Lignite, trace organics
	25		N = 33										Grading gray
	30		N = 83										POORLY-GRADED SAND (SP-SM), with Silt, yellowish brown, very dense, dry to moist, fine grained
	35		N = 50/1"										LIMESTONE, light yellowish brown, very hard, dry to moist, calcareous
	40		N = 67										SANDSTONE, yellowish brown, hard to very hard, dry to moist, fine grained, weakly to moderately cemented
	45		N = 93/11"										
	50		N = 91/7"										
			N = 25/0"										Refusal at 52 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.922342, Long. -101.767967

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LOG OF BORING GEO-49

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/6/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 18	12									LEAN CLAY (CL), with Sand, light brown, very stiff, dry to moist, calcareous
	5		N = 6	22									SANDY LEAN CLAY (CL), light brown to yellowish brown, medium stiff to stiff, moist
			N = 14	21									Grading brown to gray
	10		N = 14	22									LEAN CLAY (CL), with Sand, brown to gray, stiff to hard, dry to moist, iron stained
			N = 55										Grading trace organics
	15		N = 34										SANDY ELASTIC SILT (MH), brown to gray, medium stiff to hard, dry to moist, iron stained, calcareous
	20		N = 28										Grading trace organics
	25		N = 40										Calcareous feature and organic grades out; grading with Lignite
	30		N = 6	81	88	69	19					62	
			N = 50/4"										Grading dark brown
	35		N = 32										LEAN CLAY (CL), trace Sand, dark brown to gray, very stiff to hard, dry to moist, iron stained, trace Lignite and organics
	40		N = 30										Organic grades out; grading with Sand, calcareous
	45		N = 31										
	50		N = 33										SANDY LEAN CLAY (CL), gray, hard, dry to moist, calcareous
	55		N = 32										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.926427, Long. -101.762738

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LOG OF BORING GEO-50

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/8/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 9	19									LEAN CLAY (CL), trace Sand, brown to gray, stiff, moist, calcareous
	5		N = 12	22									Grading iron stained
			N = 7	26									FAT CLAY (CH), trace Sand, dark brown to gray, medium stiff to hard, dry to moist, calcareous, with Lignite
				37									
	10		N = 16	23									Grading brown
			P = +4.5										Grading with Shale
	15		N = 39	20	52	20	32	107				99	
	20		N = 29										
	25		N = 34										Grading brown to gray
	30		N = 86										SANDY LEAN CLAY (CL), dark brown to gray, hard, dry to moist, trace Lignite
	35		N = 46										LEAN CLAY (CL), trace Sand, dark brown to gray, hard, dry to moist, trace Lignite
	40		N = 41										
	45		N = 40										SANDY LEAN CLAY (CL), gray, hard, dry to moist
	50		N = 57										CLAYEY SAND (SC), gray, dense to very dense, dry to moist, fine grained
	55		N = 36										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.923447, Long. -101.751849

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LOG OF BORING GEO-51

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/10/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 9	12									5 in. Topsoil SANDY LEAN CLAY (CL), light brown, stiff, dry to moist, iron stained, calcareous
	5		N = 13	26									LEAN CLAY (CL), with Sand, gray to brown, stiff to hard, dry to moist, iron stained
			N = 19	23									Grading trace Sand, light brown to yellowish brown, trace organics
	10		N = 16	22									Grading light brown to brown
			P = +4.5										
	15		N = 18										
	20		N = 72/7"										
	25		N = 30										Grading light gray
	30		N = 42										Grading with Sand, light brown to gray
	35		N = 40										Grading trace Sand, gray to dark gray
	40		N = 40										
	45		N = 44										
	50		N = 59										Grading with Lignite interbeddings
	55		N = 50/6"										
													Total Depth = 55 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.922422, Long. -101.730508

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LOG OF BORING GEO-52

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/8/2025 - 5/10/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 15	16									SANDY LEAN CLAY (CL), brown to gray, stiff, moist, calcareous
	5		N = 21	17									LEAN CLAY (CL), with Sand, brown to gray, stiff to very stiff, moist
			N = 14	20									Grading trace Sand, light brown to light gray, trace organics
	10		N = 22	48									Grading dark brown, with Lignite
			N = 50	19									CLAYEY SAND (SC), light brown, dense, moist, fine grained, trace organics
	15		N = 32										LEAN CLAY (CL), trace Sand, brown, hard, dry to moist, iron stained
	20		N = 50/6"										SILTY SAND (SM), brown, very dense, dry to moist, fine grained, trace organics
	25		N = 43										LEAN CLAY (CL), trace Sand, dark brown, hard, dry to moist, with Lignite, trace organics
	30		N = 36										SANDY LEAN CLAY (CL), brown, hard, dry to moist, iron stained
	35		N = 81										CLAYEY SAND (SC), light brown, dense to very dense, dry to moist, fine grained
	40		N = 69										Grading brown to gray
	45		N = 42										
	50		N = 37										Grading light brown to gray
	55		N = 56										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.923094, Long. -101.724068

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LOG OF BORING GEO-53

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/6/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 11	16									FAT CLAY (CH), trace Sand, light brown, medium stiff to stiff, moist, calcareous
				17	54	19	35					93	
	5		N = 7	22									Calcareous feature grades out; grading with Sand, iron stained
			N = 6	23									Grading trace organics
	10		P = +4.5										SANDY SILT (ML), black, loose, dry to moist, trace organics
			N = 13	98	NP	NP	NP	34				66	
	15		N = 34										LEAN CLAY (CL), trace Sand, gray to brown, stiff to hard, dry to moist, iron stained, with Lignite
	20		N = 9										Grading dark brown, with Lignite interbeddings
			P = +4.5	26				94					
	25		N = 35										Grading gray, calcareous
	30		N = 28										Grading dark gray
	35		N = 35										Lignite grades out
	40		N = 42										
	45		N = 33										
	50		N = 51										Grading with Lignite interbeddings
	55		N = 59										CLAYEY SAND (SC), gray, very dense, dry to moist, fine grained
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.922764, Long. -101.713804

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LOG OF BORING GEO-54

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/27/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 21	22									LEAN CLAY (CL), with Sand, yellowish brown, very stiff, moist, iron stained
	5		N = 20	22									SILTY SAND (SM), light brown, dry to moist, fine grained
													LEAN CLAY (CL), with Sand, light brown, very stiff, moist
			N = 34	18									CLAYEY SAND (SC), light brown to brown, medium dense to dense, moist, fine grained, iron stained
	10		N = 25	21									
			N = 15	56									LEAN CLAY (CL), trace Sand, dark brown to black, stiff, moist, with Lignite interbeddings
	15		N = 89										SANDY LEAN CLAY (CL), light brown, hard, dry to moist, with Lignite beddings
	20		N = 21										CLAYEY SAND (SC), brown to gray, medium dense, dry to moist, fine grained
	25		N = 50										LEAN CLAY (CL), trace Sand, light gray, hard, dry to moist, trace organics
	30		N = 54										Grading light gray to dark gray
	35		N = 45										Organic grades out
	40		N = 37										
	45		N = 55										
	50		N = 40										
	55		N = 40										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.922576, Long. -101.705791

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LOG OF BORING GEO-56

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/8/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 18	16									LEAN CLAY (CL), trace Sand, light brown, very stiff to hard, dry to moist
	5		N = 20	19									
			N = 27	26									Grading dark brown, with occasional Shale fragments, trace organics
	10		N = 18	42									Grading gray to dark brown
			P = +4.5										
	15		N = 39										Grading with Sand, brown to gray, iron stained
	20		N = 84/10"										
	25		N = 57										Grading trace Sand, dark gray to gray, with Lignite interbeddings
	30		N = 72										
	35		N = 47										SANDY LEAN CLAY (CL), light gray to gray, hard, dry to moist, trace organics
	40		N = 34										LEAN CLAY (CL), trace Sand, light gray to gray, hard, dry to moist
	45		N = 41										Grading light gray to black, with Lignite interbeddings
	50		N = 54										Grading with Sand, trace organics
	55		N = 35										SANDY LEAN CLAY (CL), dark gray to gray, hard, dry to moist, trace organics
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.907994, Long. -101.725116

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LOG OF BORING GEO-57

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/7/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													4 in. Topsoil
			N = 19	11									LEAN CLAY (CL), with Sand, light brown, very stiff to hard, dry to moist, calcareous
	5		N = 50/2"	14									
			N = 29	20									Grading trace Sand, light brown
	10		N = 24	20									
			N = 29	19									Grading light brown to gray
	15		N = 33										
	20		N = 74/9"										LIGNITE, black, hard, dry to moist
													LEAN CLAY (CL), trace Sand, light gray to gray, hard, dry to moist, trace organics
	25		N = 38										Grading dark gray to gray, with Lignite interbeddings
	30		N = 50/4"										Grading gray to black
	35		N = 40										Grading light gray
	40		N = 42										
	45		N = 50/3"										Grading gray
	50		N = 39										
	55		N = 47										Lignite and organic grades out
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.910611, Long. -101.712133

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LOG OF BORING GEO-58

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/27/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 11	21									LEAN CLAY (CL), with Sand, light brown, stiff, moist
	5		N = 10	24									
			N = 38	13									CLAYEY SAND (SC), light brown, medium dense to dense, dry to moist, fine grained
	10		N = 25	10									
			N = 37	24									SANDY LEAN CLAY (CL), brown to gray, hard, dry to moist
	15		N = 50/1"										
			N = 33										
	20		N = 35										LEAN CLAY (CL), trace Sand, gray to brown, hard, dry to moist, iron stained, trace Lignite
	25		N = 43										SANDY LEAN CLAY (CL), brown, very stiff to hard, dry to moist, iron stained
	30		N = 27										Grading dark brown, trace organics
	35		N = 41										LEAN CLAY (CL), trace Sand, dark brown to black, hard, dry to moist, with Lignite bedding
	40		N = 44										CLAYEY SAND (SC), light gray to gray, dense, dry to moist, fine grained
	45		N = 39										LEAN CLAY (CL), trace Sand, light gray to gray, hard, dry to moist
	50		N = 59										
	55		N = 42										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.915340, Long. -101.703733

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LOG OF BORING GEO-59

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/26/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 34 ft. during drilling and not measured immediately after drilling

SURFACE ELEVATION (FT):

DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
												6 in. Topsoil
		N = 11	17 21	54	20	34					98	FAT CLAY (CH), trace Sand, light brown, stiff to very stiff, moist
5		N = 17	20									LEAN CLAY (CL), trace Sand, light brown to gray, very stiff, moist, iron stained
		N = 20	22									Grading with Sand, trace calcite
10		N = 25	13									SANDY SILT (ML), light brown, medium dense to dense, dry to moist
		N = 65										
15		N = 49										SILTY SAND (SM), light brown, dense, dry to moist, fine grained
20		N = 56										LEAN CLAY (CL), trace Sand, light brown, hard, dry to moist
25		N = 72										SILTY SAND (SM), light brown to gray, very dense, dry to moist, fine to medium grained
30		N = 60										
												POORLY-GRADED SAND (SP), light brown, very dense, moist to wet, fine grained
35		N = 59										Grading brown
40		N = 68										Grading Lignite and Shale bedding
45		N = 55										
50		N = 23										LEAN CLAY (CL), with Sand, gray, very stiff to hard, moist, with Lignite bedding
55		N = 35										
												Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.911737, Long. -101.695736

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:50 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING GEO-60

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/25/2025 - 4/26/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 5	9									SILTY SAND (SM), light brown, loose to medium dense, dry to moist, fine grained
	5		N = 15	21									
			N = 24	25									SANDY LEAN CLAY(CL), light brown, very stiff, dry to moist
	10		N = 19	25									Grading calcareous
			N = 49										
	15		N = 24										Grading brown to dark brown
	20		N = 30										Grading brown to gray
	25		N = 37										LEAN CLAY (CL), trace Sand, gray to brown, hard, dry to moist
	30		N = 36										Grading gray to light gray, trace organics
													SILT (ML), trace Sand, gray, hard, dry to moist, with Lignite and Sandstone interbeddings
	35		N = 60										
	40		N = 42										
	45		N = 50/5"										LEAN CLAY (CL), with Sand, gray, hard, dry to moist
	50		N = 46										
	55		N = 42										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.918971, Long. -101.692604

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LOG OF BORING GEO-61

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/25/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 24 ft. during drilling and not measured immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 8	19									SANDY LEAN CLAY (CL), dark brown to brown, medium stiff, moist
	5		N = 22	15									CLAYEY SAND (SC), light brown, medium dense to very dense, dry to moist, fine grained, iron stained
			N = 26	14									Grading light brown to brown
	10		N = 23	27									
			N = 54										
	15		N = 40										Grading dark brown to brown
	20		N = 42										
	25		N = 70										Grading wet
	30		N = 42										
	35		N = 79										Grading gray to brown
	40		N = 58										SANDY LEAN CLAY (CL), gray to light gray, hard, moist
	45		N = 67/11"										LEAN CLAY (CL), trace Sand, gray to light gray, hard, moist, with Lignite interbeddings
	50		N = 52										Grading dark brown, with Lignite beddings Grading light gray
	55		N = 44										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.909107, Long. -101.683665

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LOG OF BORING GEO-62

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/6/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 34 ft. during drilling and measured at 52 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 4	13									CLAYEY SAND (SC), light brown, loose, dry to moist, fine grained, calcareous
		M		8	26	18	8					49	
	5		N = 9	12									
			N = 4	27									SANDY LEAN CLAY (CL), brown, soft, moist
	10		N = 19	22									FAT CLAY (CH), trace Sand, brown, very stiff to hard, dry to moist
			N = 29	21	56	23	33	105	4.51	6.6	10.0	91	Grading dark brown to gray
	15		N = 39										Grading light gray
	20		N = 21										Grading iron stained
	25		P = +4.5	25				101					
	30		N = 34										
	35		N = 32										Grading wet
	40		N = 47										
	45		N = 39										
	50		N = 70/7"										Grading gray
	55		N = 35										
													Total Depth = 55.5 ft.

FIELD DATA | LABORATORY DATA

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.908346, Long. -101.677053

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:50 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING GEO-63

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/7/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 19	9									LEAN CLAY (CL), with Sand, light brown, stiff to hard, dry to moist, calcareous
	5		N = 11	28									Grading light brown to yellowish brown, iron stained
			N = 17	21									Grading trace Sand
	10		N = 22	20									
			N = 16	23									Grading with Sand, brown
	15		N = 35										
	20		N = 21										Grading trace Sand, gray to dark brown, with Lignite interbedding
	25		N = 36										
	30		N = 32										Grading dark brown to light brown
	35		N = 31										Grading brown
	40		N = 34										
	45		N = 28										CLAYEY SAND (SC), gray to brown, medium dense, dry to moist, fine grained
	50		N = 47										SANDY LEAN CLAY (CL), light gray, hard, dry to moist
	55		N = 42										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.903390, Long. -101.708697

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:50 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING GEO-64

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/24/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 9	17									SANDY LEAN CLAY (CL), light brown, stiff to very stiff, moist
	5		N = 27	21									
			N = 28	22									LEAN CLAY (CL), with Sand, light brown, very stiff to hard, dry to moist, iron stained
				23									
	10		N = 27	23									Grading trace Sand, with Lignite seems
			N = 28	26									Grading dark gray to gray
	15		N = 34										Grading dark brown, with Lignite bedding
	20		N = 31										
	25		N = 50/4"										LIGNITE, dark brown, hard, dry to moist
													SILT (ML), with Sand, gray, hard, dry to moist
	30		N = 42										SANDY LEAN CLAY (CL), gray to dark gray, hard, dry to moist
	35		N = 36										
	40		N = 39										
	45		N = 96/10"										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist, with Lignite bedding
	50		N = 44										
	55		N = 41										
													Total Depth = 55.5 ft.

FIELD DATA | LABORATORY DATA

DESCRIPTION OF STRATUM

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.903570, Long. -101.686788

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LOG OF BORING GEO-65

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/8/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 11	11									SANDY LEAN CLAY (CL), light brown, medium stiff to stiff, dry to moist, calcareous
	5		N = 8	27									Grading trace organics
			N = 6	33									CLAYEY SAND (SC), brown, loose, moist, fine grained, trace organics
	10		N = 31	25									LEAN CLAY (CL), with Sand, brown to gray, very stiff to hard, dry to moist
			N = 32	25									Grading light brown
	15		N = 16										Grading trace Sand
	20		N = 48										
	25		N = 22										Grading dark gray, iron stained
	30		N = 34										
	35		N = 27										
	40		N = 34										
	45		N = 69/10"										
	50		N = 50/5"										
	55		N = 33										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.897699, Long. -101.696096

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LOG OF BORING GEO-66

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/23/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													9 in. Topsoil
			N = 5	15									SANDY LEAN CLAY (CL), light brown, medium stiff to stiff, moist, calcareous, trace roots
	5		N = 6	20									
			N = 14	17									Grading light brown to gray
	10		N = 11	28									FAT CLAY (CH), trace Sand, light gray to brown, stiff to hard, dry to moist, iron stained
			P = 4.5	22	52	22	30	104	6.24	5.8	10.0	100	
	15		N = 25										
	20		N = 26										SANDY LEAN CLAY (CL), light gray to brown, very stiff, dry to moist, iron stained
	25		N = 37										LEAN CLAY (CL), trace Sand, light gray to brown, hard, dry to moist, iron stained
	30		N = 48										SANDY LEAN CLAY (CL), light gray to brown, hard, dry to moist, iron stained
	35		N = 56										LEAN CLAY (CL), with Sand, light brown, hard, dry to moist, iron stained
	40		N = 55										
	45		N = 58										
	50		N = 35										SILT (ML), trace Sand, dark gray to gray, hard, dry to moist
	55		N = 54										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.896434, Long. -101.676574

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LOG OF BORING GEO-67

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/25/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 45 ft. during drilling and not measured immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 13	14									LEAN CLAY (CL), trace Sand, light brown to brown, stiff to very stiff, dry to moist, calcareous
				14	43	21	22					97	
	5		N = 26	20									
			N = 26	20									Grading iron stained
	10		N = 25	18									
			N = 48										
	15		N = 23										SANDY LEAN CLAY (CL), brown, very stiff, dry to moist, iron stained
	20		N = 32										LEAN CLAY (CL), with Sand, light brown to brown, hard, dry to moist
	25		N = 38										Grading trace Sand, iron stained
	30		N = 46										Grading light gray to brown
	35		N = 41										Iron stain grades out; grading dark gray to gray
	40		N = 72/11"										
	45		N = 60										SANDY LEAN CLAY (CL), light brown to brown, hard, dry to moist, trace organics Grading wet
	50		N = 34										LEAN CLAY (CL), with Sand, bluish gray to gray, hard, moist
	55		N = 40										SANDY LEAN CLAY (CL), bluish gray to gray, hard, moist
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.897586, Long. -101.664957

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LOG OF BORING GEO-68

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/23/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													9 in. Topsoil
			N = 19	15									LEAN CLAY (CL), with Sand, light brown, very stiff, moist, iron stained, calcareous
	5		N = 26	20									
			N = 35	20									SANDY LEAN CLAY (CL), brown to gray, hard, moist, iron stained
	10		N = 32	19									LEAN CLAY (CL), with Sand, brown to gray, very stiff to hard, dry to moist, iron stained, with Lignite
			N = 25	22									Grading trace Sand, calcareous, trace Lignite
	15		N = 54										
	20		N = 28										Lignite grades out; grading trace Calcite
	25		N = 39										
	30		N = 42										Calcite grades out
	35		N = 46										Grading light brown to gray
	40		N = 81/11"										
	45		N = 50										Grading with Sand
	50		N = 73										
			N = 50/4"										Total Depth = 54.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.896070, Long. -101.651180

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LOG OF BORING GEO-69

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/24/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 20	24									SILTY SAND (SM), light brown, medium dense, moist, fine grained
	5		N = 25	17									Grading dark brown, with Lignite seams
			N = 18	23									LEAN CLAY (CL), with Sand, light gray to brown, very stiff to hard, moist, iron stained, trace Calcite
	10		N = 18	25									Grading trace Sand
			P = N/A	25				95	4.60	3.5	0.0		
	15		N = 22										SANDY LEAN CLAY (CL), light brown, very stiff, dry to moist
	20		N = 68										SILT (ML), trace Sand, light brown, hard, dry to moist Grading dark brown, with Lignite beddings
	25		N = 26										LEAN CLAY (CL), with Sand, dark brown, very stiff, dry to moist, with Lignite beddings
	30		N = 32										SILTY SAND (SM), gray, dense, dry to moist, fine grained
	35		N = 39										LEAN CLAY (CL), trace Sand, light gray to gray, very stiff to hard, dry to moist, with Lignite seams
	40		N = 41										
	45		N = 30										
	50		N = 39										
	55		N = 40										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.890090, Long. -101.683948

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LOG OF BORING GEO-70

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/24/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 34 ft. during drilling and not measured immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 22	14									FAT CLAY (CH), trace Sand, light brown, very stiff, moist, calcareous
		M		16	61	20	41					99	
	5		N = 20	19									SANDY SILT (ML), light brown, medium dense, dry to moist
			N = 22	11									SANDY LEAN CLAY (CL), light brown to gray, very stiff, dry to moist, calcareous
	10		N = 18	15									LEAN CLAY (CL), trace Sand, light brown to gray, stiff to very stiff, dry to moist
			N = 34	26									
	15		N = 14										Grading dark brown, trace Lignite bedding
	20		N = 26										SANDY LEAN CLAY (CL), light brown to gray, very stiff to hard, dry to moist
	25		N = 33										Grading brown
	30		N = 43										
	35		N = 50/4"										LIGNITE, dark brown, hard, moist to wet
													SILT (ML), trace Sand, gray, hard, moist to wet
	40		N = 37										
	45		N = 35										SANDY LEAN CLAY (CL), gray, hard, moist
	50		N = 49										LEAN CLAY (CL), trace Sand, dark gray to light gray, hard, moist
	55		N = 51										
													Total Depth = 55.5 ft.

FIELD DATA | LABORATORY DATA

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.881269, Long. -101.690206

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LOG OF BORING GEO-71

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/3/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 25 ft. during drilling and not measured immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													4 in. Topsoil
			N = 7	14									CLAYEY SAND (SC), brown, loose to very dense, dry to moist, fine grained, iron stained
	5		N = 8	11									Grading light brown
			N = 50/3"	12									
	10		N = 34	14									SANDY LEAN CLAY (CL), light brown to gray, hard, moist, trace organics
			N = 30										CLAYEY SAND (SC), gray, medium dense, dry to moist, fine grained
	15		N = 17										LEAN CLAY (CL), with Sand, gray to brown, very stiff, dry to moist, trace organics
	20		N = 25										Organic grades out; grading iron stained
			N = 41										
	25		N = 28										Grading trace Sand, dark gray to light gray, trace organics Grading wet
	30		N = 38										CLAYEY SAND (SC), light gray to gray, dense, moist, fine grained
	35		N = 30										LEAN CLAY (CL), with Sand, light gray, very stiff to hard, moist
	40		N = 36										Grading light gray to gray, trace organics
	45		N = 61										Grading trace Sand, gray to dark gray
	50		N = 44										Grading light gray to gray
	55		N = 38										Organic grades out
													Total Depth = 55.5 ft.

FIELD DATA | LABORATORY DATA

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.951278, Long. -101.767572

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LOG OF BORING GEO-72

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 3/18/2026

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 19 ft. during drilling and measured at 6 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	0		N = 6										6 in. Topsoil
	5		N = 5										CLAYEY SAND (SC), brown to reddish brown, loose to medium dense, dry to moist, fine to medium grained, iron stained
			N = 11										Grading gray
	10		N = 18										
			N = 35										
	15		N = 19										
	20		N = 15										LEAN CLAY (CL), with Sand, dark gray to gray, stiff to hard, moist to wet
	25		N = 33										
	30		N = 45										
	35		N = 24										Grading trace Sand, trace Lignite
	40		N = 40										
	45		N = 23										
	50		N = 39										
	55		N = 70/10"										Grading with Lignite
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.951464, Long. -101.767567

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:50 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING GEO-73

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 3/18/2026

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
	5		N = 7 N = 4										LEAN CLAY (CL), trace Sand, brown to dark brown, soft to medium stiff, dry to moist
	10		N = 6 N = 10 P = 4.0										SANDY LEAN CLAY (CL), olive to gray, medium stiff to very stiff, dry to moist Grading iron stained
	15 20 25		N = 14 N = 22 N = 27										LEAN CLAY (CL), trace Sand, light brown to brown, stiff to very stiff, dry to moist Grading with Sand
	30 35		N = 33 N = 36										SANDY LEAN CLAY (CL), light gray to brown, hard, dry to moist
	40 45 50 55		N = 50/3" N = 42 N = 45 N = 57										SANDSTONE, gray to brown, medium hard to very hard, dry to moist, fine to medium grained, weakly cemented
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.940581, Long. -101.732158

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:50 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING GEO-74

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 1/30/2026

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 50/2"	22									SILT (ML), with Sand, brown, very stiff to hard, dry to moist
	5		N = 19	23									Grading trace Lignite
			N = 25	22									Grading calcareous
	10		N = 31	21									
			N = 30	16									LEAN CLAY (CL), trace Sand, brown to gray, hard, dry to moist, iron stained, calcareous, trace Lignite
	15		N = 35										
	20		N = 35										
	25		N = 52										Grading dark brown to black
	30		N = 36										Grading dark gray to gray
	35		N = 36										
	40		N = 43										
	45		N = 39										SILTSTONE, gray, medium hard to very hard, dry to moist, calcareous
	50		N = 75/7"										Grading trace Lignite
			N = 50/5"										Grading dark brown to black
													Total Depth = 54.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.937832, Long. -101.766825

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:50 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING GEO-75

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 3/17/2026

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 18										LEAN CLAY (CL), trace Sand, brown to gray, stiff to very stiff, dry to moist
	5		N = 24										Grading yellowish brown to gray, trace organics
			N = 23										Grading Lignite interlayers
	10		N = 27										Grading with Sand, light brown to gray
			N = 30										
	15		N = 11										Grading trace Sand, brown to dark brown
	20		N = 30										SILTSTONE, light gray to gray, medium hard to hard, dry to moist
	25		N = 72										
	30		N = 70										
	35		N = 52										
	40		N = 68										
	45		N = 74										
	50		N = 68										
	55		N = 52										Grading with Lignite interlayers
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.923032, Long. -101.767480

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LOG OF BORING GEO-76

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 3/17/2026

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													5 in. Topsoil
			N = 10										LEAN CLAY (CL), trace Sand, brown to dark brown, stiff to hard, dry to moist, trace organics
	5		N = 10										Grading yellowish brown, with Coal
			N = 29										Grading with Lignite interlayers
	10		N = 18										Grading brown to dark gray, trace Coal
			N = 27										Grading with Sand
	15		N = 39										Grading trace Sand, brown to dark brown
	20		N = 50/2"										SILTSTONE, gray, medium hard to very hard, dry to moist
	25		N = 34										Grading light gray
	30		N = 34										
	35		N = 36										
	40		N = 48										CLAYSTONE, light gray, medium hard to hard, dry to moist, trace Lignite
	45		N = 54										Grading light gray to gray
	50		N = 41										
	55		N = 42										Grading with Lignite
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.907995, Long. -101.724410

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LOG OF BORING GEO-77

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 1/29/2026

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													8 in. Topsoil
			N = 20	25									LEAN CLAY (CL), with Sand, light brown, medium stiff to hard, dry to moist
	5		N = 8	19									
			N = 16	23									Grading gray, iron stained, calcareous
	10		N = 12	25									
			N = 31	17	37	18	19	112	6.42	12.5	10.0	89	Grading trace Sand
	15		N = 43										Grading dark brown, trace Lignite
	20		N = 36										Grading light brown
	25		N = 36										Grading gray to brown
	30		N = 44										
	35		N = 55										
	40		N = 62										
	45		N = 69										
	50		N = 62										
	55		N = 99/9"										
													Total Depth = 55.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.895876, Long. -101.651185

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:50 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING PMM-1

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/11/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 14										LEAN CLAY (CL), with Sand, dark brown, stiff to very stiff, dry to moist
	5		N = 10										Grading trace Sand, gray to brown, calcareous
			N = 31										Grading iron stained
	10		N = 23										SANDY LEAN CLAY (CL), light brown to brown, very stiff, dry to moist, iron stained
			N = 32										CLAYEY SAND (SC), light brown to brown, medium dense to dense, dry to moist, fine grained, iron stained
	15		N = 21										
	20		N = 26										Grading gray to brown
	25		N = 29										
	30		N = 27										LEAN CLAY (CL), trace Sand, gray to dark gray, very stiff to hard, dry to moist, with Lignite
	35		N = 38										Grading light gray
													Total Depth = 35.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.976921, Long. -101.747421

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:50 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING PMM-2

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/5/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 18										SANDY LEAN CLAY (CL), with Gravel, brown to light brown, very stiff, dry to moist, iron stained, calcareous
	5		N = 8	25	77	22	55					100	FAT CLAY (CH), trace Sand, light brown to gray, medium stiff to hard, dry to moist
			P = 3.0										
	10		N = 14										Grading with Sand
			N = 17										Grading trace Sand, iron stained
	15		N = 18										
	20		N = 20										
	25		N = 22										Grading calcareous, trace organics
	30		N = 34										
	35		N = 50/5"										Grading dark brown, with Lignite
													Total Depth = 35 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.938197, Long. -101.755101

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:50 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING PMM-3

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/7/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 19										4 in. Topsoil SANDY SILT (ML), light brown, medium dense, dry to moist, calcareous
	5		N = 19										LEAN CLAY (CL), with Sand, brown to gray, very stiff to hard, dry to moist, iron stained
			N = 65										Grading trace Sand, dark brown
	10		N = 34										
			N = 47										
	15		N = 47										Grading trace organic
	20		N = 43										
	25		N = 40										
	30		N = 52										Grading dark brown to gray
			N = 50/6"										LIGNITE, black, hard, dry to moist, trace organics Total Depth = 34.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.894397, Long. -101.662007

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:50 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING ADLS-2

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/7/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 13										SILTY SAND (SM), light brown, medium dense to dense, dry to moist, fine grained
	5		N = 32										
			N = 36										
	10		N = 56										
			N = 22										LEAN CLAY (CL), trace Sand, gray, very stiff, dry to moist, iron stained, trace organics
	15		N = 37										SILTY SAND (SM), light brown, dense, dry to moist, fine grained
	20		N = 39										CLAYEY SAND (SC), light brown, dense, dry to moist, fine grained
	25		N = 36										LEAN CLAY (CL), trace Sand, dark gray to gray, hard, dry to moist, iron stained, calcareous
	30		N = 37										SILT (ML), trace Sand, gray, hard, dry to moist, iron stained, calcareous
	35		N = 43										LEAN CLAY (CL), trace Sand, dark gray, hard, dry to moist
													Total Depth = 35.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.927981, Long. -101.795351

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:50 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING MET-3

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/23/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													9 in. Topsoil
			N = 11										SANDY LEAN CLAY (CL), light brown, stiff to hard, dry to moist, iron stained, calcareous
	5		P = 4.5										
			N = 26										SANDY SILT (ML), light brown to light gray, medium dense, dry to moist, iron stained
	10		N = 21										LEAN CLAY (CL), trace Sand, brown to gray, very stiff, dry to moist, iron stained, trace organics
			N = 21										LIGNITE, dark brown, very stiff, dry to moist
	15		N = 27										LEAN CLAY (CL), trace Sand, gray to brown, very stiff, dry to moist, iron stained, trace Lignite
	20		N = 39										SANDY LEAN CLAY (CL), light brown to gray, hard, dry to moist, iron stained
	25		N = 65										Grading with Sandstone beddings
	30		N = 43										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist, trace Lignite
			N = 50/4"										LIGNITE, dark brown, hard, dry to moist, iron stained, trace organics
													Total Depth = 34.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.894016, Long. -101.661035

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 14:50 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING O&M-1

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/3/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 18 ft. during drilling and measured at 25 ft. immediately after drilling

SURFACE ELEVATION (FT):

DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
												4 in. Topsoil
		N = 6	17									CLAYEY SAND (SC), dark brown, loose to medium dense, dry to moist, fine grained, calcareous
5		N = 17	10									Grading brown, iron stained
		N = 9	19				100	0.32	1.8	5.5		
10		N = 23										Calcareous feature grades out; grading gray to light brown
		N = 50/3"										POORLY-GRADED SAND (SP-SM), with Silt, gray to light brown, very dense, dry to moist, fine grained
15		N = 30										CLAYEY SAND (SC), light brown, medium dense to dense, dry to moist, fine grained
												Grading wet
20		N = 42										Grading light brown to brown, iron stained
25		N = 20										LEAN CLAY (CL), with Sand, dark gray, very stiff, moist to wet
30		N = 21										Grading gray, trace organics
35		N = 50/5"										SANDY CLAYSTONE, gray, very hard, moist
												Total Depth = 35 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.950414, Long. -101.762334

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LOG OF BORING SUB-1

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/1/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 19.5 ft. during drilling and measured at 33 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 6	11									SILTY SAND (SM), light brown, loose, dry to moist, fine grained
	5		N = 30	14									POORLY-GRADED SAND (SP), light brown to dark brown, medium dense, dry to moist, fine to medium grained
			N = 16										Grading iron stained
	10		N = 49										
			N = 30										CLAYEY SAND (SC), light gray to brown, medium dense to dense, dry to moist, fine to medium grained
	15		N = 40										
	20		N = 38										Grading gray Grading wet
	25		N = 73										LIGNITE, gray, hard, moist to wet
	30		N = 26										LEAN CLAY (CL), trace Sand, light gray to dark brown, very stiff to hard, moist to wet
	35		N = 38										
	40		N = 41										
													Total Depth = 40.5 ft.

FIELD DATA / LABORATORY DATA

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.955712, Long. -101.761785

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LOG OF BORING SUB-2

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/1/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 14 ft. during drilling and measured at 35 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													2 in. Topsoil
			N = 7	7									SANDY LEAN CLAY (CL), dark brown, medium stiff, dry to moist
		CS		14	37	14	23					51	
	5		N = 9	14	NP	NP	NP					20	SILTY SAND (SM), light brown, loose, moist, fine grained
			N = 32										POORLY-GRADED SAND (SP), brown, medium dense, dry to moist, fine to medium grained, iron stained
	10		N = 27										CLAYEY SAND (SC), light gray to brown, medium dense to dense, dry to moist, fine to medium grained
			N = 52										Grading dark brown
	15		N = 39										Grading wet
	20		N = 40										POORLY-GRADED SAND (SP), dark brown, dense, moist to wet, fine grained, trace Lignite and organics
	25		N = 85										CLAYEY SAND (SC), dark brown to brown, very dense, moist to wet, fine to medium grained, with Lignite interbeddings
	30		N = 41										LEAN CLAY (CL), trace Sand, dark brown to brown, hard, moist to wet
	35		N = 51										CLAYEY SAND (SC), light gray, dense to very dense, moist to wet, fine grained
	40		N = 45										
													Total Depth = 40.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.955535, Long. -101.762072

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LOG OF BORING SUB-3

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 14 ft. during drilling and measured at 36 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													2 in. Topsoil
			N = 6										SILTY, CLAYEY SAND (SC-SM), dark brown to brown, loose, dry to moist, fine grained
	5		P = 1.5	15	21	16	5	108	1.62	14.3	3.0	20	Grading light brown
			N = 14										CLAYEY SAND (SC), dark brown to brown, medium dense to dense, dry to moist, fine to medium grained, iron stained
	10		N = 28										
			N = 33										
	15		N = 42										Grading gray, wet
	20		N = 44										Grading light gray
	25		N = 29										LEAN CLAY (CL), trace Sand, light gray to gray, very stiff to hard, moist to wet
	30		N = 33										
	35		N = 50										SANDY LEAN CLAY (CL), light gray to gray, hard, moist to wet
	40		N = 79										
													Total Depth = 40.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.955049, Long. -101.762273

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LOG OF BORING SUB-4

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 12 ft. during drilling and measured at 33 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 5										2 in. Topsoil SANDY LEAN CLAY (CL), dark brown to brown, medium stiff, dry to moist, trace roots
	5		N = 5										CLAYEY SAND (SC), light brown to gray, loose to dense, dry to moist, fine grained
			N = 22										
	10		N = 23										
			N = 37										Grading wet
	15		N = 46										
	20		N = 33										
	25		N = 39										Grading dark gray, fine to medium grained
	30		N = 46										Grading trace organics
	35		N = 38										LEAN CLAY (CL), trace Sand, dark gray to gray, very stiff to hard, moist
	40		N = 30										Total Depth = 40.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.955054, Long. -101.761848

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LOG OF BORING SUB-5

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/29/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 12.5 ft. during drilling and measured at 30 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 5										3 in. Topsoil SANDY LEAN CLAY (CL), light gray to gray, medium stiff, dry to moist
	5		N = 6										CLAYEY SAND (SC), dark brown to light gray, loose to dense, dry to moist, fine grained, iron stained
			N = 14										
	10		N = 9										
			N = 30	▽									Grading wet
	15		N = 36										Grading dark gray
	20		N = 31										
	25		N = 44										LEAN CLAY (CL), trace Sand, dark brown, hard, moist to wet
	30		N = 41	▼									Grading light gray
	35		N = 35										
	40		N = 42										
													Total Depth = 40.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.954784, Long. -101.761958

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LOG OF BORING SUB-6

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/1/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 19 ft. during drilling and measured at 29 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
					FIELD DATA			LABORATORY DATA					
													3 in. Topsoil
			N = 11										SILTY SAND (SM), light brown, medium dense to dense, dry to moist, fine grained, iron stained
	5		P = 2.5	6	NP	NP	NP	101				27	
			N = 12										
	10		N = 30										
			N = 31										
	15		N = 50/6"										LEAN CLAY (CL), with Sand, brown, hard, dry to moist
	20		N = 50										CLAYEY SAND (SC), light brown to dark brown, dense to very dense, moist to wet, fine to medium grained, iron stained
	25		N = 59										Iron stain grades out; grading gray
	30		N = 59										
	35		N = 24										LEAN CLAY (CL), trace Sand, gray, very stiff to hard, moist
	40		N = 44										Grading with Sand, trace organics
													Total Depth = 40.5 ft.

DESCRIPTION OF STRATUM

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.955549, Long. -101.760791

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LOG OF BORING SUB-7

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 13 ft. during drilling and measured at 34 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 3										2 in. Topsoil SANDY LEAN CLAY (CL), brown, soft, dry to moist, trace roots
	5		N = 14										CLAYEY SAND (SC), light brown to brown, medium dense to very dense, dry to moist, fine to medium grained
			N = 26										
	10		N = 28										Grading dark brown
			N = 31	▽									Grading wet
	15		N = 70/10"										Grading trace organics
	20		N = 62										Grading gray
	25		N = 68										
	30		N = 58										LEAN CLAY (CL), trace Sand, dark brown to gray, hard, moist to wet, with Lignite interbeddings
				▼									
	35		N = 44										Grading with Sand, light gray
	40		N = 46										
													Total Depth = 40.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.9550580, Long. -101.761344

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LOG OF BORING SUB-8

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 19 ft. during drilling and measured at 35 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 12										CLAYEY SAND (SC), brown, medium dense, dry to moist, fine grained, iron stained
	5		P = 3.0										
			N = 30										POORLY-GRADED SAND (SP), light brown to dark brown, medium dense to dense, dry to moist, fine grained
	10		N = 32										
			N = 35										CLAYEY SAND (SC), brown, dense to very dense, moist, fine to medium grained, iron stained
	15		N = 35										
			N = 40	▽									Grading wet
	20												
			N = 47										Grading light brown to gray
	25												
			N = 64										
	30												
			N = 36	▼									LEAN CLAY (CL), with Sand, dark gray to dark brown, hard, moist to wet, with Lignite interbeddings
	35												
			N = 36										Grading trace organics
	40												
													Total Depth = 40.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.954797, Long. -101.760801

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LOG OF BORING SUB-9

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/1/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													2 in. Topsoil
			N = 11	6									CLAYEY SAND (SC), light brown to brown, loose to dense, dry to moist, fine grained, iron stained
	5		N = 8	6	24	16	8					23	Grading dark brown, trace roots
			N = 28										
	10		N = 27										Grading light brown, fine to medium grained
			N = 30										
	15		N = 49										
													Total Depth = 15.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.953917, Long. -101.761302

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING SUB-10

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/1/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 11										CLAYEY SAND (SC), light brown, medium dense to dense, dry to moist, fine grained
	5		N = 20										Grading brown
			N = 28										
	10		N = 33										Grading dark brown
			N = 42										
	15		N = 39										
													Total Depth = 15.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.953298, Long. -101.761288

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-1

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

FIELD DATA				LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													2 in. Topsoil
													SILTY SAND (SM), light brown, dry to moist, fine grained
	1												
	2												
	3												
	4												
	5												Total Depth = 5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.955771, Long. -101.762488

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-2

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													2 in. Topsoil
													SILTY SAND (SM), light brown, dry to moist, fine grained
	1												
	2												
	3												
	4												
	5												
													Total Depth = 5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.955782, Long. -101.761487

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-3

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													4 in. Topsoil
	1												SILT (ML), trace Sand, reddish brown, dry to moist
	2												Grading light brown
	3												SILTY SAND (SM), light brown, dry to moist, fine grained
	4												
	5												Total Depth = 5 ft.

FIELD DATA / LABORATORY DATA

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.955793, Long. -101.760486

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-4

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													2 in. Topsoil
													LEAN CLAY (CL), trace Sand, dark brown, dry to moist
	1												
	2												
	3												CLAYEY SAND (SC), light brown, dry to moist, fine grained
	4												
	5												Total Depth = 5 ft.

FIELD DATA / LABORATORY DATA

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.955223, Long. -101.762475

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-5

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
	1												SILT (ML), trace Sand, dark brown, dry to moist
	2												
	3												SILTY SAND (SM), light brown, dry to moist, fine grained
	4												
	5												Total Depth = 5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.955234, Long. -101.761474

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-6

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
	1												SILT (ML), trace Sand, light brown, dry to moist
	2												
	3												
	4												
	5												Total Depth = 5 ft.

FIELD DATA / LABORATORY DATA

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.955245, Long. -101.760473

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-7

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

FIELD DATA				LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
	1												CLAYEY SAND (SC), light brown, dry to moist, fine grained
	2												
	3												
	4												
	5												Total Depth = 5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.954675, Long. -101.762462

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-8

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													2 in. Topsoil
	1												SILTY SAND (SM), dark brown, dry to moist, fine grained
	2												
	3												CLAYEY SAND (SC), light brown, dry to moist, fine grained
	4												
	5												Total Depth = 5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.954686, Long. -101.761461

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-9

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
	1												SILT (ML), trace Sand, light brown, dry to moist
	2												
	3												
	4												
	5												Total Depth = 5 ft.

FIELD DATA | LABORATORY DATA

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.954697, Long. -101.760460

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-10

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/1/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

FIELD DATA				LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1												SILTY SAND (SM), light brown, dry to moist, fine grained
	2												
	3												
	4												
	5												Total Depth = 5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.954105, Long. -101.761659

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-11

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/1/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													SILTY SAND (SM), light brown, dry to moist, fine grained
	1												
	2												
	3												
	4												
	5												Total Depth = 5 ft.

FIELD DATA / LABORATORY DATA

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.954113, Long. -101.760954

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-12

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/1/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

FIELD DATA			LABORATORY DATA										
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													SILTY SAND (SM), dark brown, dry to moist, fine grained
	1												
	2												
	3												
	4												
	5												Total Depth = 5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.953607, Long. -101.761294

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-13

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/1/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

FIELD DATA				LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
	1												SILTY SAND (SM), light brown, dry to moist, fine grained
	2												
	3												
	4												
	5												Total Depth = 5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.953102, Long. -101.761635

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING HA-14

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/1/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

FIELD DATA			LABORATORY DATA									
SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)
	1											
	2											
	3											
	4											
	5											

DESCRIPTION OF STRATUM

SILTY SAND (SM), dark brown, dry to moist, fine grained

Total Depth = 5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.953109, Long. -101.760930

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING TL-1

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/29/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 23										SANDY LEAN CLAY (CL), light brown, very stiff, dry to moist
	5		N = 42										CLAYEY SAND (SC), light brown, medium dense to very dense, dry to moist, fine grained
			N = 50/3"										
	10		N = 29										
			N = 20										
	15		N = 23										LEAN CLAY (CL), with Sand, light brown, very stiff to hard, dry to moist, iron stained
	20		N = 31										Grading trace Sand, dark brown to brown, trace organics
	25		N = 36										Grading gray to dark gray
	30		N = 48										
	35		N = 35										
	40		N = 50/4"										MUDSTONE, dark gray to gray, hard to very hard, dry to moist, trace organics
	45		N = 58										
	50		N = 67										
													Total Depth = 50.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.986205, Long. -101.766771

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING TL-2

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/29/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 5										FAT CLAY (CH), with Sand, light brown to gray, medium stiff to hard, dry to moist
	5		P = 4.5										
			N = 24										LEAN CLAY (CL), with Sand, brown to light brown, very stiff, dry to moist, iron stained
	10		N = 22										
			N = 30										
	15		N = 26										Grading trace Sand, light gray to gray
	20		N = 41										LIGNITE, dark brown to black, hard, dry to moist
	25		N = 74										LEAN CLAY (CL), with Sand, gray, hard, dry to moist
	30		N = 61										
													Total Depth = 30.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.984606, Long. -101.766776

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING TL-3

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/29/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 9										CLAYEY SAND (SC), brown, loose, dry to moist, fine grained
	5		N = 18										FAT CLAY (CH), trace Sand, light brown to gray, stiff to hard, dry to moist
			N = 20										
	10		P = 4.5										SILT (ML), with Sand, light brown to gray, hard, dry to moist
			N = 26										LEAN CLAY (CL), trace Sand, brown, very stiff to hard, dry to moist
	15		N = 30										
	20		N = 23										Grading iron stained, trace calcite and Lignite bedding
	25		N = 33										Iron stained and Lignite grade out; grading calcareous
	30		N = 26										LIGNITE, dark brown to black, very stiff, dry to moist
													Total Depth = 30.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.982158, Long. -101.766783

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING TL-4

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/29/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 6										LEAN CLAY (CL), with Sand, light brown to gray, medium stiff to hard, dry to moist
	5		P = 0.75										
			N = 8										Grading trace Sand, light gray
	10		P = 2.0										
			N = 24										Grading with Sand, gray to brown
	15		N = 33										
	20		N = 39										
	25		N = 48										
	30		N = 44										SANDY LEAN CLAY (CL), gray to dark gray, hard, dry to moist
	35		N = 55										Grading dark gray
	40		N = 60										Grading with organics
	45		N = 54										CLAYEY SAND (SC), dark gray, very dense, dry to moist, fine grained, with organics
	50		N = 54										Organic grades out
													Total Depth = 50.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.980259, Long. -101.766789

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING TL-5

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/29/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 12										LEAN CLAY (CL), trace Sand, light brown, stiff to very stiff, dry to moist, trace calcium
	5		N = 9										Grading with Sand
			P = 2.75										
	10		N = 13										Grading trace Sand
			N = 14										Grading iron stained
	15		N = 26										SANDY LEAN CLAY (CL), light brown, very stiff, dry to moist
	20		N = 51										CLAYEY SAND (SC), light brown, very dense, dry to moist, fine grained
	25		N = 78										SILT (ML), with Sand, light brown to gray, hard, dry to moist
	30		N = 34										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist
													Total Depth = 30.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.980257, Long. -101.763791

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING TL-6

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
	5		N = 8										CLAYEY SAND (SC), light brown, loose to medium dense, dry to moist, fine grained
			N = 30										
	10		N = 8										LEAN CLAY (CL), with Sand, light brown to gray, medium stiff to hard, dry to moist, trace Lignite
			P = 4.5										
			N = 14										
	15		N = 39										Lignite grades out
	20		N = 23										
	25		N = 36										CLAYEY SAND (SC), light brown, dense, dry to moist, fine grained
	30		N = 33										
	35		N = 37										Grading gray
	40		N = 40										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist
	45		N = 41										SILT (ML), trace Sand, gray, hard, dry to moist
	50		N = 84/10"										
													Total Depth = 50.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.980255, Long. -101.760946

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING TL-7

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 5										6 in. Topsoil SANDY FAT CLAY (CH), light brown, medium stiff, dry to moist
	5		P = 3.5										LEAN CLAY (CL), with Sand, light brown, very stiff, dry to moist
			N = 16										Grading trace Sand
	10		N = 20										
			N = 27										CLAYEY SAND (SC), light brown, medium dense to dense, dry to moist, fine grained
	15		N = 24										
	20		N = 43										
	25		N = 41										LEAN CLAY (CL), trace Sand, gray, hard, dry to moist
	30		N = 36										SILT (ML), trace Sand, gray, hard, dry to moist
													Total Depth = 30.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.978169, Long. -101.760927

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING TL-8

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/30/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 7										SILTY SAND (SM), light brown, loose, dry to moist, fine grained
	5		N = 5										CLAYEY SAND (SC), light brown, loose to medium dense, dry to moist, fine grained
			N = 43										
	10		N = 36										
			N = 3										LEAN CLAY (CL), trace Sand, dark brown, soft to very stiff, dry to moist, trace organics
	15		N = 16										Grading with Sand, light brown
	20		N = 38										CLAYEY SAND (SC), light brown to light gray, dense, dry to moist, fine to medium grained, iron stained
	25		N = 42										LEAN CLAY (CL), trace Sand, gray to dark gray, hard, dry to moist
	30		N = 40										
													Total Depth = 30.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.976028, Long. -101.760909

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING TL-9

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/1/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS LIQUID LIMIT LL	ATTERBERG LIMITS PLASTIC LIMIT PL	ATTERBERG LIMITS PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 15										CLAYEY SAND (SC), light brown, medium dense, dry to moist, fine grained, iron stained
	5		N = 14										
			P = +4.5										SANDY LEAN CLAY (CL), brown to gray, very stiff to hard, dry to moist
	10		N = 24										CLAYEY SAND (SC), gray, medium dense to dense, dry to moist, fine grained
			N = 32										
	15		N = 30										
	20		N = 44										
	25		N = 43										Grading light brown to brown, trace organics
	30		N = 26										Grading light brown to gray
													Total Depth = 30.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.973915, Long. -101.760890

RENEWABLE LOG - LOG A GNNL01.GDT - 4/22/26 11:39 - C:\USERS\JOHNVILLARINO\RRC COMPANIES\GEOTECHNICAL ENGINEERING - DATABASES\03.GINT\PROJECTS\2025\LONGSPUR WIND PROJECT-GE2503026\LONGSPUR WIND PROJECT-GE2503026.GPJ

LOG OF BORING TL-10

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/1/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 24 ft. during drilling and measured at 24 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 7										CLAYEY SAND (SC), light brown, very loose to very dense, dry to moist, fine grained
	5		N = 2										
			N = 47										Grading iron stained
	10		N = 32										
			N = 23										
	15		N = 32										
	20		N = 51										
	25		N = 44										Grading wet
	30		N = 59										
													Total Depth = 30.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.971640, Long. -101.760870

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LOG OF BORING TL-11

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/1/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 29 ft. during drilling and measured at 28 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 18										CLAYEY SAND (SC), light brown, loose to very dense, dry to moist, fine grained
	5		N = 8										
			N = 17										
	10		N = 33										
			N = 29										Grading iron stained
	15		N = 28										
	20		N = 31										Grading brown
	25		N = 61										Grading gray to light brown
	30		N = 58										Grading wet
													Total Depth = 30.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.969358, Long. -101.760850

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LOG OF BORING TL-12

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/2/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 7 ft. during drilling and measured at 6.5 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 8										CLAYEY SAND (SC), light brown, loose, moist, fine grained
	5		N = 6										Grading brown
			N = 8										SANDY LEAN CLAY (CL), light brown, medium stiff, moist to wet, iron stained
	10		N = 18										POORLY-GRADED SAND (SP-SC), with Clay, brown, medium dense, moist, fine to medium grained
			N = 27										CLAYEY SAND (SC), brown to light brown, medium dense to dense, moist, fine to medium grained
	15		N = 33										
	20		N = 31										
	25		N = 15										SILT (ML), trace Sand, dark gray, stiff, moist
	30		N = 42										CLAYEY SAND (SC), trace Gravel, gray, dense, moist, fine to coarse grained
													Total Depth = 30.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.967150, Long. -101.760831

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LOG OF BORING TL-13

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/2/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 13										CLAYEY SAND (SC), brown, medium dense, dry to moist, fine grained, iron stained, trace roots
	5		N = 19										SANDY LEAN CLAY (CL), light brown, stiff, dry to moist, iron stained
			N = 22										CLAYEY SAND (SC), light brown, medium dense, dry to moist, fine grained
	10		N = 13										FAT CLAY (CH), trace Sand, brown, stiff to hard, dry to moist, trace organics
			P = 4.5										
	15		N = 17										LEAN CLAY (CL), trace Sand, gray to dark gray, very stiff, dry to moist
	20		N = 27										Grading with Sand
	25		N = 50/5"										CLAYSTONE, gray, medium hard to very hard, dry to moist
	30		N = 68										Grading dark gray
	35		N = 36										
	40		N = 77/11"										LIGNITIC SHALE, dark brown, medium hard to very hard, dry to moist
	45		N = 57										Grading gray to dark gray
	50		N = 34										
													Total Depth = 50.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.964992, Long. -101.760812

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LOG OF BORING TL-14

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/2/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater not encountered during or immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
	0		N = 8										CLAYEY SAND (SC), brown, loose to medium dense, dry to moist, fine grained, iron stained, trace roots
	5		N = 5										Grading light brown, fine to medium grained, micaceous
			N = 21										
	10		N = 25										
			N = 25										
	15		N = 15										LEAN CLAY (CL), with Sand, gray to light brown, stiff to hard, dry to moist, iron stained
			P = 4.5										
	20		N = 27										Grading trace Sand
	25		N = 26										Grading with Sand
	30		N = 23										Grading trace Sand
	35		N = 31										
	40		N = 50/2"										LIGNITIC SHALE, dark brown, medium hard to very hard, dry to moist
	45		N = 49										Grading gray to dark gray
	50		N = 48										Grading light gray
													Total Depth = 50.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.964315, Long. -101.761880

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LOG OF BORING TL-15

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 5/6/2025

DRILLING METHOD(S):
Hollow Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 24 ft. during drilling and not measured immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	FIELD DATA: N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													6 in. Topsoil
			N = 13										SILTY SAND (SM), brown, medium dense, dry to moist, fine grained
	5		N = 16										CLAYEY SAND (SC), light brown, loose, dry to moist, fine grained, iron stained
			N = 10										
	10		N = 45										SANDY LEAN CLAY (CL), brown, hard, dry to moist, iron stained
			N = 50/6"										Grading trace Sandstone fragments
													SILT (ML), trace Sand, light brown, hard, dry to moist
	15		N = 53										POORLY-GRADED SAND (SP), light brown, dense to very dense, dry to moist, fine grained, iron stained, micaceous
	20		N = 50										
	25		N = 55										Grading wet
	30		N = 32										Grading dark gray
													Total Depth = 30.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.962040, Long. -101.761888

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LOG OF BORING TL-16

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/29/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 25 ft. during drilling and measured at 27 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT LL	ATTERBERG LIMITS: PLASTIC LIMIT PL	ATTERBERG LIMITS: PLASTICITY INDEX PI	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													2 in. Topsoil
			N = 14										CLAYEY SAND (SC), light brown to brown, medium dense to dense, dry to moist, fine grained, iron stained, trace roots
	5		N = 14										Grading light gray
			N = 49										Grading brown to dark brown
	10		N = 43										
			N = 42										
	15		N = 45										
	20		N = 47										
	25		N = 50	▽									Grading wet
				▼									
	30		N = 91/10"										SANDSTONE, brown, very hard, moist, fine grained, weakly cemented
													Total Depth = 30.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.960133, Long. -101.761890

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LOG OF BORING TL-17

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/29/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 12 ft. during drilling and measured at 24 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
			N = 6										3 in. Topsoil LEAN CLAY (CL), with Sand, dark brown, medium stiff, dry to moist
	5		N = 4										CLAYEY SAND (SC), light brown to light gray, loose to dense, dry to moist, fine to medium grained
			N = 8										Grading gray
	10		N = 19										Grading brown, iron stained
			N = 59										Grading dark gray, wet
	15		N = 30										
	20		N = 33										
	25		N = 35										LEAN CLAY (CL), with Sand, dark brown to gray, hard, moist to wet, trace organics
	30		N = 35										Grading trace Sand, dark gray
													Total Depth = 30.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.958219, Long. -101.761891

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LOG OF BORING TL-18

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026
DATE(S) DRILLED: 4/29/2025

DRILLING METHOD(S):
Solid Stem Auger

GROUNDWATER INFORMATION:
Groundwater encountered at 10 ft. during drilling and measured at 47 ft. immediately after drilling

SURFACE ELEVATION (FT):

SOIL SYMBOL	DEPTH (FT)	SAMPLES	N: BLOWS/FT P: TONS/SQ FT T: BLOWS R: % RQD: %	MOISTURE CONTENT (%)	ATTERBERG LIMITS: LIQUID LIMIT (LL)	ATTERBERG LIMITS: PLASTIC LIMIT (PL)	ATTERBERG LIMITS: PLASTICITY INDEX (PI)	DRY DENSITY POUNDS/CU.FT	COMPRESSIVE STRENGTH (TONS/SQ. FT)	STRAIN AT FAILURE (%)	CONFINING PRESSURE (POUNDS/SQ IN)	MINUS NO. 200 SIEVE (%)	DESCRIPTION OF STRATUM
													3 in. Topsoil
			N = 4										CLAYEY SAND (SC), light brown, very loose to very dense, dry to moist, fine grained
	5		N = 3										Grading gray
			N = 12										
	10		N = 27	▽									Grading wet
			N = 36										
	15		N = 49										Grading trace Lignite
	20		N = 50/6"										Grading gray
	25		N = 41										LIGNITE, dark brown, hard, moist to wet
	30		N = 50										LEAN CLAY (CL), with Sand, gray, hard, moist to wet
	35		N = 38										
	40		N = 51										SILT (ML), trace Sand, gray, hard, moist to wet
	45		N = 37	▼									LEAN CLAY (CL), with Sand, gray, hard, moist to wet
	50		N = 41										Grading trace Lignite
													Total Depth = 50.5 ft.

N - STANDARD PENETRATION TEST RESISTANCE
P - POCKET PENETROMETER RESISTANCE
T - TXDOT CONE PENETRATION RESISTANCE
R - ROCK CORE RECOVERY
RQD - ROCK QUALITY DESIGNATION

REMARKS:
GPS COORDINATES: Lat. 46.956549, Long. -101.761892

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810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78661
512.992.2087

APPENDIX B

MOISTURE-DENSITY RELATIONSHIP

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
Telephone: (512) 358-6048

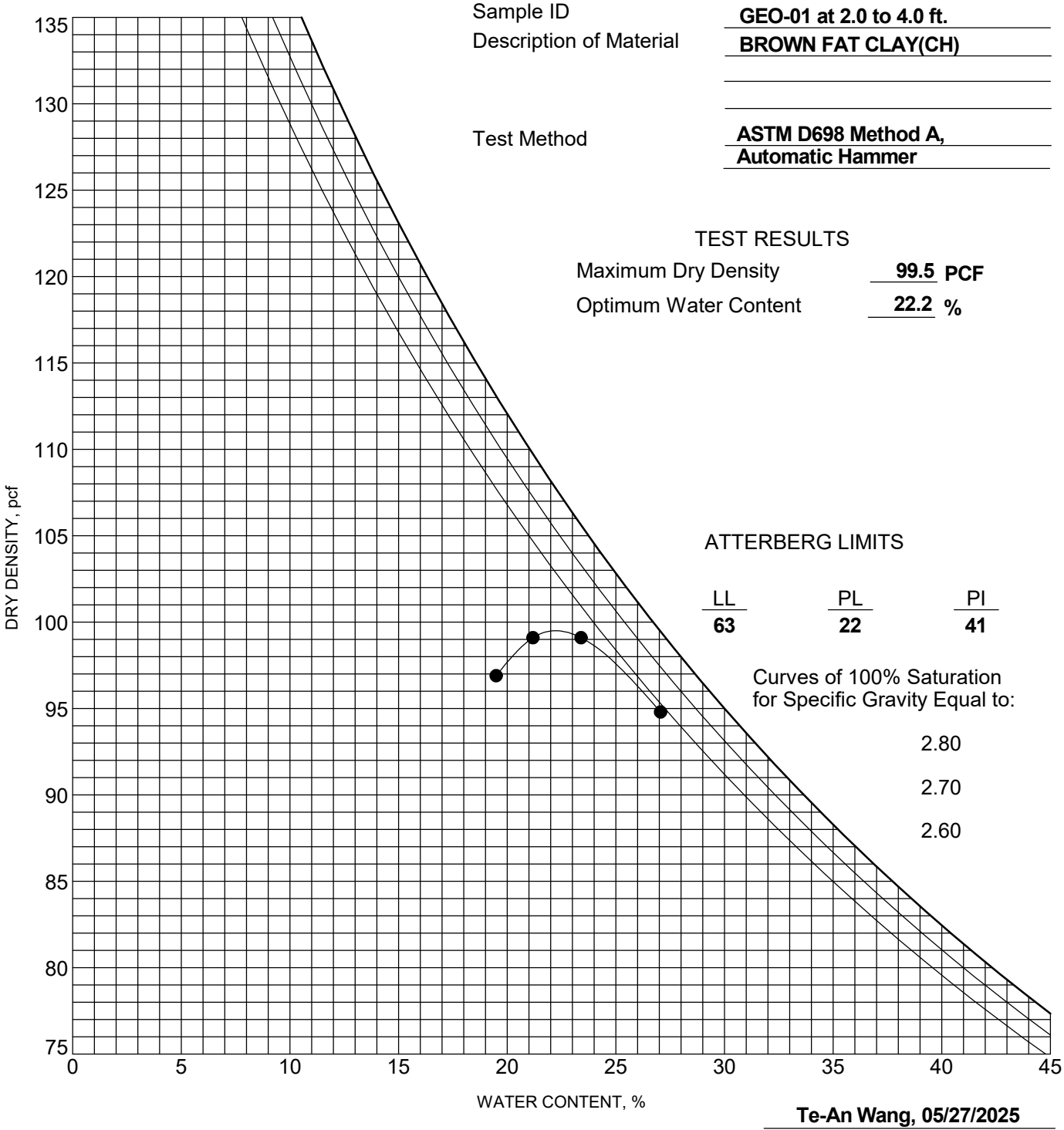
CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026

Sample ID: **GEO-01 at 2.0 to 4.0 ft.**
Description of Material: **BROWN FAT CLAY(CH)**

Test Method: **ASTM D698 Method A, Automatic Hammer**

TEST RESULTS

Maximum Dry Density	**99.5**	**PCF**
Optimum Water Content	**22.2**	**%**



ATTERBERG LIMITS

LL	PL	PI
63	**22**	**41**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80
2.70
2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

Specimens prepared by: T.W.

The results shown on this report are for the exclusive use of the client for whom they were obtained and apply only to the sample tested and / or inspected. They are not intended to be indicative of qualities of apparently identical products. The use of our name must recieve prior written approval. Reports must be reproduced in their entirety. Unauthorized use or copying of this document is strictly prohibited by anyone other than the client for the specific project.

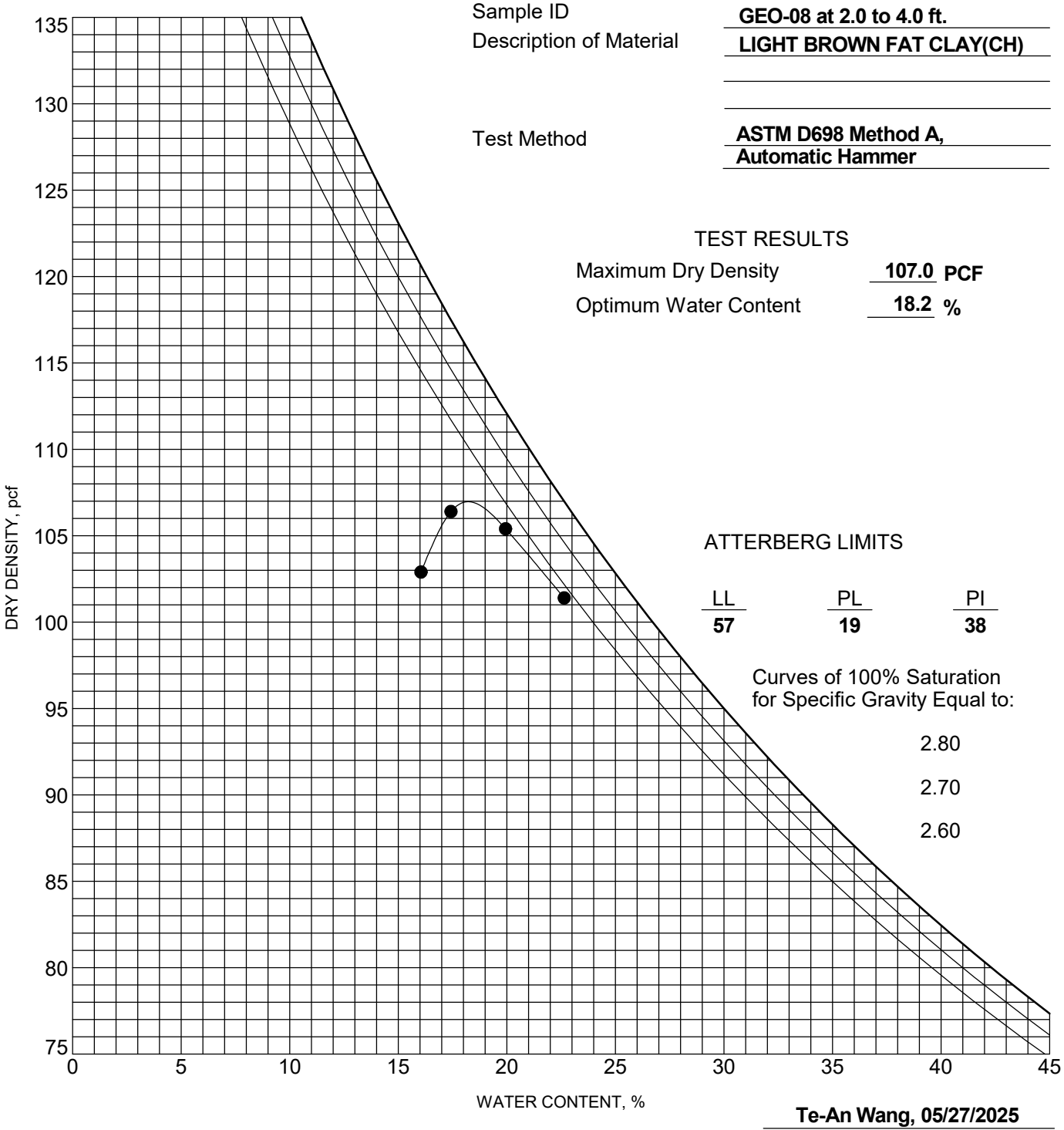
MOISTURE-DENSITY RELATIONSHIP

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
Telephone: (512) 358-6048

CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026

Sample ID: **GEO-08 at 2.0 to 4.0 ft.**
Description of Material: **LIGHT BROWN FAT CLAY(CH)**

Test Method: **ASTM D698 Method A, Automatic Hammer**



TEST RESULTS

Maximum Dry Density	**107.0**	**PCF**
Optimum Water Content	**18.2**	**%**

ATTERBERG LIMITS

LL	PL	PI
57	**19**	**38**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80
2.70
2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

Specimens prepared by: T.W.

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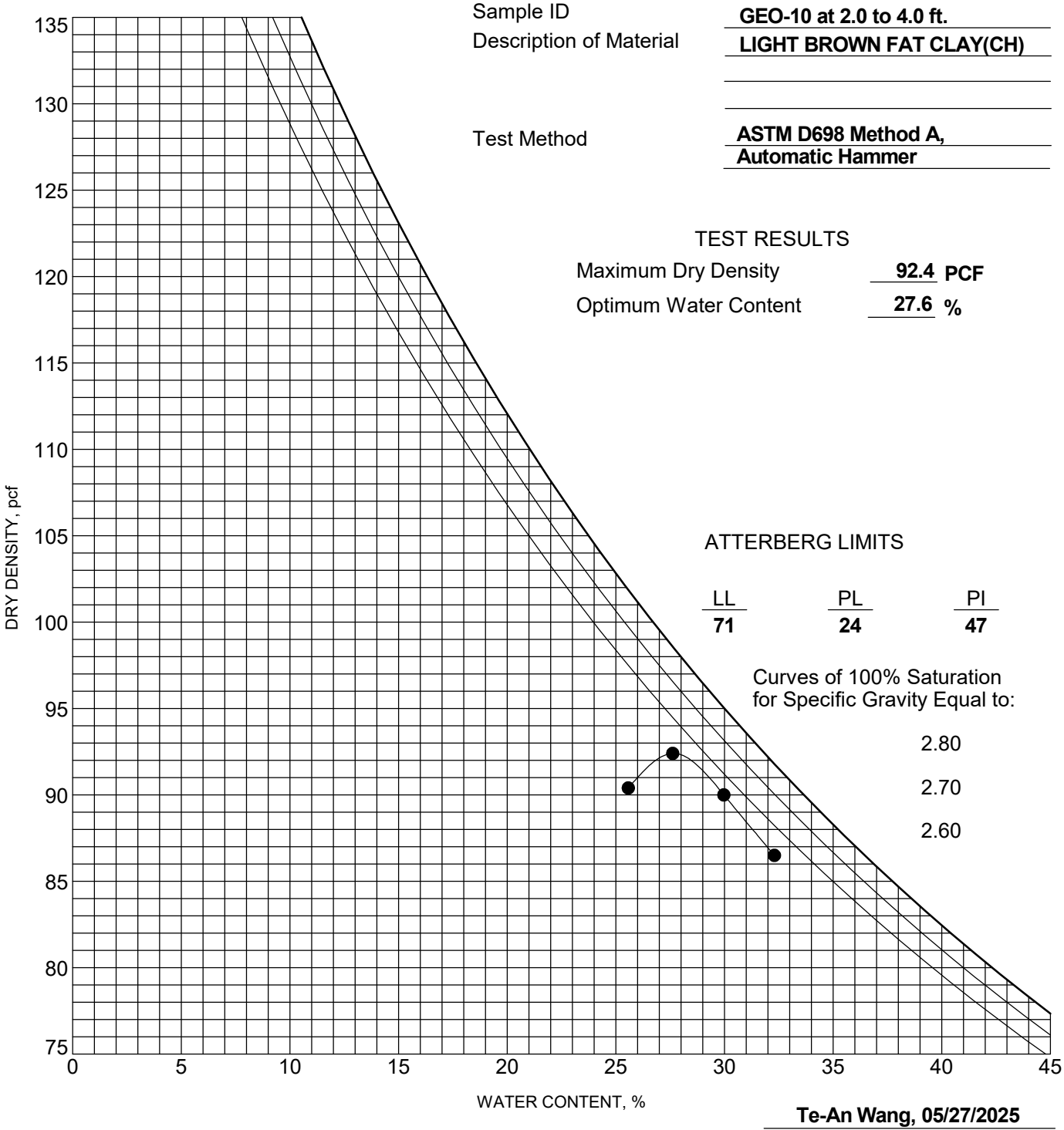
MOISTURE-DENSITY RELATIONSHIP

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
Telephone: (512) 358-6048

CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026

Sample ID: **GEO-10 at 2.0 to 4.0 ft.**
Description of Material: **LIGHT BROWN FAT CLAY(CH)**

Test Method: **ASTM D698 Method A, Automatic Hammer**



TEST RESULTS

Maximum Dry Density	**92.4**	**PCF**
Optimum Water Content	**27.6**	**%**

ATTERBERG LIMITS

LL	PL	PI
71	**24**	**47**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80
2.70
2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

Specimens prepared by: T.W.

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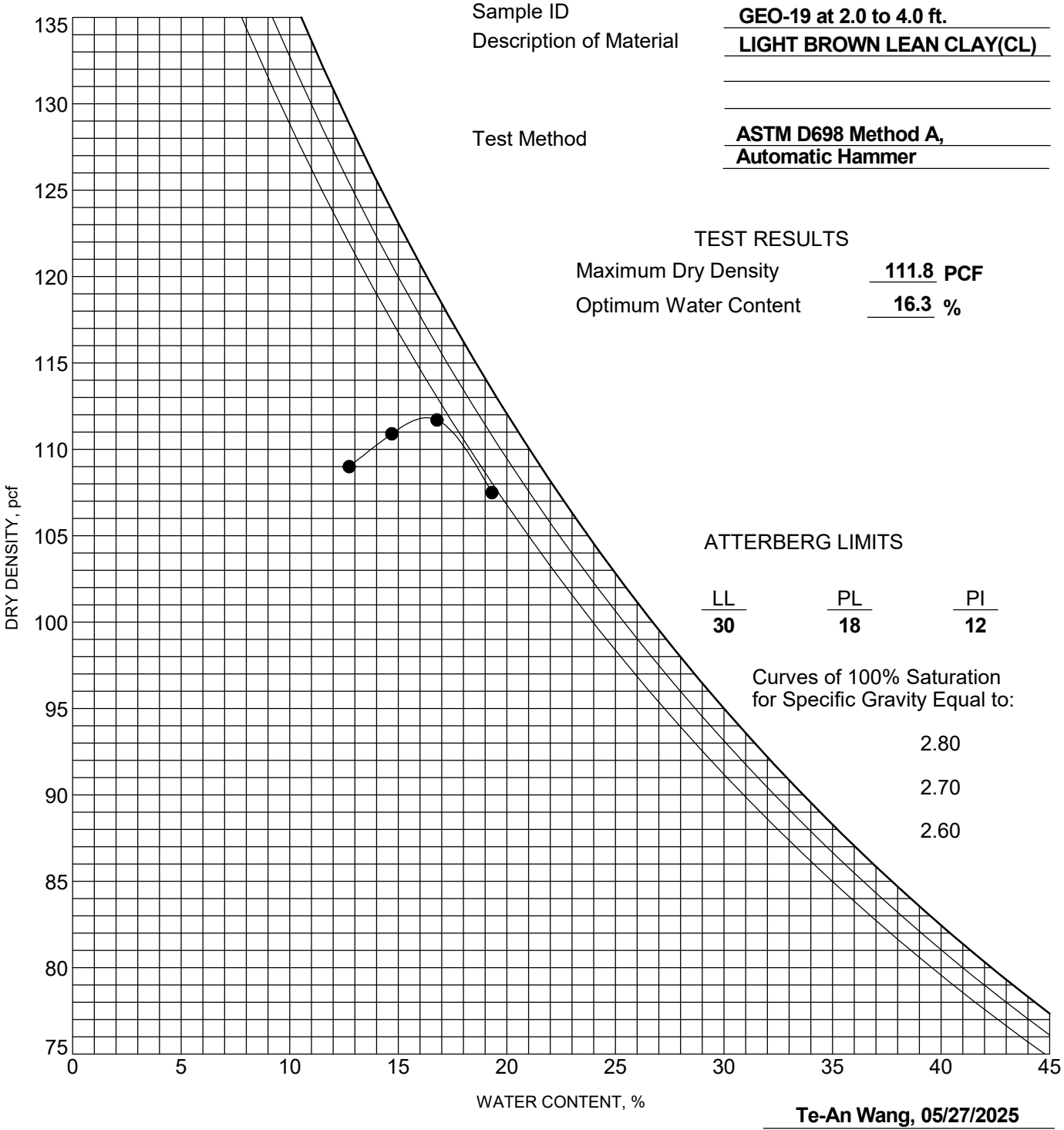
MOISTURE-DENSITY RELATIONSHIP

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
Telephone: (512) 358-6048

CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026

Sample ID: **GEO-19 at 2.0 to 4.0 ft.**
Description of Material: **LIGHT BROWN LEAN CLAY(CL)**

Test Method: **ASTM D698 Method A, Automatic Hammer**



TEST RESULTS

Maximum Dry Density	**111.8**	**PCF**
Optimum Water Content	**16.3**	**%**

ATTERBERG LIMITS

LL	PL	PI
30	**18**	**12**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80
2.70
2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

Specimens prepared by: T.W.

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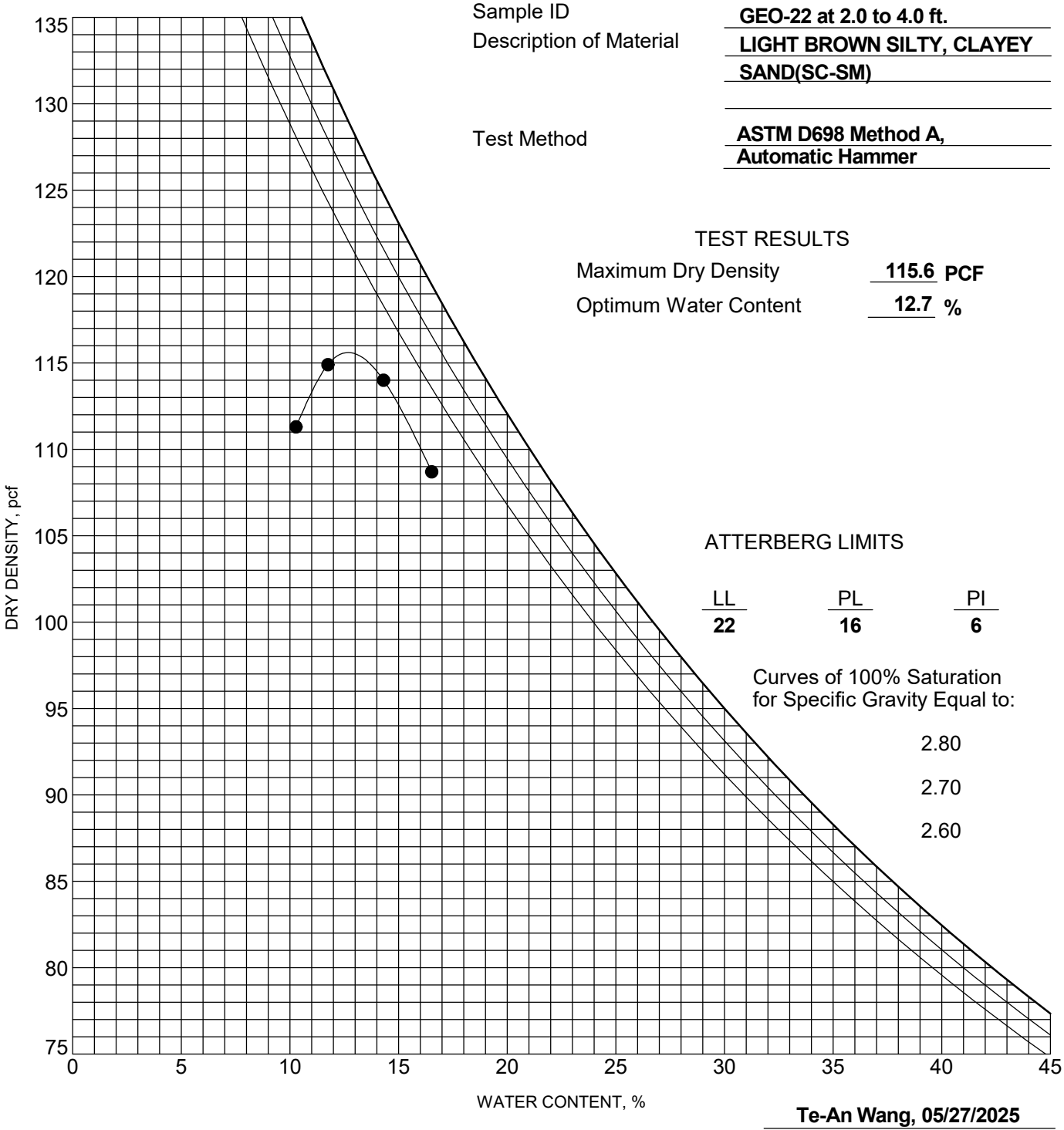
MOISTURE-DENSITY RELATIONSHIP

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
Telephone: (512) 358-6048

CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026

Sample ID: **GEO-22 at 2.0 to 4.0 ft.**
Description of Material: **LIGHT BROWN SILTY, CLAYEY SAND(SC-SM)**

Test Method: **ASTM D698 Method A, Automatic Hammer**



TEST RESULTS

Maximum Dry Density	**115.6**	**PCF**
Optimum Water Content	**12.7**	**%**

ATTERBERG LIMITS

LL	PL	PI
22	**16**	**6**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80
2.70
2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

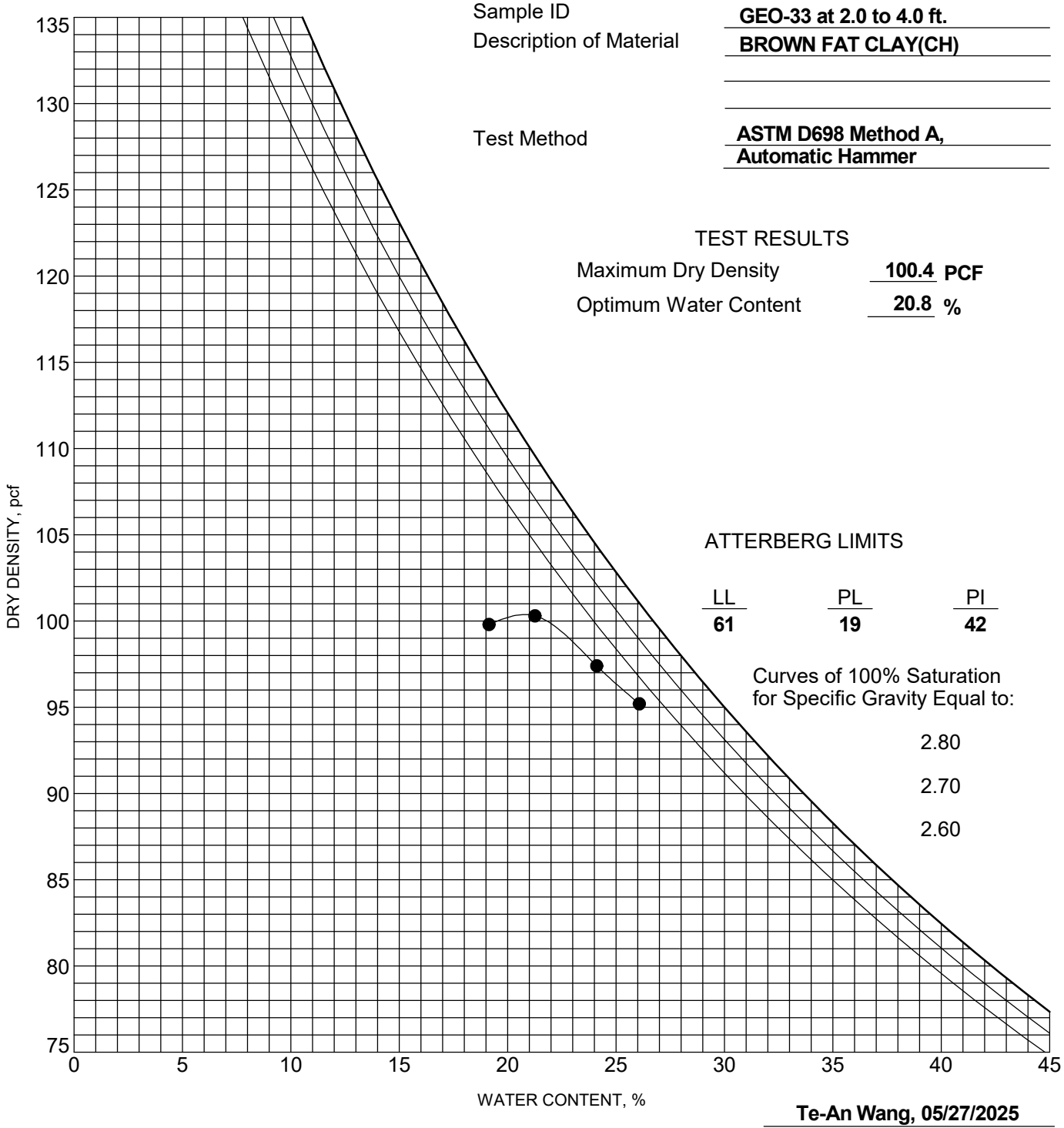
Specimens prepared by: T.W.

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MOISTURE-DENSITY RELATIONSHIP

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
Telephone: (512) 358-6048

CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026



Sample ID: **GEO-33 at 2.0 to 4.0 ft.**
Description of Material: **BROWN FAT CLAY(CH)**

Test Method: **ASTM D698 Method A, Automatic Hammer**

TEST RESULTS

Maximum Dry Density	**100.4**	**PCF**
Optimum Water Content	**20.8**	**%**

ATTERBERG LIMITS

LL	PL	PI
61	**19**	**42**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80
2.70
2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

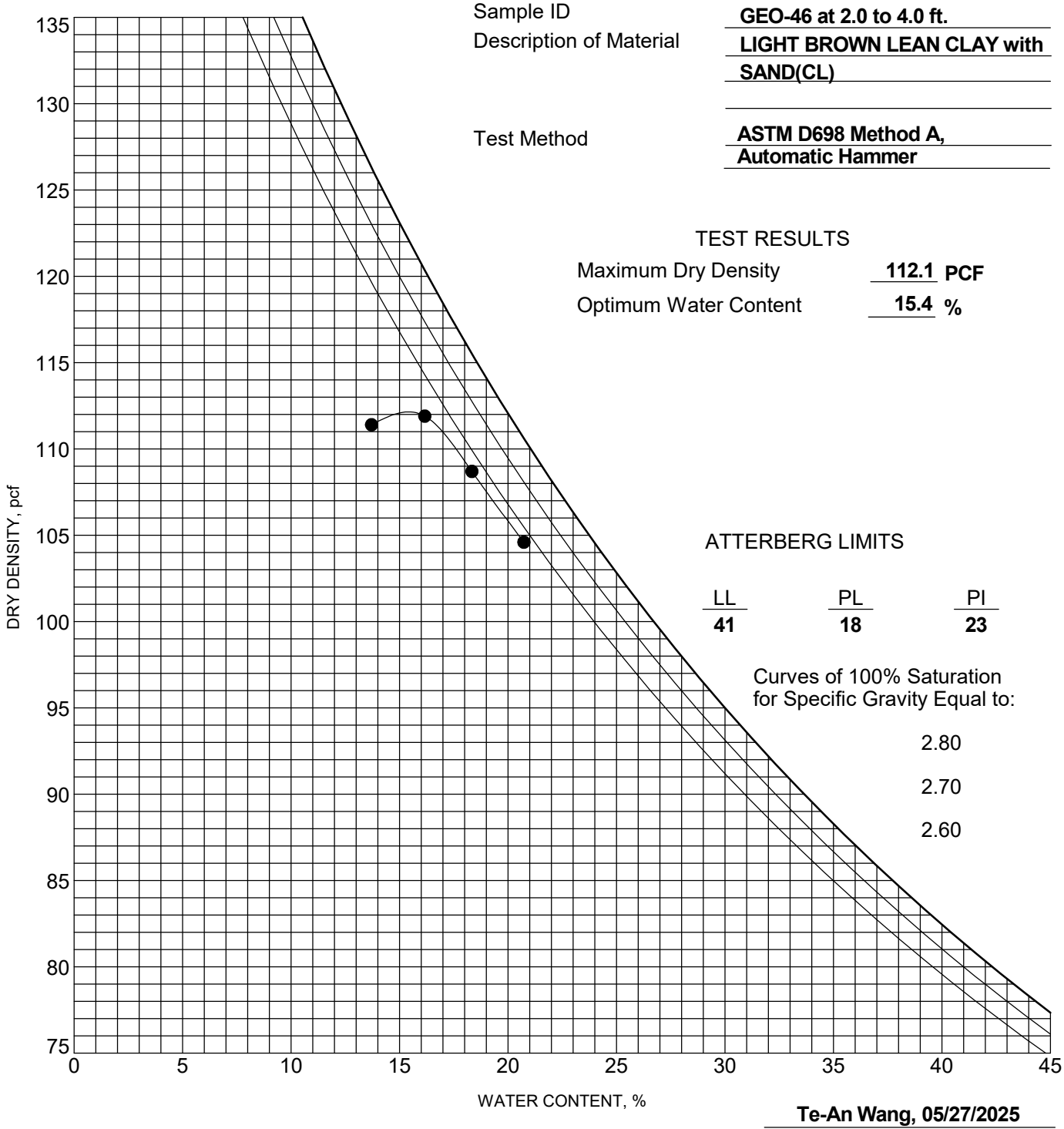
Specimens prepared by: T.W.

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Telephone: (512) 358-6048

CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026



Sample ID: **GEO-46 at 2.0 to 4.0 ft.**

Description of Material: **LIGHT BROWN LEAN CLAY with SAND(CL)**

Test Method: **ASTM D698 Method A, Automatic Hammer**

TEST RESULTS

Maximum Dry Density	**112.1**	**PCF**
Optimum Water Content	**15.4**	**%**

ATTERBERG LIMITS

LL	PL	PI
41	**18**	**23**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

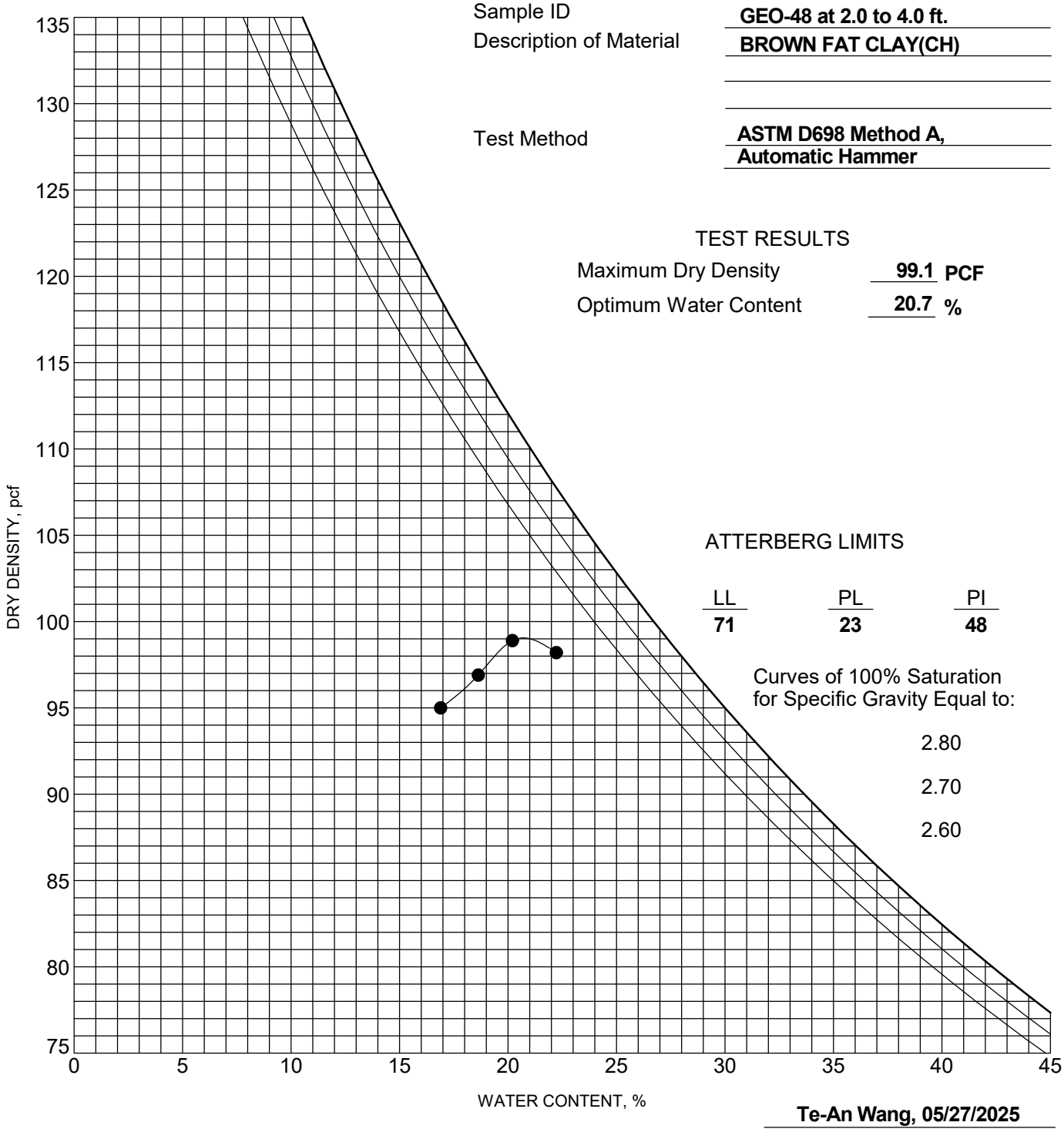
Specimens prepared by: T.W.

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Telephone: (512) 358-6048

CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026



Sample ID: **GEO-48 at 2.0 to 4.0 ft.**
Description of Material: **BROWN FAT CLAY(CH)**

Test Method: **ASTM D698 Method A, Automatic Hammer**

TEST RESULTS

Maximum Dry Density	**99.1**	**PCF**
Optimum Water Content	**20.7**	**%**

ATTERBERG LIMITS

LL	PL	PI
71	**23**	**48**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80
2.70
2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

Specimens prepared by: T.W.

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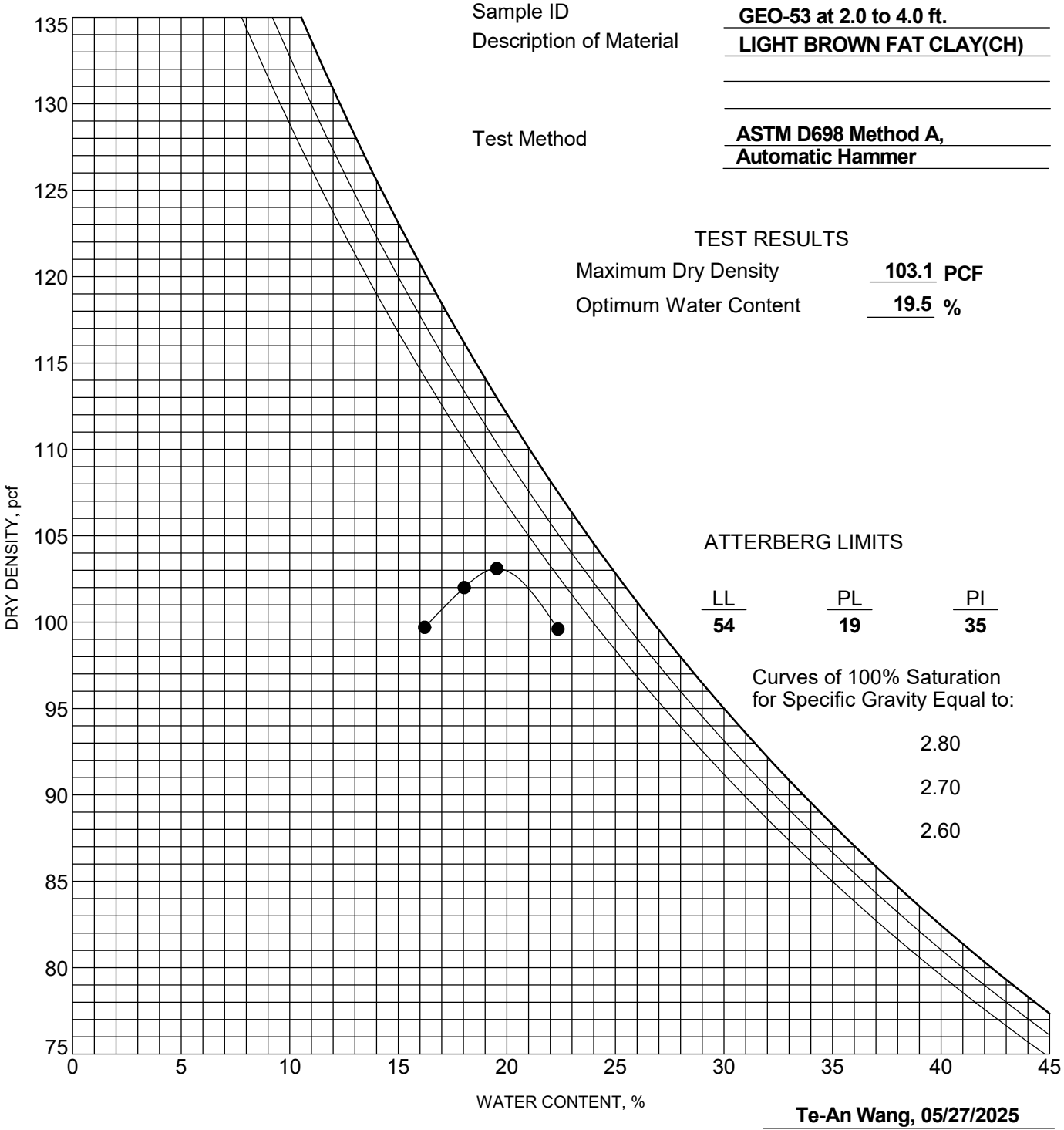
CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026

Sample ID: **GEO-53 at 2.0 to 4.0 ft.**
Description of Material: **LIGHT BROWN FAT CLAY(CH)**

Test Method: **ASTM D698 Method A, Automatic Hammer**

TEST RESULTS

Maximum Dry Density	**103.1**	**PCF**
Optimum Water Content	**19.5**	**%**



ATTERBERG LIMITS

LL	PL	PI
54	**19**	**35**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80
2.70
2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

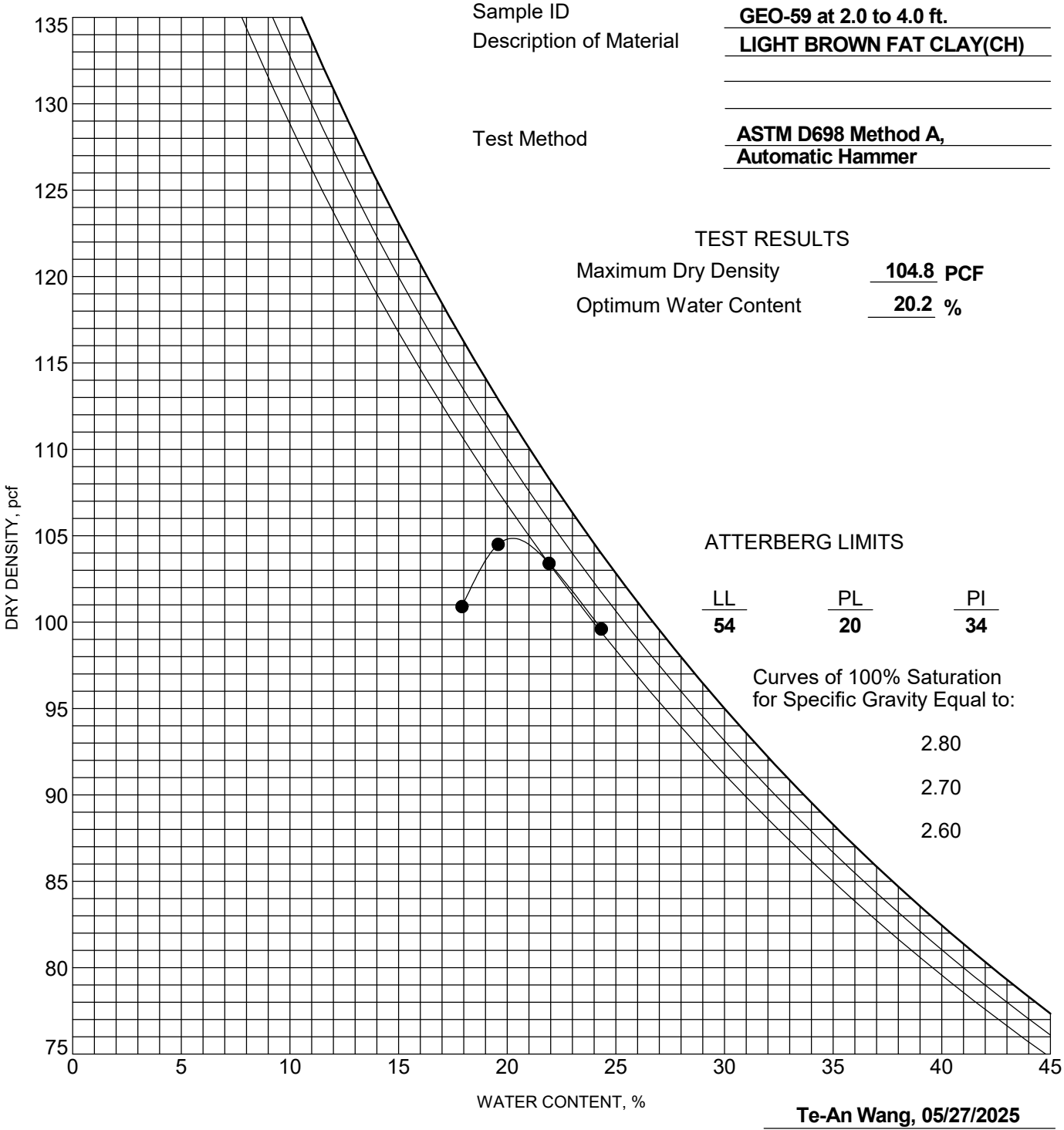
Specimens prepared by: T.W.

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Telephone: (512) 358-6048

CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026



Sample ID: **GEO-59 at 2.0 to 4.0 ft.**
Description of Material: **LIGHT BROWN FAT CLAY(CH)**

Test Method: **ASTM D698 Method A, Automatic Hammer**

TEST RESULTS

Maximum Dry Density	**104.8**	**PCF**
Optimum Water Content	**20.2**	**%**

ATTERBERG LIMITS

LL	PL	PI
54	**20**	**34**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80
2.70
2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

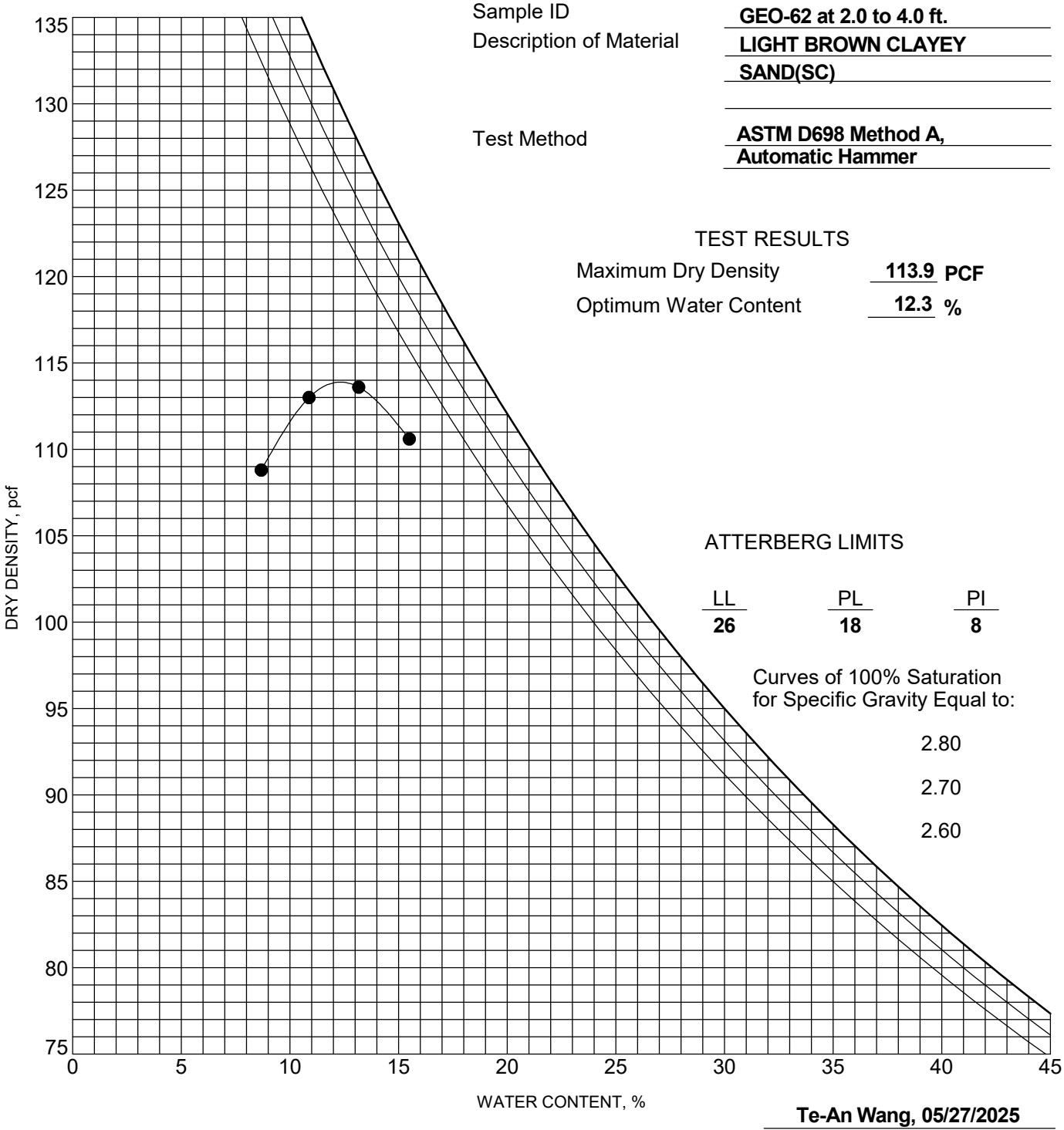
Specimens prepared by: T.W.

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Round Rock, TX 78664
Telephone: (512) 358-6048

CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026



Sample ID: **GEO-62 at 2.0 to 4.0 ft.**

Description of Material: **LIGHT BROWN CLAYEY SAND(SC)**

Test Method: **ASTM D698 Method A, Automatic Hammer**

TEST RESULTS

Maximum Dry Density	**113.9**	**PCF**
Optimum Water Content	**12.3**	**%**

ATTERBERG LIMITS

LL	PL	PI
26	**18**	**8**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

Specimens prepared by: T.W.

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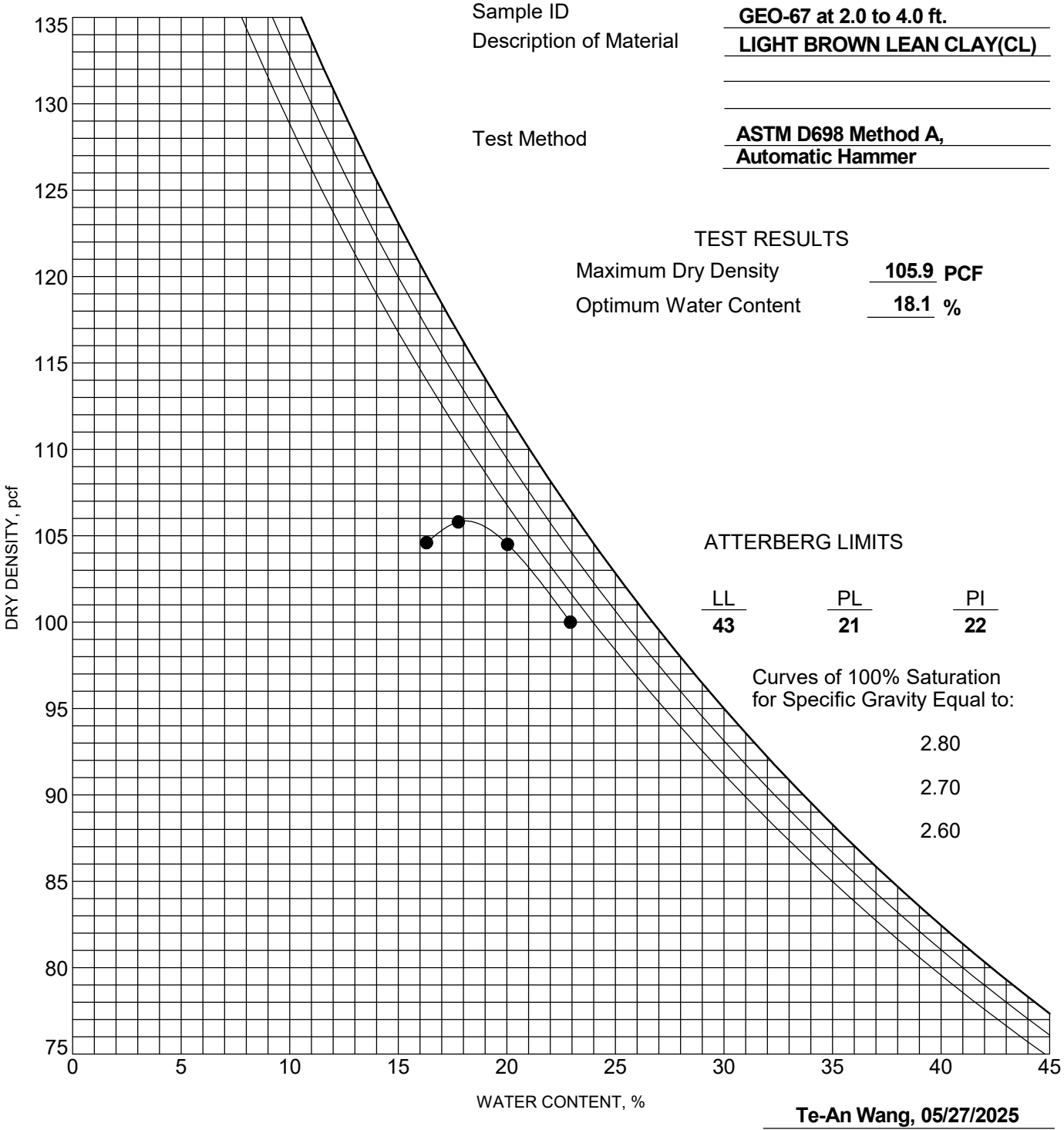
MOISTURE-DENSITY RELATIONSHIP

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
Telephone: (512) 358-6048

CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026

Sample ID: **GEO-67 at 2.0 to 4.0 ft.**
Description of Material: **LIGHT BROWN LEAN CLAY(CL)**

Test Method: **ASTM D698 Method A, Automatic Hammer**



TEST RESULTS

Maximum Dry Density	**105.9**	**PCF**
Optimum Water Content	**18.1**	**%**

ATTERBERG LIMITS

LL	PL	PI
43	**21**	**22**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80
2.70
2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

Specimens prepared by: T.W.

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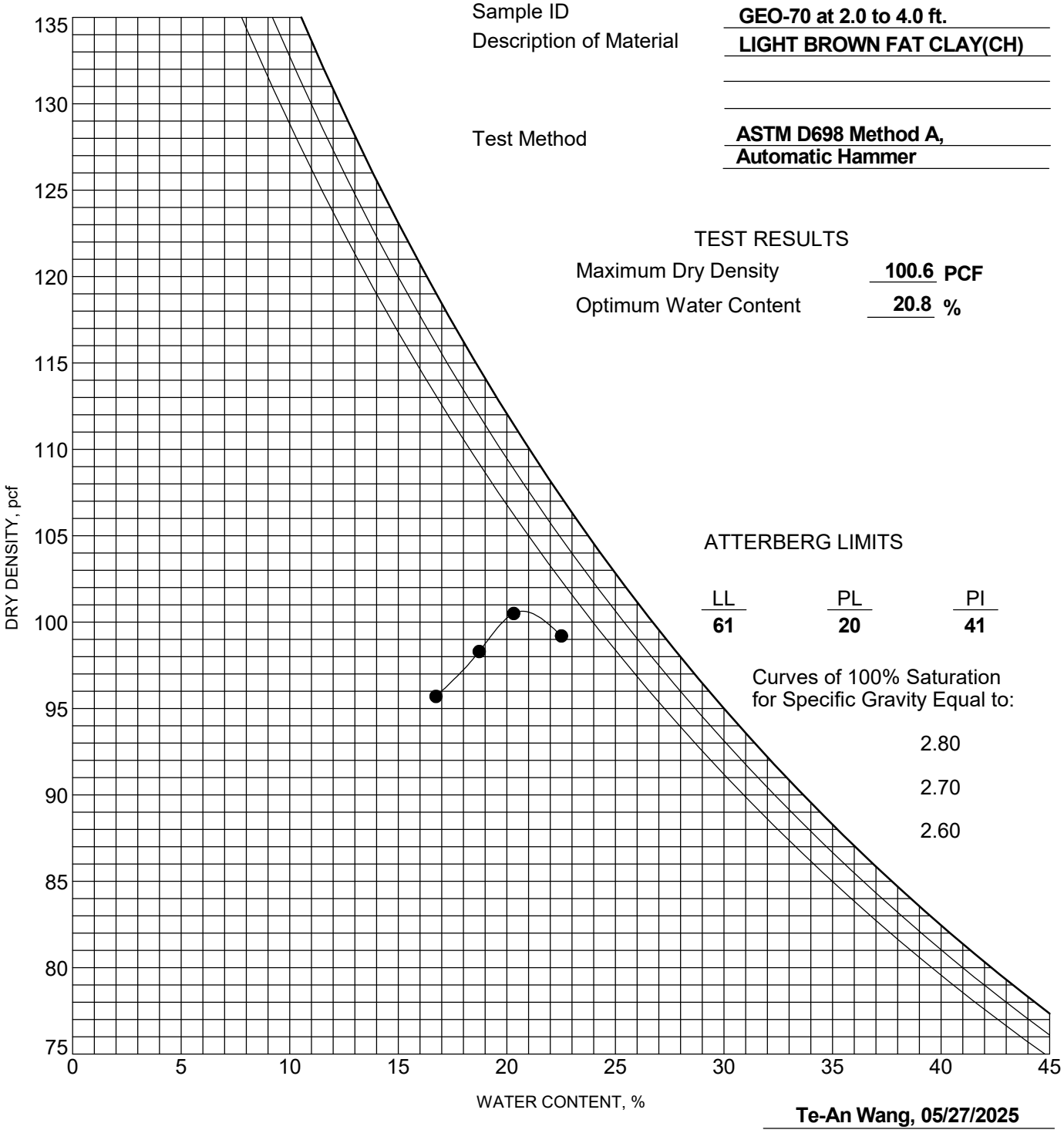
MOISTURE-DENSITY RELATIONSHIP

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3801 Doris Lane, Suite B
Round Rock, TX 78664
Telephone: (512) 358-6048

CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026

Sample ID: **GEO-70 at 2.0 to 4.0 ft.**
Description of Material: **LIGHT BROWN FAT CLAY(CH)**

Test Method: **ASTM D698 Method A, Automatic Hammer**



TEST RESULTS

Maximum Dry Density	**100.6**	**PCF**
Optimum Water Content	**20.8**	**%**

ATTERBERG LIMITS

LL	PL	PI
61	**20**	**41**

Curves of 100% Saturation for Specific Gravity Equal to:

2.80
2.70
2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

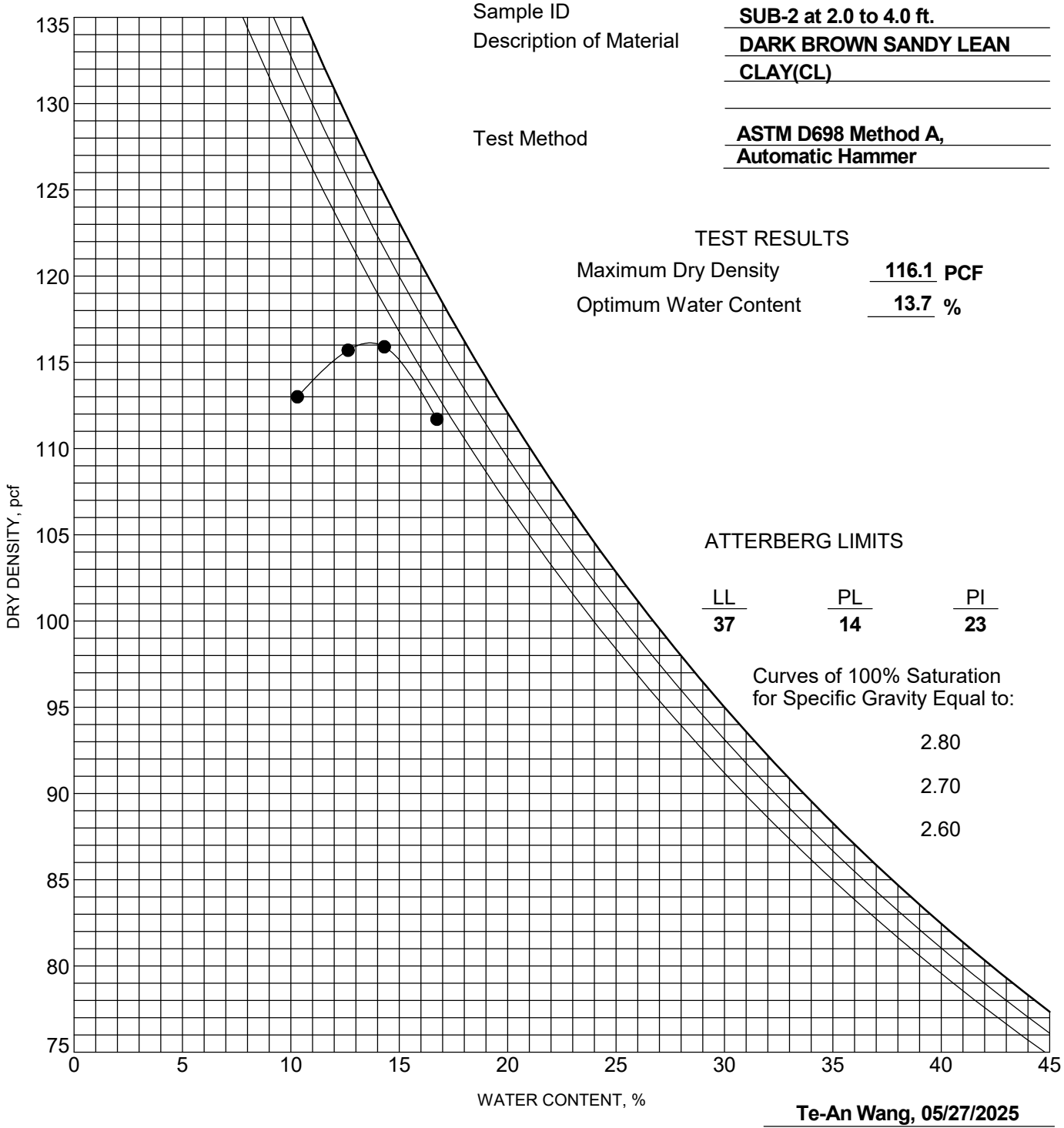
Specimens prepared by: T.W.

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3801 Doris Lane, Suite B
Round Rock, TX 78664
Telephone: (512) 358-6048

CLIENT: RRC Power & Energy, LLC
PROJECT: Longspur Wind Project
LOCATION: Morton County, ND
NUMBER: GE2503026



Sample ID: **SUB-2 at 2.0 to 4.0 ft.**

Description of Material: **DARK BROWN SANDY LEAN CLAY(CL)**

Test Method: **ASTM D698 Method A, Automatic Hammer**

TEST RESULTS

Maximum Dry Density: **116.1** PCF

Optimum Water Content: **13.7** %

ATTERBERG LIMITS

LL	PL	PI
37	14	23

Curves of 100% Saturation for Specific Gravity Equal to:

2.80

2.70

2.60

Te-An Wang, 05/27/2025
Analysis & Quality Review/Date

Specimens prepared by: T.W.

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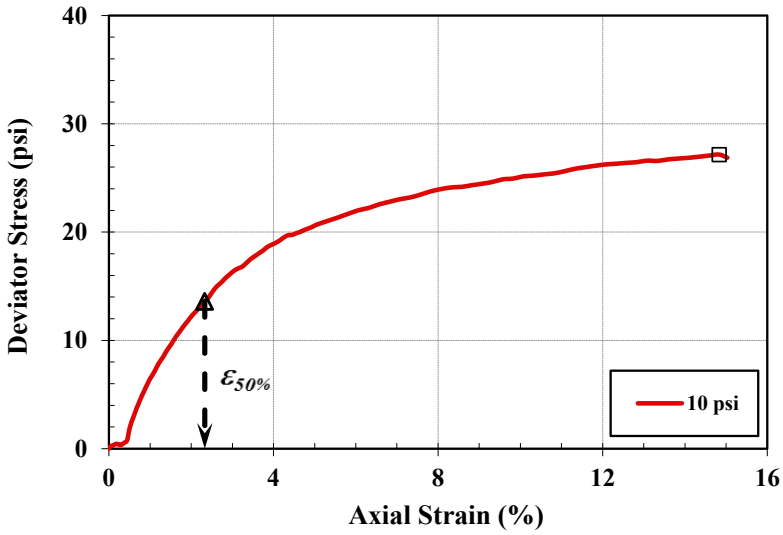
Unconsolidated-Undrained Triaxial Compression Test

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample No.: GEO-04 at 12 ft

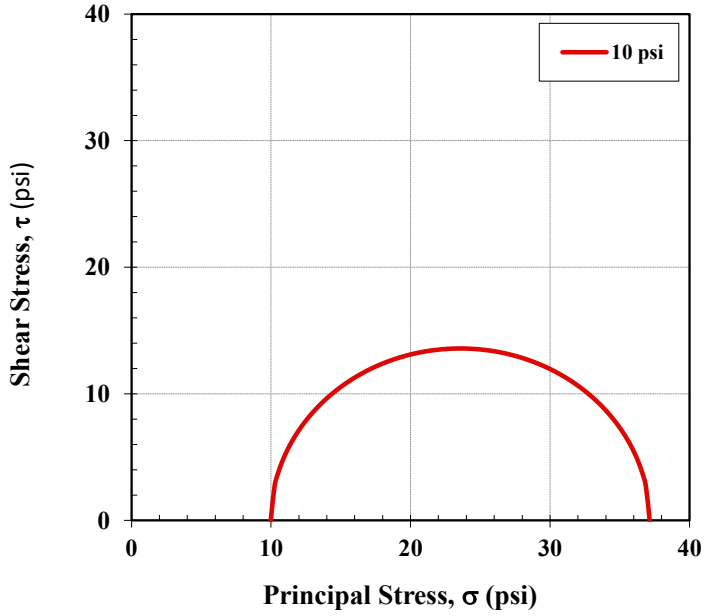
Project No.: GE2503026
Type of Test: Q-Test
Test Date: 6/3/2025

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Method: ASTM D2850

Principal Stress Difference vs. Axial Strain



Mohr Circles (Total Stress) for Peak Stress at Failure



Initial Specimen Conditions		
Confining Pressure (psi)		10.0
Avg. Diameter (in)	D_o	2.86
Avg. Height (in)	H_o	5.55
In-situ Water Content (%)	w_o	23.0
Total Unit Weight (pcf)	γ_{total}	126.7
Dry Unit Weight (pcf)	γ_{dry}	103.0
Saturation (%)	S_r	97.6
Void Ratio	e_o	0.64
Specific Gravity (Assumed)	G_s	2.70

Stresses at Failure	
Maximum Deviator Stress (psi)	27.2
Axial Strain at Failure (%)	14.8
Axial Strain at 50% of q_u, ε_{50} (%)	2.3
Total Stresses at Failure	
Major Principal Stress Corrected, σ_{1C} (psi)	37.1
Minor Principal Stress, σ_3 (psi)	10.0

Test Results	
Unconsolidated-Undrained Compressive Strength at Failure, $\sigma_{1C} - \sigma_3$ **(tsf)**	1.96

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Kainat Batool, 06/04/25
Analysis & Quality Review/Date
Specimen Prepared by: A.B.

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Unconsolidated-Undrained Triaxial Compression Test Appendix

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Specimen: GEO-04 at 12 ft

Project No.: GE2503026
Test Method: ASTM D2850
Test Date: 06/03/25





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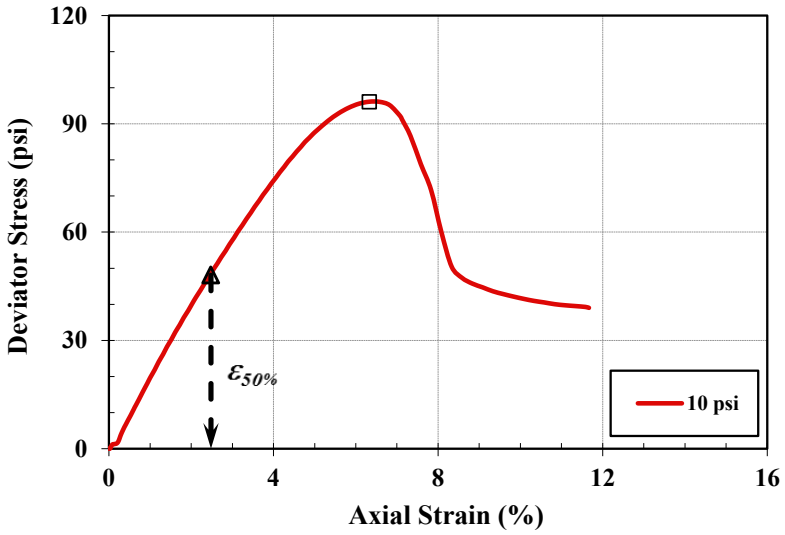
Unconsolidated-Undrained Triaxial Compression Test

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample No.: GEO-07 at 12 ft

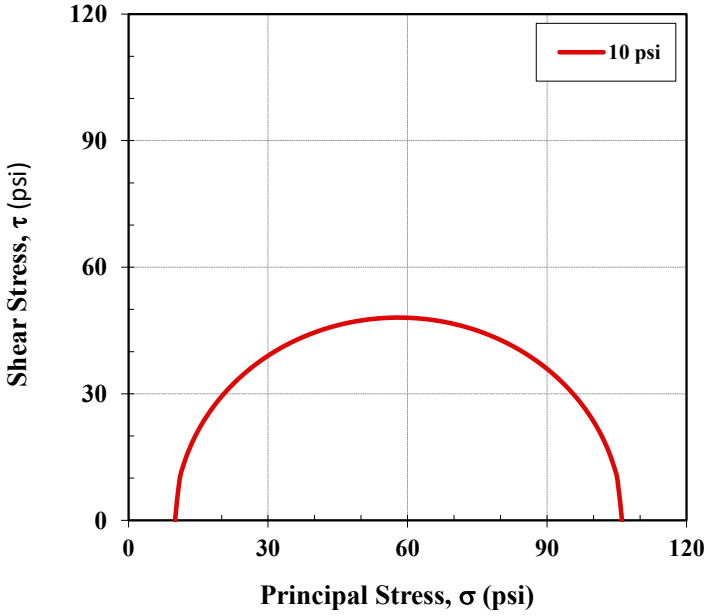
Project No.: GE2503026
Type of Test: Q-Test
Test Date: 6/3/2025

Type of Specimen: Modified CA Tube
Strain Rate: 1.0 %/min
Test Method: ASTM D2850

Principal Stress Difference vs. Axial Strain



Mohr Circles (Total Stress) for Peak Stress at Failure



Initial Specimen Conditions		
Confining Pressure (psi)		10.0
Avg. Diameter (in)	D_o	2.40
Avg. Height (in)	H_o	4.87
In-situ Water Content (%)	w_o	27.2
Total Unit Weight (pcf)	γ_{total}	125.9
Dry Unit Weight (pcf)	γ_{dry}	98.9
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.70
Specific Gravity (Assumed)	G_s	2.70

Stresses at Failure	
Maximum Deviator Stress (psi)	96.1
Axial Strain at Failure (%)	6.3
Axial Strain at 50% of q_u, ε_{50} (%)	2.5
Total Stresses at Failure	
Major Principal Stress Corrected, σ_{1C} (psi)	106.1
Minor Principal Stress, σ_3 (psi)	10.0

Test Results	
Unconsolidated-Undrained Compressive Strength at Failure, $\sigma_{1C} - \sigma_3$ (tsf)	6.92

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

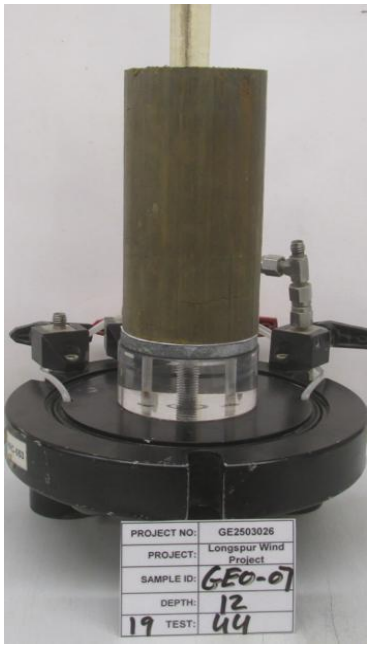
Kainat Batool, 06/04/25
Analysis & Quality Review/Date
Specimen Prepared by: A.B.

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Unconsolidated-Undrained Triaxial Compression Test Appendix

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Specimen: GEO-07 at 12 ft

Project No.: GE2503026
Test Method: ASTM D2850
Test Date: 06/03/25





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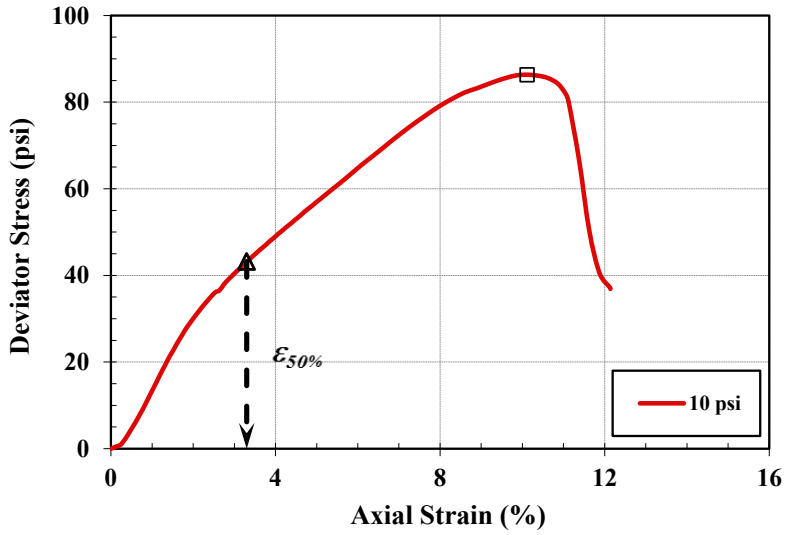
Unconsolidated-Undrained Triaxial Compression Test

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample No.: GEO-46 at 12 ft

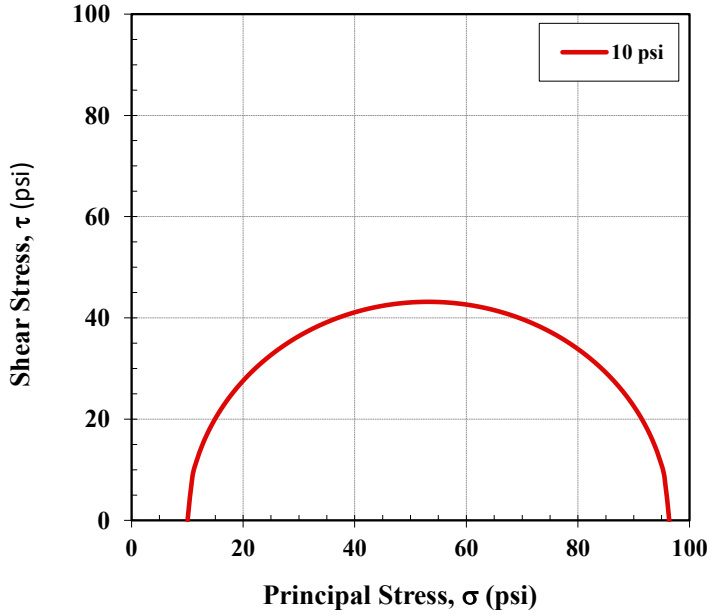
Project No.: GE2503026
Type of Test: Q-Test
Test Date: 6/5/2025

Type of Specimen: Modified CA Tube
Strain Rate: 1.0 %/min
Test Method: ASTM D2850

Principal Stress Difference vs. Axial Strain



Mohr Circles (Total Stress) for Peak Stress at Failure



Initial Specimen Conditions		
Confining Pressure (psi)		10.0
Avg. Diameter (in)	D_o	2.40
Avg. Height (in)	H_o	4.84
In-situ Water Content (%)	w_o	22.6
Total Unit Weight (pcf)	γ_{total}	127.8
Dry Unit Weight (pcf)	γ_{dry}	104.3
Saturation (%)	S_r	99.0
Void Ratio	e_o	0.62
Specific Gravity (Assumed)	G_s	2.70

Stresses at Failure	
Maximum Deviator Stress (psi)	86.3
Axial Strain at Failure (%)	10.1
Axial Strain at 50% of q_u, ε_{50} (%)	3.3
Total Stresses at Failure	
Major Principal Stress Corrected, σ_{1C} (psi)	96.4
Minor Principal Stress, σ_3 (psi)	10.0

Test Results	
Unconsolidated-Undrained Compressive Strength at Failure, $\sigma_{1C} - \sigma_3$ **(tsf)**	6.22

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 06/09/25
Analysis & Quality Review/Date
Specimen Prepared by: A.B.

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Unconsolidated-Undrained Triaxial Compression Test Appendix

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Specimen: GEO-46 at 12 ft

Project No.: GE2503026
Test Method: ASTM D2850
Test Date: 06/05/25





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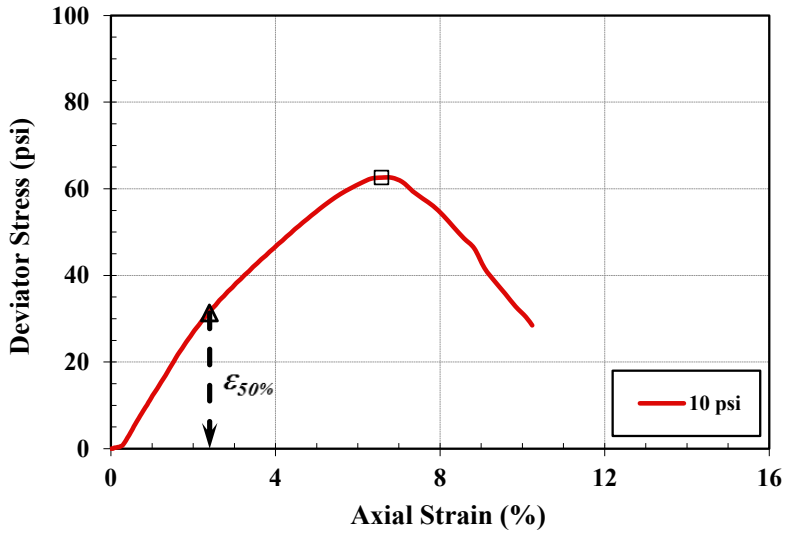
Unconsolidated-Undrained Triaxial Compression Test

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample No.: GEO-62 at 12 ft

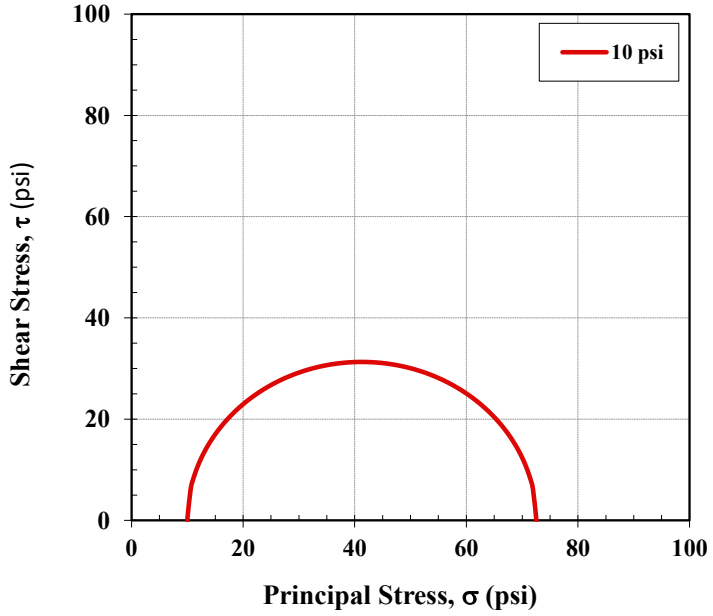
Project No.: GE2503026
Type of Test: Q-Test
Test Date: 6/6/2025

Type of Specimen: Modified CA Tube
Strain Rate: 1.0 %/min
Test Method: ASTM D2850

Principal Stress Difference vs. Axial Strain



Mohr Circles (Total Stress) for Peak Stress at Failure



Initial Specimen Conditions		
Confining Pressure (psi)		10.0
Avg. Diameter (in)	D_o	2.40
Avg. Height (in)	H_o	4.81
In-situ Water Content (%)	w_o	21.3
Total Unit Weight (pcf)	γ_{total}	127.5
Dry Unit Weight (pcf)	γ_{dry}	105.1
Saturation (%)	S_r	95.3
Void Ratio	e_o	0.60
Specific Gravity (Assumed)	G_s	2.70

Stresses at Failure	
Maximum Deviator Stress (psi)	62.6
Axial Strain at Failure (%)	6.6
Axial Strain at 50% of q_u, ε_{50} (%)	2.4
Total Stresses at Failure	
Major Principal Stress Corrected, σ_{1C} (psi)	72.6
Minor Principal Stress, σ_3 (psi)	10.0

Test Results	
Unconsolidated-Undrained Compressive Strength at Failure, $\sigma_{1C} - \sigma_3$ **(tsf)**	4.51

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 06/09/25
Analysis & Quality Review/Date
Specimen Prepared by: A.B.

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Unconsolidated-Undrained Triaxial Compression Test Appendix

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Specimen: GEO-62 at 12 ft

Project No.: GE2503026
Test Method: ASTM D2850
Test Date: 06/06/25





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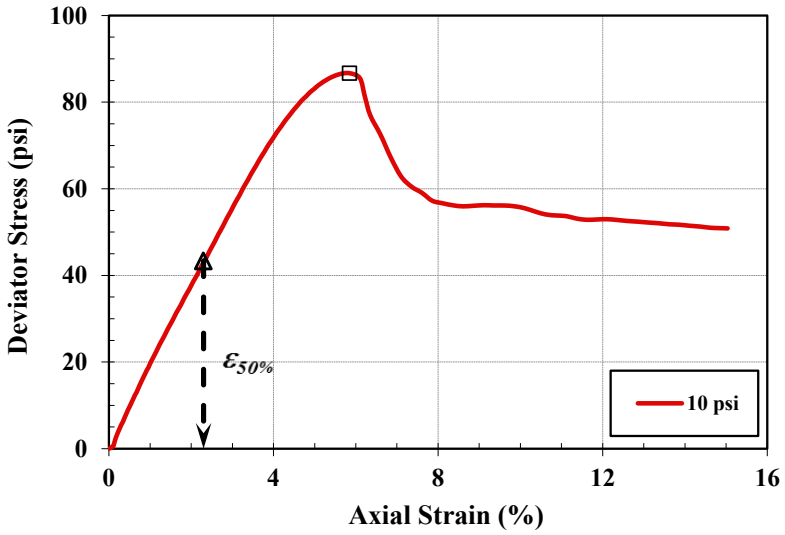
Unconsolidated-Undrained Triaxial Compression Test

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample No.: GEO-66 at 12 ft

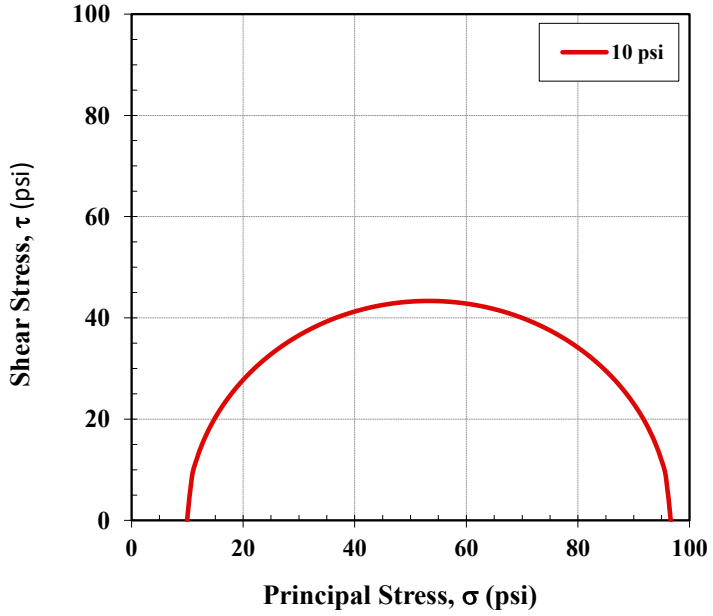
Project No.: GE2503026
Type of Test: Q-Test
Test Date: 6/6/2025

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Method: ASTM D2850

Principal Stress Difference vs. Axial Strain



Mohr Circles (Total Stress) for Peak Stress at Failure



Initial Specimen Conditions		
Confining Pressure (psi)		10.0
Avg. Diameter (in)	D_o	2.86
Avg. Height (in)	H_o	5.64
In-situ Water Content (%)	w_o	21.5
Total Unit Weight (pcf)	γ_{total}	126.6
Dry Unit Weight (pcf)	γ_{dry}	104.2
Saturation (%)	S_r	93.9
Void Ratio	e_o	0.62
Specific Gravity (Assumed)	G_s	2.70

Stresses at Failure	
Maximum Deviator Stress (psi)	86.7
Axial Strain at Failure (%)	5.8
Axial Strain at 50% of q_u, ε_{50} (%)	2.3
Total Stresses at Failure	
Major Principal Stress Corrected, σ_{1C} (psi)	96.6
Minor Principal Stress, σ_3 (psi)	10.0

Test Results	
Unconsolidated-Undrained Compressive Strength at Failure, $\sigma_{1C} - \sigma_3$ **(tsf)**	6.24

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 06/09/25
Analysis & Quality Review/Date
Specimen Prepared by: A.B.

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Unconsolidated-Undrained Triaxial Compression Test Appendix

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Specimen: GEO-66 at 12 ft

Project No.: GE2503026
Test Method: ASTM D2850
Test Date: 06/06/25





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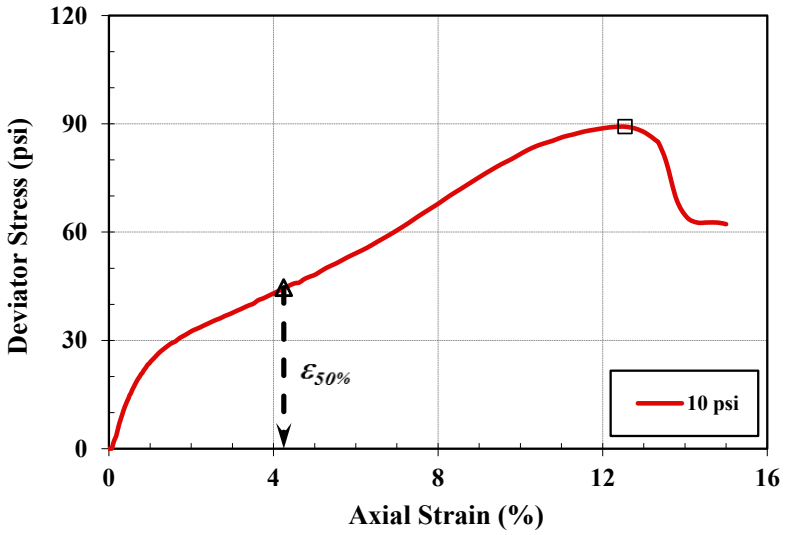
Unconsolidated-Undrained Triaxial Compression Test

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample No.: GEO-077 at 12 ft

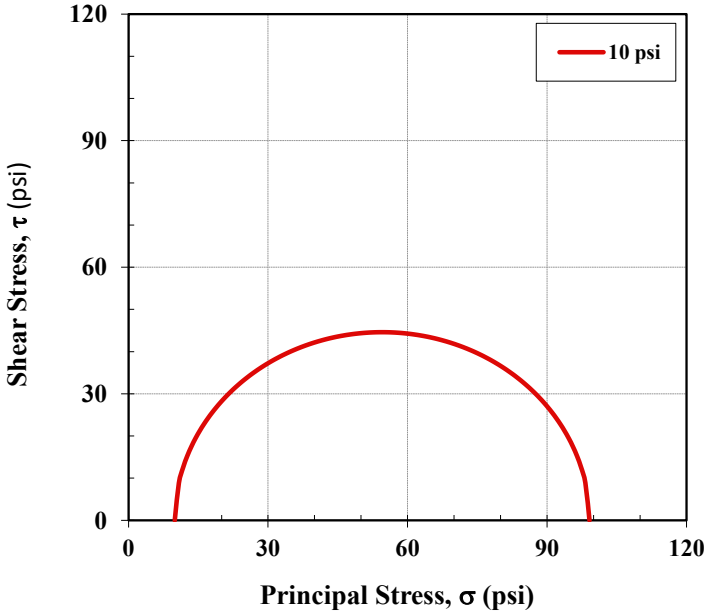
Project No.: GE2603026
Type of Test: Q-Test
Test Date: 3/20/2026

Type of Specimen: Modified CA Tube
Strain Rate: 1.0 %/min
Test Method: ASTM D2850

Principal Stress Difference vs. Axial Strain



Mohr Circles (Total Stress) for Peak Stress at Failure



Initial Specimen Conditions		
Confining Pressure (psi)		10.0
Avg. Diameter (in)	D_o	1.90
Avg. Height (in)	H_o	3.68
In-situ Water Content (%)	w_o	17.3
Total Unit Weight (pcf)	γ_{total}	131.7
Dry Unit Weight (pcf)	γ_{dry}	112.3
Saturation (%)	S_r	93.2
Void Ratio	e_o	0.50
Specific Gravity (Assumed)	G_s	2.70

Stresses at Failure	
Maximum Deviator Stress (psi)	89.2
Axial Strain at Failure (%)	12.5
Axial Strain at 50% of q_u, ε_{50} (%)	4.3
Total Stresses at Failure	
Major Principal Stress Corrected, σ_{1C} (psi)	99.1
Minor Principal Stress, σ_3 (psi)	9.9

Test Results	
Unconsolidated-Undrained Compressive Strength at Failure, $\sigma_{1C} - \sigma_3$ **(tsf)**	6.42

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

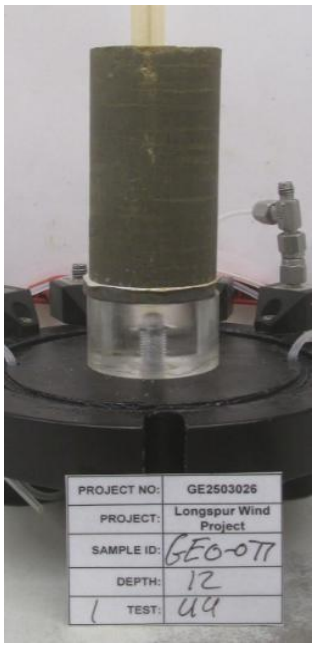
Te-An Wang, EIT, 3/24/2026
Analysis & Quality Review/Date
Specimen Prepared by: A.B.

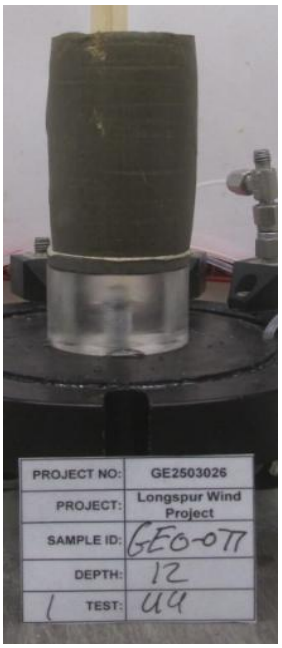
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Unconsolidated-Undrained Triaxial Compression Test Appendix

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Specimen: GEO-077 at 12 ft

Project No.: GE2603026
Test Method: ASTM D2850
Test Date: 3/20/2026





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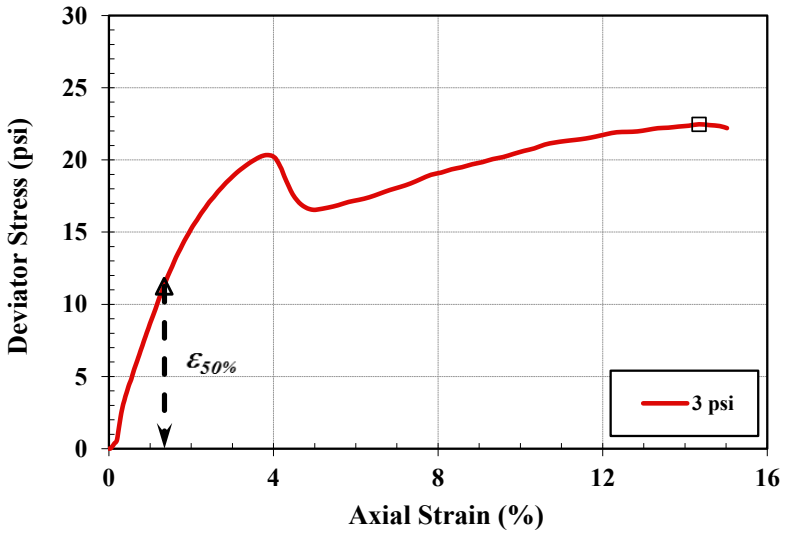
Unconsolidated-Undrained Triaxial Compression Test

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample No.: SUB-3 at 4 ft

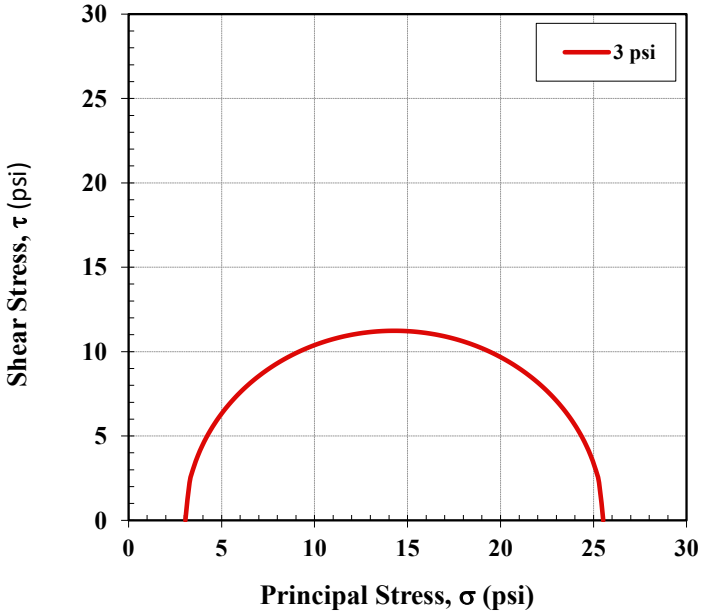
Project No.: GE2503026
Type of Test: Q-Test
Test Date: 6/6/2025

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Method: ASTM D2850

Principal Stress Difference vs. Axial Strain



Mohr Circles (Total Stress) for Peak Stress at Failure



Initial Specimen Conditions		
Confining Pressure (psi)		3.0
Avg. Diameter (in)	D_o	2.89
Avg. Height (in)	H_o	5.64
In-situ Water Content (%)	w_o	14.8
Total Unit Weight (pcf)	γ_{total}	123.7
Dry Unit Weight (pcf)	γ_{dry}	107.7
Saturation (%)	S_r	70.9
Void Ratio	e_o	0.56
Specific Gravity (Assumed)	G_s	2.70

Stresses at Failure	
Maximum Deviator Stress (psi)	22.5
Axial Strain at Failure (%)	14.3
Axial Strain at 50% of q_u, ε_{50} (%)	1.4
Total Stresses at Failure	
Major Principal Stress Corrected, σ_{1C} (psi)	25.5
Minor Principal Stress, σ_3 (psi)	3.1

Test Results	
Unconsolidated-Undrained Compressive Strength at Failure, $\sigma_{1C} - \sigma_3$ **(tsf)**	1.62

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 06/09/25
Analysis & Quality Review/Date
Specimen Prepared by: A.B.

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Unconsolidated-Undrained Triaxial Compression Test Appendix

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Specimen: SUB-3 at 4 ft

Project No.: GE2503026
Test Method: ASTM D2850
Test Date: 06/06/25





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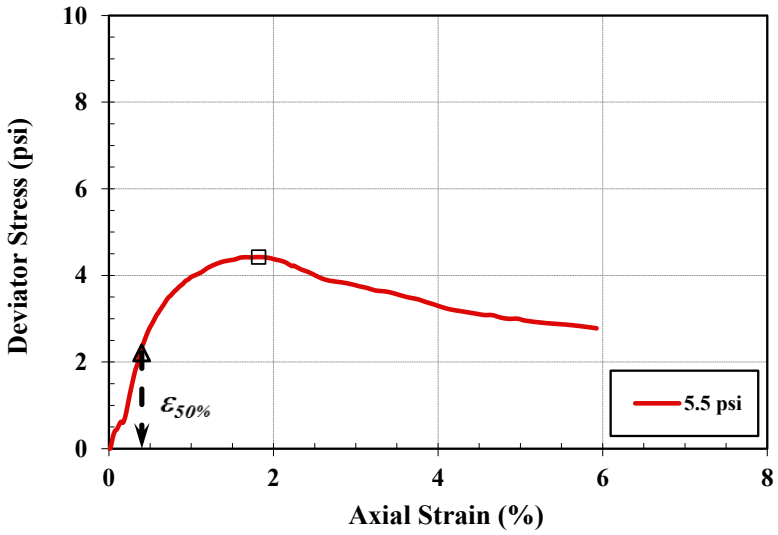
Unconsolidated-Undrained Triaxial Compression Test

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample No.: O&M-1 at 7 ft

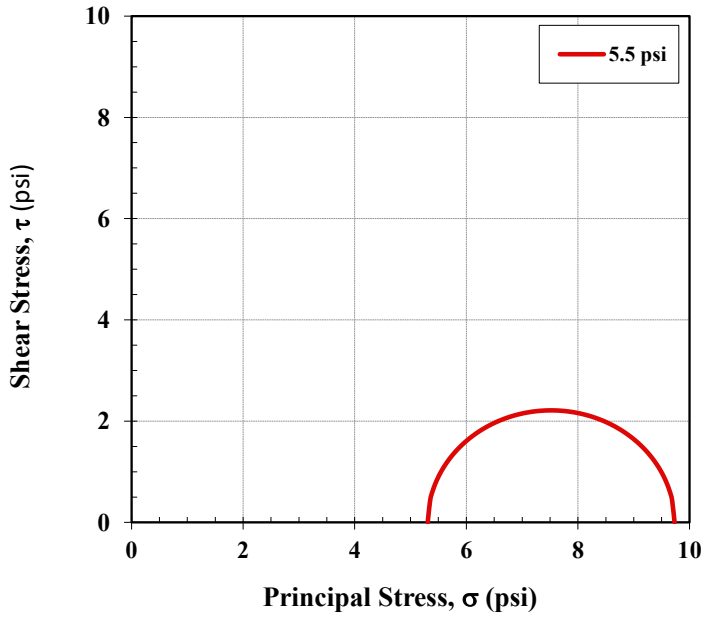
Project No.: GE2503026
Type of Test: Q-Test
Test Date: 6/6/2025

Type of Specimen: Modified CA Tube
Strain Rate: 1.0 %/min
Test Method: ASTM D2850

Principal Stress Difference vs. Axial Strain



Mohr Circles (Total Stress) for Peak Stress at Failure



Initial Specimen Conditions		
Confining Pressure (psi)		5.5
Avg. Diameter (in)	D_o	2.40
Avg. Height (in)	H_o	4.83
In-situ Water Content (%)	w_o	18.9
Total Unit Weight (pcf)	γ_{total}	119.3
Dry Unit Weight (pcf)	γ_{dry}	100.3
Saturation (%)	S_r	75.2
Void Ratio	e_o	0.68
Specific Gravity (Assumed)	G_s	2.70

Stresses at Failure	
Maximum Deviator Stress (psi)	4.4
Axial Strain at Failure (%)	1.8
Axial Strain at 50% of q_u, ε_{50} (%)	0.4
Total Stresses at Failure	
Major Principal Stress Corrected, σ_{1C} (psi)	9.7
Minor Principal Stress, σ_3 (psi)	5.3

Test Results	
Unconsolidated-Undrained Compressive Strength at Failure, $\sigma_{1C} - \sigma_3$ **(tsf)**	0.32

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

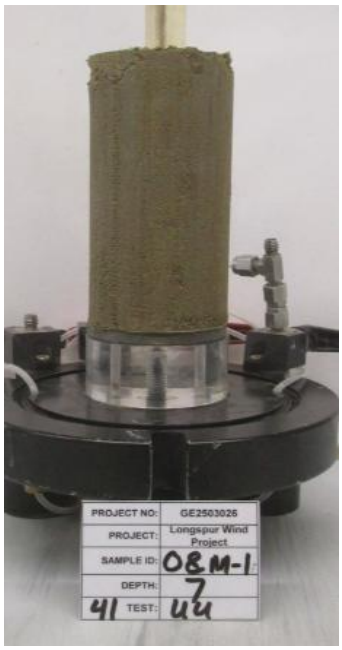
Te-An Wang, EIT, 06/09/25
Analysis & Quality Review/Date
Specimen Prepared by: A.B.

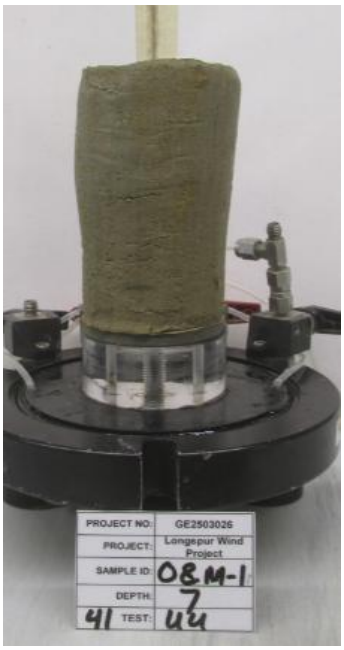
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Unconsolidated-Undrained Triaxial Compression Test Appendix

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Specimen: O&M-1 at 7 ft

Project No.: GE2503026
Test Method: ASTM D2850
Test Date: 06/06/25





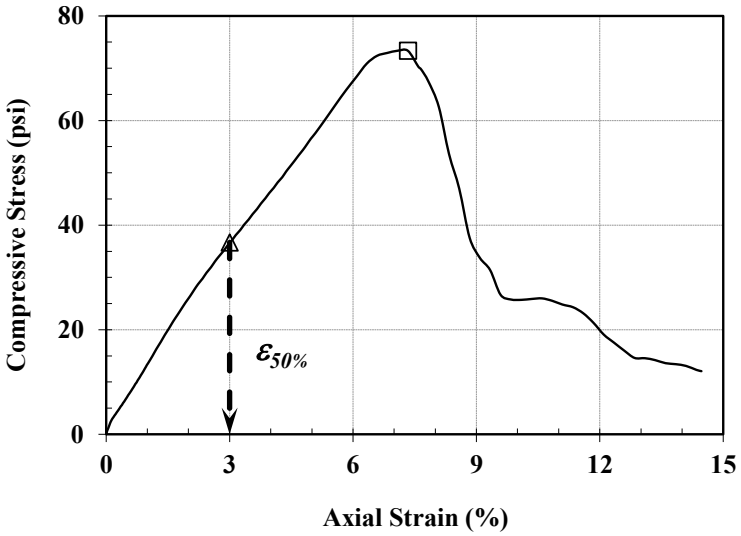
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Unconfined Compression Test Report

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample I.D.: GEO-01 at 14 ft

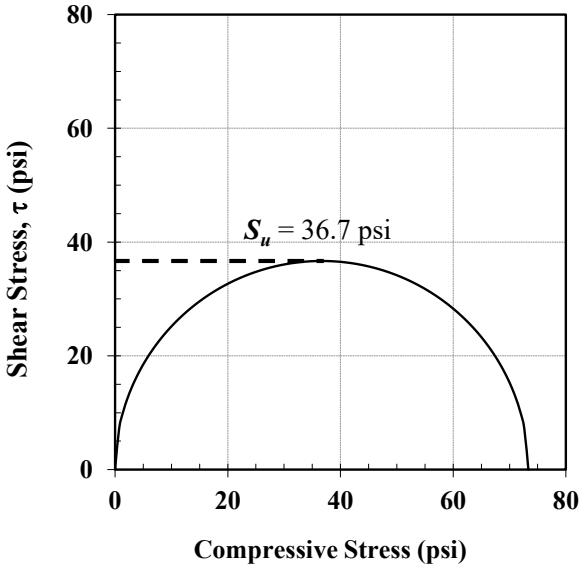
Project No.: GE2503026
Test Method: ASTM D2166
Test Date: 6/4/2025

Type of Specimen: Modified CA Tube
Strain Rate: 1.0 %/min



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.41
Avg. Height (in)	H_o	4.84
In-situ Moisture Content (%)	w_o	20.2
Total Unit Weight (pcf)	γ_{total}	133.6
Dry Unit Weight (pcf)	γ_{dry}	111.2
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.52
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Unconfined Compressive Strength, q_u (psi)	73.3
Axial Strain at Failure (%)	7.3
Axial Strain at 50 % of q_u (%)	3.0
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	73.3
Minor Principal Stress, σ_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	2.64

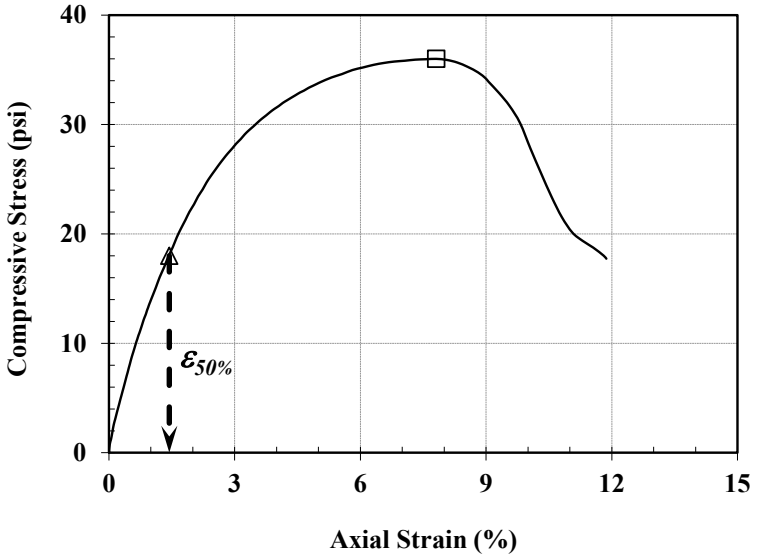
Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Kainat Batool, 06/06/25
Quality Review/Date
Specimen prepared & tested by: A.B.

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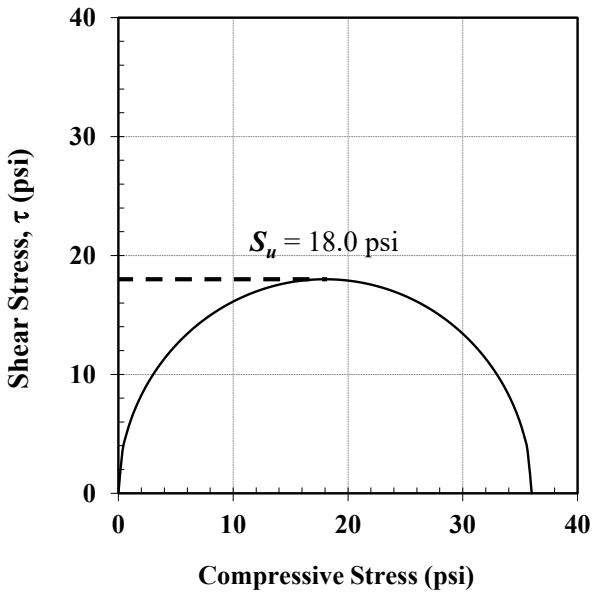
Unconfined Compression Test Report

Client: RRC Power & Energy, LLC
Project No.: GE2503026
Type of Specimen: Shelby Tube
Project: Longspur Wind Project
Test Method: ASTM D2166
Strain Rate: 1.0 %/min
Sample I.D.: GEO-04 at 19 ft
Test Date: 6/10/2025



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.87
Avg. Height (in)	H_o	5.62
In-situ Moisture Content (%)	w_o	22.1
Total Unit Weight (pcf)	γ_{total}	124.9
Dry Unit Weight (pcf)	γ_{dry}	102.3
Saturation (%)	S_r	92.0
Void Ratio	e_o	0.65
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Unconfined Compressive Strength, q_u (psi)	36.0
Axial Strain at Failure (%)	7.8
Axial Strain at 50 % of q_u (%)	1.4
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	36.0
Minor Principal Stress, σ_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	1.30

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Kainat Batool, 06/10/25
Quality Review/Date
Specimen prepared & tested by: A.B.

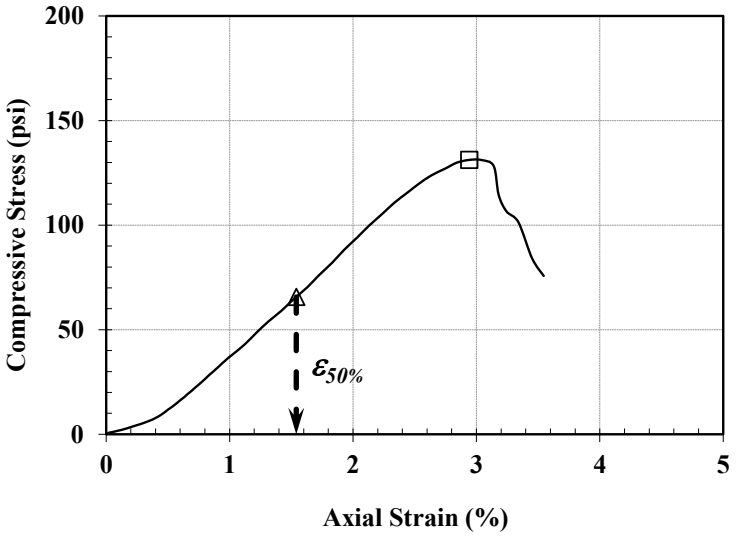
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Unconfined Compression Test Report

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample I.D.: GEO-33 at 17 ft

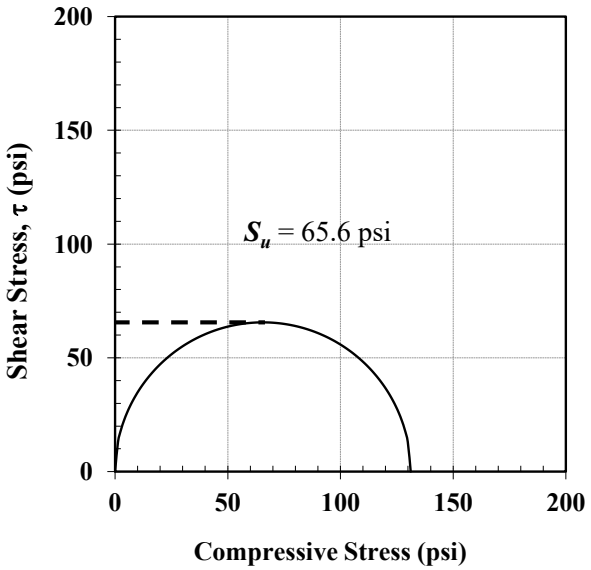
Project No.: GE2503026
Test Method: ASTM D2166
Test Date: 6/4/2025

Type of Specimen: Modified CA Tube
Strain Rate: 1.0 %/min



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.40
Avg. Height (in)	H_o	4.85
In-situ Moisture Content (%)	w_o	16.9
Total Unit Weight (pcf)	γ_{total}	130.0
Dry Unit Weight (pcf)	γ_{dry}	111.3
Saturation (%)	S_r	88.4
Void Ratio	e_o	0.51
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Unconfined Compressive Strength, q_u (psi)	131.2
Axial Strain at Failure (%)	2.9
Axial Strain at 50 % of q_u (%)	1.5
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	131.2
Minor Principal Stress, σ_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	4.72

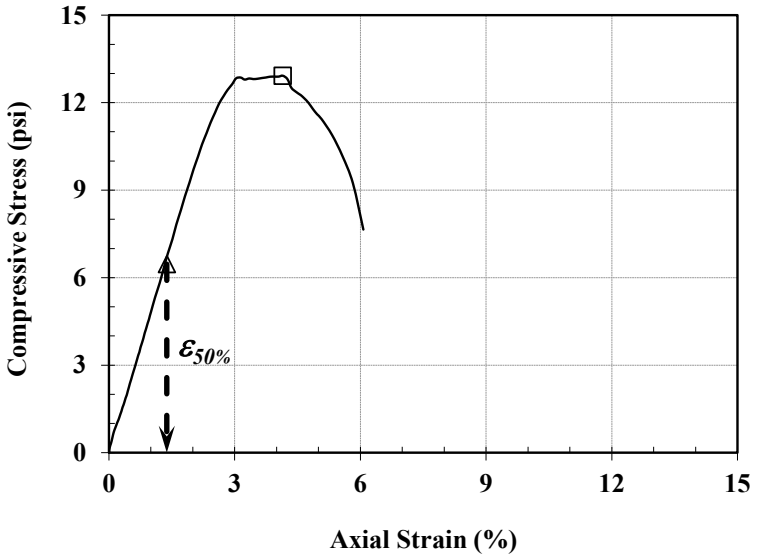
Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Kainat Batool, 06/06/25
Quality Review/Date
Specimen prepared & tested by: A.B.

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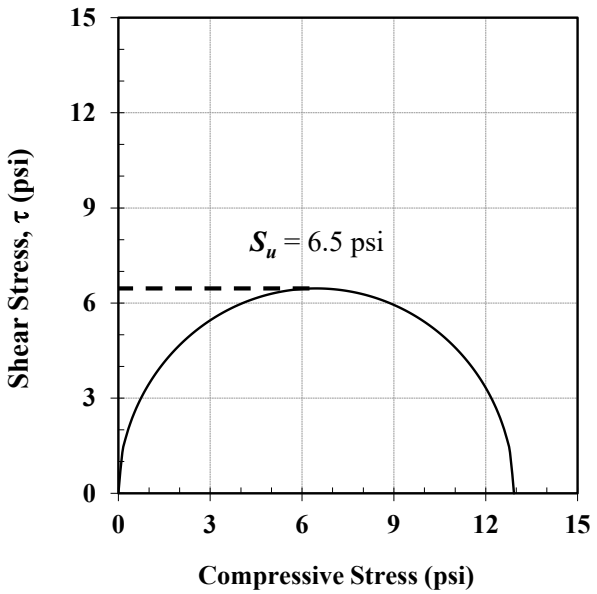
Unconfined Compression Test Report

Client: RRC Power & Energy, LLC
Project No.: GE2503026
Type of Specimen: Shelby Tube
Project: Longspur Wind Project
Test Method: ASTM D2166
Strain Rate: 1.0 %/min
Sample I.D.: GEO-036 at 17 ft
Test Date: 6/10/2025



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.87
Avg. Height (in)	H_o	5.63
In-situ Moisture Content (%)	w_o	29.9
Total Unit Weight (pcf)	γ_{total}	120.7
Dry Unit Weight (pcf)	γ_{dry}	92.9
Saturation (%)	S_r	99.2
Void Ratio	e_o	0.81
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Unconfined Compressive Strength, q_u (psi)	12.9
Axial Strain at Failure (%)	4.1
Axial Strain at 50 % of q_u (%)	1.4
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	12.9
Minor Principal Stress, σ_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	0.47

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Kainat Batool, 06/10/25
Quality Review/Date
Specimen prepared & tested by: A.B.

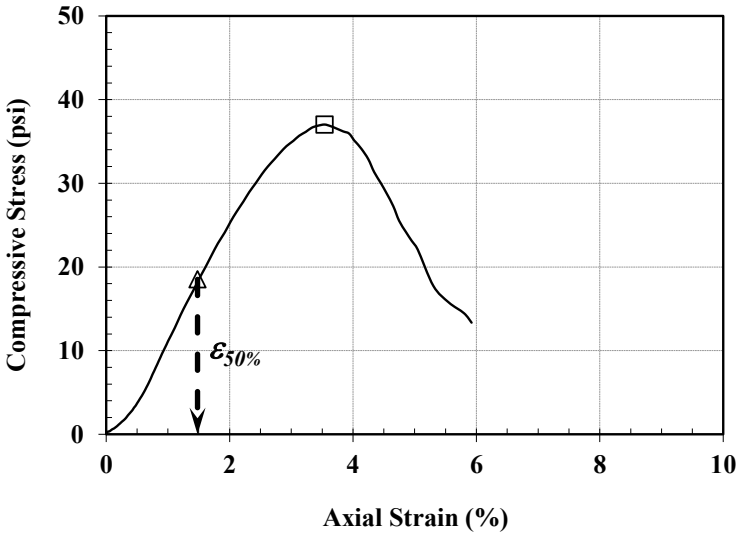
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Unconfined Compression Test Report

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample I.D.: GEO-37 at 12 ft

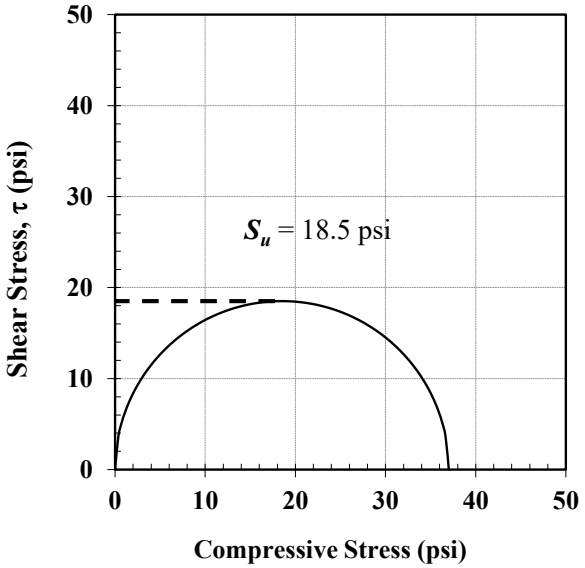
Project No.: GE2503026
Test Method: ASTM D2166
Test Date: 6/4/2025

Type of Specimen: Modified CA Tube
Strain Rate: 1.0 %/min



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.40
Avg. Height (in)	H_o	4.85
In-situ Moisture Content (%)	w_o	47.0
Total Unit Weight (pcf)	γ_{total}	95.8
Dry Unit Weight (pcf)	γ_{dry}	65.1
Saturation (%)	S_r	80.0
Void Ratio	e_o	1.59
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Unconfined Compressive Strength, q_u (psi)	37.0
Axial Strain at Failure (%)	3.5
Axial Strain at 50 % of q_u (%)	1.5
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	37.0
Minor Principal Stress, σ_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	1.33

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Kainat Batool, 06/09/25
Quality Review/Date
Specimen prepared & tested by: A.B.

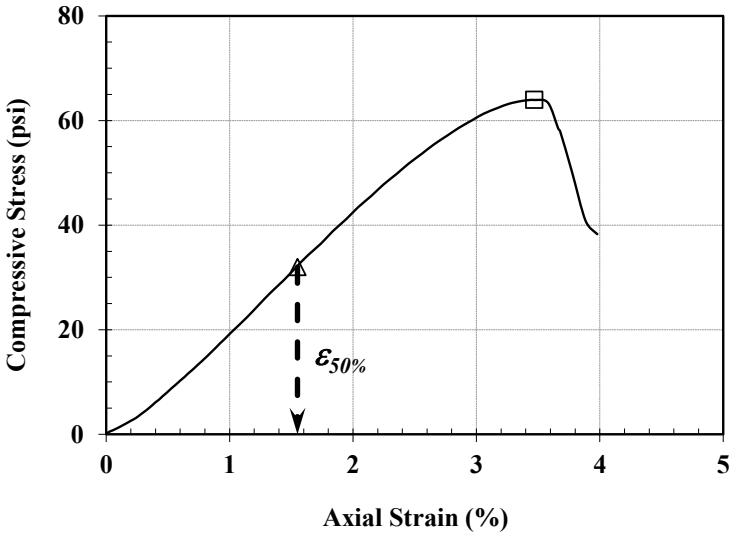
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Unconfined Compression Test Report

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample I.D.: GEO-69 at 12 ft

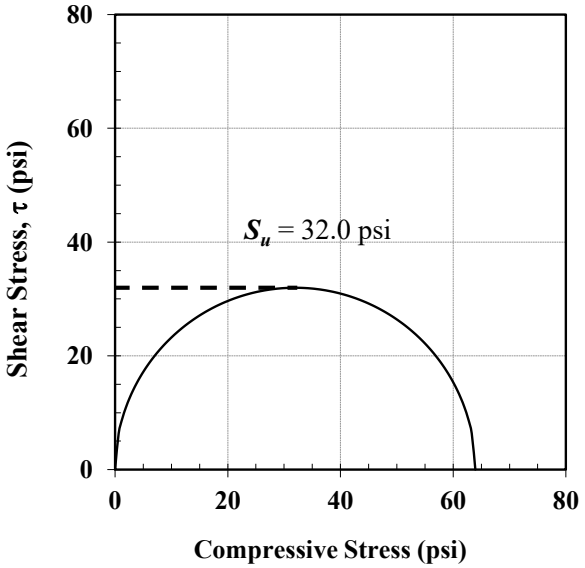
Project No.: GE2503026
Test Method: ASTM D2166
Test Date: 6/6/2025

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.89
Avg. Height (in)	H_o	5.63
In-situ Moisture Content (%)	w_o	24.8
Total Unit Weight (pcf)	γ_{total}	118.8
Dry Unit Weight (pcf)	γ_{dry}	95.1
Saturation (%)	S_r	86.9
Void Ratio	e_o	0.77
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Unconfined Compressive Strength, q_u (psi)	63.9
Axial Strain at Failure (%)	3.5
Axial Strain at 50 % of q_u (%)	1.6
Total Stresses at Failure	
Major Principal Stress, σ_1 (psi)	63.9
Minor Principal Stress, σ_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	2.30

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Kainat Batool, 06/09/25
Quality Review/Date
Specimen prepared & tested by: A.B.

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Beyond Engineering Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

One-Dimensional Swell or Collapse of Soils

Client: RRC Power & Energy, LLC
Project Name: Longspur Wind Project
Sample ID: SUB-6 at 4 ft

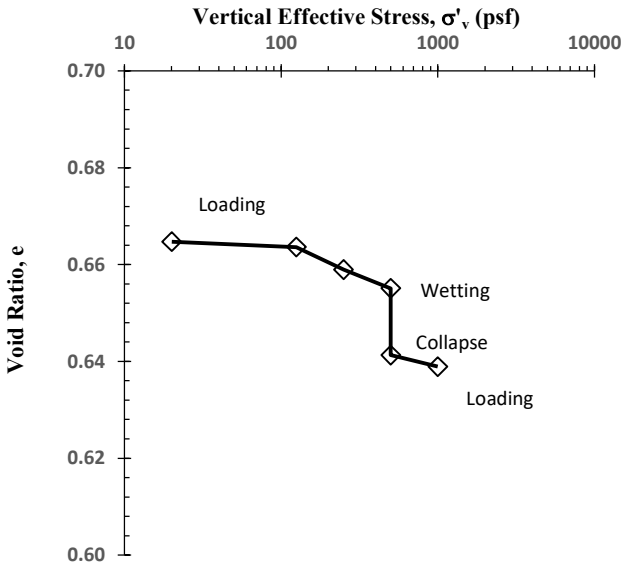
Beyond Project No.: GE2503026
Test Method: ASTM D4546, Method C
Test Date: 9/13/25-9/15/25

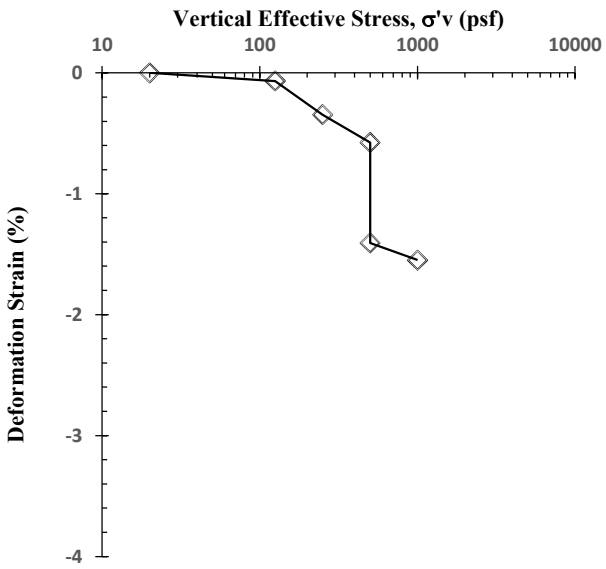
Specimen Conditions	
Avg. Water Content of Trimmings (%)	5.6
Final Specimen Water Content (%)	18.8
Initial Specimen Height (in)	0.798
Final Specimen Height (in)	0.785
Initial Dry Unit Weight, γ_o (pcf)	101.2
Final Dry Unit Weight, γ_f (pcf)	102.8
Initial Void Ratio, e_o	0.665
Final Void Ratio, e_f	0.639
Initial Degree of Saturation (%)	22.8
Final Degree of Saturation (%)	79.4
Collapse Strain (%)	-0.8

Specimen was inundated with tap water during testing. Loading increment duration was minimum 24 hours. . The calculation included the machine deflections that measured in each loading steps.

Gs assumed to be 2.70

Specimen Diameter: 2.493 inches





	Dry				Inundated	
Stage No.	1	2	3	4	5	6
σ'_v (psf)	20	125	250	500	500	1000
Height (inch)	0.798	0.797	0.795	0.793	0.787	0.785
Void Ratio, e	0.665	0.664	0.659	0.655	0.641	0.639
Axial Strain (%)	0.00	-0.07	-0.35	-0.58	-1.41	-1.55

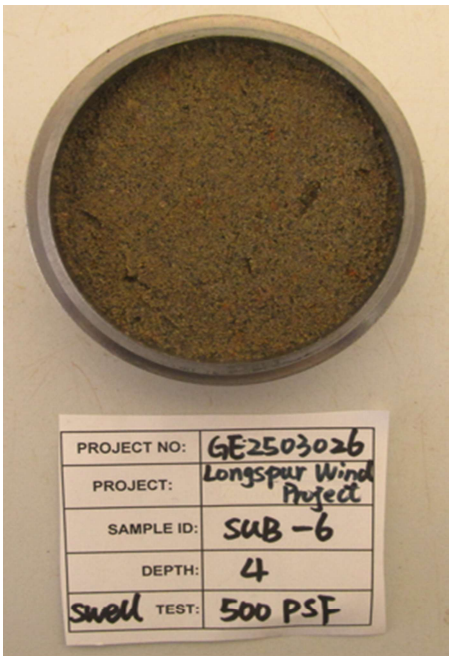
Huamiao Cao, P.E. 09/16/25
Analysis & Quality Review/Date
Specimen prepared and tested by: J.Z.

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3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

One-Dimensional Swell or Collapse of Soils

Client:	RRC Power & Energy, LLC	**Beyond Project No.:**	GE2503026
Project Name:	Longspur Wind Project	**Test Method:**	ASTM D4546, Method C
Sample ID:	SUB-6 at 4 ft	**Test Date:**	9/13/25-9/15/25



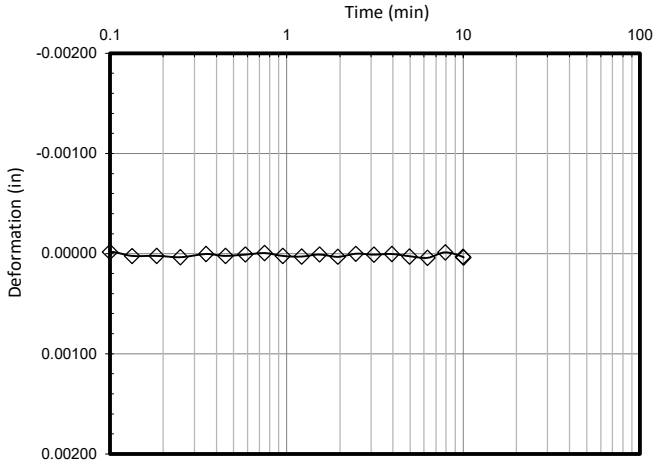


Beyond Engineering Testing, LLC
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Round Rock, TX 78664
(512) 358-6048

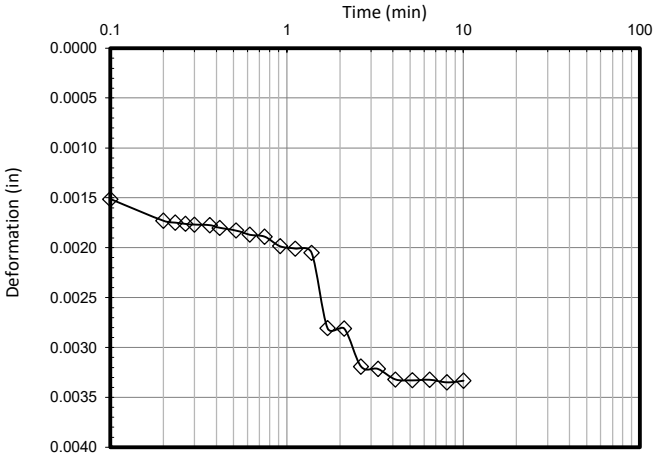
One-Dimensional Swell or Collapse of Soils

Client:	RRC Power & Energy, LLC	**Beyond Project No.:**	GE2503026
Project Name:	Longspur Wind Project	**Test Method:**	ASTM D4546, Method C
Sample ID:	SUB-6 at 4 ft	**Test Date:**	9/13/25-9/15/25

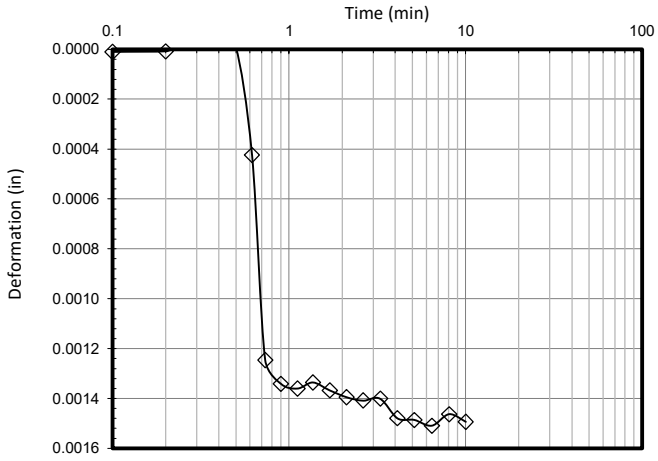
20-psf Load (Seating Load)



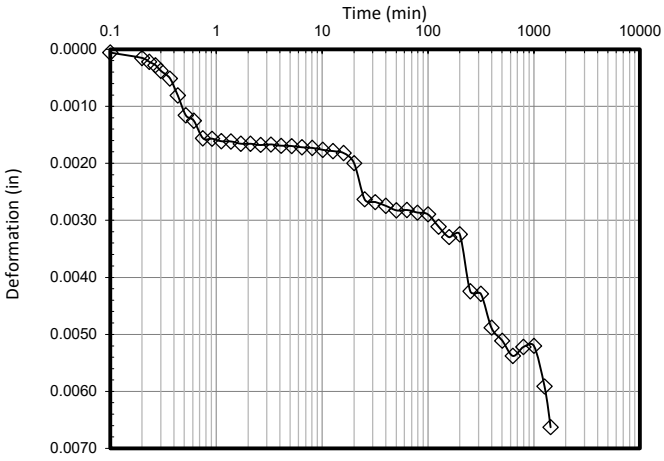
500-psf Load



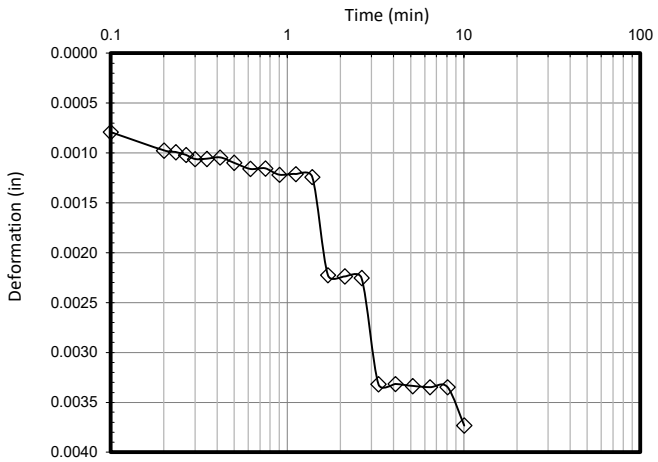
125-psf Load



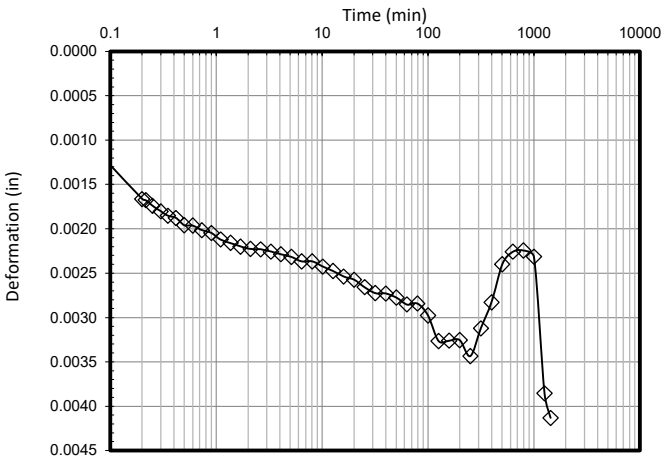
500-psf Load (inundated)



250-psf Load



1000-psf Load (inundated)



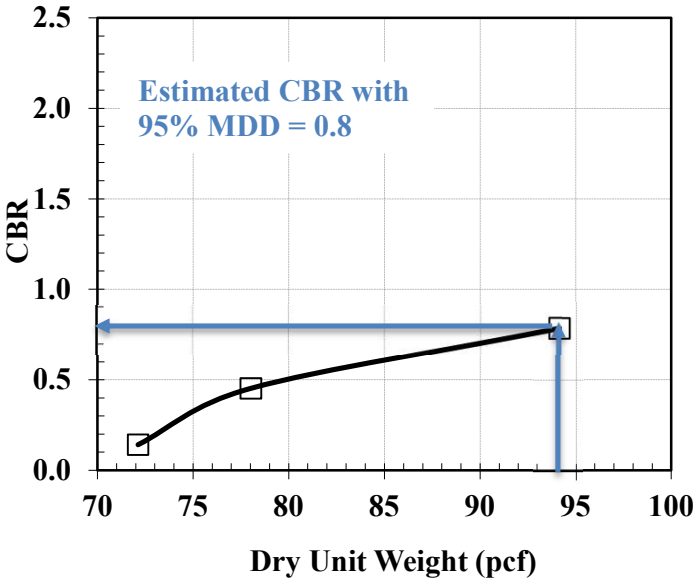
Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

CBR (California Bearing Ratio) Test

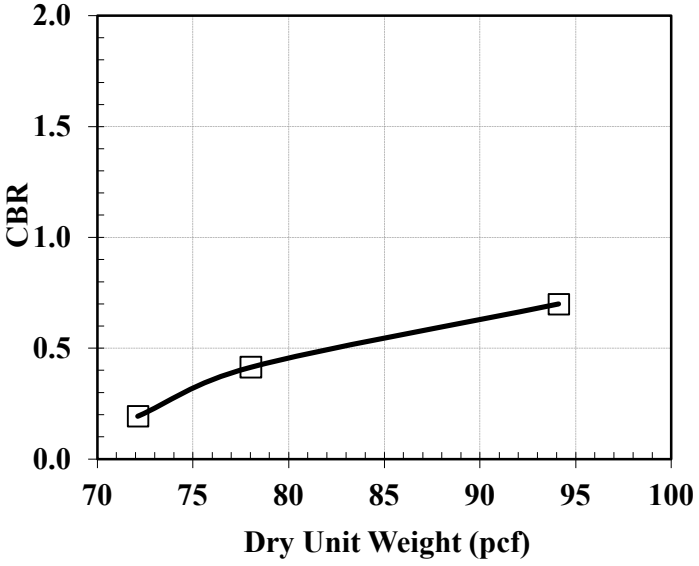
Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample No: GEO-048 at 1-4 ft

Beyond Project No.: GE2503026
Test Method: ASTM D1883
Test Date: 6/17/2025
Rate of Penetration: 0.05 in/min

CBR for 0.100-in Penetration



CBR for 0.200-in Penetration



Initial Conditions			
Specimen No.	1	2	3
Blows per Layer	15	30	60
Surcharge Weight (lbs)	10	10	10
Water Content (%)	20.6	20.9	21.3
Dry Unit Weight (pcf)	72.1	78.0	94.1
Percent Compaction (%)	72.8	78.7	95.0
Final Conditions (soaked)			
Water Content (%) at top 1-in layer after soaking	40.9	47.0	37.3
Swell (% of initial height)	4.1	6.4	5.1
Bearing Ratio of Sample at 0.100 in penetration	0.1	0.5	0.8
Bearing Ratio of Sample at 0.200 in penetration	0.2	0.4	0.7

Note: Soil specimens were molded to a range of densities using 15, 30 and 60 blows at optimum moisture content as per ASTM D 1883 to develop the CBR versus dry density curve. It was allowed the specimens to soak for 96 hrs prior bearing test. Removed the free water and allow the specimens to drain out for 15 min. The 10-lbs surcharge load was placed during bearing test.

HuaMiao Cao, P.E., 6/18/25
Analysis & Quality Review/Date
Specimens prepared and tested by: A.S.

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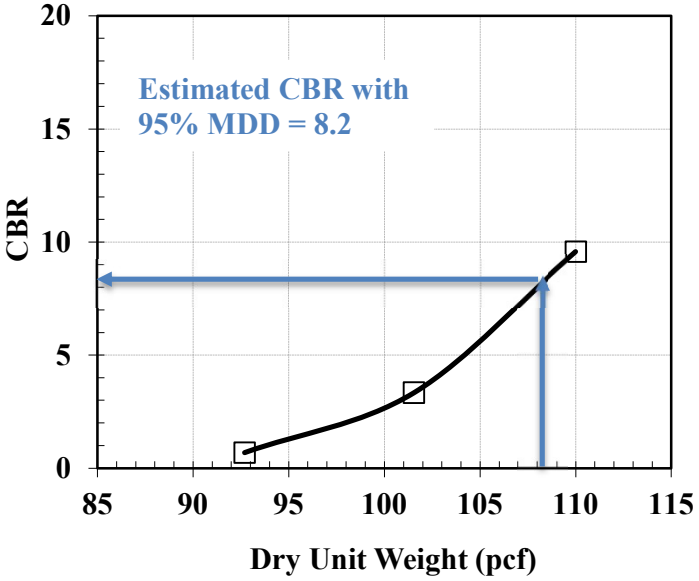
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Round Rock, TX 78664
(512) 358-6048

CBR (California Bearing Ratio) Test

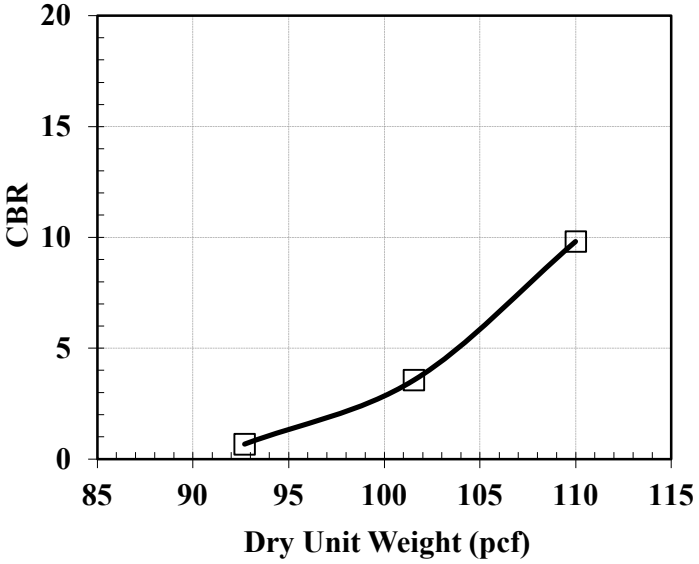
Client: RRC Power & Energy, LLC
Project: Longspur Wind Project
Sample No: GEO-062 at 1-4 ft

Beyond Project No.: GE2503026
Test Method: ASTM D1883
Test Date: 6/17/2025
Rate of Penetration: 0.05 in/min

CBR for 0.100-in Penetration



CBR for 0.200-in Penetration



Initial Conditions			
Specimen No.	1	2	3
Blows per Layer	10	25	60
Surcharge Weight (lbs)	10	10	10
Water Content (%)	12.2	12.0	12.4
Dry Unit Weight (pcf)	92.7	101.5	110.0
Percent Compaction (%)	81.4	89.2	96.6
Final Conditions (soaked)			
Water Content (%) at top 1-in layer after soaking	25.1	21.8	19.3
Swell (% of initial height)	0.5	0.8	0.5
Bearing Ratio of Sample at 0.100 in penetration	0.7	3.3	9.6
Bearing Ratio of Sample at 0.200 in penetration	0.7	3.6	9.8

Note: Soil specimens were molded to a range of densities using 10, 25 and 60 blows at optimum moisture content as per ASTM D 1883 to develop the CBR versus dry density curve. It was allowed the specimens to soak for 96 hrs prior bearing test. Removed the free water and allow the specimens to drain out for 15 min. The 10-lbs surcharge load was placed during bearing test.

HuaMiao Cao, P.E., 6/18/25

Analysis & Quality Review/Date
Specimens prepared and tested by: A.S.

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Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Client: RRC Power & Energy, LLC
Project: Longspur Wind Project

RRC Project No.: GE2503026
Testing Method: EPA 300/300.1
Test Date: 6/9/2025

No.	Sample ID & Depth	Sulfate Content (mg SO_4/kg)	Chloride Content (mg/kg)
1	GEO-04 at 1-13 ft	2,220	79.9
2	GEO-10 at 1-13 ft	672	82.8
3	GEO-25 at 1-13 ft	2,600	59.3
4	GEO-50 at 1-13 ft	4,390	78.6
5	GEO-64 at 1-13 ft	2,740	76.4
6	SUB-3 at 1-4 ft	240	305
7			
8			
9			
10			

HuaMiao Cao, 6/10/25
Quality Review/Date
Tested by: XENCO

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SUMMARY OF LABORATORY RESULTS

RRC Power & Energy, LLC
810 Hesters Crossing Rd, Suite 120
Round Rock, TX 78681
Telephone: (512) 992-2087

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026

Borehole	Depth (ft)	USCS	Water Content (%)	Dry Unit Weight (pcf)	< No. 200 (%)	LL	PL	PI	Compressive Strength (tsf)	Strain at Failure (%)	Confining Pressure (psi)	Chlorides (%/weight)	Sulfates (%/weight)	pH	Minimum Resistivity (ohm-cm)
GEO-01	1.0		23												
GEO-01	2.0	CH	24		100	63	22	41							
GEO-01	4.0		19												
GEO-01	7.0		28												
GEO-01	10.0		29												
GEO-01	12.0		47												
GEO-01	14.0	CH	20	111	81	52	20	32	5.28	7.3	0.0				
GEO-02	1.0		18												
GEO-02	4.0		22												
GEO-02	7.0		20												
GEO-02	10.0		19												
GEO-02	12.0		22												
GEO-03	1.0		11												
GEO-03	4.0		16												
GEO-03	7.0		16												
GEO-03	10.0		19												
GEO-03	12.0		16	96											
GEO-04	1.0		14												
GEO-04	1.0		23									0.0080	0.2220	7.1	589
GEO-04	4.0		19												
GEO-04	7.0		22												
GEO-04	10.0		23												
GEO-04	12.0	CL	23	103	85	47	18	29	1.96	14.8	10.0				
GEO-04	19.0		22	102					2.59	7.8	0.0				
GEO-05	1.0		16												
GEO-05	4.0		15												
GEO-05	7.0		17												
GEO-05	10.0		19												
GEO-05	12.0		17												
GEO-06	1.0		14												
GEO-06	4.0		30												

ND Not Detected; **D** Diluted;
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RRC Power & Energy, LLC
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SUMMARY OF LABORATORY RESULTS

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026

Borehole	Depth (ft)	USCS	Water Content (%)	Dry Unit Weight (pcf)	< No. 200 (%)	LL	PL	PI	Compressive Strength (tsf)	Strain at Failure (%)	Confining Pressure (psi)	Chlorides (%/weight)	Sulfates (%/weight)	pH	Minimum Resistivity (ohm-cm)
GEO-06	7.0		27												
GEO-06	10.0		30												
GEO-07	1.0		25												
GEO-07	4.0		22												
GEO-07	7.0		26												
GEO-07	10.0		27												
GEO-07	12.0	CH	27	99	100	64	23	41	6.92	6.3	10.0				
GEO-08	1.0		25												
GEO-08	2.0	CH	22		99	57	19	38							
GEO-08	4.0		22												
GEO-08	7.0		24												
GEO-08	10.0		23												
GEO-09	1.0		16												
GEO-09	4.0		23												
GEO-09	7.0		25												
GEO-10	1.0		14												
GEO-10	1.0		17									0.0083	0.0672	6.6	746
GEO-10	2.0	CH	16		91	71	24	47							
GEO-10	4.0		15												
GEO-10	7.0		16												
GEO-10	10.0		17												
GEO-10	12.0		41												
GEO-11	1.0		13												
GEO-11	4.0		12												
GEO-11	7.0		7												
GEO-11	10.0		4												
GEO-11	12.0		13												
GEO-12	1.0		12												
GEO-12	4.0		11												
GEO-12	7.0		9												
GEO-12	10.0		16												

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SUMMARY OF LABORATORY RESULTS

CLIENT: ALLETE Renewable Resources, Inc.
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NUMBER: GE2503026

Borehole	Depth (ft)	USCS	Water Content (%)	Dry Unit Weight (pcf)	< No. 200 (%)	LL	PL	PI	Compressive Strength (tsf)	Strain at Failure (%)	Confining Pressure (psi)	Chlorides (%/weight)	Sulfates (%/weight)	pH	Minimum Resistivity (ohm-cm)
GEO-12	12.0		16												
GEO-13	1.0		20												
GEO-13	4.0		26												
GEO-13	7.0		21												
GEO-13	10.0		24												
GEO-13	12.0		30												
GEO-14	1.0		19												
GEO-14	4.0		22												
GEO-14	7.0		23												
GEO-14	10.0		22												
GEO-14	12.0		18												
GEO-15	1.0		7												
GEO-15	4.0		11												
GEO-15	7.0		24												
GEO-15	10.0		23												
GEO-15	12.0		19												
GEO-16	1.0		3												
GEO-16	4.0		36												
GEO-16	7.0		23												
GEO-16	10.0		23												
GEO-16	12.0	MH	31		56	76	46	30							
GEO-17	1.0		13												
GEO-17	4.0		12												
GEO-17	7.0		14												
GEO-17	12.0		17												
GEO-18	1.0		7												
GEO-18	4.0		9												
GEO-18	7.0		9												
GEO-18	9.0		10												
GEO-18	12.0		6												
GEO-19	1.0		8												

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SUMMARY OF LABORATORY RESULTS

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
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NUMBER: GE2503026

Borehole	Depth (ft)	USCS	Water Content (%)	Dry Unit Weight (pcf)	< No. 200 (%)	LL	PL	PI	Compressive Strength (tsf)	Strain at Failure (%)	Confining Pressure (psi)	Chlorides (%/weight)	Sulfates (%/weight)	pH	Minimum Resistivity (ohm-cm)
GEO-19	2.0	CL	6		97	30	18	12							
GEO-19	4.0		20												
GEO-19	7.0		29												
GEO-19	9.0		21												
GEO-19	12.0		19												
GEO-20	1.0		21												
GEO-20	4.0		22												
GEO-20	7.0		22												
GEO-20	9.0		22												
GEO-21	1.0		8												
GEO-21	4.0		7												
GEO-21	7.0		6												
GEO-21	9.0		7												
GEO-22	1.0		10												
GEO-22	2.0	SC-SM	17		37	22	16	6							
GEO-22	4.0		23												
GEO-22	7.0		22												
GEO-22	10.0		21												
GEO-23	1.0		13												
GEO-23	4.0		21												
GEO-23	7.0		20												
GEO-23	10.0		21												
GEO-24	1.0		21												
GEO-24	4.0		19												
GEO-24	7.0		21												
GEO-24	10.0		21												
GEO-25	1.0		19												
GEO-25	1.0		16									0.0059	0.2600	7.5	455
GEO-25	4.0		21												
GEO-25	7.0		20												
GEO-25	10.0		21												

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SUMMARY OF LABORATORY RESULTS

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NUMBER: GE2503026

Borehole	Depth (ft)	USCS	Water Content (%)	Dry Unit Weight (pcf)	< No. 200 (%)	LL	PL	PI	Compressive Strength (tsf)	Strain at Failure (%)	Confining Pressure (psi)	Chlorides (%/weight)	Sulfates (%/weight)	pH	Minimum Resistivity (ohm-cm)
GEO-26	1.0		18												
GEO-26	4.0		16												
GEO-26	7.0		18												
GEO-26	10.0		21												
GEO-27	1.0		16												
GEO-27	4.0		15												
GEO-27	7.0		15												
GEO-27	10.0		14												
GEO-27	12.0		15												
GEO-28	1.0		15												
GEO-28	4.0		20												
GEO-28	7.0		22												
GEO-28	10.0		20												
GEO-28	12.0		7												
GEO-29	1.0		19												
GEO-29	4.0		21												
GEO-29	10.0		19												
GEO-29	12.0		20												
GEO-31	1.0		7												
GEO-31	4.0		7												
GEO-31	7.0		7												
GEO-31	10.0		15												
GEO-33	1.0		14												
GEO-33	2.0	CH	17		98	61	19	42							
GEO-33	4.0		25												
GEO-33	7.0		21												
GEO-33	10.0		23												
GEO-33	12.0		19												
GEO-33	17.0		17	111					9.45	2.9	0.0				
GEO-34	1.0		15												
GEO-34	4.0		12												

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SUMMARY OF LABORATORY RESULTS

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026

Borehole	Depth (ft)	USCS	Water Content (%)	Dry Unit Weight (pcf)	< No. 200 (%)	LL	PL	PI	Compressive Strength (tsf)	Strain at Failure (%)	Confining Pressure (psi)	Chlorides (%/weight)	Sulfates (%/weight)	pH	Minimum Resistivity (ohm-cm)
GEO-34	7.0		32												
GEO-34	10.0		22												
GEO-34	12.0		24												
GEO-35	1.0		30												
GEO-35	4.0		24												
GEO-35	7.0		51												
GEO-35	10.0		26												
GEO-35	12.0		23												
GEO-36	1.0		14												
GEO-36	4.0		16												
GEO-36	7.0		21												
GEO-36	10.0		6												
GEO-36	12.0		10												
GEO-36	17.0	CH	30	93	100	63	26	37	0.93	4.1	0.0				
GEO-37	1.0		21												
GEO-37	4.0		22												
GEO-37	7.0		24												
GEO-37	10.0		97												
GEO-37	12.0		47	65					2.66	3.5	0.0				
GEO-38	1.0		12												
GEO-38	4.0		15												
GEO-38	7.0		23												
GEO-38	12.0	CL	21		85	38	17	21							
GEO-39	1.0		19												
GEO-39	4.0		20												
GEO-39	7.0		20												
GEO-39	10.0		21												
GEO-40	1.0		9												
GEO-40	4.0		15												
GEO-40	7.0		17												
GEO-40	9.0		16												

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SUMMARY OF LABORATORY RESULTS

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026

Borehole	Depth (ft)	USCS	Water Content (%)	Dry Unit Weight (pcf)	< No. 200 (%)	LL	PL	PI	Compressive Strength (tsf)	Strain at Failure (%)	Confining Pressure (psi)	Chlorides (%/weight)	Sulfates (%/weight)	pH	Minimum Resistivity (ohm-cm)
GEO-42	1.0		18												
GEO-42	4.0		22												
GEO-42	7.0		22												
GEO-42	10.0		21												
GEO-43	1.0		13												
GEO-43	4.0		14												
GEO-43	7.0		13												
GEO-43	12.0		12												
GEO-44	1.0		15												
GEO-44	4.0		22												
GEO-44	7.0		19												
GEO-44	10.0		2												
GEO-44	12.0		21												
GEO-45	1.0		16												
GEO-45	4.0		20												
GEO-45	7.0		23												
GEO-45	10.0		18												
GEO-46	1.0		12												
GEO-46	2.0	CL	16		84	41	18	23							
GEO-46	4.0		19												
GEO-46	7.0		31												
GEO-46	10.0		19												
GEO-46	12.0	CH	23	104	82	69	18	51	6.21	10.1	10.0				
GEO-47	1.0		8												
GEO-47	4.0		7												
GEO-47	7.0		11												
GEO-47	10.0		14												
GEO-47	12.0		13												
GEO-48	1.0		20												
GEO-48	2.0	CH	23		96	71	23	48							
GEO-48	4.0		22												

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SUMMARY OF LABORATORY RESULTS

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026

Borehole	Depth (ft)	USCS	Water Content (%)	Dry Unit Weight (pcf)	< No. 200 (%)	LL	PL	PI	Compressive Strength (tsf)	Strain at Failure (%)	Confining Pressure (psi)	Chlorides (%/weight)	Sulfates (%/weight)	pH	Minimum Resistivity (ohm-cm)
GEO-48	7.0		22												
GEO-48	9.0		17												
GEO-48	12.0		19												
GEO-49	1.0		12												
GEO-49	4.0		22												
GEO-49	7.0		21												
GEO-49	10.0		22												
GEO-49	29.0	MH	81		62	88	69	19							
GEO-50	1.0		19												
GEO-50	1.0		26									0.0079	0.4390	7.6	408
GEO-50	4.0		22												
GEO-50	7.0		37												
GEO-50	9.0		23												
GEO-50	14.0	CH	20	107	99	52	20	32							
GEO-51	1.0		12												
GEO-51	4.0		26												
GEO-51	7.0		23												
GEO-51	10.0		22												
GEO-52	1.0		16												
GEO-52	4.0		17												
GEO-52	7.0		20												
GEO-52	10.0		48												
GEO-52	12.0		19												
GEO-53	1.0		16												
GEO-53	2.0	CH	17		93	54	19	35							
GEO-53	4.0		22												
GEO-53	7.0		23												
GEO-53	12.0	ML	98	34	66	NP	NP	NP							
GEO-53	22.0		26	94											
GEO-54	1.0		22												
GEO-54	4.0		22												

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SUMMARY OF LABORATORY RESULTS

CLIENT: ALLETE Renewable Resources, Inc.
PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026

Borehole	Depth (ft)	USCS	Water Content (%)	Dry Unit Weight (pcf)	< No. 200 (%)	LL	PL	PI	Compressive Strength (tsf)	Strain at Failure (%)	Confining Pressure (psi)	Chlorides (%/weight)	Sulfates (%/weight)	pH	Minimum Resistivity (ohm-cm)
GEO-54	7.0		18												
GEO-54	9.0		21												
GEO-54	12.0		56												
GEO-56	1.0		16												
GEO-56	4.0		19												
GEO-56	7.0		26												
GEO-56	9.0		42												
GEO-57	1.0		11												
GEO-57	4.0		14												
GEO-57	7.0		20												
GEO-57	10.0		20												
GEO-57	12.0		19												
GEO-58	1.0		21												
GEO-58	4.0		24												
GEO-58	7.0		13												
GEO-58	9.0		10												
GEO-58	12.0		24												
GEO-59	1.0		17												
GEO-59	2.0	CH	21		98	54	20	34							
GEO-59	4.0		20												
GEO-59	7.0		22												
GEO-59	9.0		13												
GEO-60	1.0		9												
GEO-60	4.0		21												
GEO-60	7.0		25												
GEO-60	9.0		25												
GEO-61	1.0		19												
GEO-61	4.0		15												
GEO-61	7.0		14												
GEO-61	9.0		27												
GEO-62	1.0		13												

ND Not Detected; **D** Diluted;
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SUMMARY OF LABORATORY RESULTS

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NUMBER: GE2503026

Borehole	Depth (ft)	USCS	Water Content (%)	Dry Unit Weight (pcf)	< No. 200 (%)	LL	PL	PI	Compressive Strength (tsf)	Strain at Failure (%)	Confining Pressure (psi)	Chlorides (%/weight)	Sulfates (%/weight)	pH	Minimum Resistivity (ohm-cm)
GEO-62	2.0	SC	8		49	26	18	8							
GEO-62	4.0		12												
GEO-62	7.0		27												
GEO-62	10.0		22												
GEO-62	12.0	CH	21	105	91	56	23	33	4.51	6.6	10.0				
GEO-62	24.0		25	101											
GEO-63	1.0		9												
GEO-63	4.0		28												
GEO-63	7.0		21												
GEO-63	10.0		20												
GEO-63	12.0		23												
GEO-64	1.0		17												
GEO-64	1.0		22									0.0076	0.2740	7.3	294
GEO-64	4.0		21												
GEO-64	7.0		23												
GEO-64	9.0		23												
GEO-64	12.0		26												
GEO-65	1.0		11												
GEO-65	4.0		27												
GEO-65	7.0		33												
GEO-65	10.0		25												
GEO-65	12.0		25												
GEO-66	1.0		15												
GEO-66	4.0		20												
GEO-66	7.0		17												
GEO-66	9.0		28												
GEO-66	12.0	CH	22	104	100	52	22	30	6.24	5.8	10.0				
GEO-67	1.0		14												
GEO-67	2.0	CL	14		97	43	21	22							
GEO-67	4.0		20												
GEO-67	7.0		20												

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SUMMARY OF LABORATORY RESULTS

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LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026

Borehole	Depth (ft)	USCS	Water Content (%)	Dry Unit Weight (pcf)	< No. 200 (%)	LL	PL	PI	Compressive Strength (tsf)	Strain at Failure (%)	Confining Pressure (psi)	Chlorides (%/weight)	Sulfates (%/weight)	pH	Minimum Resistivity (ohm-cm)
GEO-67	9.0		18												
GEO-68	1.0		15												
GEO-68	4.0		20												
GEO-68	7.0		20												
GEO-68	9.0		19												
GEO-68	12.0		22												
GEO-69	1.0		24												
GEO-69	4.0		17												
GEO-69	7.0		23												
GEO-69	9.0		25												
GEO-69	12.0		25	95					4.60	3.5	0.0				
GEO-70	1.0		14												
GEO-70	2.0	CH	16		99	61	20	41							
GEO-70	4.0		19												
GEO-70	7.0		11												
GEO-70	9.0		15												
GEO-70	12.0		26												
GEO-71	1.0		14												
GEO-71	4.0		11												
GEO-71	7.0		12												
GEO-71	10.0		14												
GEO-74	1.0		22												
GEO-74	4.0		23												
GEO-74	7.0		22												
GEO-74	9.0		21												
GEO-74	12.0		16												
GEO-77	1.0		25												
GEO-77	4.0		19												
GEO-77	7.0		23												
GEO-77	9.0		25												
GEO-77	12.0	CL	17	112	89	37	18	19	6.42	12.5	10.0				

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SUMMARY OF LABORATORY RESULTS

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PROJECT: Longspur Wind Project
LOCATION: Mercer and Morton County, ND
NUMBER: GE2503026

Borehole	Depth (ft)	USCS	Water Content (%)	Dry Unit Weight (pcf)	< No. 200 (%)	LL	PL	PI	Compressive Strength (tsf)	Strain at Failure (%)	Confining Pressure (psi)	Chlorides (%/weight)	Sulfates (%/weight)	pH	Minimum Resistivity (ohm-cm)
SUB-1	1.0		11												
SUB-1	4.0		14												
SUB-2	1.0		7												
SUB-2	2.0	CL	14		51	37	14	23							
SUB-2	4.0	SM	14		20	NP	NP	NP							
SUB-3	1.0											0.0305	0.0240	9.1	805
SUB-3	4.0	SC-SM	15	108	20	21	16	5	1.62	14.3	3.0				
SUB-6	4.0	SM	6	101	27	NP	NP	NP							
SUB-9	1.0		6												
SUB-9	4.0	SC	6		23	24	16	8							
PMM-2	4.0	CH	25		100	77	22	55							
O&M-1	1.0		17												
O&M-1	4.0		10												
O&M-1	7.0		19	100					0.32	1.8	5.5				

ND Not Detected; **D** Diluted;
*Denotes Total Unit Weight

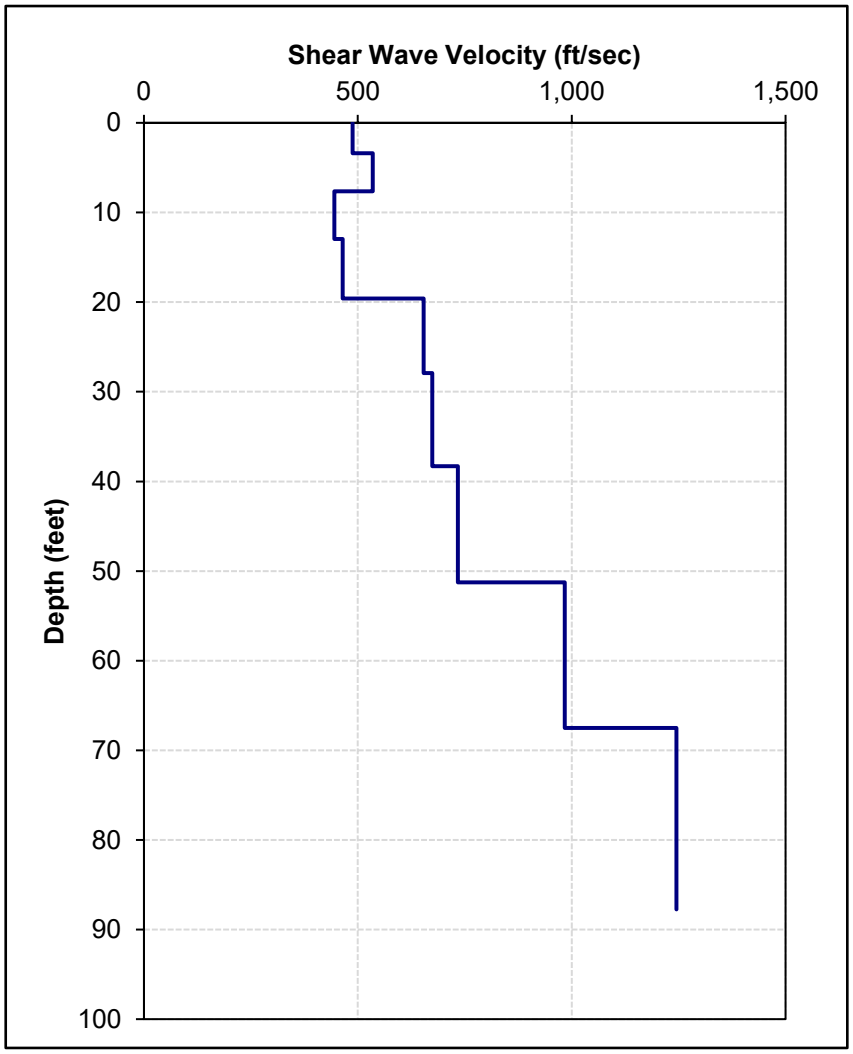
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APPENDIX C

Multi-Channel Analysis of Surface Waves (MASW) Survey Results for WTG No. GEO-004

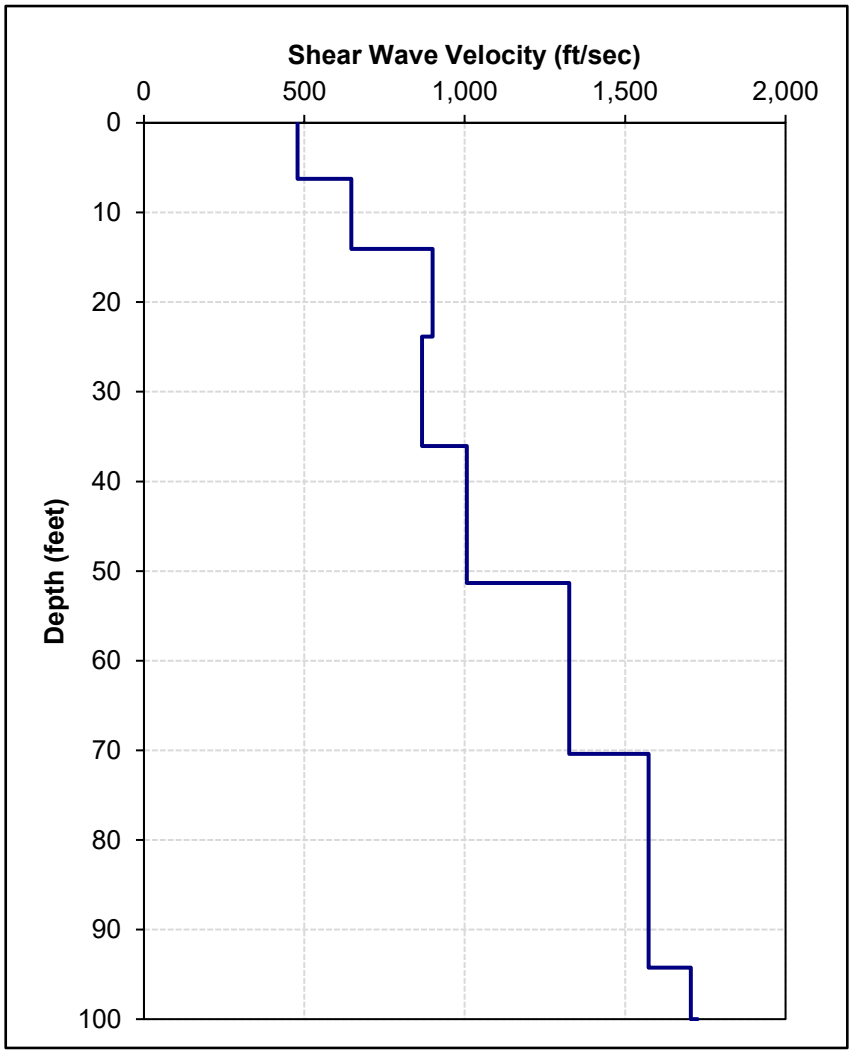
Depth (ft)	Shear Wave Velocity (ft/sec)
3.4	488
7.7	535
13.0	445
19.6	465
27.9	654
38.3	674
51.3	734
67.5	984
87.8	1,245



Note:
1. Data collected on May 09, 2025
2. SurfSeis v. 4.2.4.5 computer software developed by Kansas Geological Survey was used to process the field data.

Multi-Channel Analysis of Surface Waves (MASW) Survey Results for WTG No. GEO-014

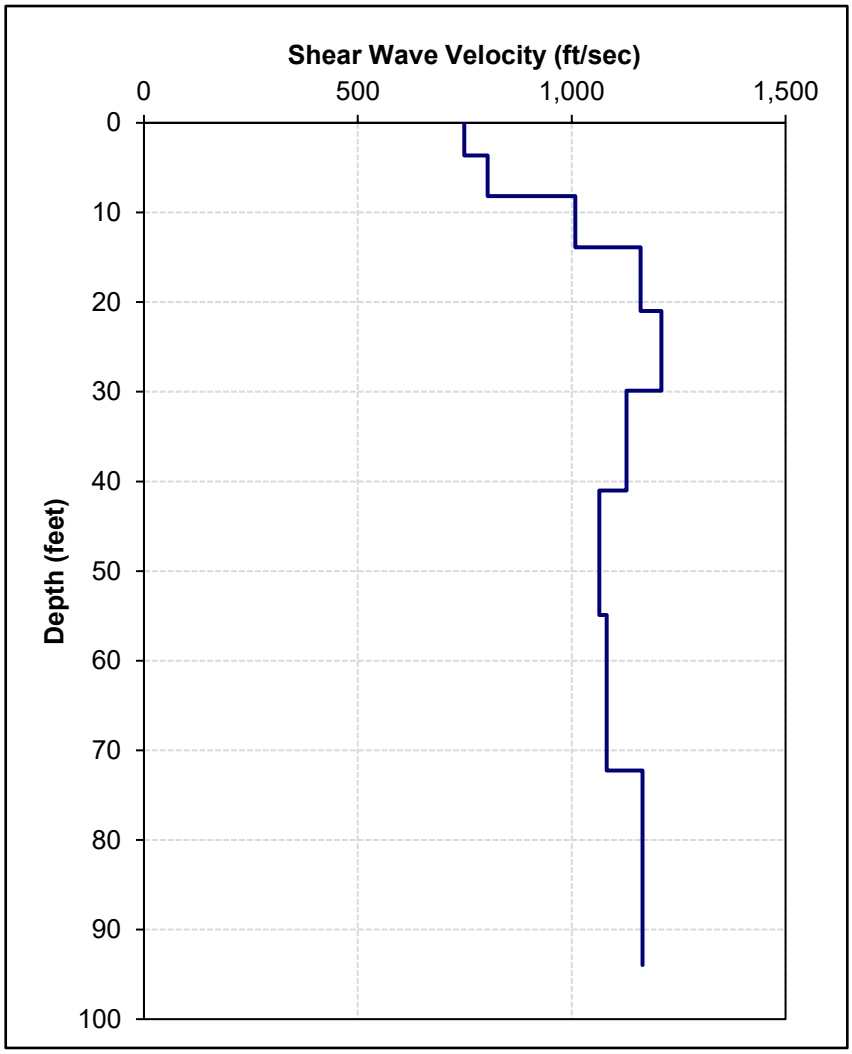
Depth (ft)	Shear Wave Velocity (ft/sec)
6.3	479
14.1	646
23.8	900
36.1	867
51.3	1,007
70.4	1,326
94.3	1,573
100.0	1,705



Note:
1. Data collected on May 09, 2025
2. SurfSeis v. 4.2.4.5 computer software developed by Kansas Geological Survey was used to process the field data.

Multi-Channel Analysis of Surface Waves (MASW) Survey Results for WTG No. GEO-018

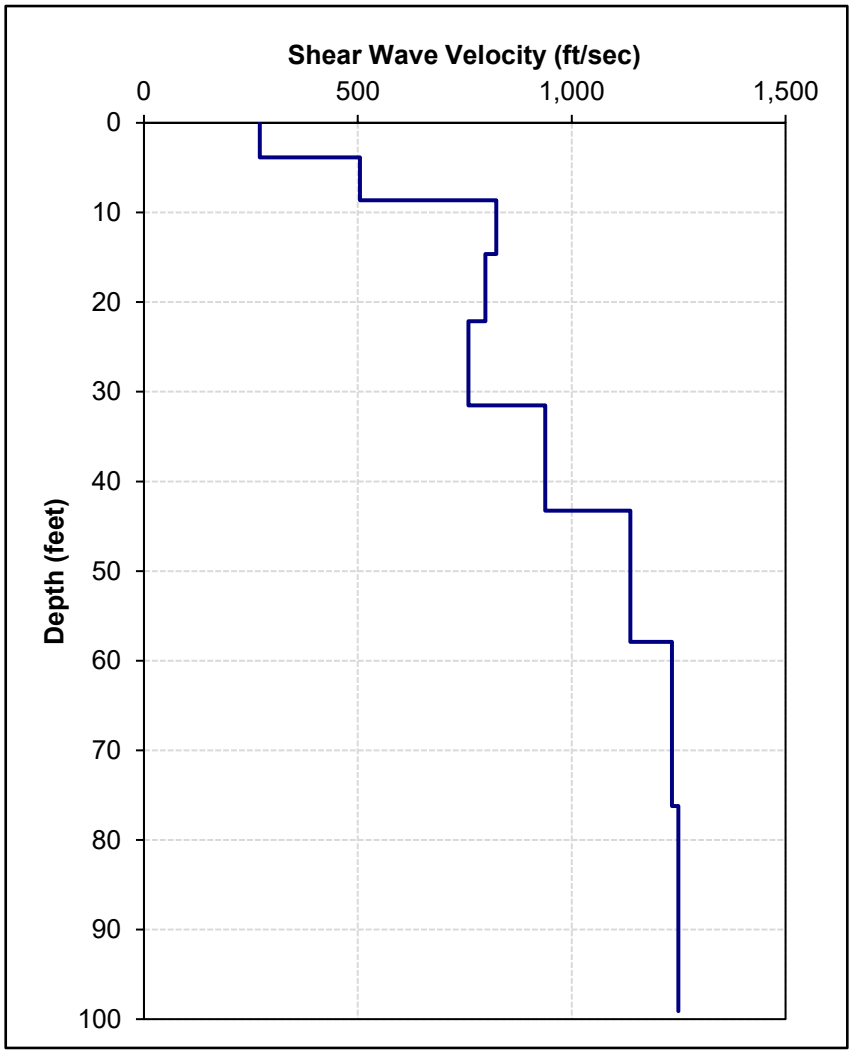
Depth (ft)	Shear Wave Velocity (ft/sec)
3.6	749
8.2	803
13.9	1,009
21.0	1,161
29.9	1,210
41.0	1,128
54.9	1,064
72.3	1,082
94.0	1,166



Note:
1. Data collected on May 09, 2025
2. SurfSeis v. 4.2.4.5 computer software developed by Kansas Geological Survey was used to process the field data.

Multi-Channel Analysis of Surface Waves (MASW) Survey Results for WTG No. GEO-029

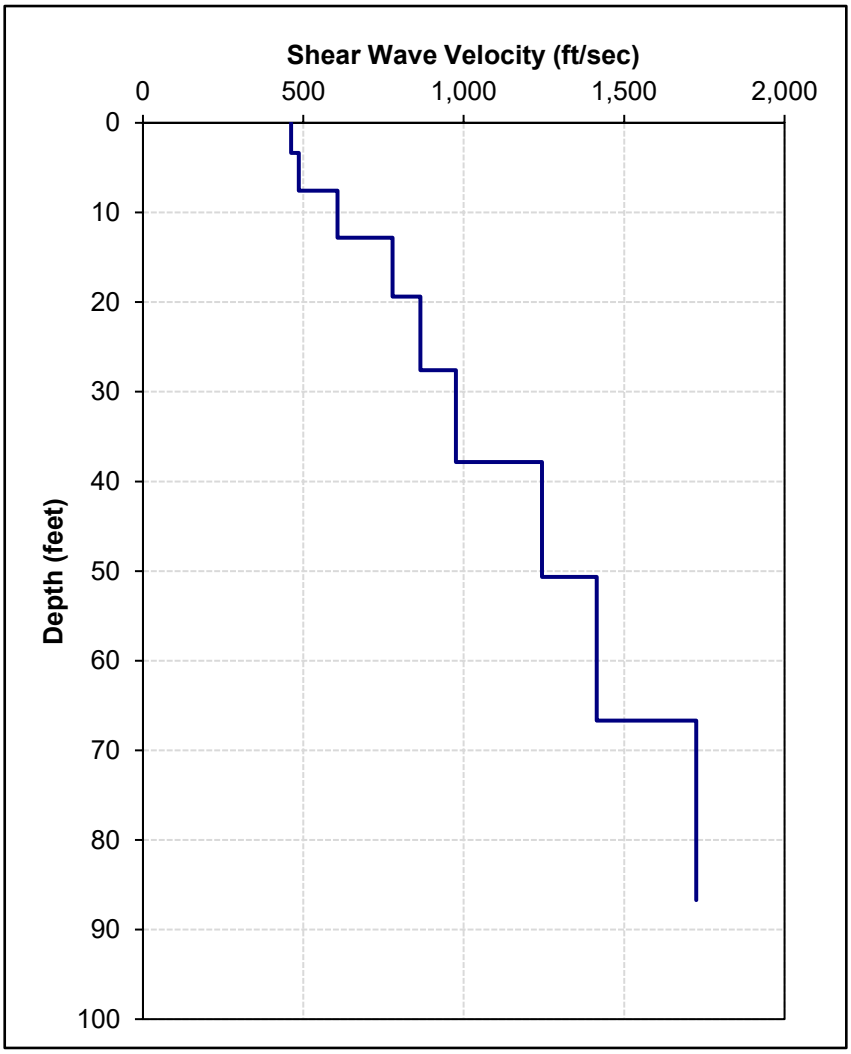
Depth (ft)	Shear Wave Velocity (ft/sec)
3.8	271
8.6	505
14.7	824
22.2	798
31.5	759
43.3	938
57.9	1,137
76.2	1,234
99.1	1,250



Note:
1. Data collected on May 09, 2025
2. SurfSeis v. 4.2.4.5 computer software developed by Kansas Geological Survey was used to process the field data.

Multi-Channel Analysis of Surface Waves (MASW) Survey Results for WTG No. GEO-033

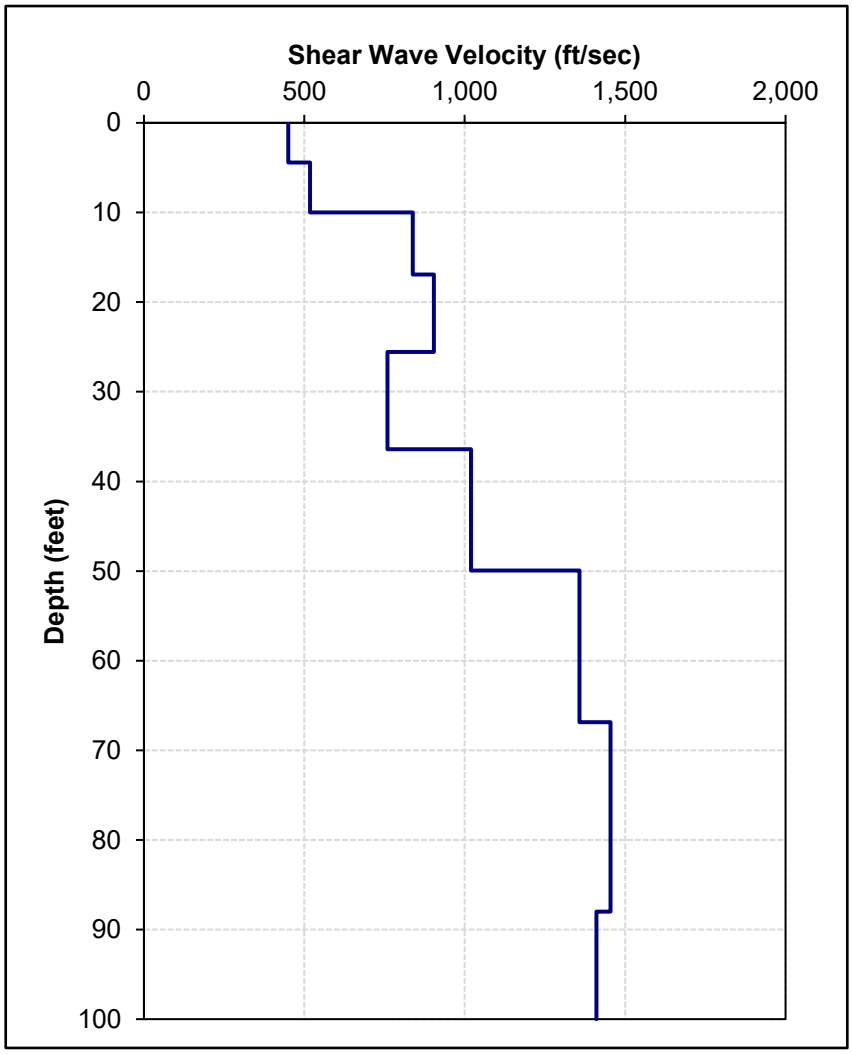
Depth (ft)	Shear Wave Velocity (ft/sec)
3.4	462
7.6	486
12.8	607
19.4	778
27.6	865
37.8	976
50.7	1,244
66.7	1,414
86.7	1,725



Note:
1. Data collected on May 09, 2025
2. SurfSeis v. 4.2.4.5 computer software developed by Kansas Geological Survey was used to process the field data.

Multi-Channel Analysis of Surface Waves (MASW) Survey Results for WTG No. GEO-064

Depth (ft)	Shear Wave Velocity (ft/sec)
4.4	450
10.0	518
16.9	838
25.6	904
36.4	760
49.9	1,020
66.9	1,357
88.0	1,455
100.0	1,411



Note:
1. Data collected on May 09, 2025
2. SurfSeis v. 4.2.4.5 computer software developed by Kansas Geological Survey was used to process the field data.

In Situ Electrical Soil Resistivity Measurement Data Form

Revision 0

Wenner Array

Project Name:	Minnesota Power - Longspur
Black & Veatch Project No.:	
Supplier Name & Operator	RRC Power & Energy; Ashutosh Shrivastava
Project Location:	West Morton, ND (46.955518, -101.761945)
Date:	5/12/2025
Measurement No. & Orientation:	DSR-1 / NE-SW
Description of Terrain & Probe Insertion:	Silt, Brown, Dry, Flat Topography; Probe insertion required some force
Weather (Present and Recent):	Sunny, 84° F
Meter Model Type:	Supersting; R8
Serial No. & Calibration Date:	SS2106234, 1/28/26

Notes: 1. Fence Lines is at approximately 500 feet East running N-S and 350 feet South running E-W.

Electrode "a" Spacing (ft)	Preferred Electrode Depth (in)	Actual Electrode Depth (in)	Electrode Configuration					Source Voltage (V)	V_{M-N} (mV) [1]	Current Injected, I (mA)	Standard deviation (%)	Apparent Resistance (Ohm)	Apparent Resistivity (Ohm-m)
			A (ft)	M (ft)	0	N (ft)	B (ft)						
1	1	2	1.5	0.5		0.5	1.5			9.996	0.2	126.6	242.33
2	2	2	3	1		1	3			135.9	0.1	27.75	106.23
3	4	2	4.5	1.5		1.5	4.5			158.3	0.2	10.83	62.19
6	6	4	9	3		3	9			134.6	0	3.401	39.06
10	6	4	15	5		5	15			147.0	0	1.809	34.63
20	12	6	30	10		10	30			186.3	0.1	0.832	31.85
30	12	6	45	15		15	45			135.0	0.2	0.553	31.76
60	12	12	90	30		30	90			169.0	0.2	0.214	24.58
100	12	12	150	50		50	150			213.2	0	0.0979	18.74
200	12	12	300	100		100	300			280.2	0.1	0.038	14.55
300	12	12	450	150		150	450			125.8	0.1	0.0219	12.58

[1] Not required if using AGI meters.

Note: Due to soil conductivity, the electrode depth may have to be increased. However, electrode depth shall not exceed 10% of “a” spacing.

In Situ Electrical Soil Resistivity Measurement Data Form

Revision 0

Wenner Array

Project Name:	Minnesota Power - Longspur
Black & Veatch Project No.:	
Supplier Name & Operator	RRC Power & Energy; Ashutosh Shrivastava
Project Location:	West Morton, ND (46.955518, -101.761945)
Date:	5/12/2025
Measurement No. & Orientation:	DSR-1 NW-SE
Description of Terrain & Probe Insertion:	Silt, Brown, Dry, Flat Topography; Probe insertion required some force
Weather (Present and Recent):	Sunny, 88° F
Meter Model Type:	Supersting; R8
Serial No. & Calibration Date:	SS2106234, 1/28/26

Notes: Fence Line is at approximately 500 feet East running N-S and 350 feet South running E-W.

Electrode "a" Spacing (ft)	Preferred Electrode Depth (in)	Actual Electrode Depth (in)	Electrode Configuration					Source Voltage (V)	V_{M-N} (mV) [1]	Current Injected, I (mA)	Standard deviation (%)	Apparent Resistance (Ohm)	Apparent Resistivity (Ohm-m)
			A (ft)	M (ft)	0	N (ft)	B (ft)						
1	1	1	1.5	0.5		0.5	1.5			9.979	0	112.5	215.34
2	2	2	3	1		1	3			102.1	0.1	30.88	118.22
3	4	4	4.5	1.5		1.5	4.5			100.4	0.1	9.618	55.23
6	6	6	9	3		3	9			115.9	0	3.383	38.85
10	6	6	15	5		5	15			163.5	0.1	1.812	34.68
20	12	12	30	10		10	30			148.2	0.1	0.908	34.76
30	12	12	45	15		15	45			144.5	0.1	0.574	32.96
60	12	12	90	30		30	90			135.7	0.1	0.206	23.66
100	12	12	150	50		50	150			175.6	0.1	0.095	18.18
200	12	12	300	100		100	300			210	0	0.037	14.16
300	12	12	450	150		150	450			135.2	0.1	0.022	12.63

[1] Not required if using AGI meters.

Note: Due to soil conductivity, the electrode depth may have to be increased. However, electrode depth shall not exceed 10% of “a” spacing.

In Situ Electrical Soil Resistivity Measurement Data Form

Revision 0

Wenner Array

Project Name:	Minnesota Power - Longspur
Black & Veatch Project No.:	
Supplier Name & Operator	RRC Power & Energy; Ashutosh Shrivastava
Project Location:	West Morton, ND (46.957200, -101.763272)
Date:	5/12/2025
Measurement No. & Orientation:	DSR-2 NE-SW
Description of Terrain & Probe Insertion:	Silt, Brown, Dry, Flat Topography; Probe insertion required some force
Weather (Present and Recent):	Sunny, 89° F
Meter Model Type:	Supersting; R8
Serial No. & Calibration Date:	SS2106234, 1/28/26

Notes: Fence Line is at approximately 150 feet East running NE-SW.

Electrode "a" Spacing (ft)	Preferred Electrode Depth (in)	Actual Electrode Depth (in)	Electrode Configuration					Source Voltage (V)	V_{M-N} (mV) [1]	Current Injected, I (mA)	Standard deviation (%)	Apparent Resistance (Ohm)	Apparent Resistivity (Ohm-m)
			A (ft)	M (ft)	0	N (ft)	B (ft)						
1	1	1	1.5	0.5		0.5	1.5			15.2	0	39.61	75.82
2	2	2	3	1		1	3			132.5	0	13.94	53.37
3	4	4	4.5	1.5		1.5	4.5			135.9	0.1	4.626	26.56
6	6	6	9	3		3	9			183.1	0	2.136	24.53
10	6	6	15	5		5	15			160.5	0.1	1.524	29.17
20	12	12	30	10		10	30			190.0	0.1	0.92	35.22
30	12	12	45	15		15	45			177.1	0.1	0.607	34.86
60	12	12	90	30		30	90			176.2	0.3	0.221	25.38
100	12	12	150	50		50	150			221.7	0.1	0.104	19.91
200	12	12	300	100		100	300			208.5	0.1	0.037	14.16
300	12	12	450	150		150	450			163.3	0.1	0.0225	12.92
600	12	12	900	300		300	900			115.4	0	0.0092	10.57

[1] Not required if using AGI meters.

Note: Due to soil conductivity, the electrode depth may have to be increased. However, electrode depth shall not exceed 10% of “a” spacing.

In Situ Electrical Soil Resistivity Measurement Data Form

Revision 0

Wenner Array

Project Name:	Minnesota Power - Longspur
Black & Veatch Project No.:	
Supplier Name & Operator	RRC Power & Energy; Ashutosh Shrivastava
Project Location:	West Morton, ND (46.954955, -101.762062)
Date:	5/13/2025
Measurement No. & Orientation:	TSR-1 E-W
Description of Terrain & Probe Insertion:	Silt, Brown, Dry, Flat Topography; Probe insertion required some force
Weather (Present and Recent):	Sunny, 91° F
Meter Model Type:	Supersting; R8
Serial No. & Calibration Date:	SS2106234, 1/28/26

Notes: Fence Line is at approximately 150 feet South running E-W and 500 feet East running N-S.

Electrode "a" Spacing (ft)	Preferred Electrode Depth (in)	Actual Electrode Depth (in)	Electrode Configuration					Source Voltage (V)	V_{M-N} (mV) [1]	Current Injected, I (mA)	Standard deviation (%)	Apparent Resistance (Ohm)	Apparent Resistivity (Ohm-m)
			A (ft)	M (ft)	0	N (ft)	B (ft)						
1	1	1	1.5	0.5		0.5	1.5			21.3	0	62.18	119.02
2	2	2	3	1		1	3			23.2	0	36.14	138.35
3	4	4	4.5	1.5		1.5	4.5			108.6	0.1	19.43	111.58
6	6	6	9	3		3	9			201.7	0	7.044	80.90
10	6	6	15	5		5	15			193.8	0	2.964	56.74
20	12	12	30	10		10	30			218.7	0.1	1.075	41.15
30	12	12	45	15		15	45			215.4	0.1	0.553	31.76

[1] Not required if using AGI meters.

Note: Due to soil conductivity, the electrode depth may have to be increased. However, electrode depth shall not exceed 10% of “a” spacing.

In Situ Electrical Soil Resistivity Measurement Data Form

Revision 0

Wenner Array

Project Name:	Minnesota Power - Longspur
Black & Veatch Project No.:	
Supplier Name & Operator	RRC Power & Energy; Ashutosh Shrivastava
Project Location:	West Morton, ND (46.954955, -101.762062)
Date:	5/13/2025
Measurement No. & Orientation:	TSR-1 N-S
Description of Terrain & Probe Insertion:	Silt, Brown, Dry, Flat Topography; Probe insertion required some force
Weather (Present and Recent):	Sunny, 90 ° F
Meter Model Type:	Supersting; R8
Serial No. & Calibration Date:	SS2106234, 1/28/26

Notes: Fence Line is at approximately 150 feet South running E-W and 500 feet East running N-S.

Electrode "a" Spacing (ft)	Preferred Electrode Depth (in)	Actual Electrode Depth (in)	Electrode Configuration					Source Voltage (V)	V_{M-N} (mV) [1]	Current Injected, I (mA)	Standard deviation (%)	Apparent Resistance (Ohm)	Apparent Resistivity (Ohm-m)
			A (ft)	M (ft)	0	N (ft)	B (ft)						
1	1	1	1.5	0.5		0.5	1.5			19.3	0	58.45	111.88
2	2	2	3	1		1	3			26.2	0.1	34.48	132.00
3	4	4	4.5	1.5		1.5	4.5			131.8	0.1	20.53	117.89
6	6	6	9	3		3	9			192.3	0	6.835	78.50
10	6	6	15	5		5	15			181.6	0	2.754	52.72
20	12	12	30	10		10	30			201.3	0	0.954	36.52
30	12	12	45	15		15	45			191.2	0.1	0.494	28.37

[1] Not required if using AGI meters.

Note: Due to soil conductivity, the electrode depth may have to be increased. However, electrode depth shall not exceed 10% of “a” spacing.

In Situ Electrical Soil Resistivity Measurement Data Form

Revision 0

Wenner Array

Project Name:	Minnesota Power - Longspur
Black & Veatch Project No.:	
Supplier Name & Operator	RRC Power & Energy; Ashutosh Shrivastava
Project Location:	West Morton, ND (46.955010, -101.760918)
Date:	5/13/2025
Measurement No. & Orientation:	TSR-2 NE-SW
Description of Terrain & Probe Insertion:	Silt, Brown, Dry, Flat Topography; Probe insertion required some force
Weather (Present and Recent):	Sunny, 88 ° F
Meter Model Type:	Supersting; R8
Serial No. & Calibration Date:	SS2106234, 1/28/26

Notes: Fence Line is at approximately 150 feet South running E-W and 225 feet East running N-S.

Electrode "a" Spacing (ft)	Preferred Electrode Depth (in)	Actual Electrode Depth (in)	Electrode Configuration					Source Voltage (V)	V_{M-N} (mV) [1]	Current Injected, I (mA)	Standard deviation (%)	Apparent Resistance (Ohm)	Apparent Resistivity (Ohm-m)
			A (ft)	M (ft)	0	N (ft)	B (ft)						
1	1	1	1.5	0.5		0.5	1.5			21.5	0	46.63	89.26
2	2	2	3	1		1	3			20.4	0	31.86	121.97
3	4	3	4.5	1.5		1.5	4.5			19.7	0	22.31	128.11
6	6	5	9	3		3	9			243.2	0.1	7.38	84.76
10	6	6	15	5		5	15			238.2	0.1	3.189	61.04
20	12	10	30	10		10	30			209.8	0.1	1.053	40.31
30	12	12	45	15		15	45			135.1	0.1	0.559	32.10

[1] Not required if using AGI meters.

Note: Due to soil conductivity, the electrode depth may have to be increased. However, electrode depth shall not exceed 10% of “a” spacing.

In Situ Electrical Soil Resistivity Measurement Data Form

Revision 0

Wenner Array

Project Name:	Minnesota Power - Longspur
Black & Veatch Project No.:	
Supplier Name & Operator	RRC Power & Energy; Ashutosh Shrivastava
Project Location:	West Morton, ND (46.955010, -101.760918)
Date:	5/13/2025
Measurement No. & Orientation:	TSR-2 NW-SE
Description of Terrain & Probe Insertion:	Silt, Brown, Dry, Flat Topography; Probe insertion required some force
Weather (Present and Recent):	Sunny, 88 ° F
Meter Model Type:	Supersting; R8
Serial No. & Calibration Date:	SS2106234, 1/28/26

Notes: Fence Line is at approximately 150 feet South running E-W and 225 feet East running N-S.

Electrode "a" Spacing (ft)	Preferred Electrode Depth (in)	Actual Electrode Depth (in)	Electrode Configuration					Source Voltage (V)	V_{M-N} (mV) [1]	Current Injected, I (mA)	Standard deviation (%)	Apparent Resistance (Ohm)	Apparent Resistivity (Ohm-m)
			A (ft)	M (ft)	0	N (ft)	B (ft)						
1	1	1	1.5	0.5		0.5	1.5			18.6	0	48.33	92.51
2	2	2	3	1		1	3			16.2	0.1	32.62	124.88
3	4	4	4.5	1.5		1.5	4.5			81.3	0	21.38	122.77
6	6	6	9	3		3	9			221.8	0	6.332	72.72
10	6	6	15	5		5	15			196.3	0.1	3.018	57.77
20	12	12	30	10		10	30			201.4	0.1	0.958	36.67
30	12	12	45	15		15	45			162.3	0.1	0.545	31.30

[1] Not required if using AGI meters.

Note: Due to soil conductivity, the electrode depth may have to be increased. However, electrode depth shall not exceed 10% of “a” spacing.

In Situ Electrical Soil Resistivity Measurement Data Form

Revision 0

Wenner Array

Project Name:	Minnesota Power - Longspur
Black & Veatch Project No.:	
Supplier Name & Operator	RRC Power & Energy; Ashutosh Shrivastava
Project Location:	West Morton, ND (46.955574, -101.760990)
Date:	5/12/2025
Measurement No. & Orientation:	TSR-3 E-W
Description of Terrain & Probe Insertion:	Silt, Brown, Dry, Flat Topography; Probe insertion required some force
Weather (Present and Recent):	Sunny, 87 ° F
Meter Model Type:	Supersting; R8
Serial No. & Calibration Date:	SS2106234, 1/28/26

Notes: Fence Line is at approximately 350 feet South running E-W and 250 feet East running N-S.

Electrode "a" Spacing (ft)	Preferred Electrode Depth (in)	Actual Electrode Depth (in)	Electrode Configuration					Source Voltage (V)	V_{M-N} (mV) [1]	Current Injected, I (mA)	Standard deviation (%)	Apparent Resistance (Ohm)	Apparent Resistivity (Ohm-m)
			A (ft)	M (ft)	0	N (ft)	B (ft)						
1	1	1	1.5	0.5		0.5	1.5			9.6	0	81.62	156.23
2	2	2	3	1		1	3			9.8	0	42.57	162.97
3	4	4	4.5	1.5		1.5	4.5			103.8	0	21.94	125.99
6	6	6	9	3		3	9			163.4	0.1	6.88	79.02
10	6	6	15	5		5	15			124.9	0	2.963	56.72
20	12	12	30	10		10	30			83.9	0.2	0.897	34.34
30	12	12	45	15		15	45			95.9	0.3	0.433	24.86

[1] Not required if using AGI meters.

Note: Due to soil conductivity, the electrode depth may have to be increased. However, electrode depth shall not exceed 10% of “a” spacing.

In Situ Electrical Soil Resistivity Measurement Data Form

Revision 0

Wenner Array

Project Name:	Minnesota Power - Longspur
Black & Veatch Project No.:	
Supplier Name & Operator	RRC Power & Energy; Ashutosh Shrivastava
Project Location:	West Morton, ND (46.955574, -101.760990)
Date:	5/12/2025
Measurement No. & Orientation:	TSR-3 N-S
Description of Terrain & Probe Insertion:	Silt, Brown, Dry, Flat Topography; Probe insertion required some force
Weather (Present and Recent):	Sunny, 91 ° F
Meter Model Type:	Supersting; R8
Serial No. & Calibration Date:	SS2106234, 1/28/26

Notes: Fence Line is at approximately 350 feet South running E-W and 250 feet East running N-S.

Electrode "a" Spacing (ft)	Preferred Electrode Depth (in)	Actual Electrode Depth (in)	Electrode Configuration					Source Voltage (V)	V_{M-N} (mV) [1]	Current Injected, I (mA)	Standard deviation (%)	Apparent Resistance (Ohm)	Apparent Resistivity (Ohm-m)
			A (ft)	M (ft)	0	N (ft)	B (ft)						
1	1	1	1.5	0.5		0.5	1.5			4.8	0	78.86	150.95
2	2	2	3	1		1	3			9.6	0	45.07	172.54
3	4	4	4.5	1.5		1.5	4.5			83.9	0.1	18.06	103.71
6	6	6	9	3		3	9			137.8	0	5.179	59.48
10	6	6	15	5		5	15			91.6	0.1	2.185	41.82
20	12	12	30	10		10	30			103.5	0	0.947	36.25
30	12	12	45	15		15	45			123.9	0.1	0.545	31.30

[1] Not required if using AGI meters.

Note: Due to soil conductivity, the electrode depth may have to be increased. However, electrode depth shall not exceed 10% of “a” spacing.

Project Name: Longspur Wind Project
Black & Veatch Project No.:
Supplier Name: RRC Power & Energy LLC

In Situ Electrical Soil Resistivity Summary Data Form

Revision 0

Instructions:
1. Enter resistance and resistivity values of all traverse locations listed below.
2. Submit this completed spreadsheet with the final report.

Apparent Resistance (ohm)

Electrode "a" spacing (ft)	DSR-1 NE-SW	DSR-1 NW-SE	TSR-1 N-S	TSR-1 E-W	TSR-2 NE-SW	TSR-2 NW-SE	TSR-3 N-S	TSR-3 E-W	DSR-2 NE-SW
1	126.600	112.500	58.450	62.180	46.630	48.330	78.860	81.620	39.610
2	27.750	30.880	34.480	36.140	31.860	32.620	45.070	42.570	13.940
3	10.830	9.618	20.530	19.430	22.310	21.380	18.060	21.940	4.626
6	3.401	3.383	6.835	7.044	7.380	6.332	5.179	6.880	2.136
10	1.809	1.812	2.754	2.964	3.189	3.018	2.185	2.963	1.524
20	0.832	0.908	0.954	1.075	1.053	0.958	0.947	0.897	0.920
30	0.553	0.574	0.494	0.553	0.559	0.545	0.545	0.433	0.607
60	0.214	0.206							0.221
100	0.098	0.095							0.104
200	0.038	0.037							0.037
300	0.022	0.022							0.023
600									0.009

Apparent Resistivity (ohm-m)

Electrode "a" spacing (ft)	DSR-1 NE-SW	DSR-1 NW-SE	TSR-1 N-S	TSR-1 E-W	TSR-2 NE-SW	TSR-2 NW-SE	TSR-3 N-S	TSR-3 E-W	DSR-2 NE-SW
1	242.331	215.341	111.882	119.021	89.257	92.511	150.949	156.232	75.82
2	106.235	118.218	131.999	138.354	121.969	124.879	172.541	162.970	53.37
3	62.191	55.231	117.892	111.575	128.114	122.773	103.708	125.989	26.56
6	39.060	38.853	78.499	80.899	84.758	72.722	59.480	79.016	24.53
10	34.627	34.684	52.716	56.735	61.042	57.769	41.824	56.716	29.17
20	31.851	34.761	36.522	41.154	40.312	36.675	36.254	34.340	35.22
30	31.756	32.962	28.368	31.756	32.100	31.296	31.296	24.865	34.86
60	24.578	23.659							25.38
100	18.739	18.184							19.91
200	14.547	14.165							14.16
300	12.576	12.633							12.92

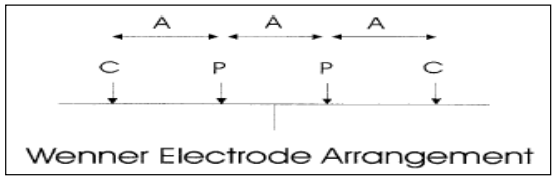
SOIL RESISTIVITY MEASURMENT DATA SHEET

Survey ID GEO-001
DATE 5/14/2025
CLIENT ALLETE Renewable Resources, Inc.
PROJECT Longspur Wind
Project No. GE2503026
LOCATION: Morton County, ND
LATITUDE : 46.928622
LONGITUDE : -101.860048
WEATHER: Sunny
Temp. (°F) 69°F
TOP SOIL: Silt (ML), Brown, Dry
TYPE OF TEST : Wenner 4-Pin Method
EQUIPMENT: SuperSting
SERIAL NO. SS2106234
MODEL: R8
CALIBRATION DUE DATE: 1/28/2026
TEST PERFORMED BY : RRC

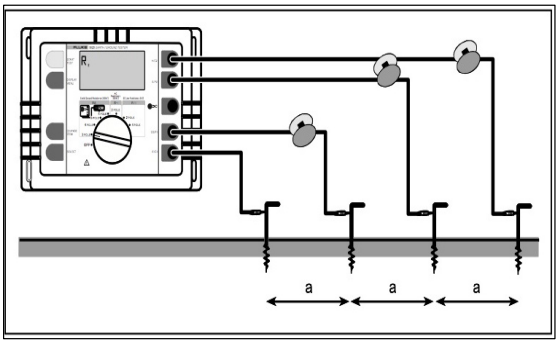
TEST SET RANGE
Meter Current: 1mA - 2000mA
Meter Resistance: 0.01Ohm - 19.99kOhm

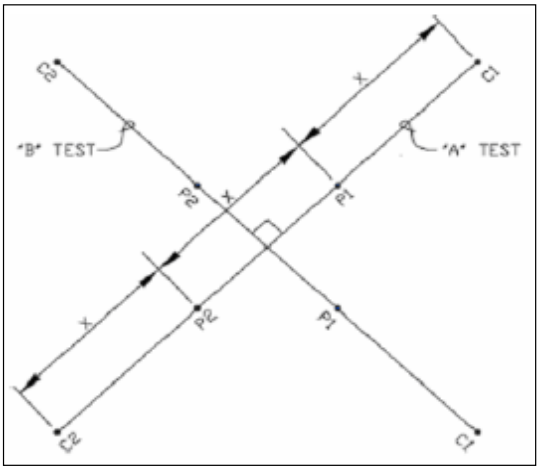
PROB Spacing (ft)	PROBE C DEPTH (Inches)	PROBE P DEPTH (Inches)	APPARENT ELECTRICAL RESISTIVITY						
			NE-SW		NW-SE				
			Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Average Soil Resistivity (Ωm)
0.5	4	2	4.452	4.26	4.628	4.43			4.35
1	4	2	3.531	6.76	3.318	6.35			6.55
1.5	4	2	2.343	6.73	2.331	6.69			6.71
2.5	4	2	1.297	6.21	1.362	6.52			6.36
3	4	2	0.824	4.73	0.816	4.69			4.71
5	4	2	0.384	3.68	0.399	3.81			3.75
7	4	2	0.201	2.70	0.194	2.60			2.65
10	12	6	0.113	2.17	0.121	2.32			2.24
15	12	6	0.068	1.95	0.067	1.92			1.93
20	12	6	0.054	2.06	0.052	1.99			2.03
30	12	6	0.044	2.54	0.043	2.49			2.51
45	12+	6+	0.037	3.16	0.037	3.20			3.18
70	12+	6+	0.029	3.86	0.030	4.05			3.96
100	12+	6+	0.021	4.01	0.020	3.76			3.88

Notes: Fence line at ~300 ft south of the profile center, going E-W.



Wenner Electrode Arrangement



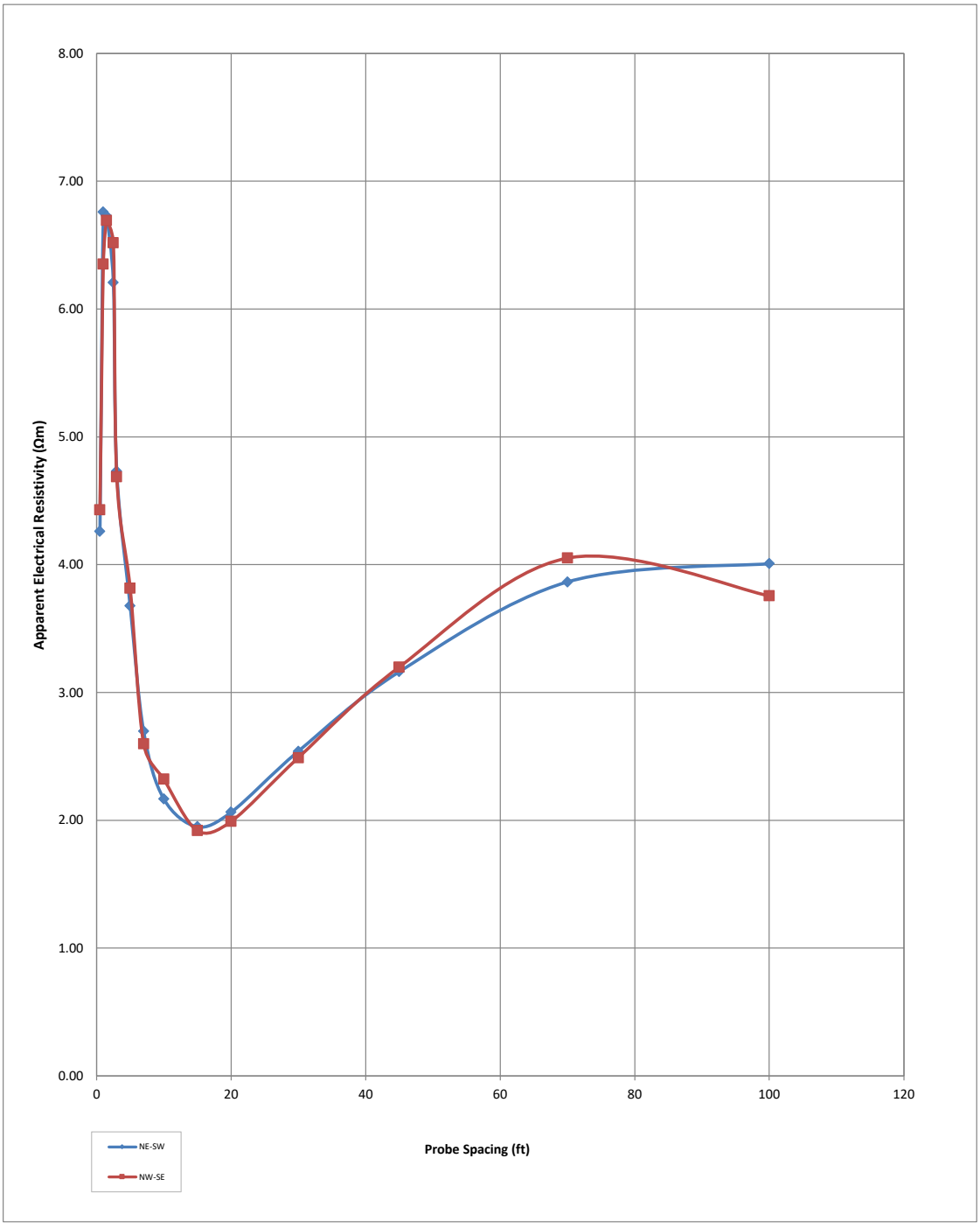


General Sketch of the test set up.

Total Array length is 3 times the probe spacing. The Apparent resistivity is calculated using the following equation: r=2*p*R*spacing*0.3048, where last item converts feet to meters. Wenner Array surveys were performed generally in accordance with IEEE std 81-2012 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." and ASTM G-57.

Longspur Wind

Electrical Resistivity Survey at GEO-001



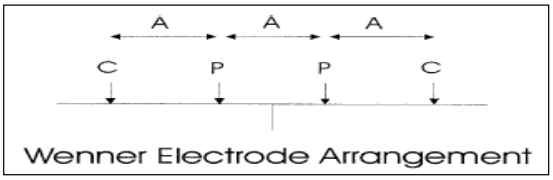
SOIL RESISTIVITY MEASURMENT DATA SHEET

Survey ID GEO-008
DATE 5/14/2025
CLIENT ALLETE Renewable Resources, Inc.
PROJECT Longspur Wind
Project No. GE2503026
LOCATION: Morton County, ND
LATITUDE : 46.916389
LONGITUDE : -101.834616
WEATHER: Sunny
Temp. (°F) 72°F
TOP SOIL: Silt (ML), Brown, Dry
TYPE OF TEST : Wenner 4-Pin Method
EQUIPMENT: SuperSting
SERIAL NO. SS2106234
MODEL: R8
CALIBRATION DUE DATE: 1/28/2026
TEST PERFORMED BY : RRC

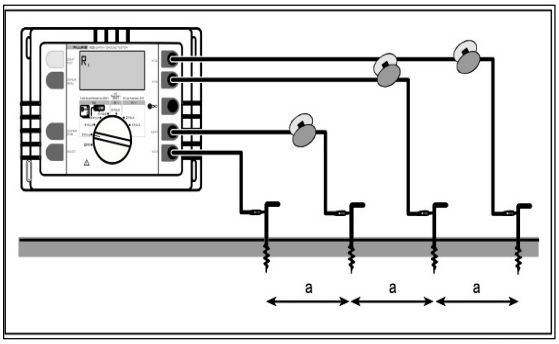
TEST SET RANGE
Meter Current: 1mA - 2000mA
Meter Resistance: 0.01Ohm - 19.99kOhm

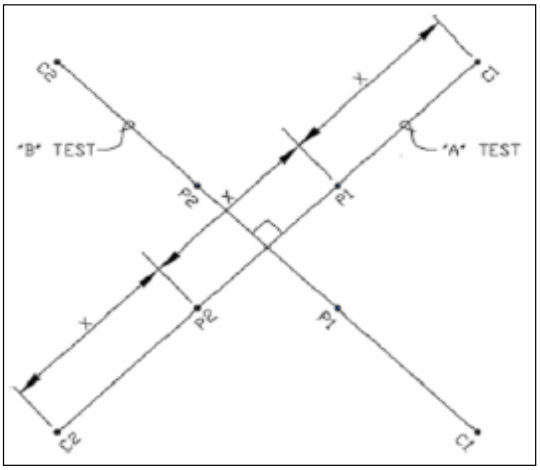
PROB Spacing (ft)	PROBE C DEPTH (Inches)	PROBE P DEPTH (Inches)	APPARENT ELECTRICAL RESISTIVITY						
			NE-SW		NW-SE				
			Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Average Soil Resistivity (Ωm)
0.5	4	2	9.113	8.72	8.884	8.50			8.61
1	4	2	7.573	14.50	7.424	14.21			14.35
1.5	4	2	5.115	14.69	5.230	15.02			14.85
2.5	4	2	3.235	15.48	3.122	14.94			15.21
3	4	2	2.342	13.45	2.456	14.10			13.78
5	4	2	1.265	12.11	1.315	12.59			12.35
7	4	2	0.858	11.50	0.856	11.47			11.49
10	12	6	0.497	9.50	0.504	9.65			9.58
15	12	6	0.295	8.48	0.310	8.89			8.69
20	12	6	0.203	7.78	0.202	7.72			7.75
30	12	6	0.142	8.15	0.141	8.11			8.13
45	12+	6+	0.097	8.32	0.093	7.97			8.14
70	12+	6+	0.063	8.47	0.064	8.58			8.53
100	12+	6+	0.048	9.10	0.048	9.14			9.12

Notes:



Wenner Electrode Arrangement



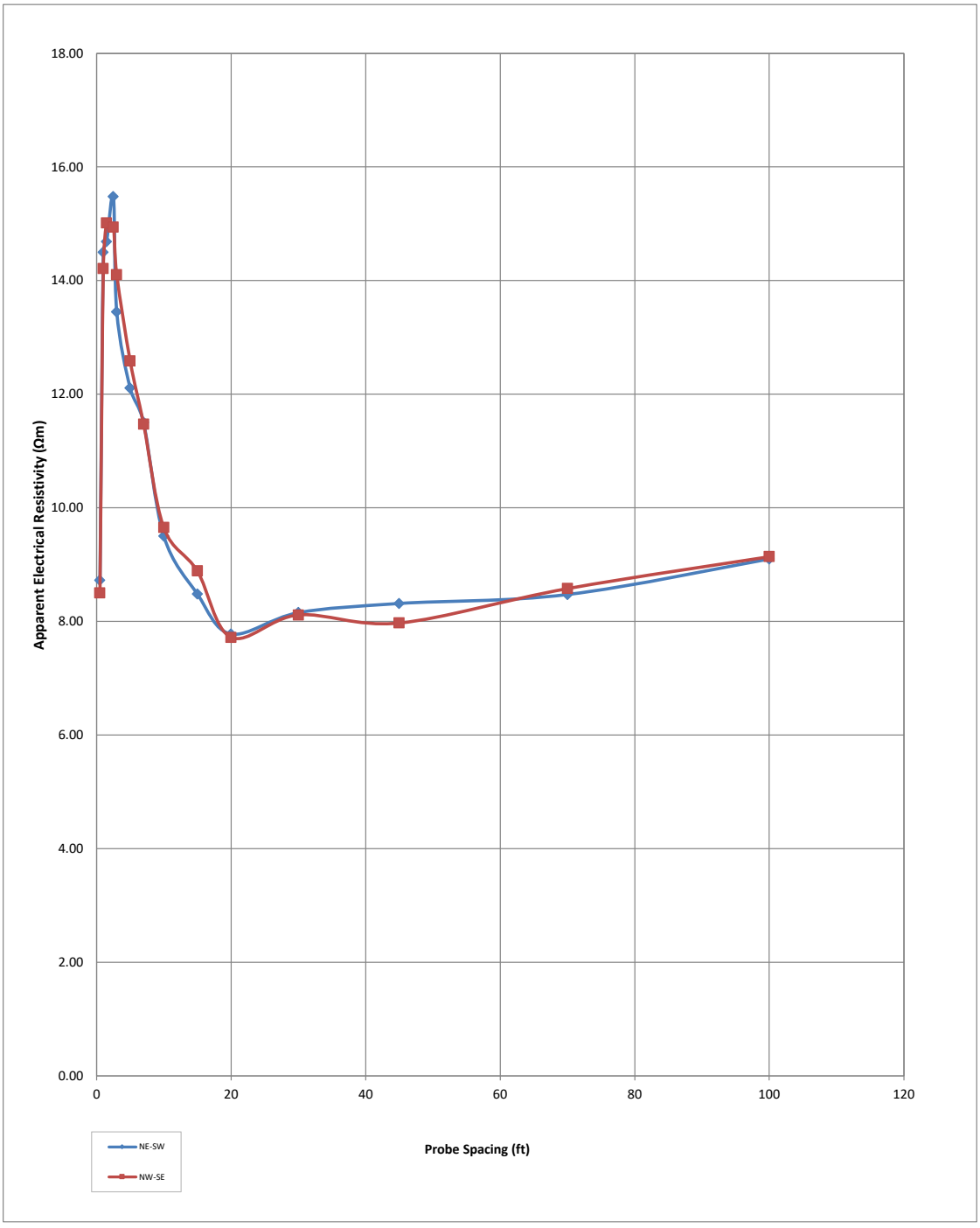


General Sketch of the test set up.

Total Array length is 3 times the probe spacing. The Apparent resistivity is calculated using the following equation: r=2*p*R*spacing*0.3048, where last item converts feet to meters. Wenner Array surveys were performed generally in accordance with IEEE std 81-2012 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." and ASTM G-57.

Longspur Wind

Electrical Resistivity Survey at GEO-008



SOIL RESISTIVITY MEASURMENT DATA SHEET

0 GEO-010

DATE 5/14/2025

CLIENT ALLETE Renewable Resources, Inc.

PROJECT Longspur Wind **Project No.** GE2503026

LOCATION: Morton County, ND

LATITUDE : 46.921177

LONGITUDE : -101.821968

WEATHER: Partly Cloudy **Temp. (°F)** 69°F

TOP SOIL: Silt (ML), Brown, Dry

TYPE OF TEST : Wenner 4-Pin Method

EQUIPMENT: SuperSting

SERIAL NO. SS2106234

MODEL: R8

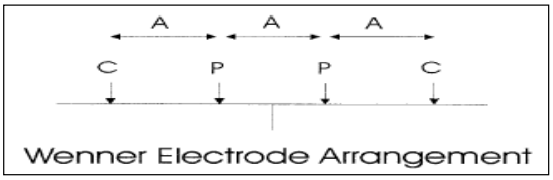
CALIBRATION DUE DATE: 1/28/2026

TEST PERFORMED BY : RRC

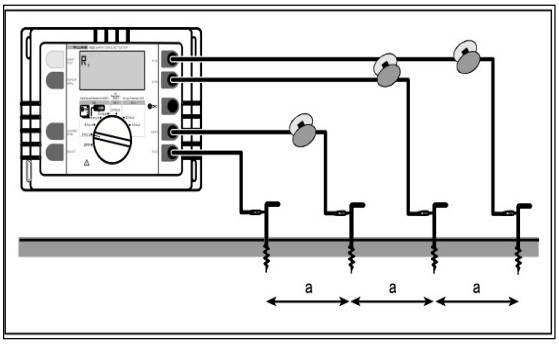
TEST SET RANGE
Meter Current: 1mA - 2000mA
Meter Resistance: 0.01Ohm - 19.99kOhom

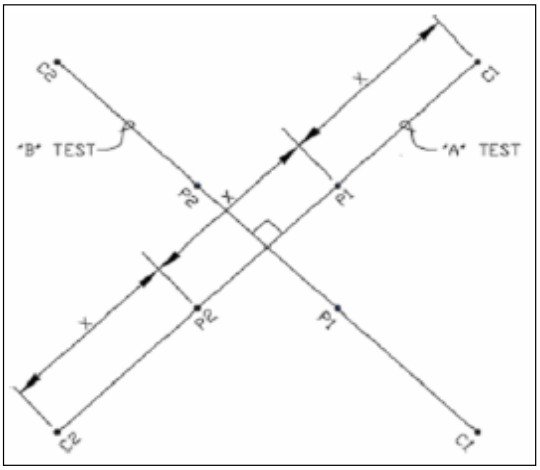
PROB Spacing (ft)	PROBE C DEPTH (Inches)	PROBE P DEPTH (Inches)	APPARENT ELECTRICAL RESISTIVITY						
			NE-SW		NW-SE				Average Soil Resistivity (Ωm)
			Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	
0.5	4	2	12.540	12.00	13.430	12.85			12.43
1	4	2	9.440	18.07	9.272	17.75			17.91
1.5	4	2	7.432	21.34	7.343	21.08			21.21
2.5	4	2	5.435	26.01	5.453	26.09			26.05
3	4	2	4.692	26.94	4.529	26.01			26.48
5	4	2	3.356	32.12	3.524	33.73			32.92
7	4	2	2.536	33.98	2.426	32.51			33.24
10	12	6	1.675	32.06	1.623	31.07			31.56
15	12	6	1.056	30.32	1.032	29.63			29.98
20	12	6	0.743	28.44	0.734	28.11			28.28
30	12	6	0.455	26.11	0.452	25.95			26.03
45	12+	6+	0.279	24.06	0.297	25.62			24.84
70	12+	6+	0.159	21.26	0.153	20.45			20.86
100	12+	6+	0.103	19.75	0.092	17.69			18.72

Notes: Fence line at ~300 ft west of the profile center, going N-S.



Wenner Electrode Arrangement



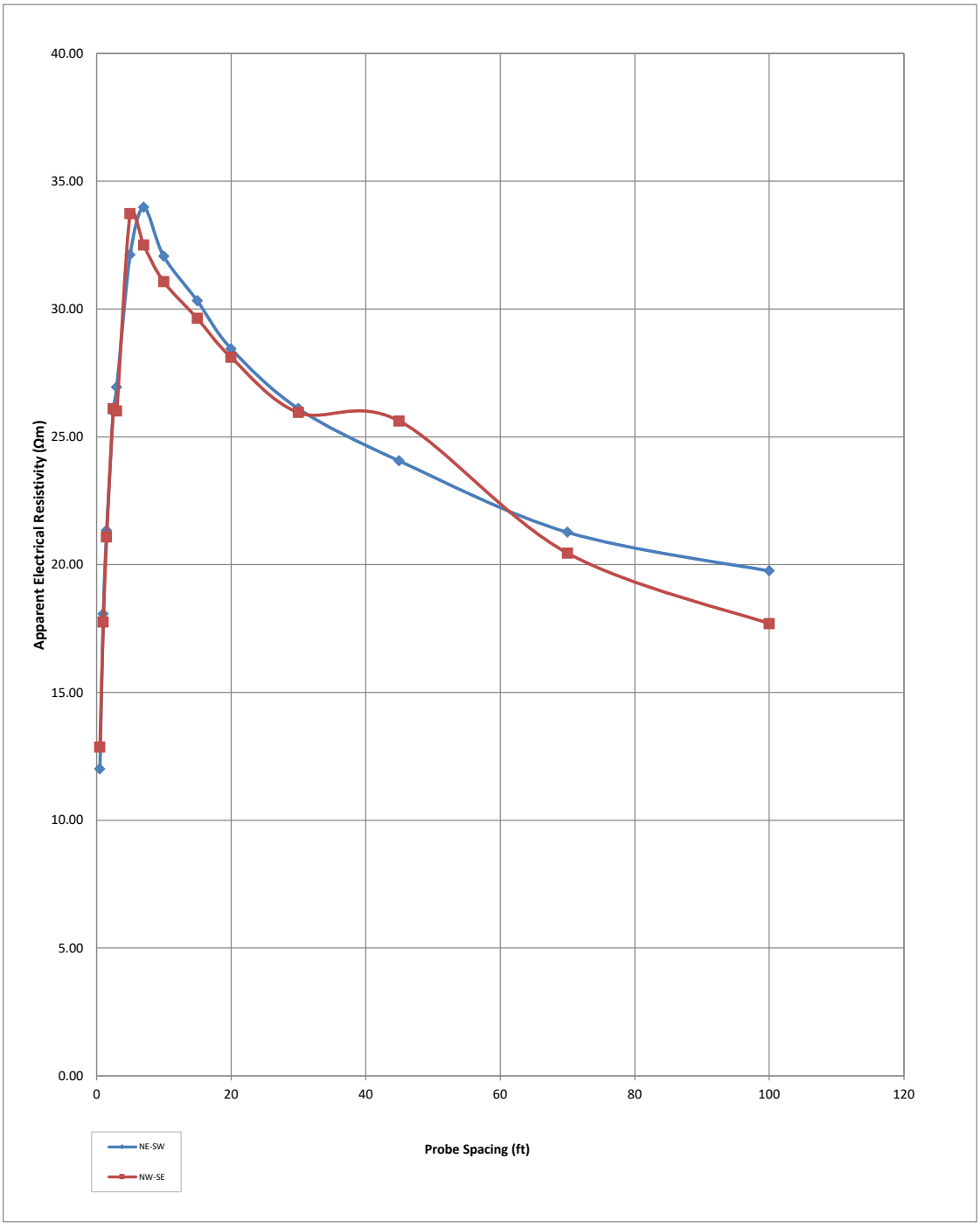


General Sketch of the test set up.

Total Array length is 3 times the probe spacing. The Apparent resistivity is calculated using the following equation: r=2*p*R*spacing*0.3048, where last item converts feet to meters. Wenner Array surveys were performed generally in accordance with IEEE std 81-2012 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." and ASTM G-57.

Longspur Wind

Electrical Resistivity Survey at GEO-010



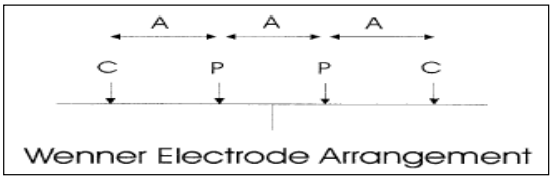
SOIL RESISTIVITY MEASURMENT DATA SHEET

Survey ID GEO-019
DATE 5/17/2025
CLIENT ALLETE Renewable Resources, Inc.
PROJECT Longspur Wind
Project No. GE2503026
LOCATION: Morton County, ND
LATITUDE : 46.886393
LONGITUDE : -101.800325
WEATHER: Sunny
Temp. (°F) 49°F
TOP SOIL: Silt (ML), Brown, Dry
TYPE OF TEST : Wenner 4-Pin Method
EQUIPMENT: SuperSting
SERIAL NO. SS2106234
MODEL: R8
CALIBRATION DUE DATE: 1/28/2026
TEST PERFORMED BY : RRC

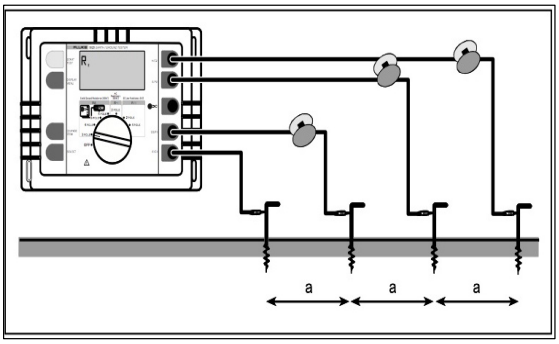
TEST SET RANGE
Meter Current: 1mA - 2000mA
Meter Resistance: 0.01Ohm - 19.99kOhom

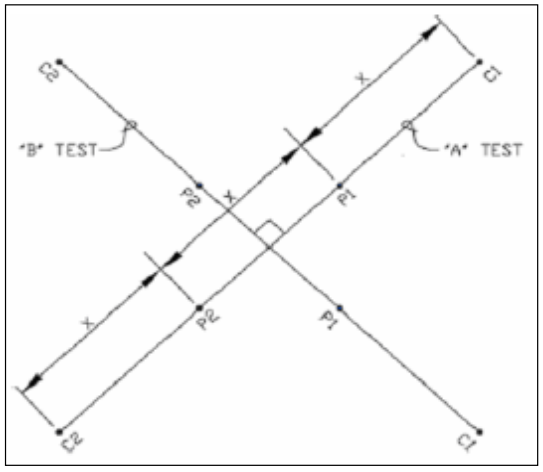
PROB Spacing (ft)	PROBE C DEPTH (Inches)	PROBE P DEPTH (Inches)	APPARENT ELECTRICAL RESISTIVITY						
			NE-SW		NW-SE				
			Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Average Soil Resistivity (Ωm)
0.5	4	2	15.320	14.66	17.250	16.51			15.59
1	4	2	8.679	16.61	9.245	17.70			17.15
1.5	4	2	6.246	17.93	6.645	19.08			18.51
2.5	4	2	5.136	24.58	5.235	25.05			24.81
3	4	2	4.964	28.51	4.883	28.04			28.27
5	4	2	4.053	38.79	3.769	36.07			37.43
7	4	2	2.735	36.65	2.756	36.93			36.79
10	12	6	1.618	30.97	1.542	29.52			30.24
15	12	6	0.854	24.53	0.853	24.48			24.50
20	12	6	0.525	20.08	0.572	21.91			20.99
30	12	6	0.301	17.31	0.299	17.16			17.24
45	12+	6+	0.125	10.80	0.117	10.11			10.46
70	12+	6+	0.060	7.99	0.058	7.75			7.87
100	12+	6+	0.039	7.56	0.041	7.91			7.73

Notes: Powerlines at ~1800 ft north of the profile center, going E-W.



Wenner Electrode Arrangement



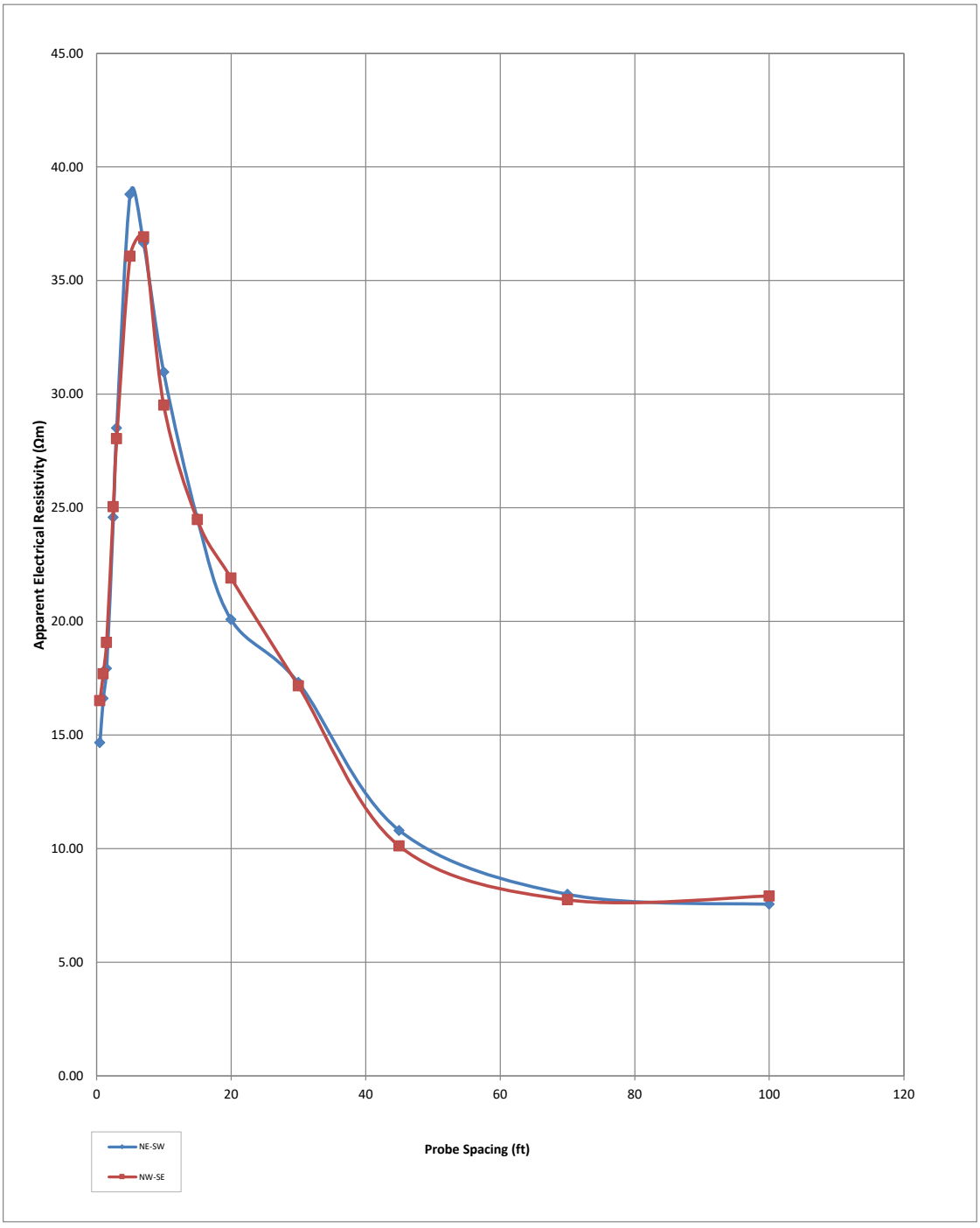


General Sketch of the test set up.

Total Array length is 3 times the probe spacing. The Apparent resistivity is calculated using the following equation: r=2*p*R*spacing*0.3048, where last item converts feet to meters. Wenner Array surveys were performed generally in accordance with IEEE std 81-2012 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." and ASTM G-57.

Longspur Wind

Electrical Resistivity Survey at GEO-019



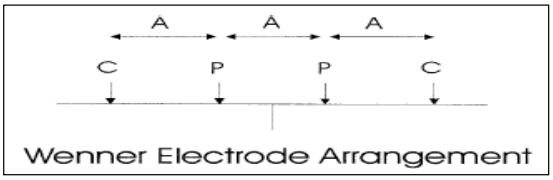
SOIL RESISTIVITY MEASURMENT DATA SHEET

Survey ID GEO-022
DATE 5/6/2025
CLIENT ALLETE Renewable Resources, Inc.
PROJECT Longspur Wind
Project No. GE2503026
LOCATION: Morton County, ND
LATITUDE : 46.973121
LONGITUDE : -101.745487
WEATHER: Sunny
Temp. (°F) 65°F
TOP SOIL: Silty Clay, Brown, Dry-Moist
TYPE OF TEST : Wenner 4-Pin Method
EQUIPMENT: SuperSting
SERIAL NO. SS2106234
MODEL: R8
CALIBRATION DUE DATE: 1/28/2026
TEST PERFORMED BY : RRC

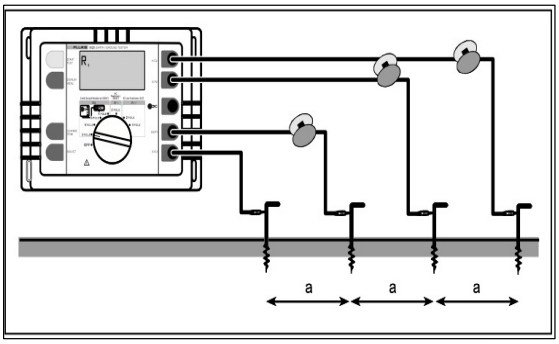
TEST SET RANGE
Meter Current: 1mA - 2000mA
Meter Resistance: 0.01Ohm - 19.99kOhm

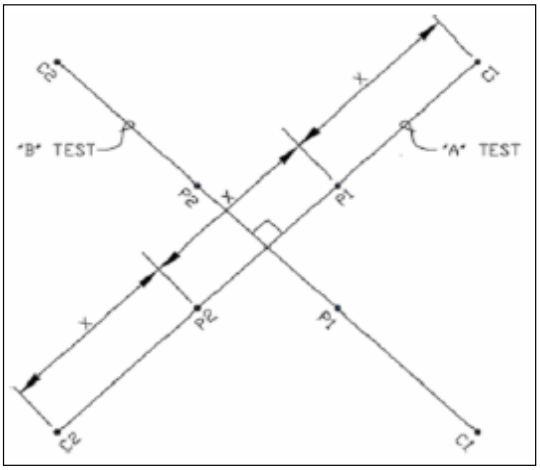
PROB Spacing (ft)	PROBE C DEPTH (Inches)	PROBE P DEPTH (Inches)	APPARENT ELECTRICAL RESISTIVITY						
			NE-SW		NW-SE				
			Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Average Soil Resistivity (Ωm)
0.5	4	2	35.280	33.77	38.660	37.00			35.38
1	4	2	26.240	50.23	27.740	53.10			51.66
1.5	4	2	21.300	61.16	20.910	60.04			60.60
2.5	4	2	12.010	57.47	11.440	54.74			56.11
3	4	2	9.882	56.75	10.330	59.32			58.03
5	4	2	4.090	39.14	4.210	40.29			39.72
7	4	2	1.980	26.53	1.998	26.77			26.65
10	12	6	0.938	17.95	0.922	17.65			17.80
15	12	6	0.502	14.40	0.489	14.05			14.23
20	12	6	0.331	12.69	0.326	12.49			12.59
30	12	6	0.219	12.55	0.210	12.07			12.31
45	12+	6+	0.135	11.62	0.139	11.95			11.78
70	12+	6+	0.088	11.83	0.088	11.77			11.80
100	12+	6+	0.063	12.02	0.062	11.80			11.91

Notes: Fence line at ~300 ft east of the profile center, going N-S.



Wenner Electrode Arrangement



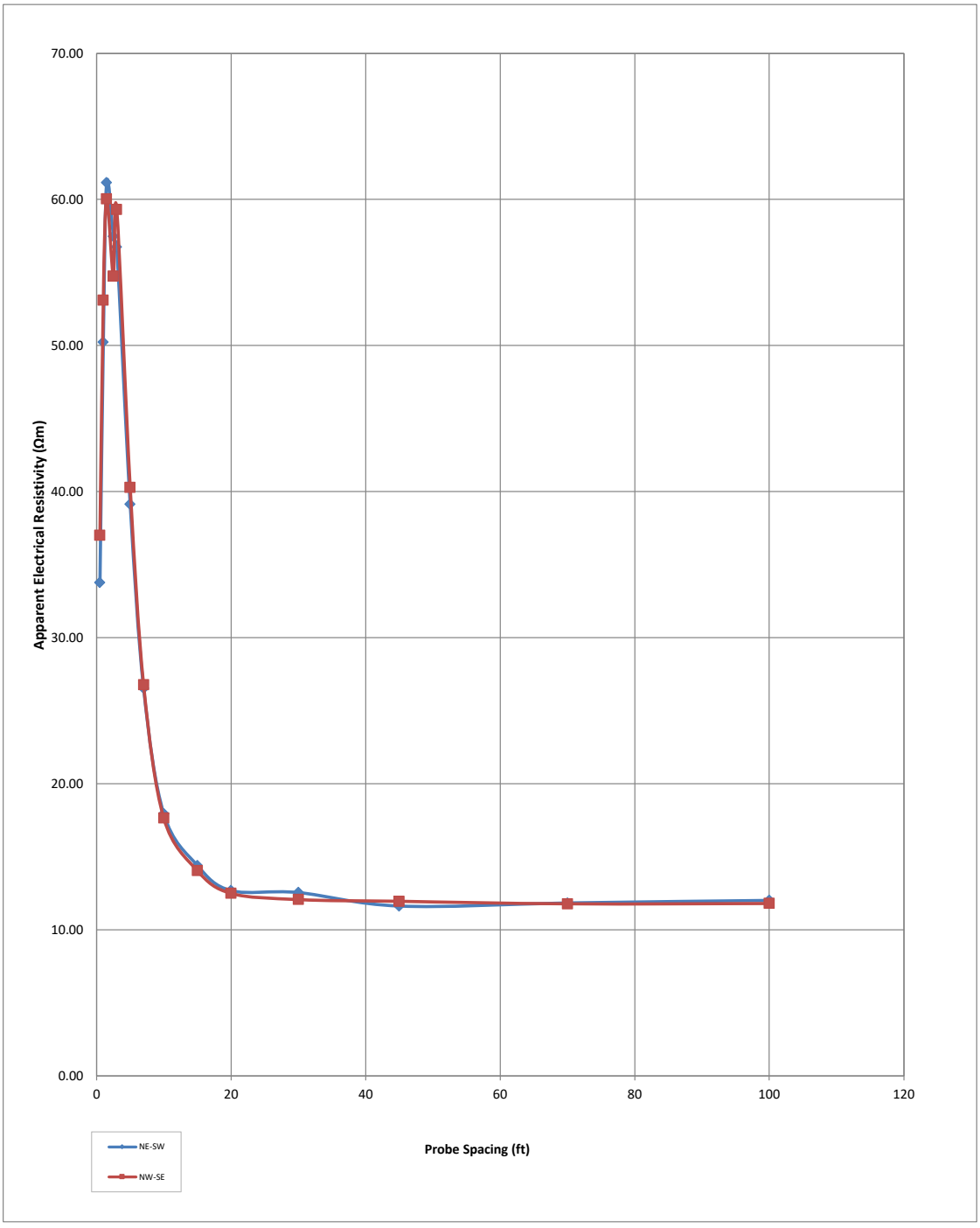


General Sketch of the test set up.

Total Array length is 3 times the probe spacing. The Apparent resistivity is calculated using the following equation: r=2*p*R*spacing*0.3048, where last item converts feet to meters. Wenner Array surveys were performed generally in accordance with IEEE std 81-2012 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." and ASTM G-57.

Longspur Wind

Electrical Resistivity Survey at GEO-022



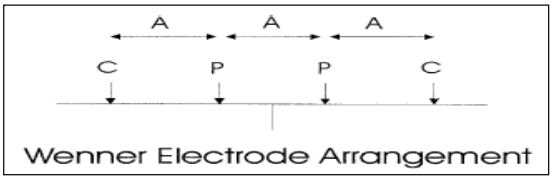
SOIL RESISTIVITY MEASURMENT DATA SHEET

Survey ID GEO-033
DATE 5/13/2025
CLIENT ALLETE Renewable Resources, Inc.
PROJECT Longspur Wind
Project No. GE2503026
LOCATION: Morton County, ND
LATITUDE : 46.95389
LONGITUDE : -101.730973
WEATHER: Partly Cloudy
Temp. (°F) 42°F
TOP SOIL: Silt (ML), Brown, Dry
TYPE OF TEST : Wenner 4-Pin Method
EQUIPMENT: SuperSting
SERIAL NO. SS2106234
MODEL: R8
CALIBRATION DUE DATE: 1/28/2026
TEST PERFORMED BY : RRC

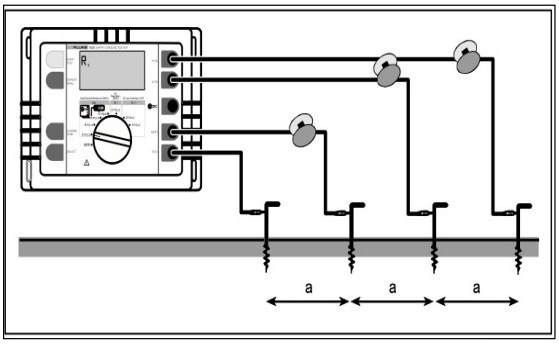
TEST SET RANGE
Meter Current: 1mA - 2000mA
Meter Resistance: 0.01Ohm - 19.99kOhm

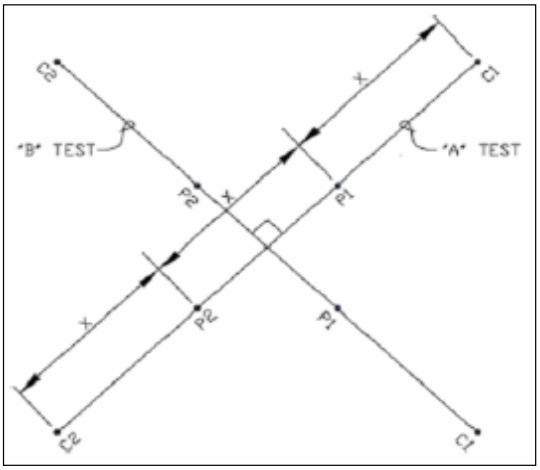
PROB Spacing (ft)	PROBE C DEPTH (Inches)	PROBE P DEPTH (Inches)	APPARENT ELECTRICAL RESISTIVITY						
			NE-SW		NW-SE				
			Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Average Soil Resistivity (Ωm)
0.5	4	2	28.530	27.31	31.560	30.21			28.76
1	4	2	19.530	37.38	20.380	39.01			38.20
1.5	4	2	14.270	40.97	15.240	43.76			42.36
2.5	4	2	8.028	38.42	8.383	40.12			39.27
3	4	2	6.249	35.88	6.862	39.40			37.64
5	4	2	2.749	26.31	2.934	28.08			27.20
7	4	2	1.592	21.33	1.574	21.09			21.21
10	12	6	0.876	16.78	0.902	17.27			17.02
15	12	6	0.498	14.30	0.501	14.40			14.35
20	12	6	0.297	11.39	0.297	11.35			11.37
30	12	6	0.172	9.90	0.177	10.19			10.04
45	12+	6+	0.104	8.98	0.118	10.12			9.55
70	12+	6+	0.063	8.49	0.065	8.74			8.61
100	12+	6+	0.041	7.83	0.044	8.39			8.11

Notes:



Wenner Electrode Arrangement



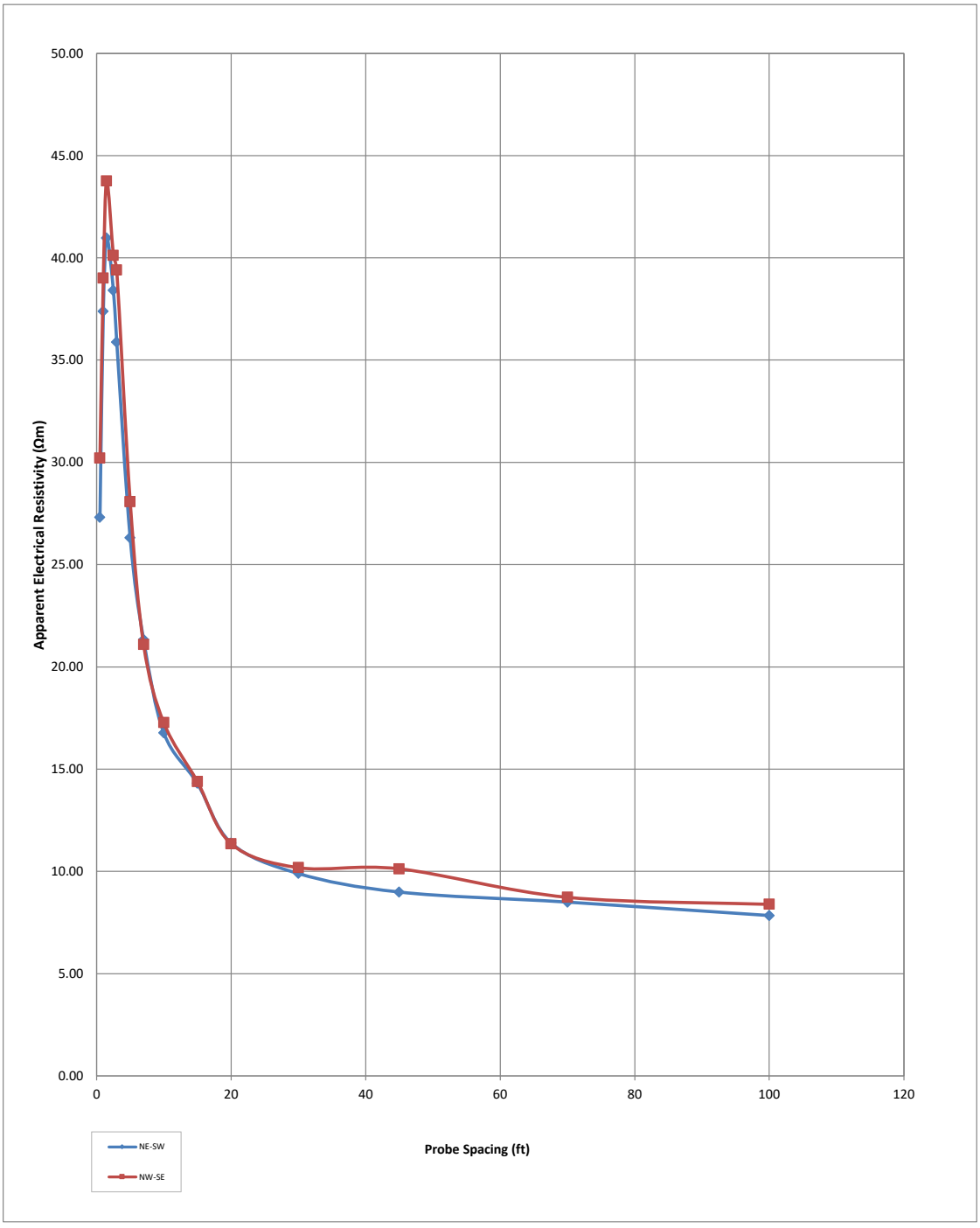


General Sketch of the test set up.

Total Array length is 3 times the probe spacing. The Apparent resistivity is calculated using the following equation: r=2*p*R*spacing*0.3048, where last item converts feet to meters. Wenner Array surveys were performed generally in accordance with IEEE std 81-2012 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." and ASTM G-57.

Longspur Wind

Electrical Resistivity Survey at GEO-033



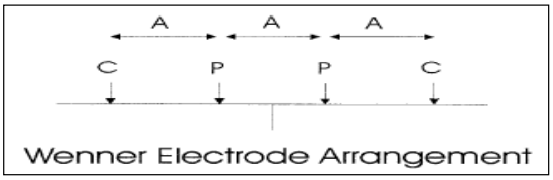
SOIL RESISTIVITY MEASURMENT DATA SHEET

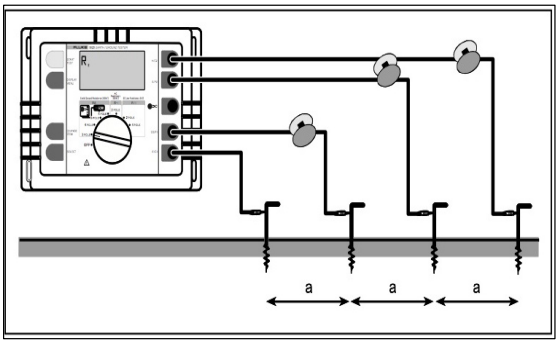
Survey ID GEO-046
DATE 5/13/2025
CLIENT ALLETE Renewable Resources, Inc.
PROJECT Longspur Wind
Project No. GE2503026
LOCATION: Morton County, ND
LATITUDE : 46.932595
LONGITUDE : -101.787575
WEATHER: Sunny
Temp. (°F) 82°F
TOP SOIL: Silt (ML), Brown, Dry
TYPE OF TEST : Wenner 4-Pin Method
EQUIPMENT: SuperSting
SERIAL NO. SS2106234
MODEL: R8
CALIBRATION DUE DATE: 1/28/2026
TEST PERFORMED BY : RRC

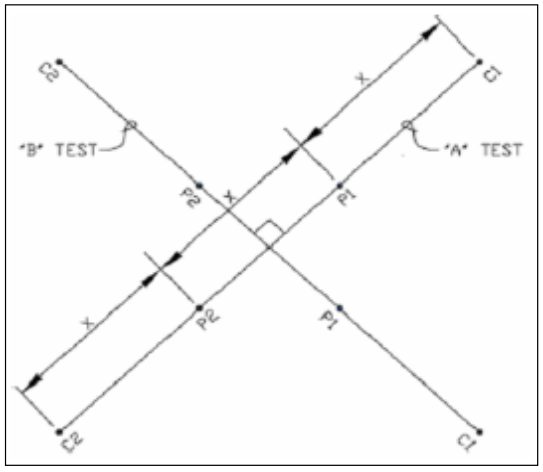
TEST SET RANGE
Meter Current: 1mA - 2000mA
Meter Resistance: 0.01Ohm - 19.99kOhm

PROB Spacing (ft)	PROBE C DEPTH (Inches)	PROBE P DEPTH (Inches)	APPARENT ELECTRICAL RESISTIVITY						
			NE-SW		NW-SE				
			Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Average Soil Resistivity (Ωm)
0.5	4	2	18.890	18.08	19.150	18.33			18.20
1	4	2	17.440	33.38	17.530	33.55			33.47
1.5	4	2	15.840	45.48	15.620	44.85			45.16
2.5	4	2	11.160	53.40	11.280	53.98			53.69
3	4	2	8.551	49.10	8.769	50.36			49.73
5	4	2	4.140	39.62	4.261	40.78			40.20
7	4	2	2.556	34.25	2.433	32.60			33.42
10	12	6	1.345	25.75	1.421	27.20			26.47
15	12	6	0.581	16.69	0.559	16.05			16.37
20	12	6	0.314	12.01	0.325	12.43			12.22
30	12	6	0.191	10.99	0.178	10.23			10.61
45	12+	6+	0.123	10.61	0.130	11.23			10.92
70	12+	6+	0.091	12.14	0.095	12.77			12.46
100	12+	6+	0.076	14.46	0.073	13.88			14.17

Notes:





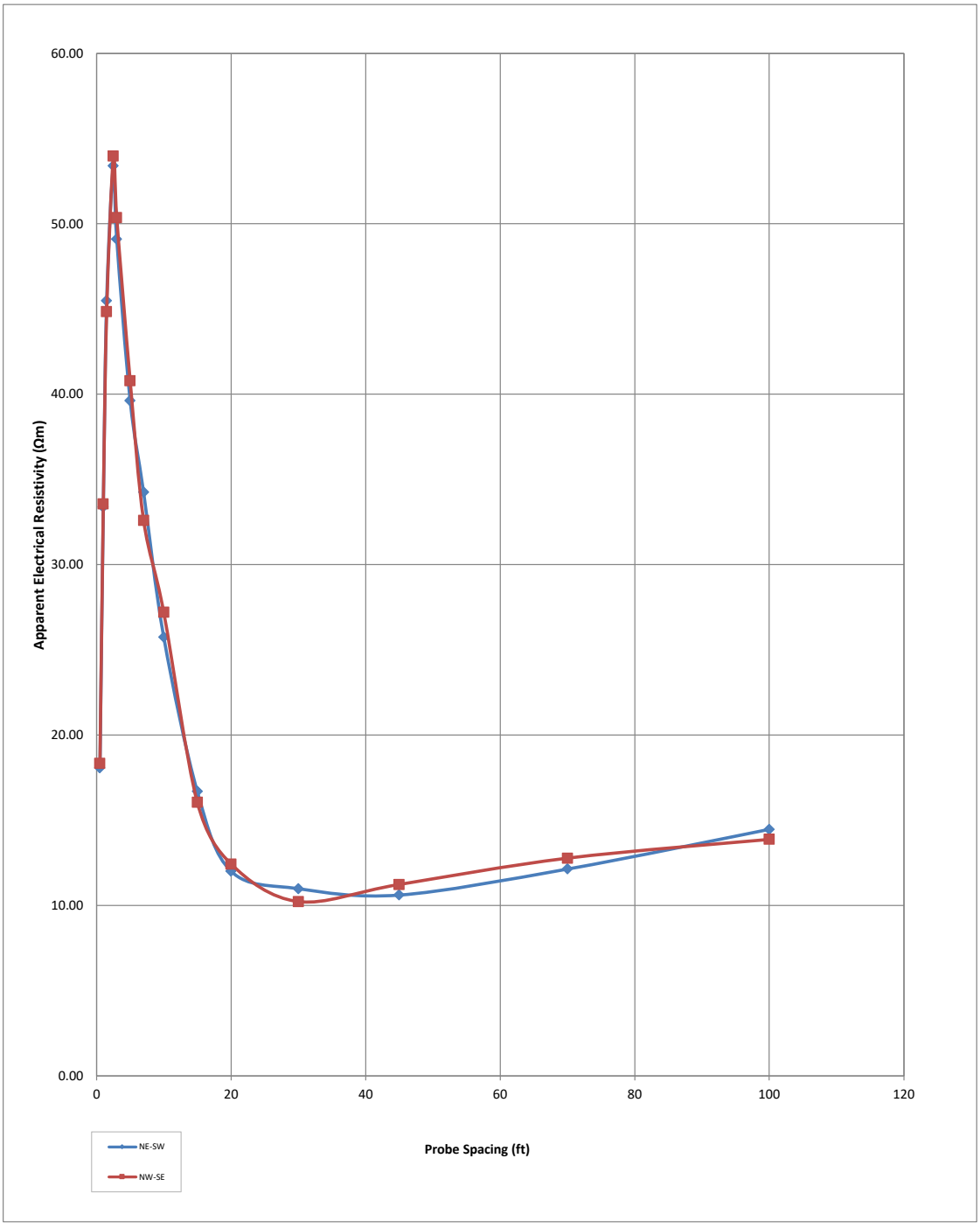


General Sketch of the test set up.

Total Array length is 3 times the probe spacing. The Apparent resistivity is calculated using the following equation: r=2*p*R*spacing*0.3048, where last item converts feet to meters. Wenner Array surveys were performed generally in accordance with IEEE std 81-2012 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." and ASTM G-57.

Longspur Wind

Electrical Resistivity Survey at GEO-046



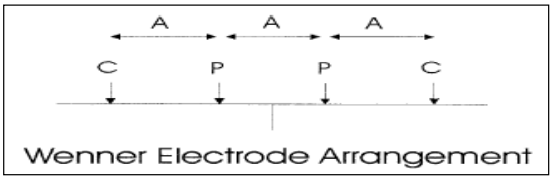
SOIL RESISTIVITY MEASURMENT DATA SHEET

Survey ID GEO-048
DATE 5/13/2025
CLIENT ALLETE Renewable Resources, Inc.
PROJECT Longspur Wind
Project No. GE2503026
LOCATION: Morton County, ND
LATITUDE : 46.932595
LONGITUDE : -101.787575
WEATHER: Partly Cloudy
Temp. (°F) 82°F
TOP SOIL: Silt (ML), Brown, Dry
TYPE OF TEST : Wenner 4-Pin Method
EQUIPMENT: SuperSting
SERIAL NO. SS2106234
MODEL: R8
CALIBRATION DUE DATE: 1/28/2026
TEST PERFORMED BY : RRC

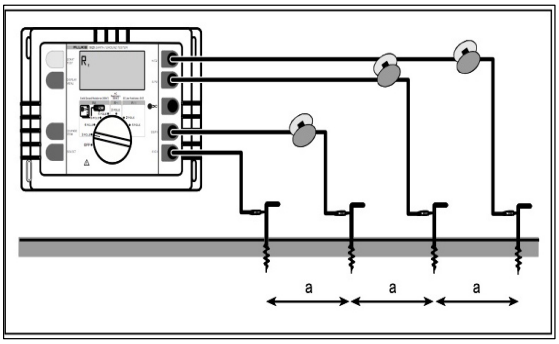
TEST SET RANGE
Meter Current: 1mA - 2000mA
Meter Resistance: 0.01Ohm - 19.99kOhm

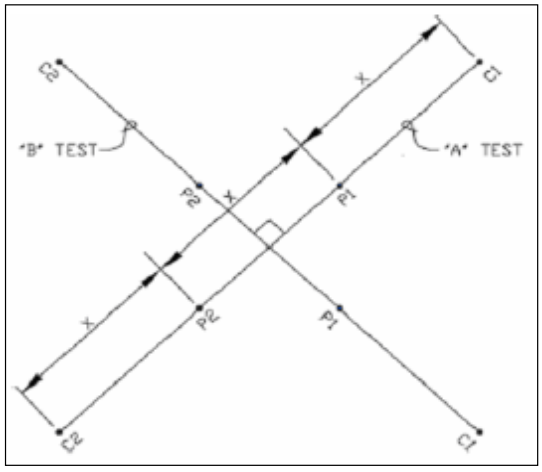
PROB Spacing (ft)	PROBE C DEPTH (Inches)	PROBE P DEPTH (Inches)	APPARENT ELECTRICAL RESISTIVITY						
			NE-SW		NW-SE				
			Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Average Soil Resistivity (Ωm)
0.5	4	2	29.850	28.57	33.930	32.47			30.52
1	4	2	20.640	39.51	22.710	43.47			41.49
1.5	4	2	16.060	46.11	16.390	47.06			46.59
2.5	4	2	12.670	60.63	12.320	58.96			59.79
3	4	2	9.053	51.99	10.050	57.71			54.85
5	4	2	4.188	40.08	4.260	40.77			40.43
7	4	2	2.257	30.24	2.292	30.71			30.48
10	12	6	1.253	23.98	1.347	25.78			24.88
15	12	6	0.592	17.01	0.605	17.36			17.18
20	12	6	0.364	13.92	0.404	15.45			14.69
30	12	6	0.176	10.08	0.194	11.16			10.62
45	12+	6+	0.102	8.82	0.119	10.28			9.55
70	12+	6+	0.075	10.09	0.078	10.46			10.27
100	12+	6+	0.055	10.60	0.057	10.97			10.78

Notes:



Wenner Electrode Arrangement



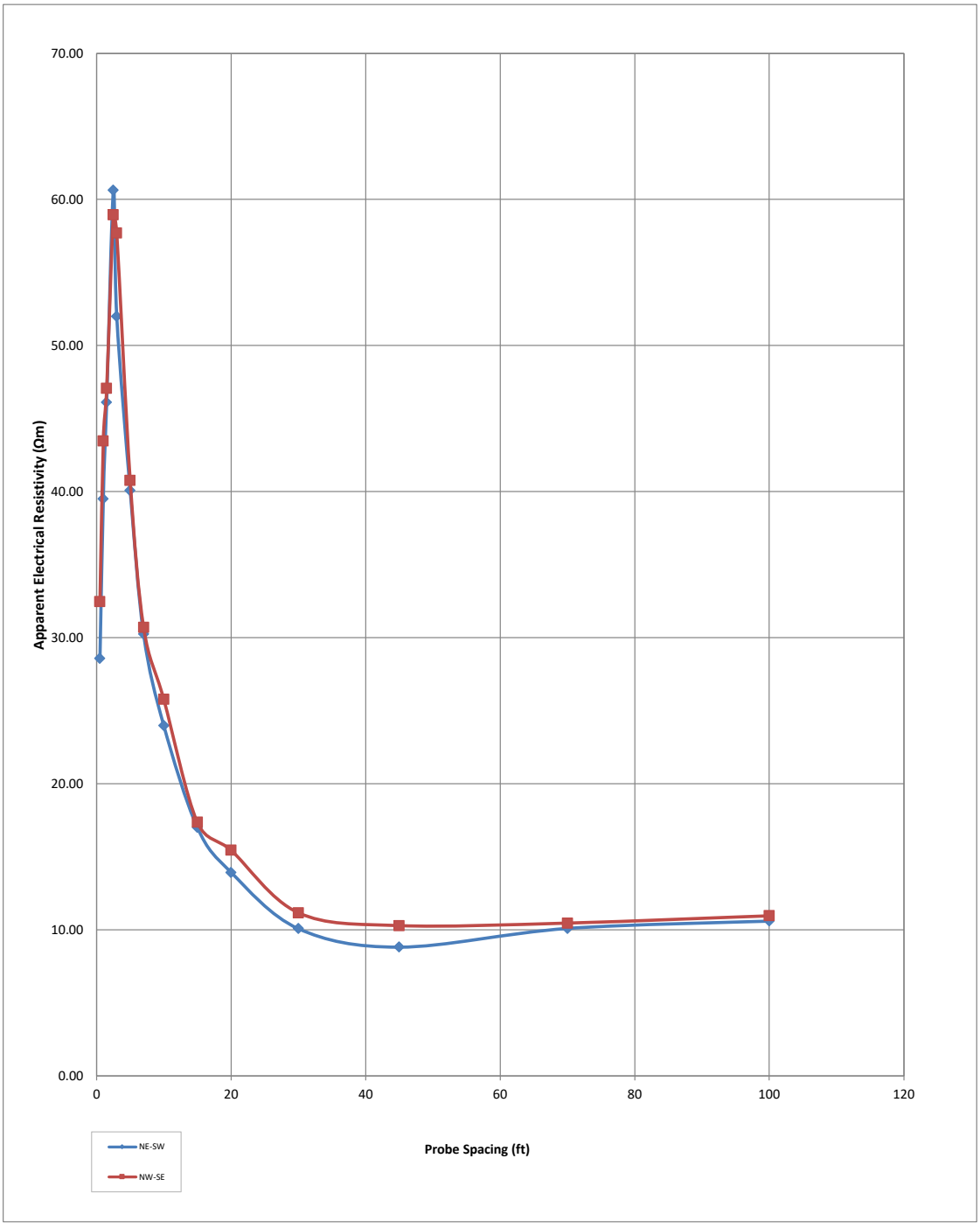


General Sketch of the test set up.

Total Array length is 3 times the probe spacing. The Apparent resistivity is calculated using the following equation: r=2*p*R*spacing*0.3048, where last item converts feet to meters. Wenner Array surveys were performed generally in accordance with IEEE std 81-2012 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." and ASTM G-57.

Longspur Wind

Electrical Resistivity Survey at GEO-048



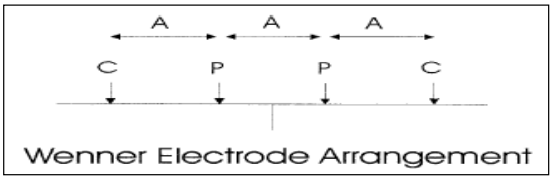
SOIL RESISTIVITY MEASURMENT DATA SHEET

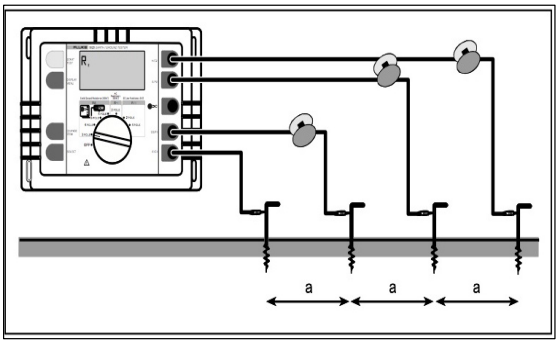
Survey ID GEO-053
DATE 5/13/2025
CLIENT ALLETE Renewable Resources, Inc.
PROJECT Longspur Wind
Project No. GE2503026
LOCATION: Morton County, ND
LATITUDE : 46.932595
LONGITUDE : -101.787575
WEATHER: Partly Cloudy
Temp. (°F) 82°F
TOP SOIL: Silt (ML), Brown, Dry
TYPE OF TEST : Wenner 4-Pin Method
EQUIPMENT: SuperSting
SERIAL NO. SS2106234
MODEL: R8
CALIBRATION DUE DATE: 1/28/2026
TEST PERFORMED BY : RRC

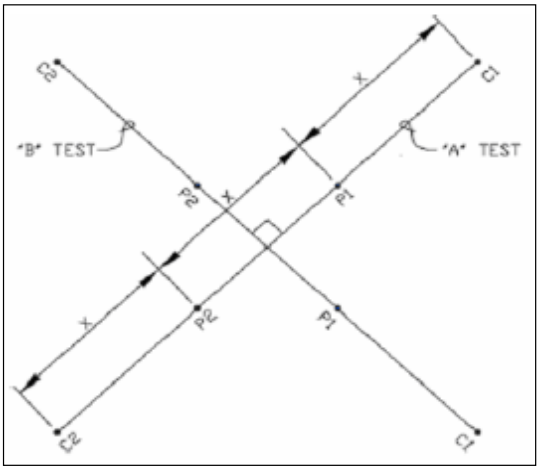
TEST SET RANGE
Meter Current: 1mA - 2000mA
Meter Resistance: 0.01Ohm - 19.99kOhm

PROB Spacing (ft)	PROBE C DEPTH (Inches)	PROBE P DEPTH (Inches)	APPARENT ELECTRICAL RESISTIVITY						
			NE-SW		NW-SE				
			Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Average Soil Resistivity (Ωm)
0.5	4	2	26.490	25.35	28.720	27.49			26.42
1	4	2	18.470	35.35	20.820	39.85			37.60
1.5	4	2	13.850	39.77	14.580	41.86			40.81
2.5	4	2	8.474	40.55	9.034	43.23			41.89
3	4	2	6.437	36.96	6.734	38.67			37.82
5	4	2	3.309	31.67	3.573	34.20			32.93
7	4	2	2.184	29.26	2.257	30.24			29.75
10	12	6	1.376	26.34	1.357	25.97			26.16
15	12	6	0.733	21.04	0.775	22.25			21.64
20	12	6	0.387	14.80	0.397	15.21			15.00
30	12	6	0.201	11.57	0.226	12.97			12.27
45	12+	6+	0.128	11.06	0.129	11.07			11.06
70	12+	6+	0.079	10.63	0.078	10.44			10.54
100	12+	6+	0.052	9.89	0.054	10.39			10.14

Notes: Powerlines at ~900 ft west of the profile center, going N-S.





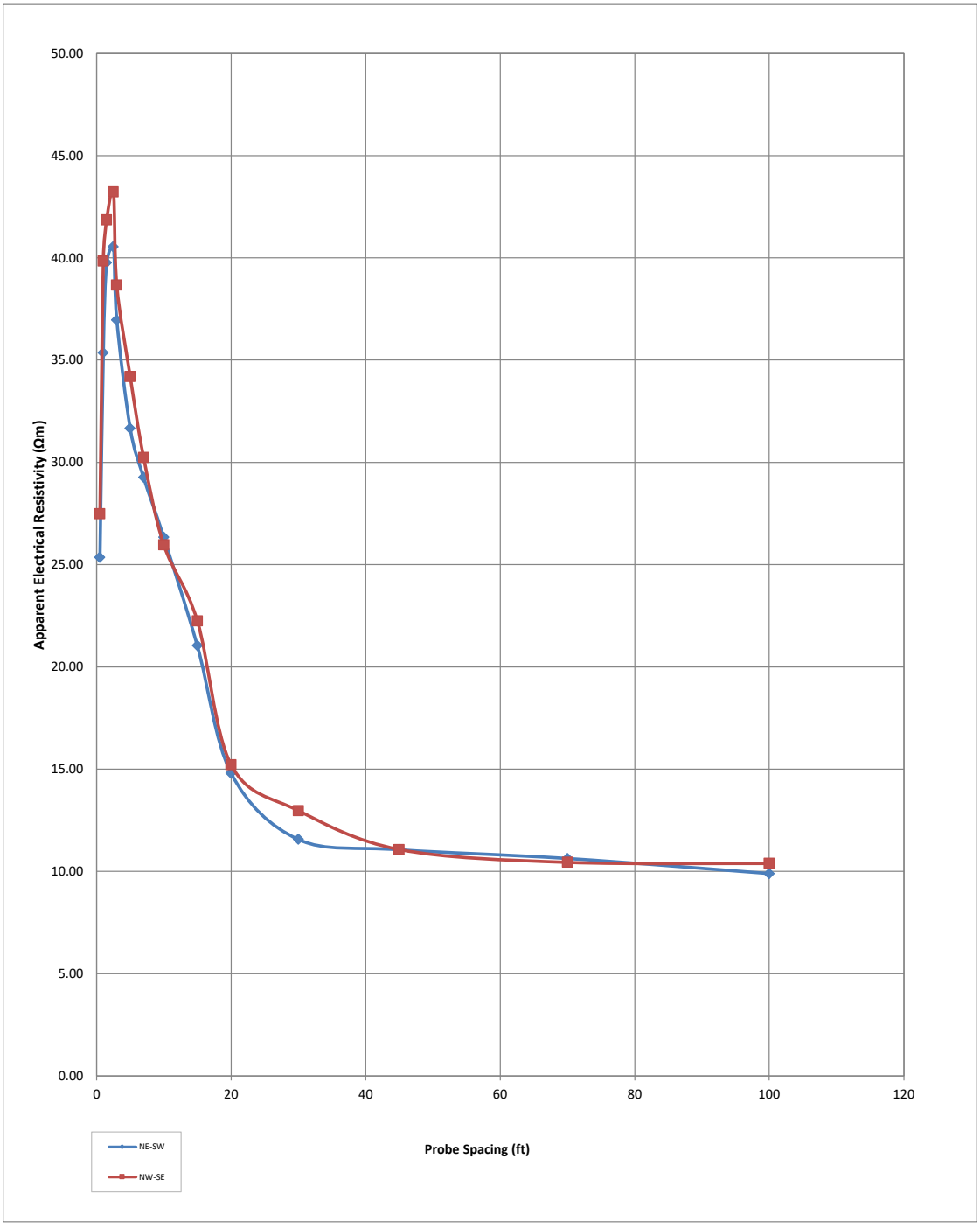


General Sketch of the test set up.

Total Array length is 3 times the probe spacing. The Apparent resistivity is calculated using the following equation: r=2*p*R*spacing*0.3048, where last item converts feet to meters. Wenner Array surveys were performed generally in accordance with IEEE std 81-2012 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." and ASTM G-57.

Longspur Wind

Electrical Resistivity Survey at GEO-053



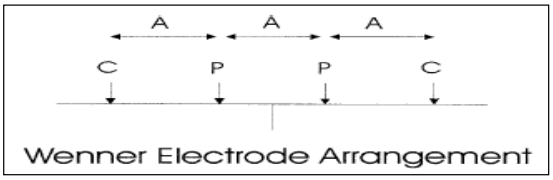
SOIL RESISTIVITY MEASURMENT DATA SHEET

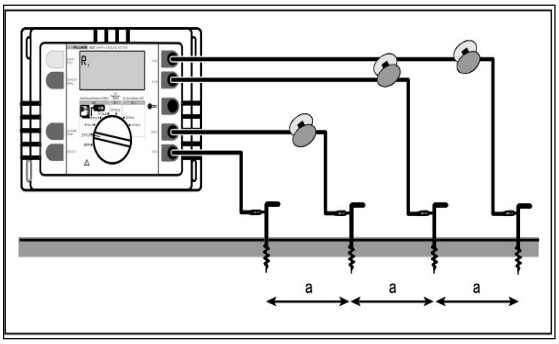
Survey ID GEO-059
DATE 5/13/2025
CLIENT ALLETE Renewable Resources, Inc.
PROJECT Longspur Wind
Project No. GE2503026
LOCATION: Morton County, ND
LATITUDE : 46.911622
LONGITUDE : -101.695731
WEATHER: Sunny
Temp. (°F) 61°F
TOP SOIL: Silt (ML), Brown, Dry
TYPE OF TEST : Wenner 4-Pin Method
EQUIPMENT: SuperSting
SERIAL NO. SS2106234
MODEL: R8
CALIBRATION DUE DATE: 1/28/2026
TEST PERFORMED BY : RRC

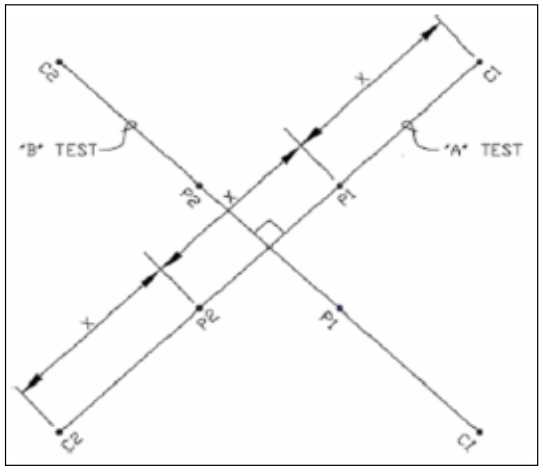
TEST SET RANGE
Meter Current: 1mA - 2000mA
Meter Resistance: 0.01Ohm - 19.99kOhm

PROB Spacing (ft)	PROBE C DEPTH (Inches)	PROBE P DEPTH (Inches)	APPARENT ELECTRICAL RESISTIVITY						
			NE-SW		NW-SE				
			Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Average Soil Resistivity (Ωm)
0.5	4	2	44.240	42.34	41.830	40.03			41.19
1	4	2	29.240	55.97	27.810	53.23			54.60
1.5	4	2	20.530	58.95	19.770	56.76			57.86
2.5	4	2	15.570	74.51	15.730	75.27			74.89
3	4	2	9.345	53.66	10.030	57.60			55.63
5	4	2	4.532	43.37	5.024	48.08			45.73
7	4	2	2.935	39.33	2.738	36.69			38.01
10	12	6	1.635	31.30	1.536	29.40			30.35
15	12	6	0.835	23.98	0.853	24.50			24.24
20	12	6	0.413	15.82	0.473	18.12			16.97
30	12	6	0.194	11.15	0.208	11.92			11.54
45	12+	6+	0.093	8.05	0.114	9.81			8.93
70	12+	6+	0.065	8.77	0.068	9.14			8.96
100	12+	6+	0.041	7.92	0.047	9.05			8.49

Notes:





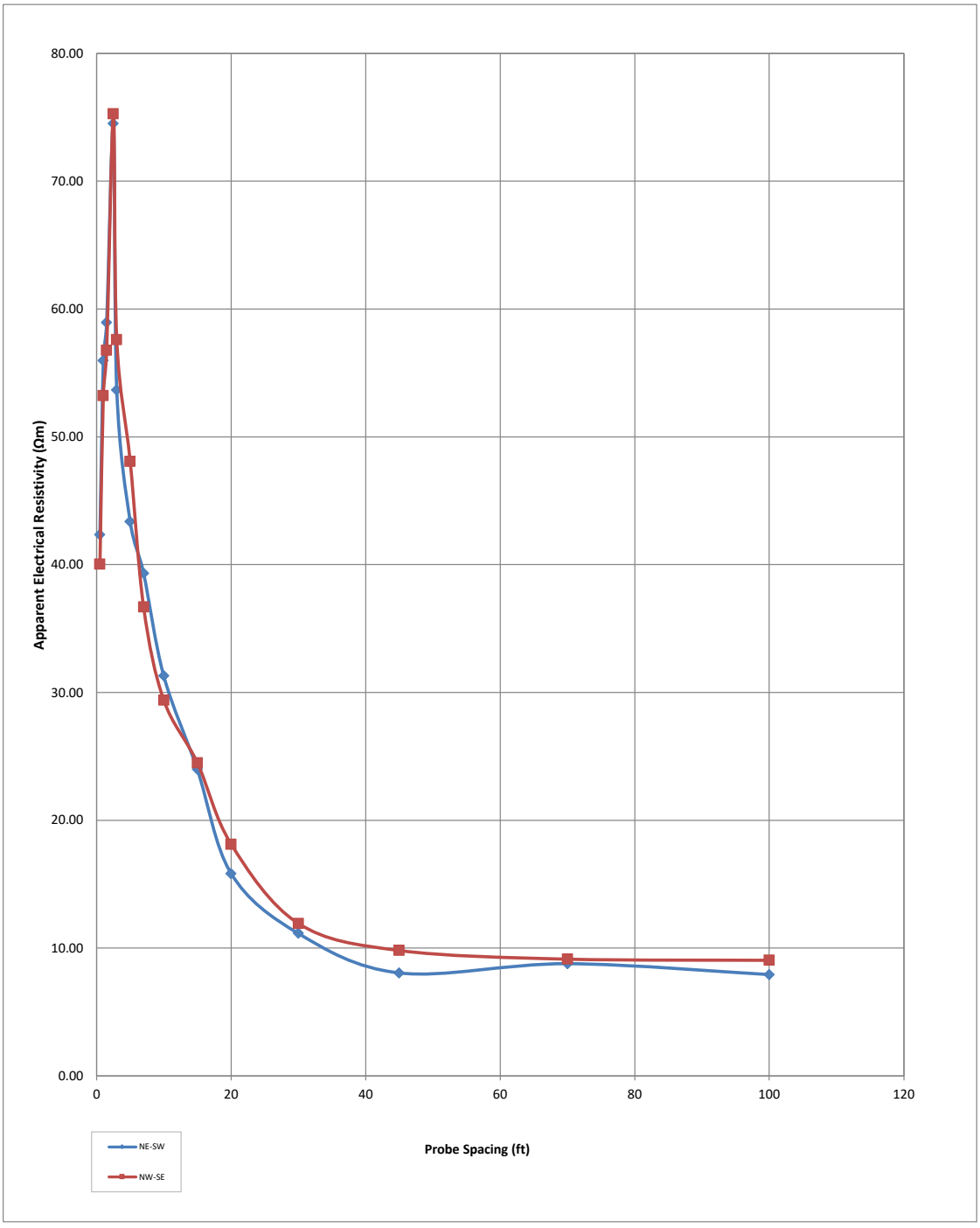


General Sketch of the test set up.

Total Array length is 3 times the probe spacing. The Apparent resistivity is calculated using the following equation: r=2*p*R*spacing*0.3048, where last item converts feet to meters. Wenner Array surveys were performed generally in accordance with IEEE std 81-2012 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." and ASTM G-57.

Longspur Wind

Electrical Resistivity Survey at GEO-059



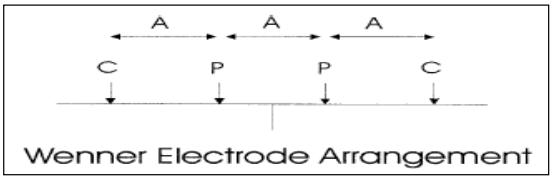
SOIL RESISTIVITY MEASURMENT DATA SHEET

Survey ID GEO-062
DATE 5/13/2025
CLIENT ALLETE Renewable Resources, Inc.
PROJECT Longspur Wind
Project No. GE2503026
LOCATION: Morton County, ND
LATITUDE : 46.908306
LONGITUDE : -101.677064
WEATHER: Sunny
Temp. (°F) 59°F
TOP SOIL: Silt (ML), Brown, Dry
TYPE OF TEST : Wenner 4-Pin Method
EQUIPMENT: SuperSting
SERIAL NO. SS2106234
MODEL: R8
CALIBRATION DUE DATE: 1/28/2026
TEST PERFORMED BY : RRC

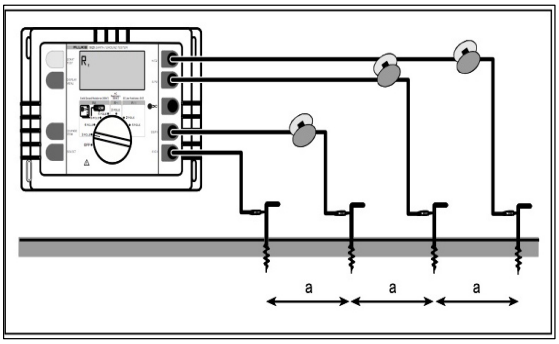
TEST SET RANGE
Meter Current: 1mA - 2000mA
Meter Resistance: 0.01Ohm - 19.99kOhm

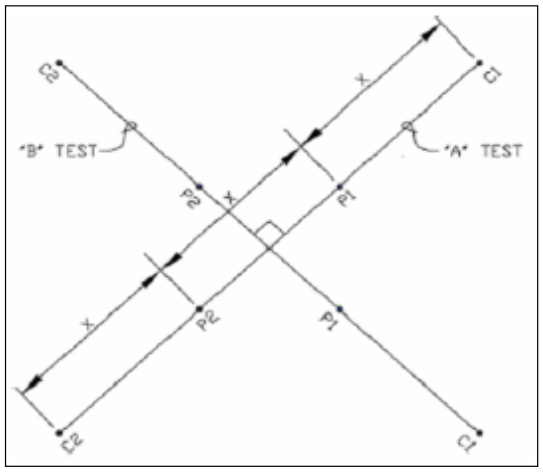
PROB Spacing (ft)	PROBE C DEPTH (Inches)	PROBE P DEPTH (Inches)	APPARENT ELECTRICAL RESISTIVITY						
			NE-SW		NW-SE				
			Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Average Soil Resistivity (Ωm)
0.5	4	2	28.230	27.02	27.420	26.24			26.63
1	4	2	19.110	36.58	21.530	41.21			38.90
1.5	4	2	13.720	39.39	14.560	41.80			40.60
2.5	4	2	8.244	39.45	8.424	40.31			39.88
3	4	2	5.124	29.42	5.066	29.09			29.26
5	4	2	2.734	26.17	2.623	25.10			25.64
7	4	2	1.582	21.20	1.613	21.61			21.40
10	12	6	1.042	19.95	0.957	18.33			19.14
15	12	6	0.614	17.63	0.592	17.01			17.32
20	12	6	0.413	15.81	0.422	16.17			15.99
30	12	6	0.201	11.51	0.213	12.20			11.86
45	12+	6+	0.109	9.41	0.114	9.81			9.61
70	12+	6+	0.065	8.68	0.068	9.14			8.91
100	12+	6+	0.048	9.23	0.044	8.48			8.85

Notes: Powerlines at ~950 ft south of the profile center, going E-W.



Wenner Electrode Arrangement



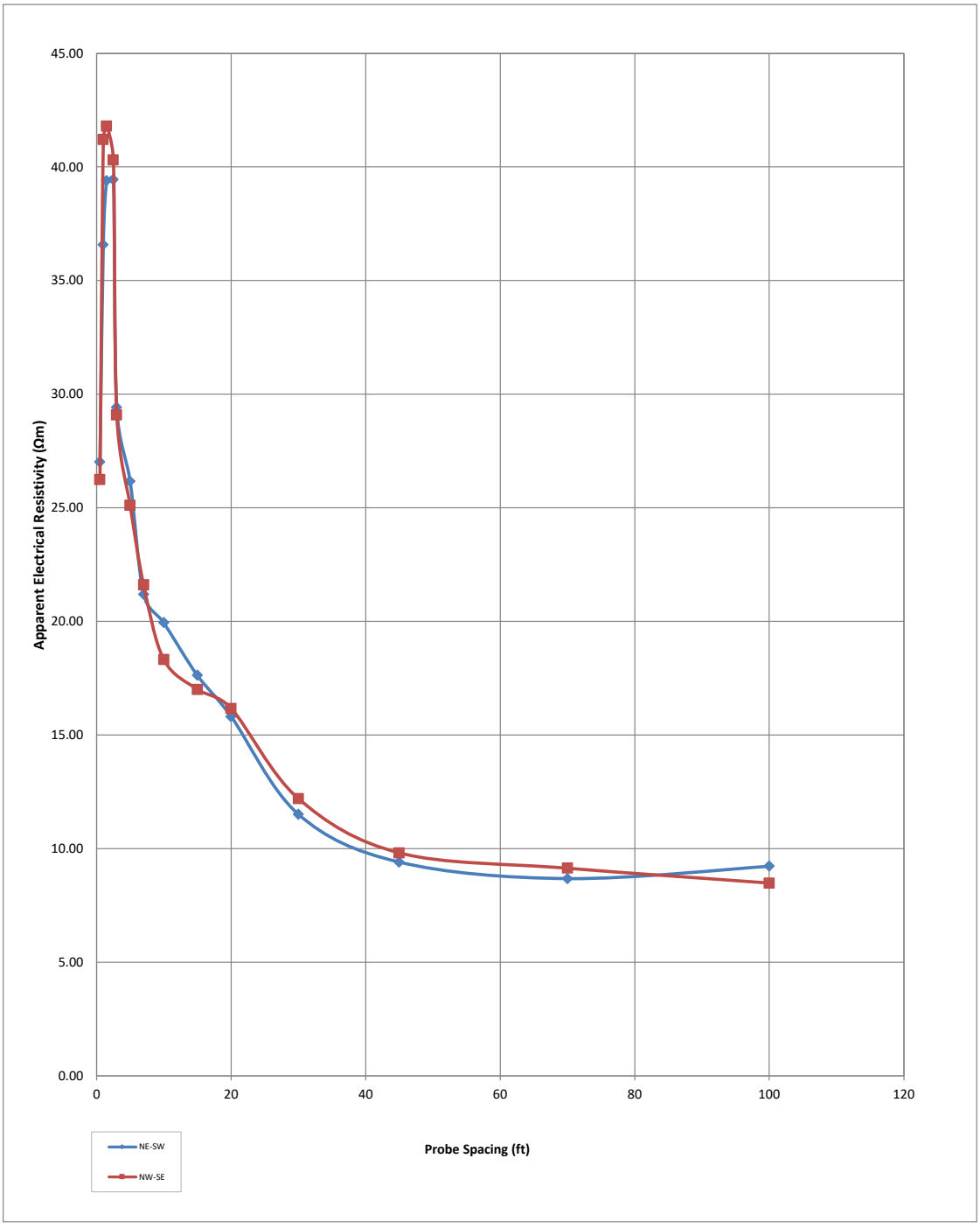


General Sketch of the test set up.

Total Array length is 3 times the probe spacing. The Apparent resistivity is calculated using the following equation: r=2*p*R*spacing*0.3048, where last item converts feet to meters. Wenner Array surveys were performed generally in accordance with IEEE std 81-2012 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." and ASTM G-57.

Longspur Wind

Electrical Resistivity Survey at GEO-062



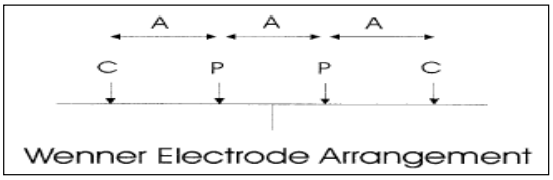
SOIL RESISTIVITY MEASURMENT DATA SHEET

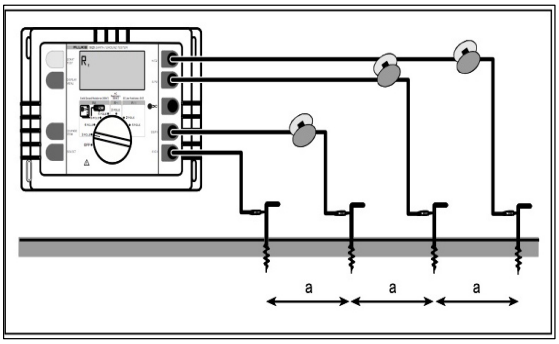
Survey ID GEO-067
DATE 5/17/2025
CLIENT ALLETE Renewable Resources, Inc.
PROJECT Longspur Wind
Project No. GE2503026
LOCATION: Morton County, ND
LATITUDE : 46.897545
LONGITUDE : -101.664921
WEATHER: Sunny
Temp. (°F) 55°F
TOP SOIL: Silt (ML), Brown, Dry
TYPE OF TEST : Wenner 4-Pin Method
EQUIPMENT: SuperSting
SERIAL NO. SS2106234
MODEL: R8
CALIBRATION DUE DATE: 1/28/2026
TEST PERFORMED BY : RRC

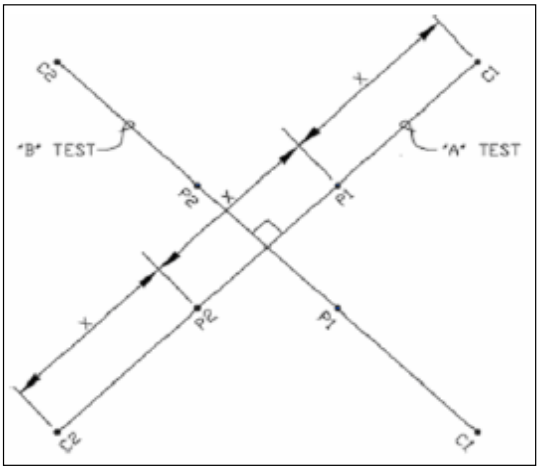
TEST SET RANGE
Meter Current: 1mA - 2000mA
Meter Resistance: 0.01Ohm - 19.99kOhom

PROB Spacing (ft)	PROBE C DEPTH (Inches)	PROBE P DEPTH (Inches)	APPARENT ELECTRICAL RESISTIVITY						
			NE-SW		NW-SE				
			Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Average Soil Resistivity (Ωm)
0.5	4	2	38.270	36.63	41.030	39.27			37.95
1	4	2	27.540	52.72	26.580	50.88			51.80
1.5	4	2	21.570	61.93	20.230	58.08			60.01
2.5	4	2	16.730	80.06	15.340	73.41			76.73
3	4	2	10.000	57.42	10.850	62.31			59.86
5	4	2	5.253	50.27	5.248	50.23			50.25
7	4	2	3.475	46.56	3.549	47.55			47.06
10	12	6	1.815	34.74	1.793	34.32			34.53
15	12	6	0.923	26.51	1.063	30.52			28.52
20	12	6	0.514	19.69	0.542	20.76			20.22
30	12	6	0.214	12.30	0.205	11.75			12.02
45	12+	6+	0.111	9.59	0.103	8.91			9.25
70	12+	6+	0.064	8.55	0.062	8.37			8.46
100	12+	6+	0.047	8.94	0.044	8.34			8.64

Notes: Fence line at ~350 ft north of the profile center, going E-W.





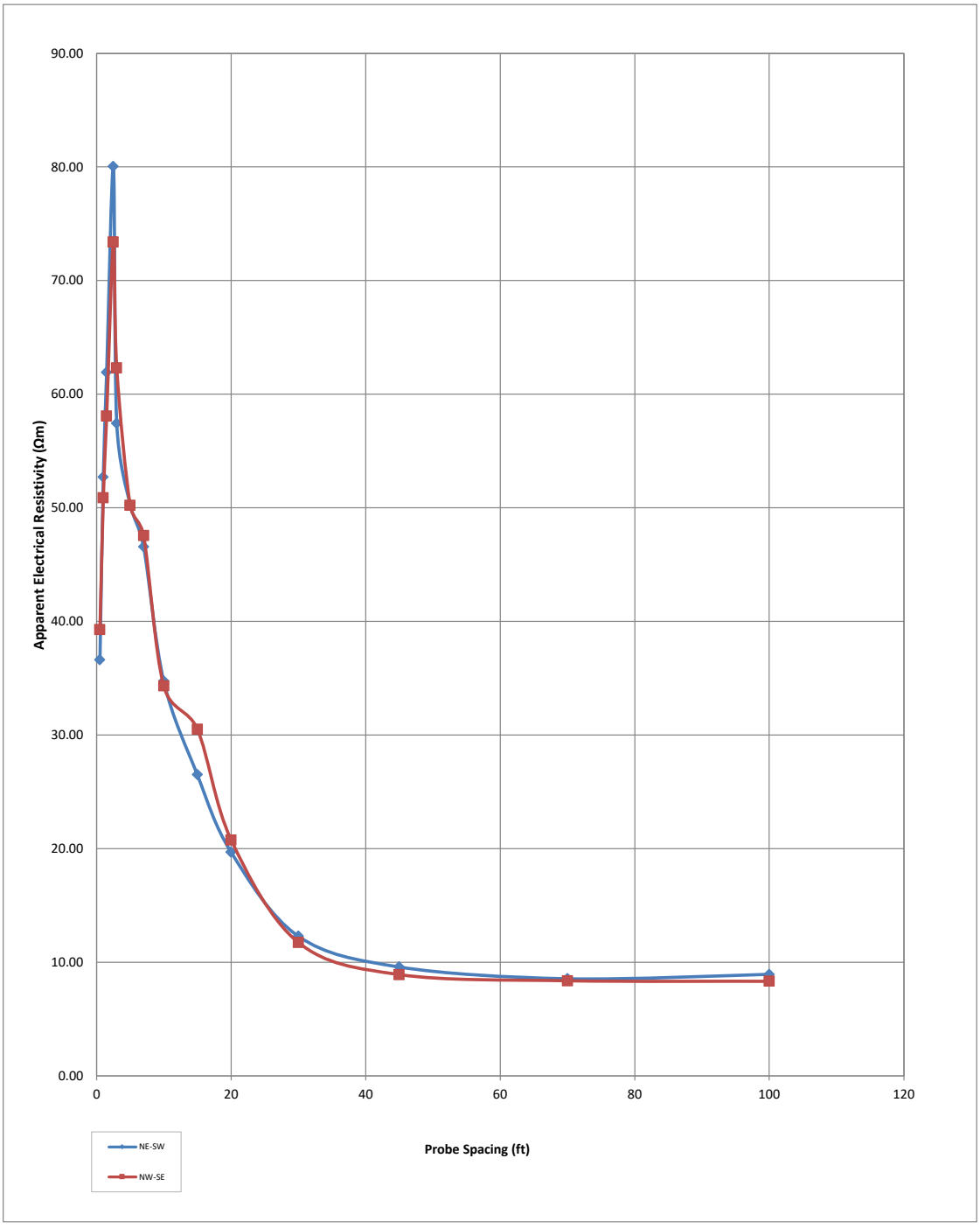


General Sketch of the test set up.

Total Array length is 3 times the probe spacing. The Apparent resistivity is calculated using the following equation: r=2*p*R*spacing*0.3048, where last item converts feet to meters. Wenner Array surveys were performed generally in accordance with IEEE std 81-2012 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." and ASTM G-57.

Longspur Wind

Electrical Resistivity Survey at GEO-067



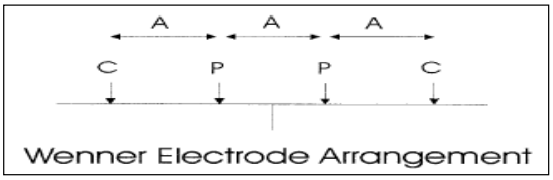
SOIL RESISTIVITY MEASURMENT DATA SHEET

Survey ID GEO-070
DATE 5/11/2025
CLIENT ALLETE Renewable Resources, Inc.
PROJECT Longspur Wind
Project No. GE2503026
LOCATION: Morton County, ND
LATITUDE : 46.881276
LONGITUDE : -101.690209
WEATHER: Sunny
Temp. (°F) 97°F
TOP SOIL: Silt (ML), Brown, Dry
TYPE OF TEST : Wenner 4-Pin Method
EQUIPMENT: SuperSting
SERIAL NO. SS2106234
MODEL: R8
CALIBRATION DUE DATE: 1/28/2026
TEST PERFORMED BY : RRC

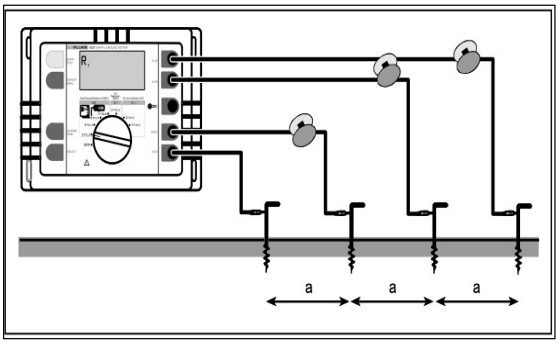
TEST SET RANGE
Meter Current: 1mA - 2000mA
Meter Resistance: 0.01Ohm - 19.99kOhm

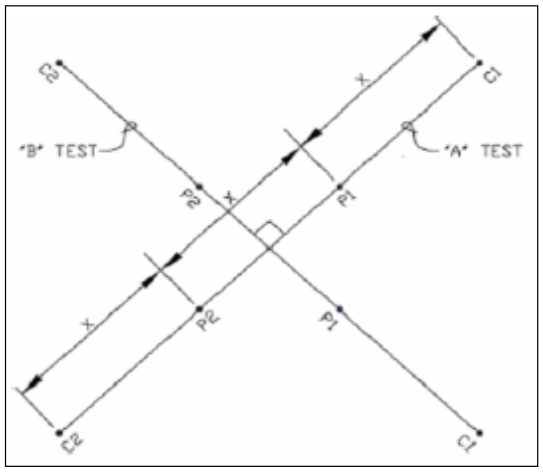
PROB Spacing (ft)	PROBE C DEPTH (Inches)	PROBE P DEPTH (Inches)	APPARENT ELECTRICAL RESISTIVITY						
			NE-SW		NW-SE				
			Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Meter reading (Ω)	Soil Resistivity (Ωm)	Average Soil Resistivity (Ωm)
0.5	4	2	8.899	8.52	9.018	8.63			8.57
1	4	2	7.183	13.75	7.281	13.94			13.84
1.5	4	2	5.038	14.47	5.162	14.82			14.64
2.5	4	2	2.963	14.18	3.010	14.40			14.29
3	4	2	2.246	12.90	2.307	13.25			13.07
5	4	2	1.250	11.96	1.382	13.23			12.60
7	4	2	0.843	11.29	0.812	10.87			11.08
10	12	6	0.537	10.28	0.544	10.42			10.35
15	12	6	0.337	9.66	0.311	8.93			9.30
20	12	6	0.215	8.25	0.211	8.09			8.17
30	12	6	0.135	7.76	0.138	7.94			7.85
45	12+	6+	0.093	8.03	0.095	8.20			8.12
70	12+	6+	0.060	8.06	0.059	7.91			7.98
100	12+	6+	0.042	8.11	0.042	7.97			8.04

Notes: Powerlines at ~2500 ft south of the profile center, going E-W.



Wenner Electrode Arrangement



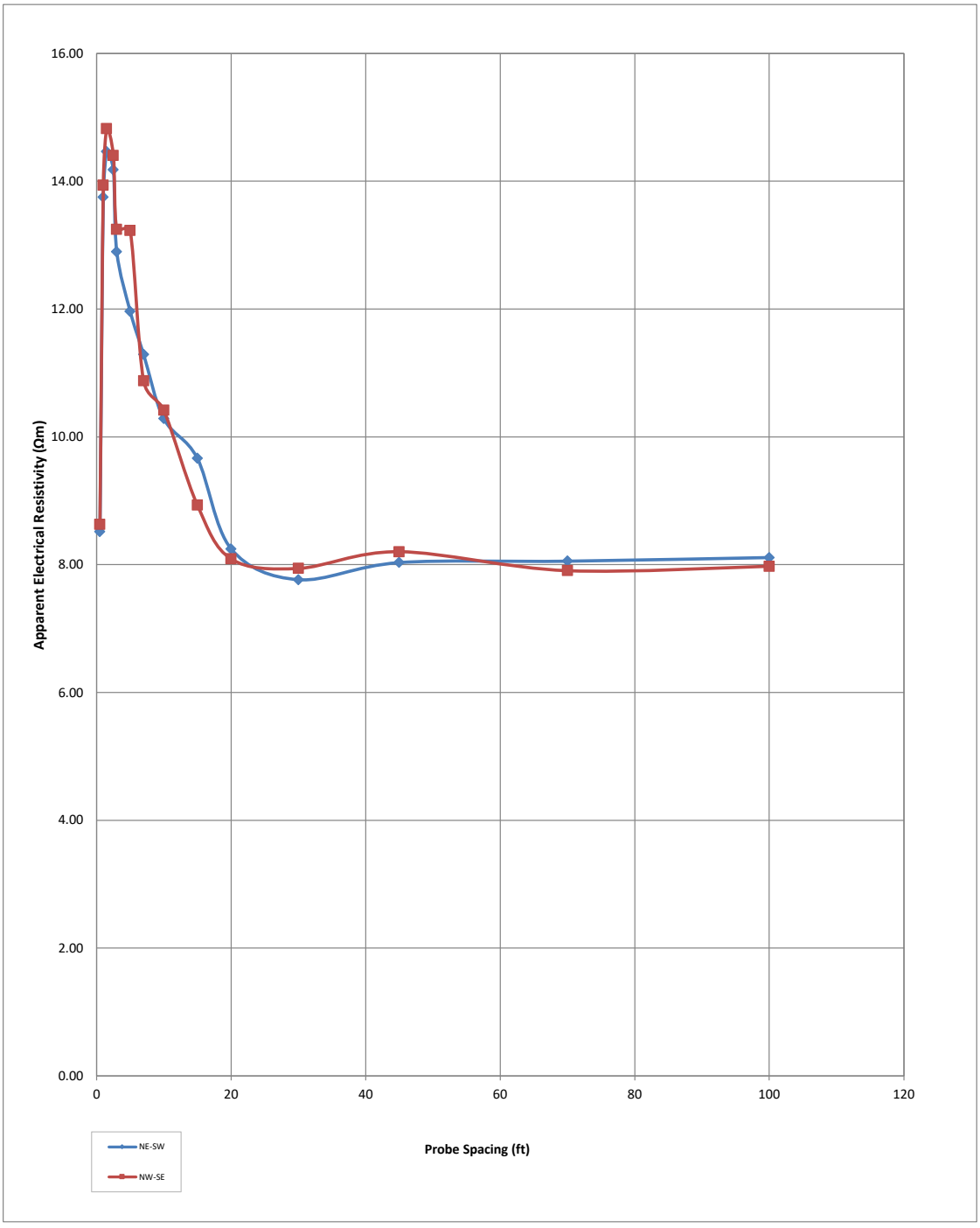


General Sketch of the test set up.

Total Array length is 3 times the probe spacing. The Apparent resistivity is calculated using the following equation: r=2*p*R*spacing*0.3048, where last item converts feet to meters. Wenner Array surveys were performed generally in accordance with IEEE std 81-2012 "IEEE Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Grounding System." and ASTM G-57.

Longspur Wind

Electrical Resistivity Survey at GEO-070



Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Soil Thermal Resistivity Sample & Testing Summary
Longspur Wind Project (PN: GE2503026)

Boring	*Depth*	*Percent Passing #200 Sieve*	*Maximum Dry Density (ASTM D698)*	*Optimum Water Content (ASTM D698)*	*LL*	*PL*	*PI*
	ft	*%*	*pcf*	*%*			
GEO-001	2-4	99.5	99.5	22.2	63	22	41
GEO-008	2-4	98.8	107.0	18.2	57	19	38
GEO-010	2-4	90.7	92.4	27.6	71	24	47
GEO-019	2-4	96.5	111.8	16.3	30	18	12
GEO-022	2-4	36.8	115.6	12.7	22	16	6
GEO-033	2-4	97.7	100.4	20.8	61	19	42
GEO-046	2-4	84.0	112.1	15.4	41	18	23
GEO-048	2-4	96.2	99.1	20.7	71	23	48
GEO-053	2-4	93.2	103.1	19.5	54	19	35
GEO-059	2-4	97.9	104.8	20.2	54	20	34
GEO-062	2-4	49.0	113.9	12.3	26	18	8
GEO-067	2-4	97.4	105.9	18.1	43	21	22
GEO-070	2-4	98.7	100.6	20.8	61	20	41
SUB-2	2-4	51.2	116.1	13.7	37	14	23

Boring	*Depth*	*Soil Type (USCS)*
GEO-001	2-4	Fat Clay (CH)
GEO-008	2-4	Fat Clay (CH)
GEO-010	2-4	Fat Clay (CH)
GEO-019	2-4	Lean Clay (CL)
GEO-022	2-4	Silty, Clayey Sand (SC-SM)
GEO-033	2-4	Fat Clay (CH)
GEO-046	2-4	Lean Clay with Sand (CL)
GEO-048	2-4	Fat Clay (CH)
GEO-053	2-4	Fat Clay (CH)
GEO-059	2-4	Fat Clay (CH)
GEO-062	2-4	Clayey Sand (SC)
GEO-067	2-4	Lean Clay (CL)
GEO-070	2-4	Fat Clay (CH)
SUB-2	2-4	Sandy Lean Clay (CL)

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(512) 358-6048

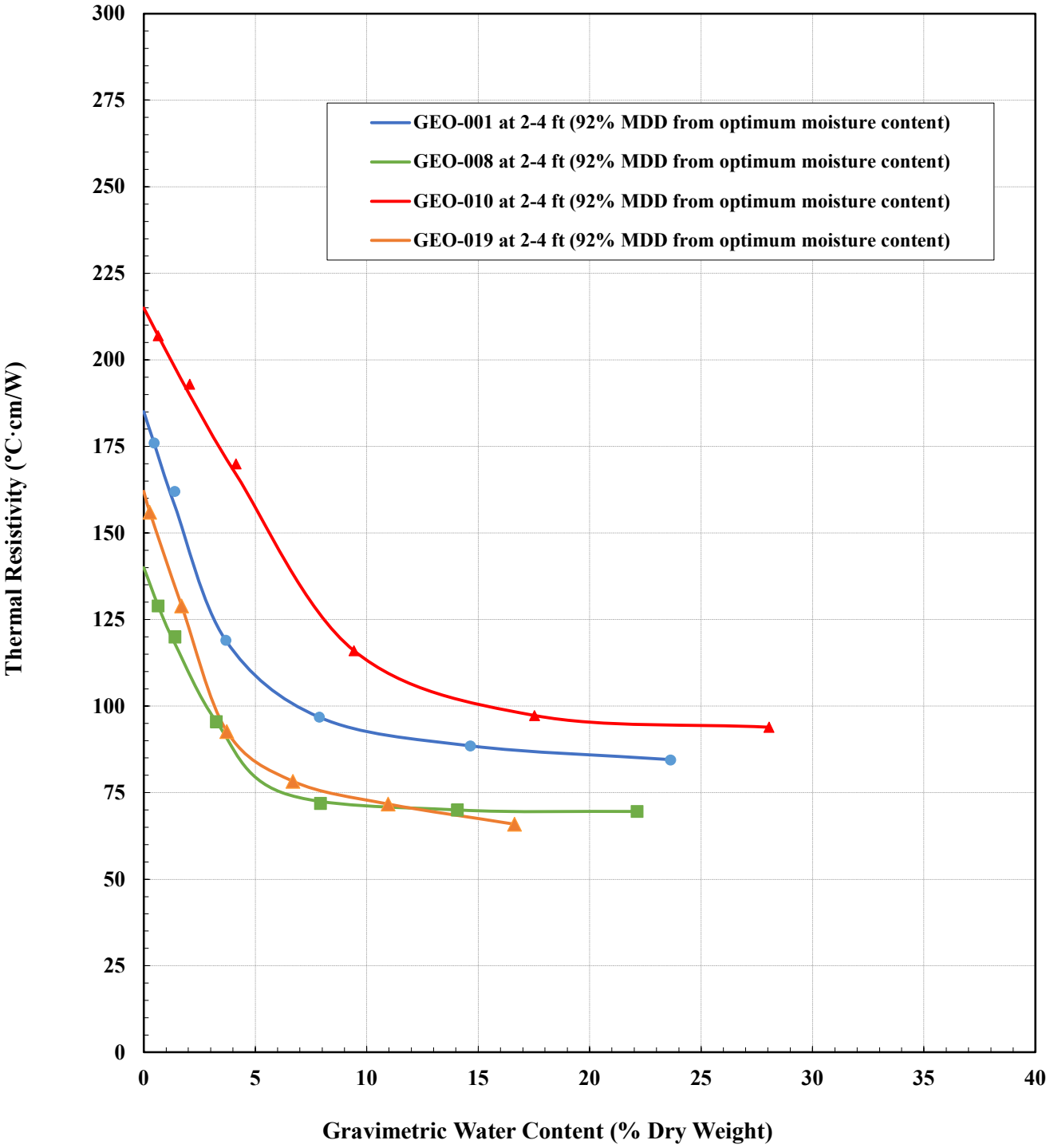
Soil Thermal Resistivity Sample & Testing Summary
Longspur Wind Project (PN: GE2503026)

Remolded Samples						
Boring	*Remold Water Content*	*Percent Compaction*	*Target Remold Dry Density*	*Actual Remold Dry Density*	*Thermal Resistivity at Wet (IEEE 442)*	*Thermal Resistivity at Dry (IEEE 442)*
	%	*%*	*pcf*	*pcf*	*°C-cm/W*	*°C-cm/W*
GEO-001	23.6	92	91.5	92.2	85	185
GEO-008	22.1		98.4	100.0	70	140
GEO-010	28.1		85.0	85.2	94	215
GEO-019	16.6		102.9	103.2	66	162
GEO-022	16.6		106.4	106.9	48	126
GEO-033	20.3		92.4	93.3	83	165
GEO-046	15.8		103.1	103.8	64	136
GEO-048	22.4		91.2	92.2	84	172
GEO-053	19.7		94.9	95.6	85	168
GEO-059	21.0		96.4	97.1	76	145
GEO-062	12.7		104.8	105.0	62	162
GEO-067	18.1		97.4	98.1	73	158
GEO-070	20.6		92.6	93.9	79	169
SUB-2	14.0		106.8	107.5	58	125

HuaMiao Cao, P.E., 6/3/25
Analysis & Quality Review/Date

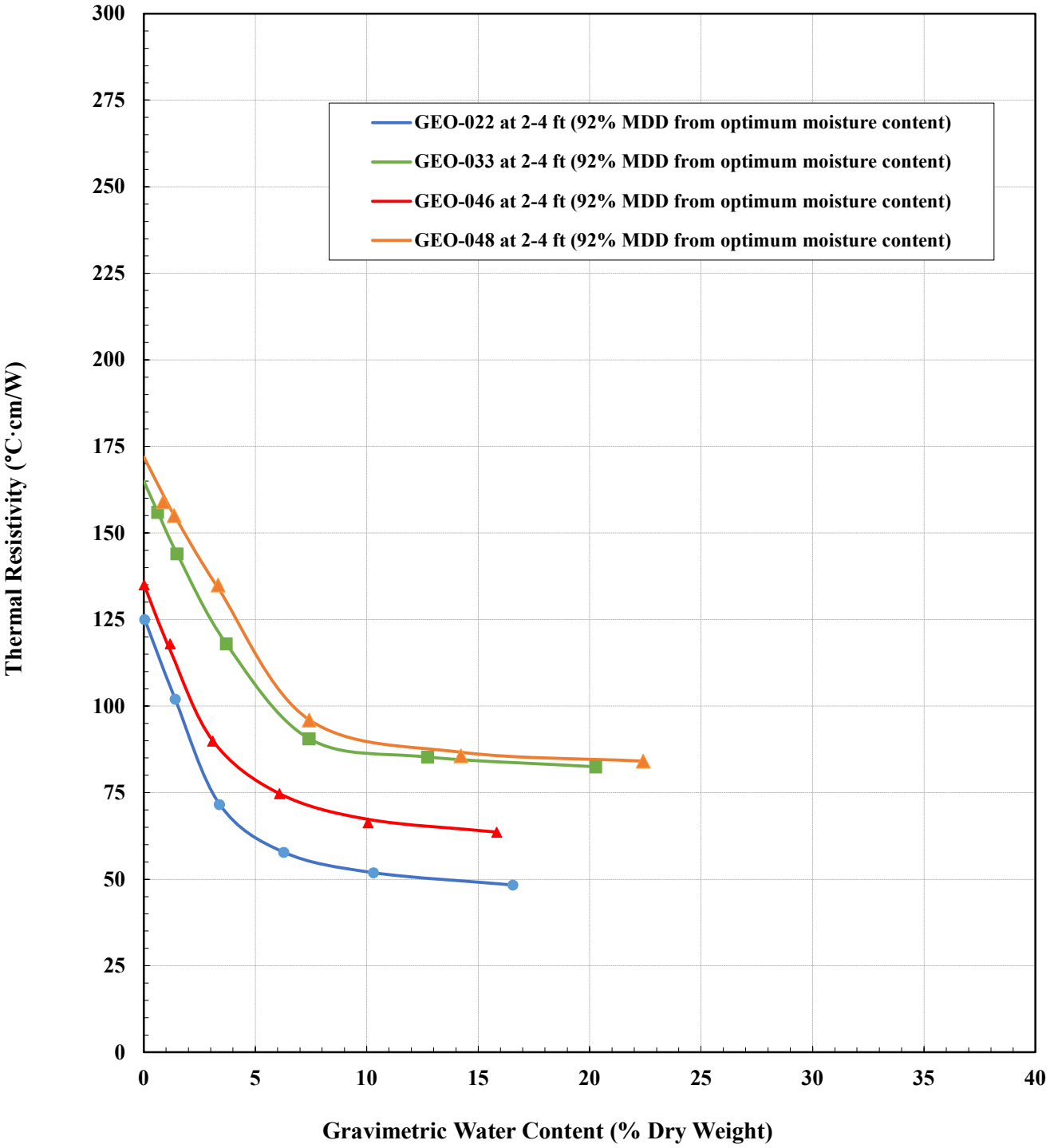
Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Soil Thermal Resistivity Testing Dryout Curves
Longspur Wind Project (PN: GE2503026)



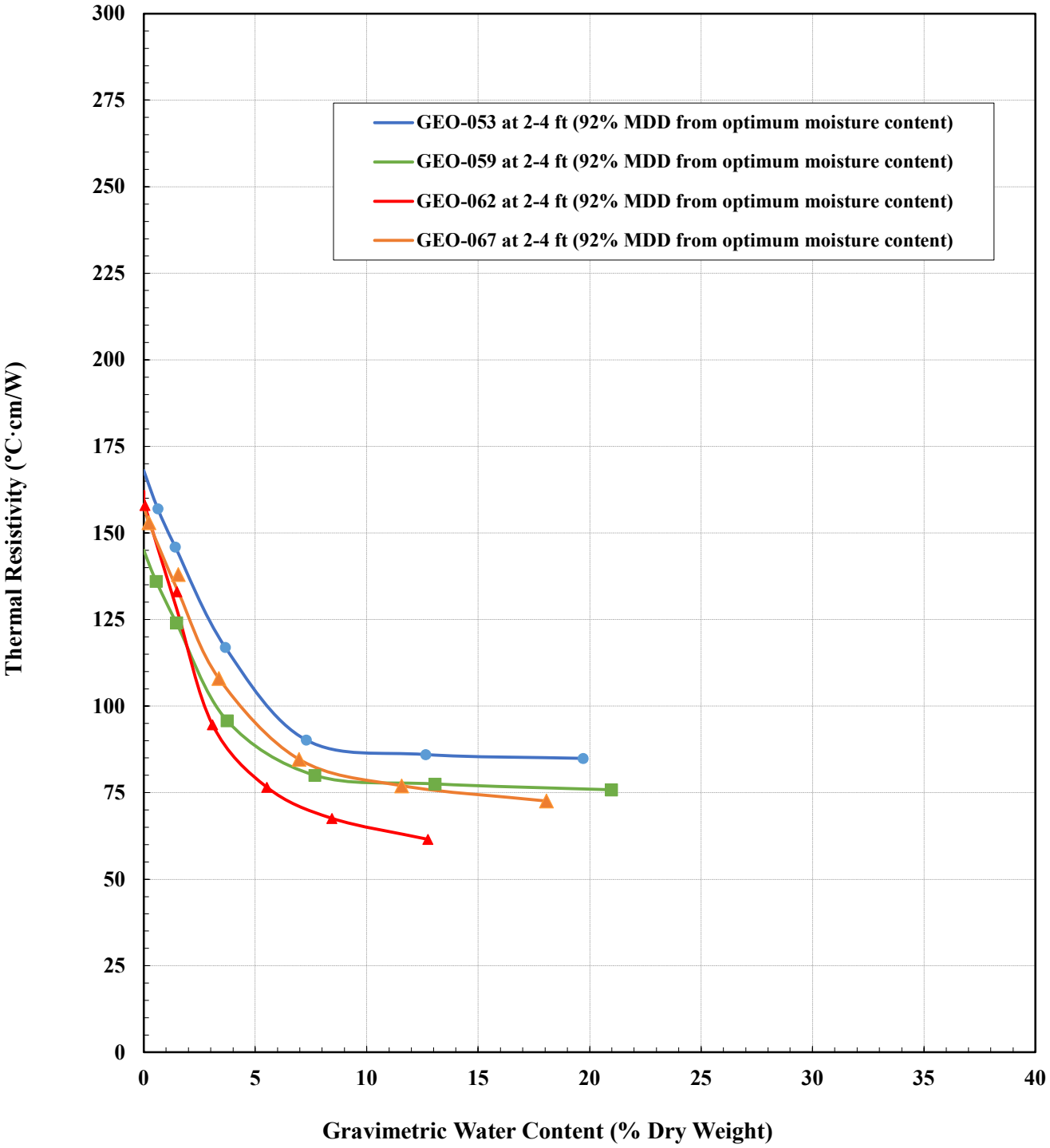
Beyond Engineering & Testing, LLC
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(512) 358-6048

Soil Thermal Resistivity Testing Dryout Curves
Longspur Wind Project (PN: GE2503026)



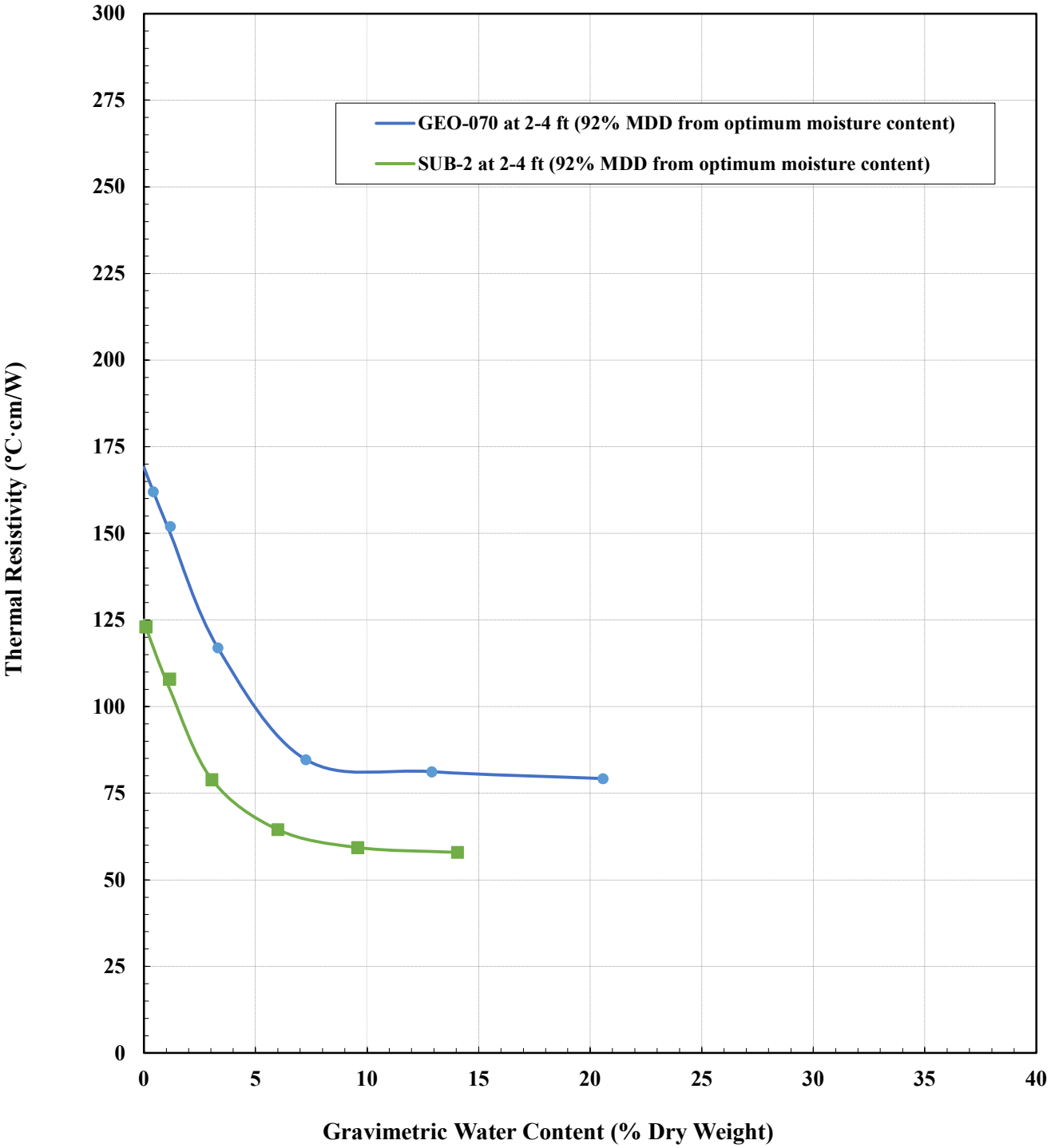
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Round Rock, TX 78664
(512) 358-6048

Soil Thermal Resistivity Testing Dryout Curves
Longspur Wind Project (PN: GE2503026)



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Soil Thermal Resistivity Testing Dryout Curves
Longspur Wind Project (PN: GE2503026)



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APPENDIX D

Table D1.1 – LPILE Computer Program Parameters for Lateral Load Analysis for SUB-1

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	790	--	0.01	--	--	--	--
2	3 to 4	Sand (Reese)	25	--	110	--	31	--	--	--	--	--
3	4 to 7	Sand (Reese)	90	--	110	--	35	--	--	--	--	--
4	7 to 12	Sand (Reese)	60	--	58	--	33	--	--	--	--	--
5	12 to 14	Sand (Reese)	60	--	63	--	35	--	--	--	--	--
6	14 to 19	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
7	19 to 24	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
8	24 to 29	Stiff Clay w/o Free Water	--	--	68	5,980	--	0.004	--	--	--	--
9	29 to 34	Stiff Clay w/o Free Water	--	--	67.6	3,450	--	0.005	--	--	--	--
10	34 to 40	Stiff Clay w/o Free Water	--	--	67.6	5,050	--	0.005	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D1.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for SUB-1

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	790	--	3.04	6	--	0	1,700
2	3 to 4	SM	110	31	--	--	3.12	6	0.6	90	2,400
3	4 to 7	SP	110	35	--	--	3.69	30	2.9	350	6,400
4	7 to 12	SP	58	33	--	--	3.39	16	1.5	370	6,400
5	12 to 14	SC	63	35	--	--	3.69	30	2.9	590	10,300
6	14 to 19	SC	63	35	--	--	3.69	40	3.9	720	10,300
7	19 to 24	SC	63	35	--	--	3.69	38	3.7	770	10,300
8	24 to 29	CL	68	--	5,980	--	3.04	73	4.2	1,070	10,300
9	29 to 34	CL	68	--	3,450	--	3.04	26	2.2	740	10,300
10	34 to 40	CL	68	--	5,050	--	3.04	38	2.8	930	15,100

Table D1.3 – Grout Anchor Design Parameters for SUB-1

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 4	SM	9
3	4 to 7	SP	15
4	7 to 12	SP	12
5	12 to 14	SC	15
6	14 to 19	SC	18
7	19 to 24	SC	17
8	24 to 29	CL	21
9	29 to 34	CL	12
10	34 to 40	CL	18

Notes: Design depth to groundwater is 7 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma'=\gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D2.1 – LPILE Computer Program Parameters for Lateral Load Analysis for SUB-2

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	920	--	0.01	--	--	--	--
2	3 to 7	Stiff Clay w/o Free Water	--	--	120	920	--	0.010	--	--	--	--
3	7 to 9	Sand (Reese)	60	--	58	--	33	--	--	--	--	--
4	9 to 14	Sand (Reese)	60	--	63	--	35	--	--	--	--	--
5	14 to 19	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
6	19 to 24	Sand (Reese)	125	--	58	--	35	--	--	--	--	--
7	24 to 29	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
8	29 to 34	Stiff Clay w/o Free Water	--	--	68	5,450	--	0.005	--	--	--	--
9	34 to 39	Sand (Reese)	125	--	62.6	--	35	--	--	--	--	--
10	39 to 40	Sand (Reese)	125	--	62.6	--	35	--	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D2.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for SUB-2

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	920	--	3.04	7	--	0	2,000
2	3 to 7	CL	120	--	920	--	3.04	7	1.0	200	2,000
3	7 to 9	SP	58	33	--	--	3.39	16	1.5	350	6,400
4	9 to 14	SC	63	35	--	--	3.69	27	2.6	550	10,800
5	14 to 19	SC	63	35	--	--	3.69	39	3.8	730	15,600
6	19 to 24	SP	58	35	--	--	3.69	40	3.9	800	16,000
7	24 to 29	SC	63	35	--	--	3.69	85	8.3	1,220	16,300
8	29 to 34	CL	68	--	5,450	--	3.04	41	2.9	980	16,300
9	34 to 39	SC	63	35	--	--	3.69	51	5.0	1,090	18,000
10	39 to 40	SC	63	35	--	--	3.69	45	4.4	1,060	18,000

Table D2.3 – Grout Anchor Design Parameters for SUB-2

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 7	CL	3
3	7 to 9	SP	12
4	9 to 14	SC	14
5	14 to 19	SC	17
6	19 to 24	SP	18
7	24 to 29	SC	29
8	29 to 34	CL	19
9	34 to 39	SC	20
10	39 to 40	SC	19

Notes: Design depth to groundwater is 7 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D3.1 – LPILE Computer Program Parameters for Lateral Load Analysis for SUB-3

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	790	--	0.01	--	--	--	--
2	3 to 7	Stiff Clay w/o Free Water	--	--	120	790	--	0.010	--	--	--	--
3	7 to 9	Sand (Reese)	60	--	63	--	33	--	--	--	--	--
4	9 to 14	Sand (Reese)	60	--	63	--	35	--	--	--	--	--
5	14 to 19	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
6	19 to 24	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
7	24 to 29	Stiff Clay w/o Free Water	--	--	68	3,850	--	0.005	--	--	--	--
8	29 to 34	Stiff Clay w/o Free Water	--	--	68	4,390	--	0.005	--	--	--	--
9	34 to 39	Stiff Clay w/o Free Water	--	--	67.6	5,980	--	0.004	--	--	--	--
10	39 to 40	Stiff Clay w/o Free Water	--	--	67.6	5,980	--	0.004	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D3.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for SUB-3

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	790	--	3.04	6	--	0	1,700
2	3 to 7	CL	120	--	790	--	3.04	6	0.9	170	1,700
3	7 to 9	SC	63	33	--	--	3.39	14	1.3	330	5,600
4	9 to 14	SC	63	35	--	--	3.69	28	2.7	560	11,200
5	14 to 19	SC	63	35	--	--	3.69	33	3.2	680	11,500
6	19 to 24	SC	63	35	--	--	3.69	44	4.3	840	11,500
7	24 to 29	CL	68	--	3,850	--	3.04	29	2.4	790	11,500
8	29 to 34	CL	68	--	4,390	--	3.04	33	2.6	860	13,100
9	34 to 39	CL	68	--	5,980	--	3.04	50	3.3	1,070	17,900
10	39 to 40	CL	68	--	5,980	--	3.04	79	4.4	1,070	17,900

Table D3.3 – Grout Anchor Design Parameters for SUB-3

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 7	CL	3
3	7 to 9	SC	11
4	9 to 14	SC	15
5	14 to 19	SC	16
6	19 to 24	SC	19
7	24 to 29	CL	13
8	29 to 34	CL	15
9	34 to 39	CL	21
10	39 to 40	CL	21

Notes: Design depth to groundwater is 7 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma'=\gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D4.1 – LPILE Computer Program Parameters for Lateral Load Analysis for SUB-4

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	650	--	0.01	--	--	--	--
2	3 to 7	Stiff Clay w/o Free Water	--	--	125	650	--	0.010	--	--	--	--
3	7 to 9	Sand (Reese)	60	--	63	--	32	--	--	--	--	--
4	9 to 14	Sand (Reese)	60	--	63	--	34	--	--	--	--	--
5	14 to 19	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
6	19 to 24	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
7	24 to 29	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
8	29 to 34	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
9	34 to 39	Stiff Clay w/o Free Water	--	--	67.6	5,050	--	0.005	--	--	--	--
10	39 to 40	Stiff Clay w/o Free Water	--	--	67.6	3,990	--	0.005	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D4.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for SUB-4

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	650	--	3.04	5	--	0	1,400
2	3 to 7	CL	125	--	650	--	3.04	5	0.8	140	1,400
3	7 to 9	SC	63	32	--	--	3.25	11	1.1	300	4,400
4	9 to 14	SC	63	34	--	--	3.54	23	2.2	500	9,200
5	14 to 19	SC	63	35	--	--	3.69	46	4.5	790	11,900
6	19 to 24	SC	63	35	--	--	3.69	33	3.2	740	11,900
7	24 to 29	SC	63	35	--	--	3.69	39	3.8	860	11,900
8	29 to 34	SC	63	35	--	--	3.69	46	4.5	990	11,900
9	34 to 39	CL	68	--	5,050	--	3.04	38	2.8	930	11,900
10	39 to 40	CL	68	--	3,990	--	3.04	30	2.4	810	11,900

Table D4.3 – Grout Anchor Design Parameters for SUB-4

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 7	CL	2
3	7 to 9	SC	10
4	9 to 14	SC	13
5	14 to 19	SC	19
6	19 to 24	SC	16
7	24 to 29	SC	17
8	29 to 34	SC	19
9	34 to 39	CL	18
10	39 to 40	CL	14

Notes: Design depth to groundwater is 7 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma'=\gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D5.1 – LPILE Computer Program Parameters for Lateral Load Analysis for SUB-5

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	650	--	0.01	--	--	--	--
2	3 to 4	Stiff Clay w/o Free Water	--	--	120	650	--	0.010	--	--	--	--
3	4 to 7	Sand (Reese)	25	--	125	--	30	--	--	--	--	--
4	7 to 14	Sand (Reese)	20	--	63	--	31	--	--	--	--	--
5	14 to 19	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
6	19 to 24	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
7	24 to 29	Stiff Clay w/o Free Water	--	--	68	5,850	--	0.004	--	--	--	--
8	29 to 34	Stiff Clay w/o Free Water	--	--	68	5,450	--	0.005	--	--	--	--
9	34 to 39	Stiff Clay w/o Free Water	--	--	67.6	4,650	--	0.005	--	--	--	--
10	39 to 40	Stiff Clay w/o Free Water	--	--	67.6	5,590	--	0.005	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D5.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for SUB-5

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	650	--	3.04	5	--	0	1,400
2	3 to 4	CL	120	--	650	--	3.04	5	0.8	140	1,400
3	4 to 7	SC	125	30	--	--	3.00	6	0.6	150	2,400
4	7 to 14	SC	63	31	--	--	3.12	9	0.9	290	3,600
5	14 to 19	SC	63	35	--	--	3.69	36	3.5	710	12,400
6	19 to 24	SC	63	35	--	--	3.69	31	3.0	720	12,400
7	24 to 29	CL	68	--	5,850	--	3.04	44	3.1	1,050	13,900
8	29 to 34	CL	68	--	5,450	--	3.04	41	2.9	980	13,900
9	34 to 39	CL	68	--	4,650	--	3.04	35	2.7	890	13,900
10	39 to 40	CL	68	--	5,590	--	3.04	42	3.0	1,000	16,700

Table D5.3 – Grout Anchor Design Parameters for SUB-5

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 4	CL	2
3	4 to 7	SC	9
4	7 to 14	SC	10
5	14 to 19	SC	17
6	19 to 24	SC	15
7	24 to 29	CL	20
8	29 to 34	CL	19
9	34 to 39	CL	16
10	39 to 40	CL	19

Notes: Design depth to groundwater is 7 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma'=\gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D6.1 – LPILE Computer Program Parameters for Lateral Load Analysis for SUB-6

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	1,450	--	0.007	--	--	--	--
2	3 to 7	Sand (Reese)	90	--	120	--	33	--	--	--	--	--
3	7 to 9	Sand (Reese)	60	--	63	--	32	--	--	--	--	--
4	9 to 14	Sand (Reese)	60	--	63	--	35	--	--	--	--	--
5	14 to 19	Stiff Clay w/o Free Water	--	--	68	5,980	--	0.004	--	--	--	--
6	19 to 24	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
7	24 to 29	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
8	29 to 34	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
9	34 to 39	Sand (Reese)	60	--	62.6	--	33	--	--	--	--	--
10	39 to 40	Sand (Reese)	125	--	62.6	--	35	--	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D6.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for SUB-6

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	1,450	--	3.04	11	--	0	3,800
2	3 to 7	SC	120	33	--	--	3.39	12	1.2	200	4,800
3	7 to 9	SC	63	32	--	--	3.25	12	1.2	300	4,800
4	9 to 14	SC	63	35	--	--	3.69	30	2.9	580	9,600
5	14 to 19	CL	68	--	5,980	--	3.04	100	5.2	1,070	9,600
6	19 to 24	SC	63	35	--	--	3.69	50	4.9	900	9,600
7	24 to 29	SC	63	35	--	--	3.69	59	5.8	1,040	9,600
8	29 to 34	SC	63	35	--	--	3.69	59	5.8	1,110	9,600
9	34 to 39	SC	63	33	--	--	3.39	24	2.3	730	9,600
10	39 to 40	SC	63	35	--	--	3.69	44	4.3	1,050	17,600

Table D6.3 – Grout Anchor Design Parameters for SUB-6

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 7	SC	11
3	7 to 9	SC	11
4	9 to 14	SC	15
5	14 to 19	CL	21
6	19 to 24	SC	20
7	24 to 29	SC	22
8	29 to 34	SC	22
9	34 to 39	SC	14
10	39 to 40	SC	19

Notes: Design depth to groundwater is 7 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D7.1 – LPILE Computer Program Parameters for Lateral Load Analysis for SUB-7

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	390	--	0.02	--	--	--	--
2	3 to 4	Stiff Clay w/o Free Water	--	--	115	390	--	0.020	--	--	--	--
3	4 to 7	Sand (Reese)	90	--	120	--	33	--	--	--	--	--
4	7 to 14	Sand (Reese)	60	--	63	--	35	--	--	--	--	--
5	14 to 19	Stiff Clay w/o Free Water	--	--	63	5,980	--	0.004	--	--	--	--
6	19 to 24	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
7	24 to 29	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
8	29 to 34	Stiff Clay w/o Free Water	--	--	68	5,980	--	0.004	--	--	--	--
9	34 to 39	Stiff Clay w/o Free Water	--	--	67.6	5,850	--	0.004	--	--	--	--
10	39 to 40	Stiff Clay w/o Free Water	--	--	67.6	5,980	--	0.004	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D7.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for SUB-7

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	390	--	3.04	3	--	0	800
2	3 to 4	CL	115	--	390	--	3.04	3	0.6	80	800
3	4 to 7	SC	120	33	--	--	3.39	14	1.3	240	5,600
4	7 to 14	SC	63	35	--	--	3.69	28	2.7	550	11,200
5	14 to 19	SC	63	--	5,980	--	3.04	85	4.7	1,070	17,500
6	19 to 24	SC	63	35	--	--	3.69	62	6.1	990	17,500
7	24 to 29	SC	63	35	--	--	3.69	68	6.6	1,110	17,500
8	29 to 34	CL	68	--	5,980	--	3.04	58	3.7	1,070	17,500
9	34 to 39	CL	68	--	5,850	--	3.04	44	3.1	1,050	17,500
10	39 to 40	CL	68	--	5,980	--	3.04	46	3.2	1,070	17,900

Table D7.3 – Grout Anchor Design Parameters for SUB-7

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 4	CL	1
3	4 to 7	SC	11
4	7 to 14	SC	15
5	14 to 19	SC	29
6	19 to 24	SC	23
7	24 to 29	SC	25
8	29 to 34	CL	21
9	34 to 39	CL	20
10	39 to 40	CL	21

Notes: Design depth to groundwater is 7 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D8.1 – LPILE Computer Program Parameters for Lateral Load Analysis for SUB-8

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	1,590	--	0.007	--	--	--	--
2	3 to 7	Sand (Reese)	90	--	120	--	33	--	--	--	--	--
3	7 to 9	Sand (Reese)	60	--	58	--	35	--	--	--	--	--
4	9 to 12	Sand (Reese)	125	--	58	--	35	--	--	--	--	--
5	12 to 19	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
6	19 to 24	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
7	24 to 29	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
8	29 to 34	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
9	34 to 40	Stiff Clay w/o Free Water	--	--	67.6	4,790	--	0.005	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D8.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for SUB-8

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	1,590	--	3.04	12	--	0	4,200
2	3 to 7	SC	120	33	--	--	3.39	12	1.2	200	4,800
3	7 to 9	SP	58	35	--	--	3.69	30	2.9	510	12,000
4	9 to 12	SP	58	35	--	--	3.69	32	3.1	580	12,800
5	12 to 19	SC	63	35	--	--	3.69	35	3.4	680	14,000
6	19 to 24	SC	63	35	--	--	3.69	40	3.9	800	14,300
7	24 to 29	SC	63	35	--	--	3.69	47	4.6	930	14,300
8	29 to 34	SC	63	35	--	--	3.69	64	6.3	1,140	14,300
9	34 to 40	CL	68	--	4,790	--	3.04	36	2.7	900	14,300

Table D8.3 – Grout Anchor Design Parameters for SUB-8

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 7	SC	11
3	7 to 9	SP	15
4	9 to 12	SP	16
5	12 to 19	SC	16
6	19 to 24	SC	18
7	24 to 29	SC	19
8	29 to 34	SC	24
9	34 to 40	CL	17

Notes: Design depth to groundwater is 7 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D9.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-1 (POI)

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	3,060	--	0.005	--	--	--	--
2	3 to 4	Stiff Clay w/o Free Water	--	--	125	3,060	--	0.005	--	--	--	--
3	4 to 9	Sand (Reese)	225	--	120	--	35	--	--	--	--	--
4	9 to 14	Sand (Reese)	90	--	120	--	35	--	--	--	--	--
5	14 to 19	Stiff Clay w/o Free Water	--	--	125	3,060	--	0.005	--	--	--	--
6	19 to 29	Stiff Clay w/o Free Water	--	--	125	4,120	--	0.005	--	--	--	--
7	29 to 34	Stiff Clay w/o Free Water	--	--	125	5,980	--	0.004	--	--	--	--
8	34 to 39	Stiff Clay w/o Free Water	--	--	125	4,650	--	0.005	--	--	--	--
9	39 to 44	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--
10	44 to 50	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D9.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-1 (POI)

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	3,060	--	3.04	23	--	0	9,100
2	3 to 4	CL	125	--	3,060	--	3.04	23	2.0	670	9,100
3	4 to 9	SC	120	35	--	--	3.69	42	4.1	520	9,100
4	9 to 14	SC	120	35	--	--	3.69	29	2.8	630	9,100
5	14 to 19	CL	125	--	3,060	--	3.04	23	2.0	670	9,100
6	19 to 29	CL	125	--	4,120	--	3.04	31	2.5	830	12,300
7	29 to 34	CL	125	--	5,980	--	3.04	48	3.3	1,070	13,900
8	34 to 39	CL	125	--	4,650	--	3.04	35	2.7	890	13,900
9	39 to 44	CL	130	--	5,980	--	3.04	75	4.3	1,070	17,900
10	44 to 50	CL	130	--	5,980	--	3.04	67	4.0	1,070	17,900

Table D9.3 – Grout Anchor Design Parameters for TL-1 (POI)

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 4	CL	11
3	4 to 9	SC	18
4	9 to 14	SC	15
5	14 to 19	CL	11
6	19 to 29	CL	14
7	29 to 34	CL	21
8	34 to 39	CL	16
9	39 to 44	CL	21
10	44 to 50	CL	21

Notes: Design depth to groundwater is 50 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D10.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-2

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	650	--	0.01	--	--	--	--
2	3 to 7	Stiff Clay w/o Free Water	--	--	125	650	--	0.010	--	--	--	--
3	7 to 9	Stiff Clay w/o Free Water	--	--	125	3,190	--	0.005	--	--	--	--
4	9 to 12	Stiff Clay w/o Free Water	--	--	125	2,920	--	0.005	--	--	--	--
5	12 to 14	Stiff Clay w/o Free Water	--	--	125	3,990	--	0.005	--	--	--	--
6	14 to 19	Stiff Clay w/o Free Water	--	--	125	3,450	--	0.005	--	--	--	--
7	19 to 24	Stiff Clay w/o Free Water	--	--	125	5,450	--	0.005	--	--	--	--
8	24 to 29	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--
9	29 to 30	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D10.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-2

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value (blows/ft)	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)					
1*	0 to 3	CH	105	--	650	--	3.04	5	--	0	1,400
2	3 to 7	CH	125	--	650	--	3.04	5	0.8	140	1,400
3	7 to 9	CL	125	--	3,190	--	3.04	24	2.1	700	8,700
4	9 to 12	CL	125	--	2,920	--	3.04	22	2.0	640	8,700
5	12 to 14	CL	125	--	3,990	--	3.04	30	2.4	810	10,300
6	14 to 19	CL	125	--	3,450	--	3.04	26	2.2	740	10,300
7	19 to 24	CL	125	--	5,450	--	3.04	41	2.9	980	16,300
8	24 to 29	CL	130	--	5,980	--	3.04	74	4.3	1,070	17,900
9	29 to 30	CL	130	--	5,980	--	3.04	61	3.8	1,070	17,900

Table D10.3 – Grout Anchor Design Parameters for TL-2

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CH	--
2	3 to 7	CH	2
3	7 to 9	CL	11
4	9 to 12	CL	10
5	12 to 14	CL	14
6	14 to 19	CL	12
7	19 to 24	CL	19
8	24 to 29	CL	21
9	29 to 30	CL	21

Notes: Design depth to groundwater is 30 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D11.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-3

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	1,190	--	0.007	--	--	--	--
2	3 to 4	Sand (Reese)	25	--	120	--	32	--	--	--	--	--
3	4 to 7	Stiff Clay w/o Free Water	--	--	125	1,190	--	0.007	--	--	--	--
4	7 to 12	Stiff Clay w/o Free Water	--	--	130	2,650	--	0.005	--	--	--	--
5	12 to 14	Stiff Clay w/o Free Water	--	--	125	3,450	--	0.005	--	--	--	--
6	14 to 19	Stiff Clay w/o Free Water	--	--	125	3,990	--	0.005	--	--	--	--
7	19 to 24	Stiff Clay w/o Free Water	--	--	125	3,060	--	0.005	--	--	--	--
8	24 to 29	Stiff Clay w/o Free Water	--	--	125	4,390	--	0.005	--	--	--	--
9	29 to 30	Stiff Clay w/o Free Water	--	--	125	3,450	--	0.005	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D11.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-3

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value (blows/ft)	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)					
1*	0 to 3	SC	105	--	1,190	--	3.04	9	--	0	3,100
2	3 to 4	SC	120	32	--	--	3.25	9	0.9	110	3,100
3	4 to 7	CH	125	--	1,190	--	3.04	9	1.1	260	3,100
4	7 to 12	CH	130	--	2,650	--	3.04	20	1.9	580	7,900
5	12 to 14	CL	125	--	3,450	--	3.04	26	2.2	740	9,100
6	14 to 19	CL	125	--	3,990	--	3.04	30	2.4	810	9,100
7	19 to 24	CL	125	--	3,060	--	3.04	23	2.0	670	9,100
8	24 to 29	CL	125	--	4,390	--	3.04	33	2.6	860	10,300
9	29 to 30	CL	125	--	3,450	--	3.04	26	2.2	740	10,300

Table D11.3 – Grout Anchor Design Parameters for TL-3

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	SC	--
2	3 to 4	SC	10
3	4 to 7	CH	4
4	7 to 12	CH	9
5	12 to 14	CL	12
6	14 to 19	CL	14
7	19 to 24	CL	11
8	24 to 29	CL	15
9	29 to 30	CL	12

Notes: Design depth to groundwater is 50 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D12.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-4 (POI)

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	790	--	0.01	--	--	--	--
2	3 to 7	Stiff Clay w/o Free Water	--	--	120	790	--	0.010	--	--	--	--
3	7 to 12	Stiff Clay w/o Free Water	--	--	120	1,050	--	0.007	--	--	--	--
4	12 to 14	Stiff Clay w/o Free Water	--	--	125	3,190	--	0.005	--	--	--	--
5	14 to 19	Stiff Clay w/o Free Water	--	--	125	4,390	--	0.005	--	--	--	--
6	19 to 24	Stiff Clay w/o Free Water	--	--	125	5,190	--	0.005	--	--	--	--
7	24 to 34	Stiff Clay w/o Free Water	--	--	125	5,850	--	0.004	--	--	--	--
8	34 to 39	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--
9	39 to 44	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--
10	44 to 50	Sand (Reese)	225	--	125	--	34	--	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D12.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-4 (POI)

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	790	--	3.04	6	--	0	1,700
2	3 to 7	CL	120	--	790	--	3.04	6	0.9	170	1,700
3	7 to 12	CL	120	--	1,050	--	3.04	8	1.1	230	2,800
4	12 to 14	CL	125	--	3,190	--	3.04	24	2.1	700	9,500
5	14 to 19	CL	125	--	4,390	--	3.04	33	2.6	860	13,100
6	19 to 24	CL	125	--	5,190	--	3.04	39	2.9	940	15,500
7	24 to 34	CL	125	--	5,850	--	3.04	44	3.1	1,050	17,500
8	34 to 39	CL	130	--	5,980	--	3.04	55	3.5	1,070	17,900
9	39 to 44	CL	130	--	5,980	--	3.04	60	3.7	1,070	17,900
10	44 to 50	SC	125	34	--	--	3.54	54	5.3	1,530	20,000

Table D12.3 – Grout Anchor Design Parameters for TL-4 (POI)

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 7	CL	3
3	7 to 12	CL	4
4	12 to 14	CL	11
5	14 to 19	CL	15
6	19 to 24	CL	18
7	24 to 34	CL	20
8	34 to 39	CL	21
9	39 to 44	CL	21
10	44 to 50	SC	21

Notes: Design depth to groundwater is 50 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma'=\gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D13.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-5

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	1,590	--	0.007	--	--	--	--
2	3 to 9	Stiff Clay w/o Free Water	--	--	120	1,190	--	0.007	--	--	--	--
3	9 to 14	Stiff Clay w/o Free Water	--	--	125	1,720	--	0.007	--	--	--	--
4	14 to 19	Stiff Clay w/o Free Water	--	--	125	3,450	--	0.005	--	--	--	--
5	19 to 24	Sand (Reese)	225	--	125	--	35	--	--	--	--	--
6	24 to 29	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--
7	29 to 30	Stiff Clay w/o Free Water	--	--	125	4,520	--	0.005	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D13.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-5

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	1,590	--	3.04	12	--	0	3,100
2	3 to 9	CL	120	--	1,190	--	3.04	9	1.1	260	3,100
3	9 to 14	CL	125	--	1,720	--	3.04	13	1.4	380	4,600
4	14 to 19	CL	125	--	3,450	--	3.04	26	2.2	740	10,300
5	19 to 24	SC	125	35	--	--	3.69	51	5.0	1,080	13,500
6	24 to 29	ML	130	--	5,980	--	3.04	78	4.4	1,070	13,500
7	29 to 30	CL	125	--	4,520	--	3.04	34	2.6	880	13,500

Table D13.3 – Grout Anchor Design Parameters for TL-5

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 9	CL	4
3	9 to 14	CL	6
4	14 to 19	CL	12
5	19 to 24	SC	20
6	24 to 29	ML	21
7	29 to 30	CL	16

Notes: Design depth to groundwater is 30 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma'=\gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D14.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-6 (POI)

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	1,050	--	0.007	--	--	--	--
2	3 to 7	Stiff Clay w/o Free Water	--	--	120	3,990	--	0.005	--	--	--	--
3	7 to 12	Stiff Clay w/o Free Water	--	--	125	1,050	--	0.007	--	--	--	--
4	12 to 14	Stiff Clay w/o Free Water	--	--	125	1,850	--	0.007	--	--	--	--
5	14 to 19	Stiff Clay w/o Free Water	--	--	125	5,190	--	0.005	--	--	--	--
6	19 to 24	Stiff Clay w/o Free Water	--	--	125	3,060	--	0.005	--	--	--	--
7	24 to 39	Sand (Reese)	225	--	120	--	33	--	--	--	--	--
8	39 to 44	Stiff Clay w/o Free Water	--	--	130	5,320	--	0.005	--	--	--	--
9	44 to 49	Stiff Clay w/o Free Water	--	--	130	5,450	--	0.005	--	--	--	--
10	49 to 50	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D14.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-6 (POI)

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	SC	105	--	1,050	--	3.04	8	--	0	2,800
2	3 to 7	SC	120	--	3,990	--	3.04	30	2.4	810	2,800
3	7 to 12	CL	125	--	1,050	--	3.04	8	1.1	230	2,800
4	12 to 14	CL	125	--	1,850	--	3.04	14	1.5	400	4,900
5	14 to 19	CL	125	--	5,190	--	3.04	39	2.9	940	9,100
6	19 to 24	CL	125	--	3,060	--	3.04	23	2.0	670	9,100
7	24 to 39	SC	120	33	--	--	3.39	36	3.5	1,030	14,400
8	39 to 44	CL	130	--	5,320	--	3.04	40	2.9	950	15,900
9	44 to 49	CL	130	--	5,450	--	3.04	41	2.9	980	16,300
10	49 to 50	CL	130	--	5,980	--	3.04	100	5.2	1,070	17,900

Table D14.3 – Grout Anchor Design Parameters for TL-6 (POI)

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	SC	--
2	3 to 7	SC	15
3	7 to 12	CL	4
4	12 to 14	CL	6
5	14 to 19	CL	18
6	19 to 24	CL	11
7	24 to 39	SC	17
8	39 to 44	CL	18
9	44 to 49	CL	19
10	49 to 50	CL	21

Notes: Design depth to groundwater is 50 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D15.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-7

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	650	--	0.01	--	--	--	--
2	3 to 4	Stiff Clay w/o Free Water	--	--	125	650	--	0.010	--	--	--	--
3	4 to 9	Stiff Clay w/o Free Water	--	--	125	2,120	--	0.007	--	--	--	--
4	9 to 12	Stiff Clay w/o Free Water	--	--	125	2,650	--	0.005	--	--	--	--
5	12 to 19	Sand (Reese)	90	--	120	--	34	--	--	--	--	--
6	19 to 24	Sand (Reese)	225	--	120	--	35	--	--	--	--	--
7	24 to 29	Stiff Clay w/o Free Water	--	--	130	5,450	--	0.005	--	--	--	--
8	29 to 30	Stiff Clay w/o Free Water	--	--	130	4,790	--	0.005	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D15.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-7

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value (blows/ft)	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)					
1*	0 to 3	CH	105	--	650	--	3.04	5	--	0	1,400
2	3 to 4	CH	125	--	650	--	3.04	5	0.8	140	1,400
3	4 to 9	CL	125	--	2,120	--	3.04	16	1.6	460	6,300
4	9 to 12	CL	125	--	2,650	--	3.04	20	1.9	580	7,900
5	12 to 19	SC	120	34	--	--	3.54	27	2.6	680	10,800
6	19 to 24	SC	120	35	--	--	3.69	43	4.2	1,000	14,300
7	24 to 29	CL	130	--	5,450	--	3.04	41	2.9	980	14,300
8	29 to 30	CL	130	--	4,790	--	3.04	36	2.7	900	14,300

Table D15.3 – Grout Anchor Design Parameters for TL-7

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CH	--
2	3 to 4	CH	2
3	4 to 9	CL	7
4	9 to 12	CL	9
5	12 to 19	SC	14
6	19 to 24	SC	18
7	24 to 29	CL	19
8	29 to 30	CL	17

Notes: Design depth to groundwater is 30 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D16.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-8

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	920	--	0.01	--	--	--	--
2	3 to 7	Sand (Reese)	25	--	120	--	30	--	--	--	--	--
3	7 to 9	Sand (Reese)	90	--	125	--	34	--	--	--	--	--
4	9 to 12	Sand (Reese)	225	--	125	--	35	--	--	--	--	--
5	12 to 14	Stiff Clay w/o Free Water	--	--	115	390	--	0.020	--	--	--	--
6	14 to 19	Stiff Clay w/o Free Water	--	--	125	2,120	--	0.007	--	--	--	--
7	19 to 24	Sand (Reese)	225	--	125	--	34	--	--	--	--	--
8	24 to 30	Stiff Clay w/o Free Water	--	--	130	5,590	--	0.005	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D16.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-8

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value (blows/ft)	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)					
1*	0 to 3	SM	105	--	920	--	3.04	7	--	0	800
2	3 to 7	SC	120	30	--	--	3.00	5	0.5	120	800
3	7 to 9	SC	125	34	--	--	3.54	21	2.0	440	800
4	9 to 12	SC	125	35	--	--	3.69	36	3.5	670	800
5	12 to 14	CL	115	--	390	--	3.04	3	0.6	80	800
6	14 to 19	CL	125	--	2,120	--	3.04	16	1.6	460	6,300
7	19 to 24	SC	125	34	--	--	3.54	38	3.7	910	15,200
8	24 to 30	CL	130	--	5,590	--	3.04	42	3.0	1,000	16,700

Table D16.3 – Grout Anchor Design Parameters for TL-8

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	SM	--
2	3 to 7	SC	9
3	7 to 9	SC	13
4	9 to 12	SC	17
5	12 to 14	CL	1
6	14 to 19	CL	7
7	19 to 24	SC	17
8	24 to 30	CL	19

Notes: Design depth to groundwater is 30 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma'=\gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D17.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-9

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	1,990	--	0.007	--	--	--	--
2	3 to 7	Sand (Reese)	90	--	120	--	33	--	--	--	--	--
3	7 to 12	Sand (Reese)	90	--	120	--	34	--	--	--	--	--
4	12 to 14	Stiff Clay w/o Free Water	--	--	125	4,250	--	0.005	--	--	--	--
5	14 to 19	Sand (Reese)	90	--	125	--	34	--	--	--	--	--
6	19 to 24	Sand (Reese)	225	--	125	--	35	--	--	--	--	--
7	24 to 29	Sand (Reese)	225	--	125	--	34	--	--	--	--	--
8	29 to 30	Sand (Reese)	90	--	125	--	32	--	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D17.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-9

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value (blows/ft)	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)					
1*	0 to 3	SC	105	--	1,990	--	3.04	15	--	0	5,300
2	3 to 7	SC	120	33	--	--	3.39	14	1.3	210	5,600
3	7 to 12	SC	120	34	--	--	3.54	24	2.3	510	9,600
4	12 to 14	CL	125	--	4,250	--	3.04	32	2.5	840	10,400
5	14 to 19	SC	125	34	--	--	3.54	30	2.9	720	10,400
6	19 to 24	SC	125	35	--	--	3.69	44	4.3	1,010	10,400
7	24 to 29	SC	125	34	--	--	3.54	43	4.2	1,060	10,400
8	29 to 30	SC	125	32	--	--	3.25	26	2.5	840	10,400

Table D17.3 – Grout Anchor Design Parameters for TL-9

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	SC	--
2	3 to 7	SC	11
3	7 to 12	SC	14
4	12 to 14	CL	15
5	14 to 19	SC	15
6	19 to 24	SC	19
7	24 to 29	SC	18
8	29 to 30	SC	14

Notes: Design depth to groundwater is 30 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D18.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-10

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	920	--	0.01	--	--	--	--
2	3 to 7	Sand (Reese)	25	--	115	--	26	--	--	--	--	--
3	7 to 9	Sand (Reese)	90	--	120	--	35	--	--	--	--	--
4	9 to 12	Sand (Reese)	225	--	120	--	35	--	--	--	--	--
5	12 to 14	Sand (Reese)	90	--	120	--	34	--	--	--	--	--
6	14 to 19	Sand (Reese)	225	--	125	--	34	--	--	--	--	--
7	19 to 24	Sand (Reese)	225	--	130	--	35	--	--	--	--	--
8	24 to 30	Sand (Reese)	125	--	68	--	35	--	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D18.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-10

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value (blows/ft)	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)					
1*	0 to 3	SC	105	--	920	--	3.04	7	--	0	800
2	3 to 7	SC	115	26	--	--	2.52	2	0.2	70	800
3	7 to 9	SC	120	35	--	--	3.69	24	2.3	480	9,200
4	9 to 12	SC	120	35	--	--	3.69	32	3.1	630	9,200
5	12 to 14	SC	120	34	--	--	3.54	23	2.2	570	9,200
6	14 to 19	SC	125	34	--	--	3.54	32	3.1	740	12,800
7	19 to 24	SC	130	35	--	--	3.69	51	5.0	1,080	17,600
8	24 to 30	SC	68	35	--	--	3.69	44	4.3	1,090	17,600

Table D18.3 – Grout Anchor Design Parameters for TL-10

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	SC	--
2	3 to 7	SC	8
3	7 to 9	SC	14
4	9 to 12	SC	16
5	12 to 14	SC	13
6	14 to 19	SC	16
7	19 to 24	SC	20
8	24 to 30	SC	19

Notes: Design depth to groundwater is 24 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D19.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-11

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	2,390	--	0.005	--	--	--	--
2	3 to 7	Sand (Reese)	25	--	120	--	31	--	--	--	--	--
3	7 to 9	Sand (Reese)	90	--	120	--	33	--	--	--	--	--
4	9 to 12	Sand (Reese)	225	--	125	--	35	--	--	--	--	--
5	12 to 19	Sand (Reese)	90	--	125	--	34	--	--	--	--	--
6	19 to 24	Sand (Reese)	225	--	125	--	34	--	--	--	--	--
7	24 to 28	Sand (Reese)	225	--	130	--	35	--	--	--	--	--
8	28 to 30	Sand (Reese)	125	--	68	--	35	--	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D19.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-11

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value (blows/ft)	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)					
1*	0 to 3	SC	105	--	2,390	--	3.04	18	--	0	3,200
2	3 to 7	SC	120	31	--	--	3.12	8	0.8	160	3,200
3	7 to 9	SC	120	33	--	--	3.39	17	1.6	380	6,800
4	9 to 12	SC	125	35	--	--	3.69	33	3.2	640	11,600
5	12 to 19	SC	125	34	--	--	3.54	29	2.8	700	11,600
6	19 to 24	SC	125	34	--	--	3.54	31	3.0	830	12,400
7	24 to 28	SC	130	35	--	--	3.69	61	6.0	1,280	20,000
8	28 to 30	SC	68	35	--	--	3.69	58	5.7	1,300	20,000

Table D19.3 – Grout Anchor Design Parameters for TL-11

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	SC	--
2	3 to 7	SC	10
3	7 to 9	SC	12
4	9 to 12	SC	16
5	12 to 19	SC	15
6	19 to 24	SC	15
7	24 to 28	SC	23
8	28 to 30	SC	22

Notes: Design depth to groundwater is 28 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D20.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-12

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	1,050	--	0.007	--	--	--	--
2	3 to 7	Sand (Reese)	25	--	115	--	31	--	--	--	--	--
3	7 to 9	Stiff Clay w/o Free Water	--	--	63	1,050	--	0.007	--	--	--	--
4	9 to 12	Sand (Reese)	60	--	63	--	33	--	--	--	--	--
5	12 to 19	Sand (Reese)	125	--	68	--	35	--	--	--	--	--
6	19 to 24	Sand (Reese)	125	--	68	--	35	--	--	--	--	--
7	24 to 29	Stiff Clay w/o Free Water	--	--	63	1,990	--	0.007	--	--	--	--
8	29 to 30	Sand (Reese)	125	--	68	--	35	--	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D20.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-12

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value (blows/ft)	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)					
1*	0 to 3	SC	105	--	1,050	--	3.04	8	--	0	2,400
2	3 to 7	SC	115	31	--	--	3.12	6	0.6	130	2,400
3	7 to 9	CL	63	--	1,050	--	3.04	8	1.1	230	2,800
4	9 to 12	SP	63	33	--	--	3.39	18	1.7	410	5,300
5	12 to 19	SC	68	35	--	--	3.69	33	3.2	660	5,300
6	19 to 24	SC	68	35	--	--	3.69	31	3.0	720	5,300
7	24 to 29	ML	63	--	1,990	--	3.04	15	1.6	430	5,300
8	29 to 30	SC	68	35	--	--	3.69	42	4.1	930	16,800

Table D20.3 – Grout Anchor Design Parameters for TL-12

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	SC	--
2	3 to 7	SC	9
3	7 to 9	CL	4
4	9 to 12	SP	12
5	12 to 19	SC	16
6	19 to 24	SC	15
7	24 to 29	ML	7
8	29 to 30	SC	18

Notes: Design depth to groundwater is 7 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D21.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-13 (POI)

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 4	Soft Clay (1)	--	--	105	1,720	--	0.007	--	--	--	--
2	4 to 6	Stiff Clay w/o Free Water	--	--	120	1,320	--	0.007	--	--	--	--
3	6 to 9	Sand (Reese)	90	--	120	--	34	--	--	--	--	--
4	9 to 14	Stiff Clay w/o Free Water	--	--	125	1,720	--	0.007	--	--	--	--
5	14 to 19	Stiff Clay w/o Free Water	--	--	125	2,250	--	0.005	--	--	--	--
6	19 to 24	Stiff Clay w/o Free Water	--	--	125	3,600	--	0.005	--	--	--	--
7	24 to 34	Stiff Clay w/o Free Water	--	--	133	5,980	--	0.004	--	--	--	--
8	34 to 39	Stiff Clay w/o Free Water	--	--	130	4,790	--	0.005	--	--	--	--
9	39 to 44	Stiff Clay w/o Free Water	--	--	133	5,980	--	0.004	--	--	--	--
10	44 to 50	Stiff Clay w/o Free Water	--	--	133	5,980	--	0.004	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D21.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-13 (POI)

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 4	SC	105	--	1,720	--	3.04	13	--	380	3,500
2	4 to 6	CL	120	--	1,320	--	3.04	10	1.2	290	3,500
3	6 to 9	SC	120	34	--	--	3.54	22	2.1	420	4,600
4	9 to 14	CH	125	--	1,720	--	3.04	13	1.4	380	4,600
5	14 to 19	CL	125	--	2,250	--	3.04	17	1.7	490	6,700
6	19 to 24	CL	125	--	3,600	--	3.04	27	2.3	760	10,800
7	24 to 34	CL	133	--	5,980	--	3.04	68	4.0	1,070	14,300
8	34 to 39	CL	130	--	4,790	--	3.04	36	2.7	900	14,300
9	39 to 44	CL	133	--	5,980	--	3.04	77	4.4	1,070	17,900
10	44 to 50	CL	133	--	5,980	--	3.04	57	3.6	1,070	17,900

Table D21.3 – Grout Anchor Design Parameters for TL-13 (POI)

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 4	SC	--
2	4 to 6	CL	5
3	6 to 9	SC	13
4	9 to 14	CH	6
5	14 to 19	CL	8
6	19 to 24	CL	13
7	24 to 34	CL	21
8	34 to 39	CL	17
9	39 to 44	CL	21
10	44 to 50	CL	21

Notes: Design depth to groundwater is 50 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D22.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-14 (POI)

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	1,050	--	0.007	--	--	--	--
2	3 to 7	Sand (Reese)	25	--	115	--	30	--	--	--	--	--
3	7 to 9	Sand (Reese)	90	--	115	--	32	--	--	--	--	--
4	9 to 14	Stiff Clay w/o Free Water	--	--	125	3,320	--	0.005	--	--	--	--
5	14 to 19	Stiff Clay w/o Free Water	--	--	125	1,990	--	0.007	--	--	--	--
6	19 to 29	Stiff Clay w/o Free Water	--	--	125	3,600	--	0.005	--	--	--	--
7	29 to 34	Stiff Clay w/o Free Water	--	--	125	3,060	--	0.005	--	--	--	--
8	34 to 39	Stiff Clay w/o Free Water	--	--	125	4,120	--	0.005	--	--	--	--
9	39 to 44	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--
10	44 to 50	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D22.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-14 (POI)

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction	Allowable Bearing Pressure (FS=3)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)		(FS=2.5)[1] (psf)	(psf)
1*	0 to 3	SC	105	--	1,050	--	3.04	8	--	0	2,000
2	3 to 7	SC	115	30	--	--	3.00	5	0.5	120	2,000
3	7 to 9	SC	115	32	--	--	3.25	11	1.1	300	4,400
4	9 to 14	CL	125	--	3,320	--	3.04	25	2.2	720	5,300
5	14 to 19	CL	125	--	1,990	--	3.04	15	1.6	430	5,300
6	19 to 29	CL	125	--	3,600	--	3.04	27	2.3	760	9,100
7	29 to 34	CL	125	--	3,060	--	3.04	23	2.0	670	9,100
8	34 to 39	CL	125	--	4,120	--	3.04	31	2.5	830	12,300
9	39 to 44	CL	130	--	5,980	--	3.04	50	3.3	1,070	17,900
10	44 to 50	CL	130	--	5,980	--	3.04	49	3.3	1,070	17,900

Table D22.3 – Grout Anchor Design Parameters for TL-14 (POI)

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	SC	--
2	3 to 7	SC	9
3	7 to 9	SC	10
4	9 to 14	CL	12
5	14 to 19	CL	7
6	19 to 29	CL	13
7	29 to 34	CL	11
8	34 to 39	CL	14
9	39 to 44	CL	21
10	44 to 50	CL	21

Notes: Design depth to groundwater is 50 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma'=\gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D23.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-15

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	1,720	--	0.007	--	--	--	--
2	3 to 7	Sand (Reese)	25	--	115	--	32	--	--	--	--	--
3	7 to 9	Sand (Reese)	25	--	120	--	32	--	--	--	--	--
4	9 to 14	Sand (Reese)	225	--	125	--	35	--	--	--	--	--
5	14 to 19	Sand (Reese)	225	--	125	--	35	--	--	--	--	--
6	19 to 24	Sand (Reese)	225	--	125	--	35	--	--	--	--	--
7	24 to 29	Stiff Clay w/o Free Water	--	--	68	5,980	--	0.004	--	--	--	--
8	29 to 30	Sand (Reese)	125	--	73	--	33	--	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D23.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-15

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value (blows/ft)	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)					
1*	0 to 3	SM	105	--	1,720	--	3.04	13	--	0	3,200
2	3 to 7	SC	115	32	--	--	3.25	8	0.8	160	3,200
3	7 to 9	SC	120	32	--	--	3.25	10	1.0	290	4,000
4	9 to 14	SC	125	35	--	--	3.69	45	4.4	770	12,800
5	14 to 19	SC	125	35	--	--	3.69	53	5.2	970	12,800
6	19 to 24	SC	125	35	--	--	3.69	50	4.9	1,070	12,800
7	24 to 29	ML	68	--	5,980	--	3.04	55	3.5	1,070	12,800
8	29 to 30	SC	73	33	--	--	3.39	32	3.1	910	12,800

Table D23.3 – Grout Anchor Design Parameters for TL-15

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	SM	--
2	3 to 7	SC	10
3	7 to 9	SC	10
4	9 to 14	SC	19
5	14 to 19	SC	21
6	19 to 24	SC	20
7	24 to 29	ML	21
8	29 to 30	SC	16

Notes: Design depth to groundwater is 24 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D24.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-16

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	1,850	--	0.007	--	--	--	--
2	3 to 7	Sand (Reese)	90	--	120	--	33	--	--	--	--	--
3	7 to 9	Sand (Reese)	90	--	125	--	35	--	--	--	--	--
4	9 to 14	Sand (Reese)	225	--	125	--	35	--	--	--	--	--
5	14 to 19	Sand (Reese)	225	--	125	--	35	--	--	--	--	--
6	19 to 25	Sand (Reese)	225	--	125	--	35	--	--	--	--	--
7	25 to 29	Sand (Reese)	125	--	68	--	35	--	--	--	--	--
8	29 to 30	Sand (Reese)	125	--	63	--	35	--	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D24.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-16

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value (blows/ft)	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)					
1*	0 to 3	SC	105	--	1,850	--	3.04	14	--	0	4,900
2	3 to 7	SC	120	33	--	--	3.39	14	1.3	210	5,600
3	7 to 9	SC	125	35	--	--	3.69	25	2.4	500	10,000
4	9 to 14	SC	125	35	--	--	3.69	43	4.2	760	17,200
5	14 to 19	SC	125	35	--	--	3.69	45	4.4	910	18,000
6	19 to 25	SC	125	35	--	--	3.69	47	4.6	1,050	18,800
7	25 to 29	SC	68	35	--	--	3.69	50	4.9	1,170	20,000
8	29 to 30	SP	63	35	--	--	3.69	100	9.8	1,640	20,000

Table D24.3 – Grout Anchor Design Parameters for TL-16

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	SC	--
2	3 to 7	SC	11
3	7 to 9	SC	14
4	9 to 14	SC	18
5	14 to 19	SC	19
6	19 to 25	SC	19
7	25 to 29	SC	20
8	29 to 30	SP	33

Notes: Design depth to groundwater is 25 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D25.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-17

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	790	--	0.01	--	--	--	--
2	3 to 4	Stiff Clay w/o Free Water	--	--	115	790	--	0.010	--	--	--	--
3	4 to 9	Sand (Reese)	25	--	115	--	30	--	--	--	--	--
4	9 to 12	Sand (Reese)	25	--	120	--	31	--	--	--	--	--
5	12 to 14	Sand (Reese)	60	--	68	--	35	--	--	--	--	--
6	14 to 19	Sand (Reese)	60	--	68	--	34	--	--	--	--	--
7	19 to 24	Sand (Reese)	125	--	68	--	34	--	--	--	--	--
8	24 to 30	Stiff Clay w/o Free Water	--	--	71	4,650	--	0.005	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D25.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-17

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ' (pcf)	ϕ (degree)	C (psf)	C'_{Rock} (psf)	K_p	SPT N-Value (blows/ft)	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
1*	0 to 3	CL	105	--	790	--	3.04	6	--	0	1,600
2	3 to 4	CL	115	--	790	--	3.04	6	0.9	170	1,600
3	4 to 9	SC	115	30	--	--	3.00	4	0.4	150	1,600
4	9 to 12	SC	120	31	--	--	3.12	9	0.9	310	3,600
5	12 to 14	SC	68	35	--	--	3.69	30	2.9	660	12,000
6	14 to 19	SC	68	34	--	--	3.54	30	2.9	680	12,000
7	19 to 24	SC	68	34	--	--	3.54	33	3.2	770	13,200
8	24 to 30	CL	71	--	4,650	--	3.04	35	2.7	890	13,900

Table D25.3 – Grout Anchor Design Parameters for TL-17

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 4	CL	3
3	4 to 9	SC	9
4	9 to 12	SC	10
5	12 to 14	SC	15
6	14 to 19	SC	15
7	19 to 24	SC	16
8	24 to 30	CL	16

Notes: Design depth to groundwater is 12 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D26.1 – LPILE Computer Program Parameters for Lateral Load Analysis for TL-18 (POI)

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	520	--	0.01	--	--	--	--
2	3 to 7	Sand (Reese)	25	--	120	--	28	--	--	--	--	--
3	7 to 9	Sand (Reese)	25	--	120	--	30	--	--	--	--	--
4	9 to 14	Sand (Reese)	60	--	63	--	35	--	--	--	--	--
5	14 to 24	Sand (Reese)	125	--	68	--	35	--	--	--	--	--
6	24 to 29	Sand (Reese)	125	--	68	--	35	--	--	--	--	--
7	29 to 34	Stiff Clay w/o Free Water	--	--	71	5,980	--	0.004	--	--	--	--
8	34 to 39	Stiff Clay w/o Free Water	--	--	71	5,050	--	0.005	--	--	--	--
9	39 to 44	Stiff Clay w/o Free Water	--	--	70.6	5,980	--	0.004	--	--	--	--
10	44 to 50	Stiff Clay w/o Free Water	--	--	70.6	5,450	--	0.005	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D26.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for TL-18 (POI)

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	SC	105	--	520	--	3.04	4	--	0	1,100
2	3 to 7	SC	120	28	--	--	2.77	3	0.3	90	1,200
3	7 to 9	SC	120	30	--	--	3.00	6	0.6	220	2,400
4	9 to 14	SC	63	35	--	--	3.69	27	2.6	580	10,800
5	14 to 24	SC	68	35	--	--	3.69	49	4.8	880	15,100
6	24 to 29	SC	68	35	--	--	3.69	41	4.0	910	15,100
7	29 to 34	CL	71	--	5,980	--	3.04	50	3.3	1,070	15,100
8	34 to 39	CL	71	--	5,050	--	3.04	38	2.8	930	15,100
9	39 to 44	CL	71	--	5,980	--	3.04	51	3.4	1,070	16,300
10	44 to 50	CL	71	--	5,450	--	3.04	41	2.9	980	16,300

Table D26.3 – Grout Anchor Design Parameters for TL-18 (POI)

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	SC	--
2	3 to 7	SC	8
3	7 to 9	SC	9
4	9 to 14	SC	14
5	14 to 24	SC	20
6	24 to 29	SC	18
7	29 to 34	CL	21
8	34 to 39	CL	18
9	39 to 44	CL	21
10	44 to 50	CL	19

Notes: Design depth to groundwater is 9 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma'=\gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D27.1 – LPILE Computer Program Parameters for Lateral Load Analysis for MET-3

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	1,450	--	0.007	--	--	--	--
2	3 to 7	Stiff Clay w/o Free Water	--	--	125	1,450	--	0.007	--	--	--	--
3	7 to 9	Stiff Clay w/o Free Water	--	--	125	3,450	--	0.005	--	--	--	--
4	9 to 12	Stiff Clay w/o Free Water	--	--	125	2,790	--	0.005	--	--	--	--
5	12 to 14	Stiff Clay w/o Free Water	--	--	125	2,790	--	0.005	--	--	--	--
6	14 to 19	Stiff Clay w/o Free Water	--	--	125	3,600	--	0.005	--	--	--	--
7	19 to 24	Stiff Clay w/o Free Water	--	--	130	5,190	--	0.005	--	--	--	--
8	24 to 29	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--
9	29 to 34	Stiff Clay w/o Free Water	--	--	130	5,720	--	0.005	--	--	--	--
10	34 to 35	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D27.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for MET-3

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	1,450	--	3.04	11	--	0	3,800
2	3 to 7	CL	125	--	1,450	--	3.04	11	1.3	320	3,800
3	7 to 9	ML	125	--	3,450	--	3.04	26	2.2	740	8,300
4	9 to 12	CL	125	--	2,790	--	3.04	21	1.9	610	8,300
5	12 to 14	CL	125	--	2,790	--	3.04	21	1.9	610	8,300
6	14 to 19	CL	125	--	3,600	--	3.04	27	2.3	760	10,800
7	19 to 24	CL	130	--	5,190	--	3.04	39	2.9	940	15,500
8	24 to 29	CL	130	--	5,980	--	3.04	65	3.9	1,070	17,100
9	29 to 34	CL	130	--	5,720	--	3.04	43	3.0	1,030	17,100
10	34 to 35	CL	130	--	5,980	--	3.04	50	3.3	1,070	17,900

Table D27.3 – Grout Anchor Design Parameters for MET-3

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 7	CL	5
3	7 to 9	ML	12
4	9 to 12	CL	10
5	12 to 14	CL	10
6	14 to 19	CL	13
7	19 to 24	CL	18
8	24 to 29	CL	21
9	29 to 34	CL	20
10	34 to 35	CL	21

Notes: Design depth to groundwater is 35 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D28.1 – LPILE Computer Program Parameters for Lateral Load Analysis for PMM-1

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	1,850	--	0.007	--	--	--	--
2	3 to 7	Stiff Clay w/o Free Water	--	--	125	1,320	--	0.007	--	--	--	--
3	7 to 9	Stiff Clay w/o Free Water	--	--	125	2,120	--	0.007	--	--	--	--
4	9 to 12	Stiff Clay w/o Free Water	--	--	125	3,060	--	0.005	--	--	--	--
5	12 to 14	Sand (Reese)	225	--	125	--	35	--	--	--	--	--
6	14 to 19	Sand (Reese)	90	--	125	--	33	--	--	--	--	--
7	19 to 24	Sand (Reese)	90	--	125	--	33	--	--	--	--	--
8	24 to 29	Sand (Reese)	90	--	125	--	33	--	--	--	--	--
9	29 to 34	Stiff Clay w/o Free Water	--	--	130	3,600	--	0.005	--	--	--	--
10	34 to 35	Stiff Clay w/o Free Water	--	--	130	5,050	--	0.005	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D28.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for PMM-1

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	1,850	--	3.04	14	--	0	3,500
2	3 to 7	CL	125	--	1,320	--	3.04	10	1.2	290	3,500
3	7 to 9	CL	125	--	2,120	--	3.04	16	1.6	460	6,300
4	9 to 12	CL	125	--	3,060	--	3.04	23	2.0	670	8,400
5	12 to 14	SC	125	35	--	--	3.69	32	3.1	700	8,400
6	14 to 19	SC	125	33	--	--	3.39	21	2.0	600	8,400
7	19 to 24	SC	125	33	--	--	3.39	26	2.5	750	10,400
8	24 to 29	SC	125	33	--	--	3.39	29	2.8	870	10,800
9	29 to 34	CL	130	--	3,600	--	3.04	27	2.3	760	10,800
10	34 to 35	CL	130	--	5,050	--	3.04	38	2.8	930	15,100

Table D28.3 – Grout Anchor Design Parameters for PMM-1

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 7	CL	5
3	7 to 9	CL	7
4	9 to 12	CL	11
5	12 to 14	SC	16
6	14 to 19	SC	13
7	19 to 24	SC	14
8	24 to 29	SC	15
9	29 to 34	CL	13
10	34 to 35	CL	18

Notes: Design depth to groundwater is 35 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma'=\gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D29.1 – LPILE Computer Program Parameters for Lateral Load Analysis for PMM-2

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	2,390	--	0.005	--	--	--	--
2	3 to 4	Stiff Clay w/o Free Water	--	--	125	2,390	--	0.005	--	--	--	--
3	4 to 9	Stiff Clay w/o Free Water	--	--	120	1,050	--	0.007	--	--	--	--
4	9 to 12	Stiff Clay w/o Free Water	--	--	125	1,850	--	0.007	--	--	--	--
5	12 to 14	Stiff Clay w/o Free Water	--	--	125	2,250	--	0.005	--	--	--	--
6	14 to 19	Stiff Clay w/o Free Water	--	--	125	2,390	--	0.005	--	--	--	--
7	19 to 24	Stiff Clay w/o Free Water	--	--	125	2,650	--	0.005	--	--	--	--
8	24 to 29	Stiff Clay w/o Free Water	--	--	125	2,920	--	0.005	--	--	--	--
9	29 to 34	Stiff Clay w/o Free Water	--	--	130	4,520	--	0.005	--	--	--	--
10	34 to 35	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D29.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for PMM-2

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	2,390	--	3.04	18	--	0	2,800
2	3 to 4	CL	125	--	2,390	--	3.04	18	1.8	520	2,800
3	4 to 9	CL	120	--	1,050	--	3.04	8	1.1	230	2,800
4	9 to 12	CL	125	--	1,850	--	3.04	14	1.5	400	4,900
5	12 to 14	CL	125	--	2,250	--	3.04	17	1.7	490	6,700
6	14 to 19	CL	125	--	2,390	--	3.04	18	1.8	520	7,100
7	19 to 24	CL	125	--	2,650	--	3.04	20	1.9	580	7,900
8	24 to 29	CL	125	--	2,920	--	3.04	22	2.0	640	8,700
9	29 to 34	CL	130	--	4,520	--	3.04	34	2.6	880	13,500
10	34 to 35	CL	130	--	5,980	--	3.04	100	5.2	1,070	17,900

Table D29.3 – Grout Anchor Design Parameters for PMM-2

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 4	CL	8
3	4 to 9	CL	4
4	9 to 12	CL	6
5	12 to 14	CL	8
6	14 to 19	CL	8
7	19 to 24	CL	9
8	24 to 29	CL	10
9	29 to 34	CL	16
10	34 to 35	CL	21

Notes: Design depth to groundwater is 35 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma'=\gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D30.1 – LPILE Computer Program Parameters for Lateral Load Analysis for PMM-3

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	2,520	--	0.005	--	--	--	--
2	3 to 7	Stiff Clay w/o Free Water	--	--	125	2,520	--	0.005	--	--	--	--
3	7 to 9	Stiff Clay w/o Free Water	--	--	125	4,250	--	0.005	--	--	--	--
4	9 to 12	Stiff Clay w/o Free Water	--	--	125	4,520	--	0.005	--	--	--	--
5	12 to 14	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--
6	14 to 19	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--
7	19 to 24	Stiff Clay w/o Free Water	--	--	130	5,720	--	0.005	--	--	--	--
8	24 to 29	Stiff Clay w/o Free Water	--	--	130	5,320	--	0.005	--	--	--	--
9	29 to 34	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--
10	34 to 35	Stiff Clay w/o Free Water	--	--	130	5,980	--	0.004	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D30.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for PMM-3

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	CL	105	--	2,520	--	3.04	19	--	0	7,500
2	3 to 7	CL	125	--	2,520	--	3.04	19	1.8	550	7,500
3	7 to 9	CL	125	--	4,250	--	3.04	32	2.5	840	12,700
4	9 to 12	CL	125	--	4,520	--	3.04	34	2.6	880	13,500
5	12 to 14	CL	130	--	5,980	--	3.04	47	3.2	1,070	15,900
6	14 to 19	CL	130	--	5,980	--	3.04	47	3.2	1,070	15,900
7	19 to 24	CL	130	--	5,720	--	3.04	43	3.0	1,030	15,900
8	24 to 29	CL	130	--	5,320	--	3.04	40	2.9	950	15,900
9	29 to 34	CL	130	--	5,980	--	3.04	52	3.4	1,070	17,900
10	34 to 35	CL	130	--	5,980	--	3.04	100	5.2	1,070	17,900

Table D30.3 – Grout Anchor Design Parameters for PMM-3

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	CL	--
2	3 to 7	CL	9
3	7 to 9	CL	15
4	9 to 12	CL	16
5	12 to 14	CL	21
6	14 to 19	CL	21
7	19 to 24	CL	20
8	24 to 29	CL	18
9	29 to 34	CL	21
10	34 to 35	CL	21

Notes: Design depth to groundwater is 35 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma'=\gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D31.1 – LPILE Computer Program Parameters for Lateral Load Analysis for ADLS-2

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	1,720	--	0.007	--	--	--	--
2	3 to 7	Sand (Reese)	225	--	128	--	35	--	--	--	--	--
3	7 to 9	Sand (Reese)	225	--	128	--	35	--	--	--	--	--
4	9 to 12	Sand (Reese)	90	--	128	--	35	--	--	--	--	--
5	12 to 14	Stiff Clay w/o Free Water	--	--	125	2,920	--	0.005	--	--	--	--
6	14 to 19	Sand (Reese)	225	--	130	--	35	--	--	--	--	--
7	19 to 24	Sand (Reese)	225	--	125	--	34	--	--	--	--	--
8	24 to 29	Stiff Clay w/o Free Water	--	--	130	4,790	--	0.005	--	--	--	--
9	29 to 34	Stiff Clay w/o Free Water	--	--	130	4,920	--	0.005	--	--	--	--
10	34 to 35	Stiff Clay w/o Free Water	--	--	130	5,720	--	0.005	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D31.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for ADLS-2

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	SM	105	--	1,720	--	3.04	13	--	0	4,600
2	3 to 7	SM	128	35	--	--	3.69	32	3.1	350	8,700
3	7 to 9	SM	128	35	--	--	3.69	36	3.5	600	8,700
4	9 to 12	SM	128	35	--	--	3.69	28	2.7	600	8,700
5	12 to 14	CL	125	--	2,920	--	3.04	22	2.0	640	8,700
6	14 to 19	SM	130	35	--	--	3.69	37	3.6	840	14,300
7	19 to 24	SC	125	34	--	--	3.54	39	3.8	940	14,300
8	24 to 29	CL	130	--	4,790	--	3.04	36	2.7	900	14,300
9	29 to 34	ML	130	--	4,920	--	3.04	37	2.8	920	14,700
10	34 to 35	CL	130	--	5,720	--	3.04	43	3.0	1,030	17,100

Table D31.3 – Grout Anchor Design Parameters for ADLS-2

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	SM	--
2	3 to 7	SM	16
3	7 to 9	SM	17
4	9 to 12	SM	15
5	12 to 14	CL	10
6	14 to 19	SM	17
7	19 to 24	SC	17
8	24 to 29	CL	17
9	29 to 34	ML	17
10	34 to 35	CL	20

Notes: Design depth to groundwater is 35 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma' = \gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.

Table D32.1 – LPILE Computer Program Parameters for Lateral Load Analysis for O&M-1 Building

Soil Layer	Depth (feet)	LPILE Soil Type	K (pci)		γ'	C	ϕ	ε_{50}	E_{rm}	UCS	RQD	K_{rm}
			Static	Cyclic	(pcf)	(psf)	(degree)		(psi)	(psi)	(%)	
1*	0 to 3	Soft Clay (1)	--	--	105	790	--	0.01	--	--	--	--
2	3 to 7	Sand (Reese)	90	--	125	--	34	--	--	--	--	--
3	7 to 9	Sand (Reese)	25	--	120	--	30	--	--	--	--	--
4	9 to 12	Sand (Reese)	90	--	125	--	34	--	--	--	--	--
5	12 to 14	Sand (Reese)	225	--	120	--	35	--	--	--	--	--
6	14 to 18	Sand (Reese)	90	--	125	--	34	--	--	--	--	--
7	18 to 24	Sand (Reese)	125	--	63	--	35	--	--	--	--	--
8	24 to 29	Stiff Clay w/o Free Water	--	--	68	2,650	--	0.005	--	--	--	--
9	29 to 34	Stiff Clay w/o Free Water	--	--	67.6	2,790	--	0.005	--	--	--	--
10	34 to 35	Stiff Clay w/o Free Water	--	--	67.6	5,980	--	0.004	--	--	--	--

Notes: *Upper 3 feet of soil should be neglected due to seasonal moisture change.

Table D32.2 – Direct Embedment/Drilled Pier Foundation Design Parameters for O&M-1 Building

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	γ'	ϕ	C	C'_{Rock}	K_p	SPT N-Value	Deformation Modulus (ksi)	Allowable Unit Skin Friction (FS=2.5)[1] (psf)	Allowable Bearing Pressure (FS=3) (psf)
			(pcf)	(degree)	(psf)	(psf)		(blows/ft)			
1*	0 to 3	SC	105	--	790	--	3.04	6	--	0	1,700
2	3 to 7	SC	125	34	--	--	3.54	17	1.6	250	2,000
3	7 to 9	SC	120	30	--	--	3.00	5	0.5	210	2,000
4	9 to 12	SC	125	34	--	--	3.54	23	2.2	530	7,900
5	12 to 14	SP	120	35	--	--	3.69	50	4.9	860	7,900
6	14 to 18	SC	125	34	--	--	3.54	30	2.9	720	7,900
7	18 to 24	SC	63	35	--	--	3.69	42	4.1	950	7,900
8	24 to 29	CL	68	--	2,650	--	3.04	20	1.9	580	7,900
9	29 to 34	CL	67.6	--	2,790	--	3.04	21	1.9	610	8,300
10	34 to 35	CL	67.6	--	5,980	--	3.04	100	5.2	1,070	17,900

Table D32.3 – Grout Anchor Design Parameters for O&M-1 Building

Soil Layer	Depth (feet)	USCS Soil & Rock Classification	Ultimate Grout Bond Strength[2] (psi)
1*	0 to 3	SC	--
2	3 to 7	SC	12
3	7 to 9	SC	9
4	9 to 12	SC	13
5	12 to 14	SP	20
6	14 to 18	SC	15
7	18 to 24	SC	18
8	24 to 29	CL	9
9	29 to 34	CL	10
10	34 to 35	CL	21

Notes: Design depth to groundwater is 18 feet.

*Upper 3 feet of soils should be neglected due to seasonal moisture change; Kp: Rankine Passive Earth Pressure Coefficient; γ': Effective Unit Weight ($\gamma'=\gamma_{Total}$-62.4 pcf); ϕ: Angle of Internal Friction.

[1] For uplift resistance, the allowable skin friction provided in table above should be reduced by 25 percent.

[2] A minimum bond length of 10 feet in bedrock and 15 feet in soils is recommended. Estimated bond strength are for gravity grout anchors. RRC recommends grout anchor capacities be verified by pull-out test.