Appendix F

Geotechnical Evaluation of New ISFISI Pads

Geotechnical Evaluation Report

New ISFISI Pads
Xcel Energy – Prairie Island Nuclear Generating Plant
1717 Wakonade Drive
Welch, Minnesota

Prepared for

Xcel Energy Services, Inc.

Professional Certification:
I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Eric J. Dagenhardt, PE
Associate Director, Senior Engineer
License Number: 54281
November 27, 2024

ERIC J. DAGENHARDT
54281

Project B2403029

Braun Intertec Corporation

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November 27, 2024

Project B2403029

Ms. Amanda Jepson
Manager of Nuclear Strategic Regulatory Policy
Xcel Energy Services, Inc.
414 Nicollet Avenue, 7th Floor
Minneapolis, MN 55401

Re: Geotechnical Evaluation
New ISFISI Pads
Xcel Energy – Prairie Island Nuclear Generating Plant
1717 Wakonade Drive
Welch, Minnesota

Dear Ms. Jepson:

We are pleased to present this Geotechnical Evaluation Report for the new ISFSI pads at Xcel Energy's Prairie Island Nuclear Generating Plant in Welch, Minnesota.

Thank you for making Braun Intertec your geotechnical consultant for this project. If you have questions about this report, or if there are other services that we can provide in support of our work to date, please contact Eric Dagenhardt at 612.875.2053 (edagenhardt@braunintertec.com).

Sincerely,

BRAUN INTERTEC CORPORATION

Trey

Trey M. Krautkremer
Staff Engineer

Eric J.

Eric J. Dagenhardt, PE
Associate Director, Senior Engineer

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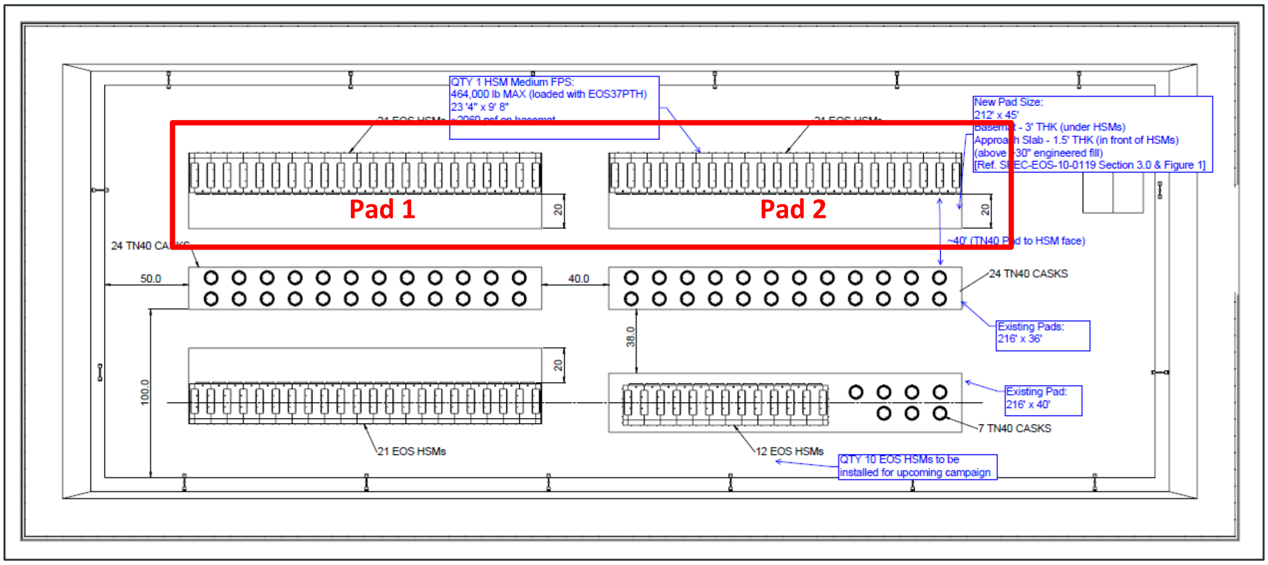
A. Introduction

A.1. Project Description

This Geotechnical Evaluation Report addresses the design and construction of two new Independent Spent Fuel Storage Installation (ISFSI) pads at Xcel Energy's Prairie Island Nuclear Generating Plant (PINGP) in Welch, Minnesota. These two new storage pads for spent fuel rods produced from plant operations are required for plant permitting.

These pads will support NUHOMS EOS Horizontal Storage Module (HSM) arrays. The ISFSI pads will be cast-in-place reinforced concrete mat (raft) slabs designed to meet site-specific HSM loading configurations which are typically 18 to 36 inches thick reinforced concrete on a prepared subgrade. A cast-in-place concrete approach slab, typically 12 to 18 inches thick will also be constructed adjacent to these pads to facilitate loading of the storage modules. Figure 1 presents the two northern ISFSI pads.

Figure 1. New ISFSI Pads



A.1.a. Expected ISFSI Pad Sizing

As presented above in Figure 1, both pads will measure 212 feet by 45 feet (including the 20-foot approach slab). The concrete basemat will be 3 feet thick and the concrete approach slab will be 1 1/2 feet thick. Pad sizing will be in accordance with the single array of modules Orano Specifications EOS-01-0119.

A.1.b. Expected ISFSI Pad Loading Conditions

Permanent loading conditions of each pad basemat with 21 installed EOS HSM storage units is approximately 2,060 pounds per square feet. Each EOS37PTH storage units have an approximate bearing surface of 23’4” by 9’8” and a weight of about 464,000 pounds. The approach slabs will be subject to intermediate live loading conditions from the transfer trailers and EOS transfer casks, and possibly the installation cranes. However, the approach slabs will have no long-term dead load applied to them.

A.1.c. Expected ISFSI Pad Section

Based on our review of the provided documents, we anticipate the following basemat and subgrade profile for each pad:

- 3 feet thick reinforced concrete mat (designed by others)
  *1 1/2 feet for the approach slab
- 3 feet thick MnDOT Class 5 (crushed limestone) aggregate base
- 2’6” (minimum) engineered fill consisting of poorly graded sand (SP) compacted to 100 percent of a standard Proctor
- Existing Alluvial sand soil subgrade (beginning approximately 8 1/2 feet below the top of the basemat)

A.2. Purpose

The purpose of our geotechnical evaluation is to characterize subsurface geologic conditions at selected exploration locations, evaluate their impact on the project, and provide geotechnical recommendations for the design and construction of the new northern ISFSI pads.

A.3. Background Information and Reference Documents

We reviewed the following information:

- A Preliminary Geotechnical Exploration Report performed by Haugo Geotechnical Services, dated November 10, 2014 (HGTS Project Number: 14-661) for previously designed and constructed ISFSI pads.

- A Summary of CPT Soundings letter prepared by Braun Intertec under project number B1806014, dated August 8, 2018.
- A Plate Load Test Results letter prepared by Braun Intertec under project number B2102952, dated August 17, 2021.
- South-East ISFSI Pad design plans and specifications sheets EC60100000444-NF (120914-C, 120920-1-C, 120946-C, 120947-C) and SK-PINGP-EC60100000444 (S-01, S-02, S-02-1).
- Braun Intertec materials testing results and observation reports for the South-East ISFSI Pad constructed in 2021.
- Orano Specifications EOS-01-0119 (Project number EOS01) for the NUHOMS EOS System Design of the ISFSI Basemat and Approach Slab, dated May 29, 2024.
- LOP Prairie Island ISFSI Proposed EOS Arrangement plans sheet prepared by Orano TN, with comments dated June 21, 2024.

We have described our understanding of the proposed construction and site to the extent others reported it to us. Depending on the extent of available information, we may have made assumptions based on our experience with similar projects. If we have not correctly recorded or interpreted the project details, the project team should notify us. New or changed information could require additional evaluation, analyses and/or recommendations.

A.4. Scope of Services

We performed our scope of services for the project in accordance with our Revised Proposal QTB193021 to Xcel Energy Services, Inc., dated March 18, 2024, and authorized under Purchase Order 4000034458 of our Master Services Agreement 13661 - Amendment 12, dated May 1, 2024. The following list describes the geotechnical tasks completed in accordance with our authorized scope of services.

- Reviewing the background information and reference documents previously cited.
- Performing ground penetrating radar prior to the advancement of the 6 feet deep archeological shovel tests at six locations (three per pad). The Hand Auger Probe Sketch included in the Appendix shows the approximate locations of these locations.

- Performing four hand auger probes during the hydrovac excavation operation, denoted as HAP-1 to HAP-4, to a nominal depth of 14 1/2 feet or refusal within the naturally deposited sands.

- Performing laboratory testing on select samples to aid in soil classification and engineering analysis.

- Perform engineering analysis including modeling the ISFSI pads to quantify settlement of the mat foundations when fully loaded.

- Preparing this report containing a hand auger probe location sketch, logs of hand auger probes, a summary of the soils encountered, results of laboratory tests, and recommendations for ISFSI basemat and approach slab subgrade preparation, utilities installation, and stormwater management.

Our scope of services did not include environmental services or testing and our geotechnical personnel performing this evaluation are not trained to provide environmental services or testing. We can provide environmental services or testing at your request.

B. Results

B.1. Geologic Overview

We based the geologic origins used in this report on the soil types, in-situ and laboratory testing, and available common knowledge of the geological history of the site. Because of the complex depositional history, geologic origins can be difficult to ascertain. We did not perform a detailed investigation of the geologic history for the site.

B.2. Previous Geotechnical Information (South-East and South-West Pads)

B.2.a. Haugo GeoTechnical Services Preliminary Geotechnical Evaluation

Haugo GeoTechnical Services performed soil borings and prepared a Preliminary Geotechnical Evaluation Report for the proposed storage facility and southern line of spent fuel rod pads within the ISFSI area. This report was dated November 10, 2014, under Haugo GeoTechnical Services project number 14-661. Soil borings ST-1, ST-5, and ST-9, found in the Appendix, were performed for these two pads.

The typical soil profile encountered in these three pad-specific soil borings consisted of an existing aggregate base layer consisting of crushed limestone measuring about 12 inches thick. Below this surficial aggregate base layer, a 12-inch layer of granular existing fill soils were encountered generally consisting of silty sand (SM). Below these surficial materials, naturally deposited alluvial sands were encountered to boring termination depth of 16 feet. These alluvial sands were layered and highly variable consisting of poorly graded sand (SP), poorly graded sand with silt (SP-SM) and silty sand. Penetration resistances recorded below the upper 6 feet which were augured by hand ranged from 3 to 26 blows per foot but were generally less than 8 blows per foot. These penetration resistances indicate the naturally deposited sands had a very loose to loose relative density. Groundwater was not encountered during these soil borings.

This report described the spent fuel rod storage pads to exert a uniform loading of 4,000 pounds per square feet (psf). It was recommended that the surficial aggregate base and existing fill be stripped from the new pad footprint and oversize zone to facilitate construction of the new pads. No additional subgrade preparation recommendations were provided in this evaluation and estimated settlement of the pads based on loading conditions was not provided.

B.2.b. Braun Intertec Seismic CPT Soundings

Braun Intertec performed a series of four (4) Seismic Cone Penetration Test (CPT) soundings within the ISFSI area for the southern pads in 2018. These four soundings, denoted as CPT-1 through CPT-4 were extended to depths ranging between approximate depths of 15 to 56 feet in accordance with ASTM D3740. Termination of each sounding occurred when 90 percent of the equipment maximum capacity was encountered, likely on gravel or cobbles/boulders. This factual report outlining the compression wave velocity and estimated Poisson’s ratio were provided to the Sargent and Lundy project team.

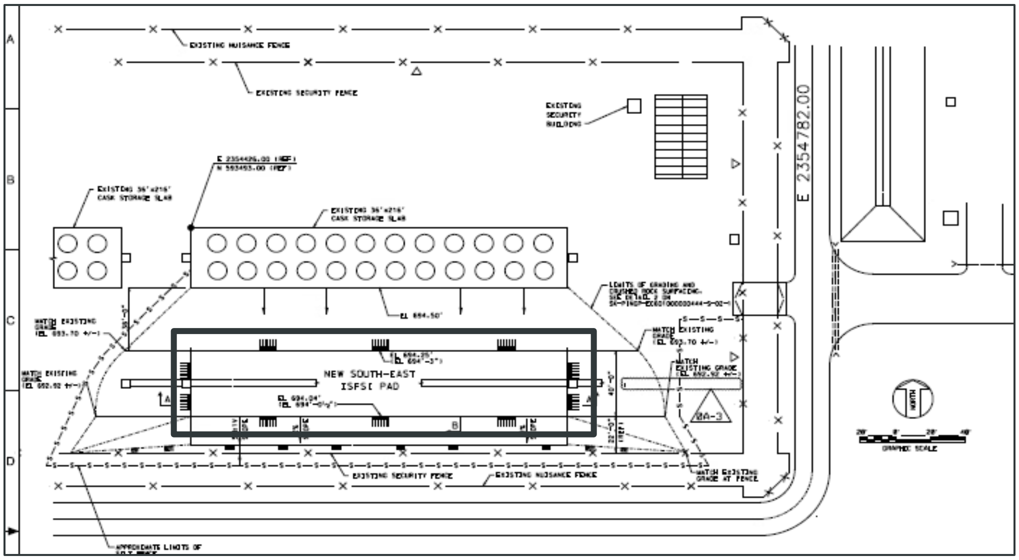
Specific to use for preparation of this evaluation, the naturally deposited soils between the depths of 8 feet (depth of the surface of the naturally deposited soils supporting these new pad basemats) to about 40 feet below grade typically ranged between 110 and 115 pounds per cubic foot. These estimated unit weights were determined from the soundings. As our hand auger probes were relatively shallow (extending up to 14 1/2 feet below grade), deeper unit weights from these 2018 soundings were used as a basis for the settlement calculations of the new pads.

This letter with subsequent CPT sounding data is found in the Appendix.

B.3. 2021 South-East ISFSI Pad Construction

Braun Intertec performed the construction materials testing services for construction of the southeastern most pad in 2021. Figure 2 below presents the location of this pad.

Figure 2. 2021 South-East ISFSI Pad



The pad subgrade was prepared in accordance with the referenced plans and specifications in Section A.3. Notable to this evaluation, a similar subgrade preparation is presented in Section C prior to placement of the aggregate base section and reinforced concrete mat foundation. As part of our testing services during construction of this South-East ISFSI pad, we performed plate loading in accordance with ASTM D1196. Our test results indicated a full range modulus of subgrade reaction, k, ranging from 320 to 333 pounds per square inch per inch (lb/in^2/in). The 1-3 KSF modulus of subgrade reaction ranged from 232 to 272 lb/in^2/in. These results validate our design recommendation for subgrade modulus in Section C.2.

This Plate Load Test Results letter is found in the Appendix.

B.4. Hand Auger Boring Results

Table 1 provides a summary of the hand auger probe results, in the general order we encountered the strata. Please refer to the Log of Hand Auger sheets in the Appendix for additional details. The Descriptive Terminology sheet in the Appendix includes definitions of abbreviations used in Table 1.

Table 1. Subsurface Profile Summary*

Strata	Soil Type - ASTM Classification	Commentary and Details
ISFSI Pad Surfacing	Aggregate Base	▪ Aggregate base material surfacing the ISFSI Pad area. ▪ Thickness not measured. ▪ The 2014 Haugo GeoTechnical Services soil borings indicate the aggregate base is crushed limestone.
Fill	SP, SP-SM, SM	▪ Based on previously performed soil borings, existing granular fill is expected to be in place below the surfacing aggregate base. ▪ Depth of this fill is unknown below these new pad areas as the upper 6 feet was removed prior to the hand auger borings as part of the archeological shovel tests. ▪ 2014 Haugo GeoTechnical Services soil borings ST-1, ST-5, and ST-9 encountered existing fill to a depth of two feet. ▪ Review of the “shovel test” stockpiles suggest the soils in the upper 6 feet generally consisted of poorly graded sand (SP) and poorly graded sand with silt (SP-SM). However, there were some shovel test stockpiles with silty sand (SM).
Alluvial	SP, SP-SM, SM,	▪ Hand Auger Probes HAP-1 through HAP-4 all began at a depth of 6 feet measured from the aggregate surfacing. ▪ Naturally deposited alluvial soils were encountered in the base of the “shovel test” holes. ▪ The alluvial soils were granular, typically classifying as poorly graded sand with silt (SP-SM) and silty sand (SM). Generally, the SP-SM sands overlay the SM sands. ▪ Moisture condition generally dry to moist. ▪ 2014 Haugo GeoTechnical Services soil borings ST-1, ST-5, and ST-9 recorded penetration resistances in the naturally deposited sands of 3 to 9 blows per foot (BPF) in the upper 15 feet indicating a very loose to loose relative density. With depth these penetration resistances and gravel content increase.

*Abbreviations defined in the attached Descriptive Terminology sheet.

We did not perform gradation analysis on the apparent aggregate base surfacing material within the ISFSI pad area encountered, in accordance with our scope of work. Therefore, we cannot conclusively determine if the encountered material satisfies a particular specification.

For simplicity in this report, we define existing fill to mean existing, uncontrolled or undocumented fill.

B.5. Groundwater

We did not observe groundwater while advancing our hand auger borings, nor was it encountered in the previous geotechnical evaluation performed by Haugo GeoTechnical Services. Therefore, it appears that groundwater is below the depths explored. Considering the granular nature of the naturally deposited soil profile and proximity to the Mississippi River, we anticipate the hydrostatic groundwater table within the ISFSI pad area to be near the river surface elevation.

Project planning should anticipate seasonal and annual fluctuations of groundwater, especially in relation to the Mississippi River level.

B.6. Laboratory Test Results

We performed a limited laboratory testing program on samples collected from the hand auger probes at depths below 6 feet which were removed prior to our arrival for the archeologic study. The Log of Hand Auger sheets in the Appendix show the results of the tests performed, next to the tested sample depth. Our laboratory testing focused on moisture content tests and mechanical analyses through a number 200 sieve to aid in classification of the alluvial sands.

C. Recommendations

C.1. Site Grading and Subgrade Preparation

C.1.a. ISFSI Pad Excavations

As presented in Section A.1.c, excavations to facilitate construction of the reinforced concrete basemat or approach slab overlaying an aggregate base layer and engineered granular fill section, are expected to remove unsuitable materials for support of the new pads. We define unsuitable materials as existing fill, frozen materials, organic soils, existing structures, existing utilities, vegetation, and soft or loose soils. The bottom of excavation is expected to be approximately 8 1/2 feet below existing grade. This excavation will expose the naturally deposited alluvial sands. While previously performed soil borings and the recent hand auger probes do not suggest excavations will extend deeper than required to construct the pads and their designed subgrade section, it is possible portions of the excavations may extend deeper. A geotechnical representative should observe the excavations to make the necessary field judgments regarding the suitability of the exposed soils.

To minimize settlement as the pads are loaded over time, we recommend thorough surface compaction of the exposed subgrade with a large vibratory compactor with a minimum dynamic force of 50,000 pounds. This may require use of a smooth-drum vibratory compactor with a minimum roller diameter of 3 1/2 feet. We recommend a minimum of five overlapping passes in each of the two perpendicular directions considering the naturally deposited soils have a very loose to loose relative density based on the penetration resistance tests performed in the 2014 Haugo GeoTechnical Services soil borings within the ISFSI area. This surface compaction operation will densify the upper 5 feet of the exposed alluvial sands to at least 95 percent of a modified Proctor (ASTM D1557).

C.1.b. Excavation Oversizing

The excavation for the pads (both basemat and approach slab footprints) should be oversized during construction. We recommend the excavation extend outward and downward at a slope of 1H:1V (horizontal:vertical) or flatter from the outside pad edges.

C.1.c. Excavated Slopes

Based on the borings, we anticipate on-site soils in excavations will be granular (sands). These soils are typically considered Type C Soil under OSHA (Occupational Safety and Health Administration) guidelines. OSHA guidelines indicate unsupported excavations in Type C soils should have a gradient no steeper than 1 1/2H:1V. Slopes constructed in this manner may still exhibit surface sloughing. OSHA requires an engineer to evaluate slopes or excavations over 20 feet in depth.

An OSHA-approved qualified person should review the soil classification in the field. Excavations must comply with the requirements of OSHA 29 CFR, Part 1926, Subpart P, “Excavations and Trenches.” This document states excavation safety is the responsibility of the contractor. The project specifications should reference these OSHA requirements.

C.1.d. Engineered Fill Materials and Compaction

We recommend all engineered fill placed within the excavation below the aggregate base layer consist of “free draining” coarse sand meeting the following requirements:

- 100 percent passing a 2-inch sieve
- 50 percent retained on a #40 sieve
- Less than 5 percent passing a #200 sieve

We recommend spreading engineered fill or the aggregate base in loose lifts of approximately 8 inches thick. We recommend compacting engineered fill to a minimum of 95 percent of a modified Proctor (ASTM D 1557) maintaining moisture content within +/- 2 percent of optimum.

The project documents should not allow the contractor to use frozen material as engineered fill or to place engineered fill on frozen material. Frost should not penetrate under foundations during construction.

We recommend performing density tests in engineered fill to evaluate if the contractors are effectively compacting the soil and meeting project requirements.

C.1.e. Plate Load Testing

Following completion of preparation of the subgrade, we recommend plate load testing be performed in at least two locations per pad. Testing should be performed in accordance with ASTM D1196. This testing should be performed to validate the modulus of subgrade preparation under loading conditions selected by the foundation designer.

C.2. ISFSI Pad – Mat Foundations

These basemats and approach slabs are mat or “raft” foundations. Determining the subgrade modulus below a mat foundation is complicated due to the interaction between the mat and the soil. A single value is used for the mat even if the soil conditions are variable. Based on NAVFAC Design Manual 7.02, which uses values for a 1-foot square plate, we recommend a using a modulus of subgrade reaction (K_{v1}) of 225 pounds per square inch/inch (psi/inch) to evaluated shear and bending moments. Unless the value is modified by the design software, the value used for design should be modified based on the following equation:

$$K_b = K_{v1}\left(\frac{b+1}{2b}\right)^2$$

Where:
K_b = design value (pci)
b = footing width (feet)
K_{v1} = modulus of subgrade reaction (psi/in)

This design modulus of subgrade represents the engineered granular fill and surface compacted alluvial sand subgrade and does not incorporate the aggregate base section below the concrete mat.

C.2.a. Settlement

We understand that each basemat foundation will support approximately 9,750 kips between the 21 storage units. Considering the thickness of the mat foundation and underlying aggregate base section, a net bearing pressure of about 3,000 psf on the supporting soil. We estimate that this stress will induce total and differential settlements in the underlying soils on the order of 1 2/3 and 1 inches, respectively.

Total settlement was modeled for the pads using parameters presented in Sections A.1.a, A.1.b, and A.1.c using PLAXIS 3D. The modeling deformed shape, contour, and section detail are presented in the Appendix. Maximum settlement was calculated to be 0.1397 feet (1.67 inches) following full loading of the spent fuel rod storage units on each basemat. As each horizontal storage module is added (final dead load), settlement will increase towards that maximum value. Consideration should be given to minimizing differential settlement during placement of the storage modules.

C.2.b. Sliding Resistance

The mat foundation may be subjected to lateral sliding forces. We recommend the mat be designed with a coefficient of sliding friction of 0.35. This value does not include a factor of safety.

C.3. Utilities

C.3.a. Subgrade Stabilization

For exterior utilities, we anticipate the soils at typical invert elevations will be suitable for utility support. However, if construction encounters unfavorable conditions such as debris laden existing fill, soft clay, organic soils or perched water at invert grades, the unsuitable soils may require some additional subcutting and replacement with sand or crushed rock to prepare a proper subgrade for pipe support. Project design and construction should not place utilities within the 1H:1V oversizing of the new pads unless designed to be within designed duct banks.

C.3.b. Corrosion Potential

The hand auger probes indicated the site predominantly consists of sandy soils. We consider these soils non- to slightly corrosive to metallic conduits. If utilities extend through clay soils, we recommend bedding the utilities in sandy soil free of any clay lumps or constructing the utilities with non-corrosive materials.

C.4. Stormwater

Recommendations for stormwater management features was not a part of our scope of services. However, based on experience within the ISFSI pad area, it is expected that stormwater will be managed through infiltration within the aggregate base surfacing around the pads as water sheds across the pad surfaces.

We estimated infiltration rates for some of the soils we encountered in our soil borings, as listed in Table 2. These infiltration rates represent the long-term infiltration capacity of a practice and not the capacity of the soils in their natural state. Field testing, such as with a double-ring infiltrometer (ASTM D3385), may justify the use of higher infiltration rates. However, we recommend adjusting field test rates by the appropriate correction factor, as provided for in the Minnesota Stormwater Manual or as allowed by the local watershed. We recommend consulting the Minnesota Stormwater Manual for stormwater design.

Table 2. Estimated Design Infiltration Rates Based on Soil Classification

Soil Type	**Infiltration Rate * (inches/hour)**
Gravels and gravelly sands (Aggregate Base Layer)	1.63
Sands with less than 12% fines, poorly graded or well graded sands	0.8
Silty sands, silty gravelly sands	0.45

* From Minnesota Stormwater Manual. Rates may differ at individual sites.

This geotechnical evaluation does not constitute a review of site suitability for stormwater infiltration or evaluate the potential impacts, if any, from infiltration of large amounts of stormwater.

D. Procedures

D.1. Manual Exploration

D.1.a. Hand Auger Borings

Prairie Island Nuclear Generating Facility procedures did not allow for extending soil borings within the ISFSI area. Therefore, we drilled hand auger borings with a 3-inch-diameter bucket auger. We advanced these borings in 4-inch increments periodically as the borehole was advanced by hydrovac equipment. These borings began at a depth of 6 feet within the open borehole hand dug during the archeological “shovel tests” and extended to depths of 13 to 14 1/2 feet below existing grade. During advancement of the hand auger probes, we withdrew the auger from the borehole to obtain cuttings for visual classification. We made preliminary estimates of soil consistency and density based on resistance to penetration of the hand auger and the turning resistance.

D.2. Exploration Logs

D.2.a. Log of Hand Auger Sheets

The Appendix includes Log of Hand Auger sheets for our hand auger borings. The logs identify and describe the penetrated geologic materials. The logs also present the results of laboratory tests performed on auger cutting test samples and groundwater measurements.

We inferred strata boundaries from changes in the auger cuttings. Because we did not perform continuous sampling, the strata boundary depths are only approximate. The boundary depths likely vary away from the boring locations, and the boundaries themselves may occur as gradual rather than abrupt transitions.

D.2.b. Geologic Origins

We assigned geologic origins to the materials shown on the logs and referenced within this report, based on: (1) a review of the background information and reference documents cited above, (2) visual classification of the various geologic material samples retrieved during the course of our subsurface exploration, (3) penetration resistance and other in-situ testing performed within the ISFSI area from previous geotechnical evaluations, (4) laboratory test results, and (5) available common knowledge of the geologic processes and environments that have impacted the site and surrounding area in the past.

D.3. Material Classification and Testing

D.3.a. Visual and Manual Classification

We visually and manually classified the geologic materials encountered based on ASTM D2488. When we performed laboratory classification tests, we used the results to classify the geologic materials in accordance with ASTM D2487. The Appendix includes a chart explaining the classification system we used.

D.3.b. Laboratory Testing

The exploration logs in the Appendix note most of the results of the laboratory tests performed on geologic material samples. The remaining laboratory test results follow the exploration logs. We performed the tests in general accordance with ASTM procedures.

D.4. Groundwater Measurements

Our engineer checked for groundwater while advancing the hand auger borings. Following completion of the hand auger probes, the open borehole was observed to be dry. The borehole was filled with cuttings by the assisting contractor who provided hydrovac services.

E. Qualifications

E.1. Variations in Subsurface Conditions

E.1.a. Material Strata

We developed our evaluation, analyses and recommendations from a limited amount of site and subsurface information. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth. Therefore, we must infer strata boundaries and thicknesses to some extent. Strata boundaries may also be gradual transitions, and project planning should expect the strata to vary in depth, elevation and thickness, away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until performing additional exploration work or starting construction. If future activity for this project reveals any such variations, you should notify us so that we may reevaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.

E.1.b. Groundwater Levels

We made groundwater measurements under the conditions reported herein and shown on the exploration logs and interpreted in the text of this report. Note that the observation periods were relatively short, and project planning can expect groundwater levels to fluctuate in response to rainfall, flooding, irrigation, seasonal freezing and thawing, surface drainage modifications and other seasonal and annual factors.

E.2. Continuity of Professional Responsibility

E.2.a. Plan Review

We based this report on a limited amount of information, and we made a number of assumptions to help us develop our recommendations. We should be retained to review the geotechnical aspects of the designs and specifications. This review will allow us to evaluate whether we anticipated the design correctly, if any design changes affect the validity of our recommendations, and if the design and specifications correctly interpret and implement our recommendations.

E.2.b. Construction Observations and Testing

We recommend retaining us to perform the required observations and testing during construction as part of the ongoing geotechnical evaluation. This will allow us to correlate the subsurface conditions exposed during construction with those encountered by the borings and provide professional continuity from the design phase to the construction phase. If we do not perform observations and testing during construction, it becomes the responsibility of others to validate the assumption made during the preparation of this report and to accept the construction-related geotechnical engineer-of-record responsibilities.

E.3. Use of Report

This report is for the exclusive use of the addressed parties. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses and recommendations may not be appropriate for other parties or projects.

E.4. Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

Appendix


HAP-1
HAP-2
HAP-3
HAP-4

LOG OF HAND AUGER

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2403029
Geotechnical Evaluation
PINGP - ISFSI Pad Geotechnical Evaluation
1717 Wakonade Drive
Welch, Minnesota

HAND AUGER:	**HAP-1**		
LOCATION: See attached sketch			
DATUM:			
NORTHING:		EASTING:	
OPERATOR: Westinghouse	LOGGED BY: E. Dagenhardt	START DATE: 04/16/24	END DATE: 04/16/24
SURFACE ELEVATION: 693.0 ft	METHOD: Hand Auger	SURFACING:	WEATHER: Overcast, 50°

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
		Upper 6 feet removed from prior shovel test holes to approximate elevation 687					Approximate surface elevation at 693
687.0 6.0		POORLY GRADED SAND with SILT (SP-SM), fine to medium-grained, brown, moist (ALLUVIUM)	⧖ ⧖			9	P200=11%
682.0 11.0		SILTY SAND (SM), fine to medium-grained, brown, moist (ALLUVIUM) *With Gravel at 13 1/2 feet*	⧖			12	P200=15%
678.5 14.5		END OF HAND AUGER					Water not observed while augering. Hydrovac between sample intervals.

LOG OF HAND AUGER

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2403029
Geotechnical Evaluation
PINGP - ISFSI Pad Geotechnical Evaluation
1717 Wakonade Drive
Welch, Minnesota

HAND AUGER:	**HAP-2**		
LOCATION: See attached sketch			
DATUM:			
NORTHING:		EASTING:	
OPERATOR:	Westinghouse	LOGGED BY:	E. Dagenhardt
START DATE:	04/16/24	END DATE:	04/16/24
SURFACE ELEVATION:	693.0 ft	METHOD:	Hand Auger
SURFACING:		WEATHER:	Overcast, 50°

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
		Upper 6 feet removed from prior shovel test holes to approximate elevation 687					Approximate surface elevation at 693
		5					
687.0 6.0		POORLY GRADED SAND with SILT (SP-SM), fine-grained, brown, moist (ALLUVIUM)	⧗				
		With Gravel at 9 1/2 feet	⧗			12	P200=7%
		10					
682.0 11.0		SILTY SAND (SM), fine-grained, brown, moist (ALLUVIUM)					
			⧗			12	P200=17%
678.5 14.5		END OF HAND AUGER					Water not observed while augering.
		15					Hydrovac between sample intervals.

LOG OF HAND AUGER

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2403029
Geotechnical Evaluation
PINGP - ISFSI Pad Geotechnical Evaluation
1717 Wakonade Drive
Welch, Minnesota

HAND AUGER:	**HAP-3**		
LOCATION: See attached sketch			
DATUM:			
NORTHING:		EASTING:	
OPERATOR:	Westinghouse	LOGGED BY:	E. Dagenhardt
START DATE:	04/16/24	END DATE:	04/16/24
SURFACE ELEVATION:	693.0 ft	METHOD:	Hand Auger
SURFACING:		WEATHER:	Overcast, 50°

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487)	Sample	Sample Blows Recovery	q_p tsf	MC %	Tests or Remarks
		Upper 6 feet removed from prior shovel test holes to approximate elevation 687					Approximate surface elevation at 693
687.0 6.0		SILTY SAND (SM), fine to medium-grained, brown, moist (ALLUVIUM)	⧖			14	P200=15%
684.0 9.0		POORLY GRADED SAND (SP), fine to medium-grained, with Gravel, brown, moist (ALLUVIUM)	⧖			9	P200=5%
681.0 12.0		SILTY SAND (SM), fine to medium-grained, brown, moist (ALLUVIUM)	⧖ ⧖			14	P200=14%
678.5 14.5		END OF HAND AUGER					Water not observed while augering. Hydrovac between sample intervals.

LOG OF HAND AUGER

See Descriptive Terminology sheet for explanation of abbreviations

Project Number B2403029
Geotechnical Evaluation
PINGP - ISFSI Pad Geotechnical Evaluation
1717 Wakonade Drive
Welch, Minnesota

HAND AUGER: **HAP-4**
LOCATION: See attached sketch
DATUM:
NORTHING:
EASTING:
OPERATOR: Westinghouse
LOGGED BY: E. Dagenhardt
START DATE: 04/16/24
END DATE: 04/16/24
SURFACE ELEVATION: 693.0 ft
METHOD: Hand Auger
SURFACING:
WEATHER: Overcast, 50°

Elev./ Depth ft	Water Level	Description of Materials (Soil-ASTM D2488 or 2487)	Sample	Sample Blows Recovery	qp tsf	MC %	Tests or Remarks
		Upper 6 feet removed from prior shovel test holes to approximate elevation 687					Approximate surface elevation at 693
687.0 6.0		POORLY GRADED SAND (SP), fine-grained, brown, moist (ALLUVIUM)	☒			8	P200=5%
684.0 9.0		POORLY GRADED SAND with SILT (SP-SM), fine to medium-grained, with Gravel, brown, moist (ALLUVIUM)	☒				
682.0 11.0		SILTY SAND (SM), fine to medium-grained, brown, moist (ALLUVIUM)	☒			12	P200=13%
680.0 13.0		END OF HAND AUGER					Water not observed while augering. Hydrovac between sample intervals. Hand auger terminated at 13 feet due to equipment malfunction.

Descriptive Terminology of Soil

Based on Standards ASTM D2487/2488
(Unified Soil Classification System)

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

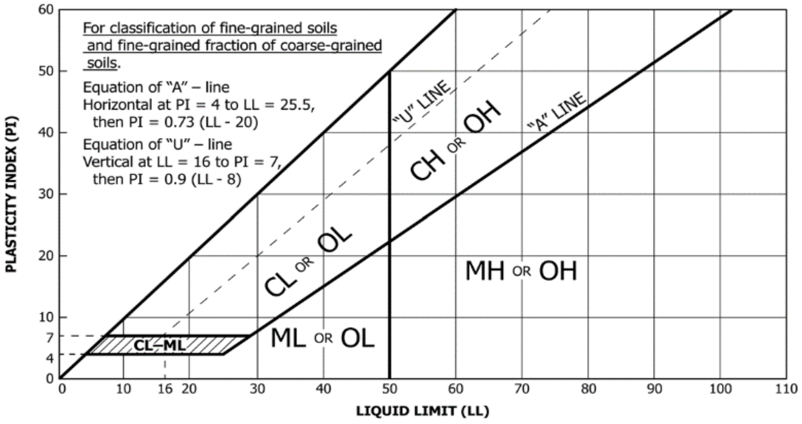
A. Based on the material passing the 3-inch (75-mm) sieve.
B. If field sample contained cobbles or boulders, or both, add "with cobbles or boulders, or both" to group name.
C. Gravels with 5 to 12% fines require dual symbols:

GW-GM	well-graded gravel with silt
GW-GC	well-graded gravel with clay
GP-GM	poorly graded gravel with silt
GP-GC	poorly graded gravel with clay

D. $C_u = D_{60} / D_{10}$ $C_c = (D_{30})^2 / (D_{10}\ x\ D_{60})$
E. If soil contains ≥ 15% sand, add "with sand" to group name.
F. If fines classify as CL-ML, use dual symbol GC-GM or SC-SM.
G. If fines are organic, add "with organic fines" to group name.
H. Sands with 5 to 12% fines require dual symbols:

SW-SM	well-graded sand with silt
SW-SC	well-graded sand with clay
SP-SM	poorly graded sand with silt
SP-SC	poorly graded sand with clay

I. If soil contains ≥ 15% gravel, add "with gravel" to group name.
J. If Atterberg limits plot in hatched area, soil is CL-ML, silty clay.
K. If soil contains 15 to < 30% plus No. 200, add "with sand" or "with gravel", whichever is predominant.
L. If soil contains ≥ 30% plus No. 200, predominantly sand, add "sandy" to group name.
M. If soil contains ≥ 30% plus No. 200 predominantly gravel, add "gravelly" to group name.
N. PI ≥ 4 and plots on or above "A" line.
O. PI < 4 or plots below "A" line.
P. PI plots on or above "A" line.
Q. PI plots below "A" line.



Laboratory Tests

DD	Dry density, pcf	**q_p**	Pocket penetrometer strength, tsf
WD	Wet density, pcf	**q_U**	Unconfined compression test, tsf
P200	% Passing #200 sieve	**LL**	Liquid limit
MC	Moisture content, %	**PL**	Plastic limit
OC	Organic content, %	**PI**	Plasticity index

Particle Size Identification

Boulders	over 12"
Cobbles	3" to 12"
Gravel	
Coarse	3/4" to 3" (19.00 mm to 75.00 mm)
Fine	No. 4 to 3/4" (4.75 mm to 19.00 mm)
Sand	
Coarse	No. 10 to No. 4 (2.00 mm to 4.75 mm)
Medium	No. 40 to No. 10 (0.425 mm to 2.00 mm)
Fine	No. 200 to No. 40 (0.075 mm to 0.425 mm)
Silt	No. 200 (0.075 mm) to .005 mm
Clay	< .005 mm

Relative Proportions[L, M]

trace	0 to 5%
little	6 to 14%
with	≥ 15%

Inclusion Thicknesses

lens	0 to 1/8"
seam	1/8" to 1"
layer	over 1"

Apparent Relative Density of Cohesionless Soils

Very loose	0 to 4 BPF
Loose	5 to 10 BPF
Medium dense	11 to 30 BPF
Dense	31 to 50 BPF
Very dense	over 50 BPF

Consistency of Cohesive Soils	**Blows Per Foot**	**Approximate Unconfined Compressive Strength**
Very soft	0 to 1 BPF	< 0.25 tsf
Soft	2 to 4 BPF	0.25 to 0.5 tsf
Medium	5 to 8 BPF	0.5 to 1 tsf
Stiff	9 to 15 BPF	1 to 2 tsf
Very Stiff	16 to 30 BPF	2 to 4 tsf
Hard	over 30 BPF	> 4 tsf

Moisture Content:

Dry: Absence of moisture, dusty, dry to the touch.
Moist: Damp but no visible water.
Wet: Visible free water, usually soil is below water table.

Drilling Notes:

Blows/N-value: Blows indicate the driving resistance recorded for each 6-inch interval. The reported N-value is the blows per foot recorded by summing the second and third interval in accordance with the Standard Penetration Test, ASTM D1586.

Partial Penetration: If the sampler could not be driven through a full 6-inch interval, the number of blows for that partial penetration is shown as #/x" (i.e. 50/2"). The N-value is reported as "REF" indicating refusal.

Recovery: Indicates the inches of sample recovered from the sampled interval. For a standard penetration test, full recovery is 18", and is 24" for a thinwall/shelby tube sample.

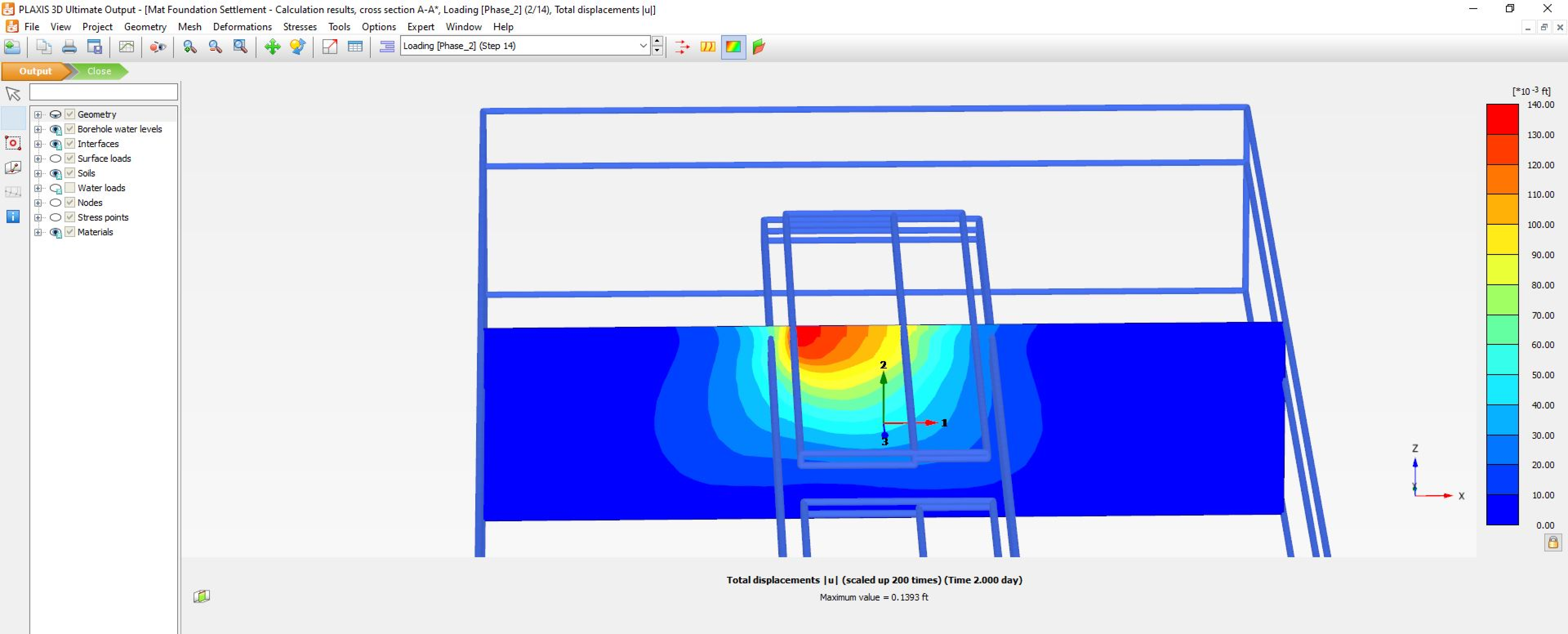
WOH: Indicates the sampler penetrated soil under weight of hammer and rods alone; driving not required.

WOR: Indicates the sampler penetrated soil under weight of rods alone; hammer weight and driving not required.

Water Level: Indicates the water level measured by the drillers either while drilling (▽), at the end of drilling (▼), or at some time after drilling (▼).

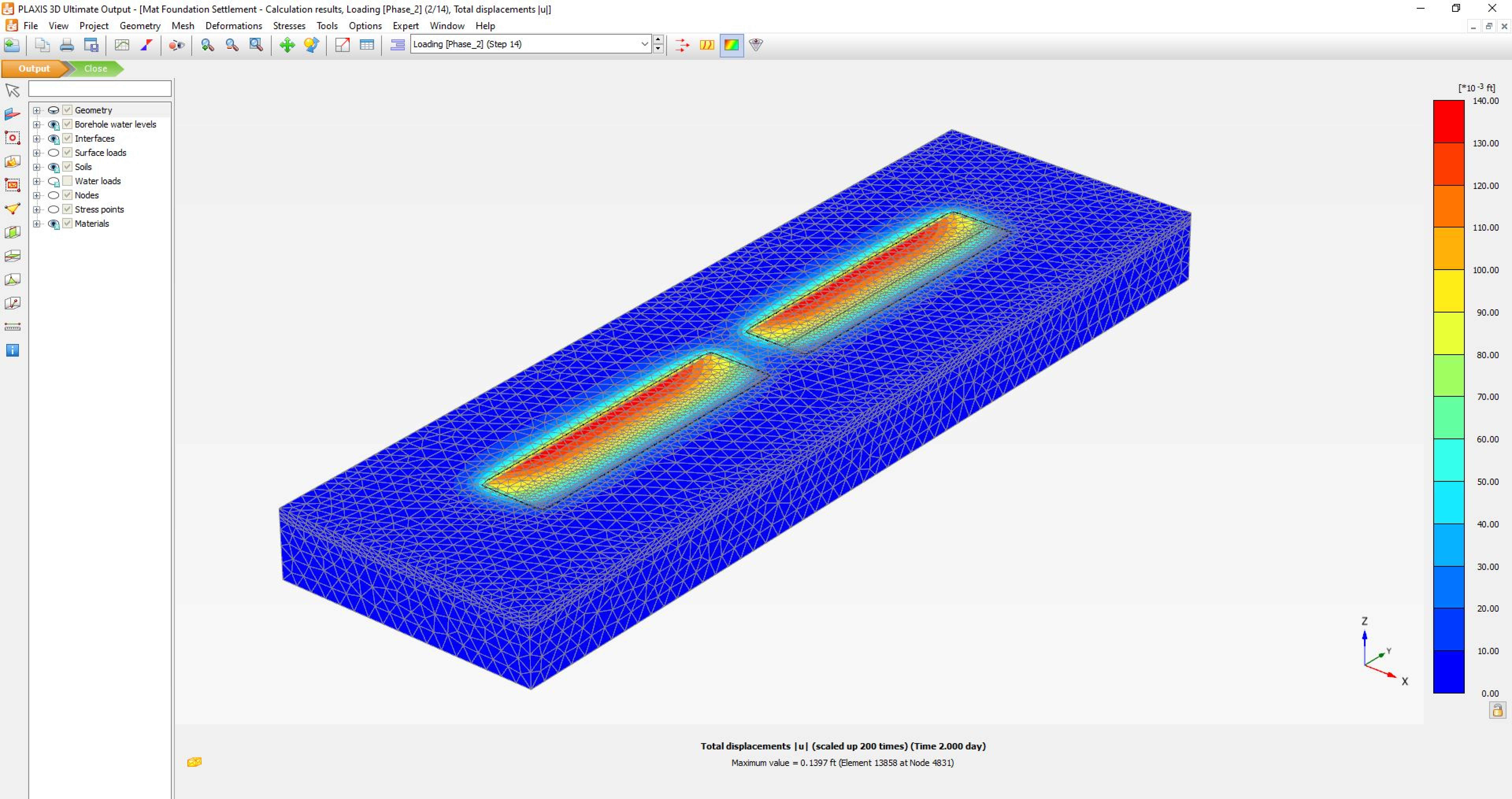
Sample Symbols

☒	Standard Penetration Test	▮	Rock Core
⧗	Modified California (MC)	■	Thinwall (TW)/Shelby Tube (SH)
⬇	Auger	▽	Texas Cone Penetrometer
✋	Grab Sample	▽	Dynamic Cone Penetrometer



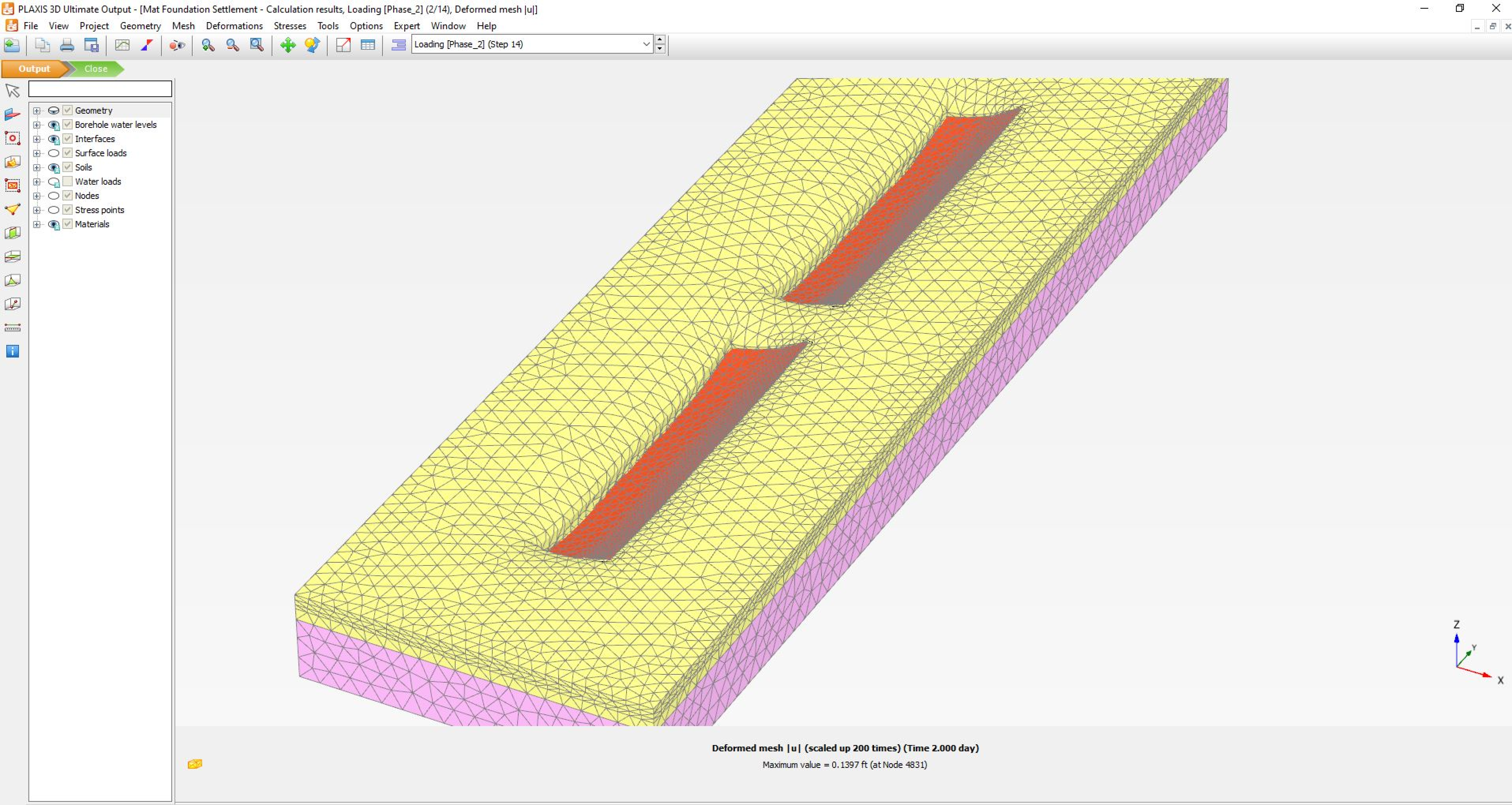
Total displacements |u| (scaled up 200 times) (Time 2.000 day)

Maximum value = 0.1393 ft



Total displacements |u| (scaled up 200 times) (Time 2.000 day)

Maximum value = 0.1397 ft (Element 13858 at Node 4831)



Deformed mesh |u| (scaled up 200 times) (Time 2.000 day)

Maximum value = 0.1397 ft (at Node 4831)

⊕ = Approximate Boring Location

Haugo GeoTechnical Services.
2825 Cedar Avenue S
Minneapolis, MN 55407

Soil Boring Location Sketch
Proposed ISFSI Expansion
Welch, Minnesota

N
W E
S

Figure #: 1
Drawn By: CP
Date: 10/29/14
Scale: None
HGTS Project #: 14-661

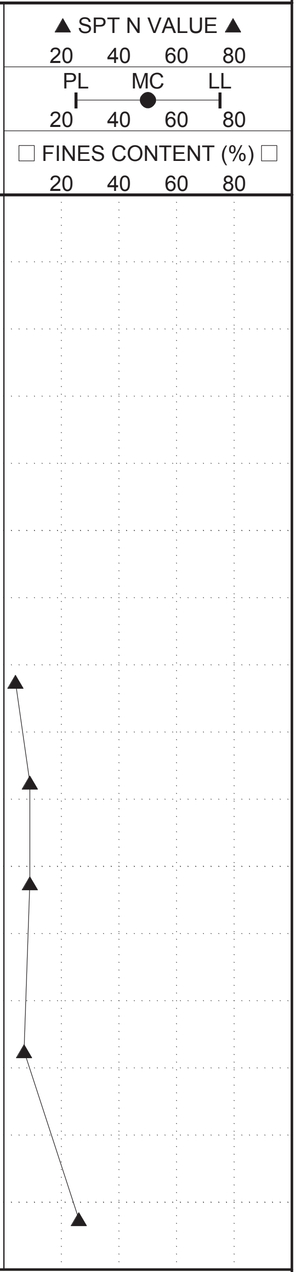
Haugo GeoTechnical Services
2825 Cedar Avenue S
Minneapolis, MN 55407

BORING NUMBER ST-1

PAGE 1 OF 1

CLIENT Xcel Energy
PROJECT NAME ISFSI Archeological Support Upgrade
PROJECT NUMBER 14-661
PROJECT LOCATION Welch, Minnesota
DATE STARTED 9/23/14 **COMPLETED** 9/23/14
GROUND ELEVATION 693 ft MSL **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY CP **CHECKED BY** PG
AT END OF DRILLING --- Not Encountered
NOTES Surface Elevation Approximate
AFTER DRILLING --- Not Encountered at Cave-In of 13 Feet

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		Aggregate Base, Crushed Limestone, possible MnDot Class 5. (FILL)	AU				
			AU				
		(SP-SM) Poorly Graded Sand with Silt, fine grained, brown, damp. (Possible Fill)	AU				
			AU				
		(SP-SM) Poorly Graded Sand with Silt, fine grained, brown, moist. (Alluvium)	AU				
			AU				
			AU				
			AU				
			AU				
			AU				
5		(SP) Poorly Graded Sand, fine grained, brown, moist, very loose. (Alluvium)	AU				
			AU				
			AU				
			SS 2		2-2-2 (4)		
		(SP-SM) Poorly Graded Sand with Silt, fine grained, brown, moist, loose. (Alluvium)	SS 3		6-4-5 (9)		
10			SS 4		4-4-5 (9)		
			SS 5		3-4-3 (7)		
		(SP) Poorly Graded Sand, fine to medium grained, brown, moist, medium dense. (Alluvium)					
15			SS 6		7-12-14 (26)		



Bottom of borehole at 16.0 feet.

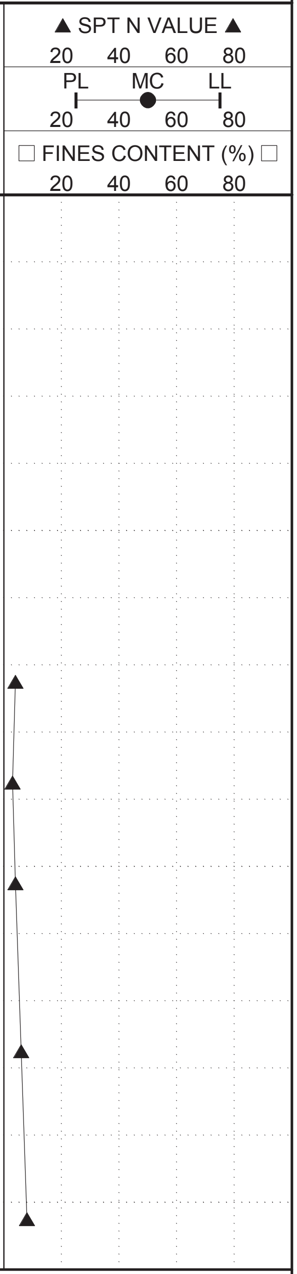
Haugo GeoTechnical Services
2825 Cedar Avenue S
Minneapolis, MN 55407

BORING NUMBER ST-5

PAGE 1 OF 1

CLIENT Xcel Energy
PROJECT NAME ISFSI Archeological Support Upgrade
PROJECT NUMBER 14-661
PROJECT LOCATION Welch, Minnesota
DATE STARTED 9/23/14 **COMPLETED** 9/23/14
GROUND ELEVATION 693 ft MSL **HOLE SIZE** 3 1/4 inches
DRILLING CONTRACTOR HGTS
GROUND WATER LEVELS:
DRILLING METHOD Hollow Stem Auger/Split Spoon
AT TIME OF DRILLING --- Not Encountered
LOGGED BY CP **CHECKED BY** PG
AT END OF DRILLING --- Not Encountered
NOTES Surface Elevation Approximate
AFTER DRILLING --- Not Encountered at Cave-In of 12.5 Feet

DEPTH (ft)	GRAPHIC LOG	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0		Aggregate Base, Crushed Limestone, possible MnDot Class 5. (FILL)	AU				
			AU				
		(SM) Silty Sand, fine grained, brown, moist. (Possible FILL)	AU				
			AU				
		(SM) Silty Sand, fine grained, brown, moist, very loose to loose. (Alluvium)	AU				
			AU				
			AU				
			AU				
			AU				
			AU				
5			AU				
			AU				
			AU				
			SS 8		2-2-2 (4)		
			SS 9		2-1-2 (3)		
10			SS 10		2-2-2 (4)		
			SS 11		2-3-3 (6)		
		(SP-SM) Poorly Graded Sand with Silt, mostly fine grained, brown, moist, loose. (Alluvium)					
15			SS 12		3-4-4 (8)		



Bottom of borehole at 16.0 feet.

Haugo GeoTechnical Services
2825 Cedar Avenue S
Minneapolis, MN 55407

BORING NUMBER ST-9

PAGE 1 OF 1

CLIENT Xcel Energy

PROJECT NAME ISFSI Archeological Support Upgrade

PROJECT NUMBER 14-661

PROJECT LOCATION Welch, Minnesota

DATE STARTED 9/23/14 **COMPLETED** 9/23/14

GROUND ELEVATION 693 ft MSL **HOLE SIZE** 3 1/4 inches

DRILLING CONTRACTOR HGTS

GROUND WATER LEVELS:

DRILLING METHOD Hollow Stem Auger/Split Spoon

AT TIME OF DRILLING --- Not Encountered

LOGGED BY CP **CHECKED BY** PG

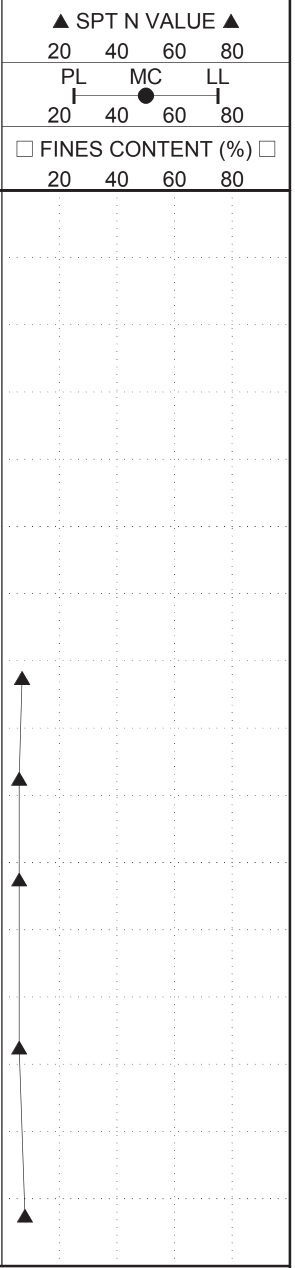
AT END OF DRILLING --- Not Encountered

NOTES Surface Elevation Approximate

AFTER DRILLING --- Not Encountered at Cave-In of 13 Feet

DEPTH (ft)	MATERIAL DESCRIPTION	SAMPLE TYPE NUMBER	RECOVERY % (RQD)	BLOW COUNTS (N VALUE)	POCKET PEN. (tsf)	DRY UNIT WT. (pcf)
0	Aggregate Base, Crushed Limestone, possible MnDot Class 5. (FILL)	AU				
		AU				
	(SM) Silty Sand, fine grained, brown, moist. (FILL)	AU				
		AU				
	(SM) Silty Sand, fine grained, brown, moist, loose. (Alluvium)	AU				
		AU				
		AU				
		AU				
		AU				
		AU				
5		AU				
		AU				
		AU				
		SS 14		3-4-3 (7)		
		SS 15		3-3-3 (6)		
10		SS 16		3-3-3 (6)		
	(SM) Silty Sand, fine grained, dark brown, moist, loose. (Alluvium)	SS 17		3-3-3 (6)		
	(SP) Poorly Graded Sand, fine to coarse grained, trace Gravel, brown, moist, loose. (Alluvium)					
15		SS 18		2-4-4 (8)		

Bottom of borehole at 16.0 feet.



BRAUN INTERTEC
The Science You Build On.

Braun Intertec Corporation
1826 Buerkle Road
Saint Paul, MN 55110

Phone: 651.487.3245
Fax: 651.487.1812
Web: braunintertec.com

August 8, 2018 Project B1806014

Mr. Gregory M. Peebles
Program Manager
Sargent & Lundy – Mailcode 25X50
55 E. Monroe Street
Chicago, IL 60603-5780

Re: Summary of CPT Soundings
Prairie Island ISFSI Expansion
1717 Wakonade Drive
Welch, Minnesota

Dear Mr. Reyes:

This letter serves to summarize geotechnical services provided by Braun Intertec Corporation as part of Prairie Island ISFSI Expansion Geotechnical Investigation.

Background

We received written authorization for this project on June 15, 2018 in the form of Purchase Order 37234 received from Sargent & Lundy, LLC. Our authorized scope of services included performing a series of 4 Seismic Cone Penetration Test (CPT) soundings. The initial schedule of quantities included 425 feet of CPT soundings with anticipated termination depths of 100 to 125 feet below the ground surface. Our investigation was performed in accordance with ASTM D3740.

Field Procedures

Field procedures for this project were completed on July 11, 2018. Sounding locations were staked in the field by Braun personnel prior to the arrival of our testing equipment. Additional discussion of the CPT sounding procedures is provided below.

CPT Soundings: CPT soundings for this project were performed using designated push equipment manufactured by A.P. van den Berg. The rig is mounted on a rubber-tracked Marooka carrier and is capable of generating 15 tons of reaction force. CPT soundings were performed using an A.P. van den Berg icone (60 degree cone apex and 15 square centimeter tip area) with porous stones mounted in the U_2 position. The serial number of the icone used for these soundings is 170717, as noted in the attached CPT sounding logs and on the attached icone calibration record.

A new porous stone was used for each sounding and was fully saturated with silicone oil. Tip resistance (Q_t), sleeve friction (F_S) and pore pressure (U_2) were measured continuously as the probe was advanced. Seismic testing was performed at 1 meter intervals and we obtained shear wave (S-wave) and compressive wave (P-wave) data in general accordance with procedures described in ASTM D5778 and D7400 at all 4 CPT locations.

The shear wave velocity (V_s) and compression wave velocity (V_p) was estimated based on the wave arrival times to the A.P. van den Berg geophone module attached to our icone. We used the software suites CPeT-IT and SPAS by Geologismiki to reduce the data and produce the graphical CPT logs and seismic wave plots. Note that P-wave data obtained below groundwater, about 12 feet below the ground surface, is included in the attached graphical representation of the wave forms but is unreliable due to the compression waves propagating at a very high velocity through the water and less through the soil matrix. A summary of our wave velocity profiles is attached. The banded results on the attached wave velocity profiles indicate the maximum and minimum values measured from independently analyzing the arrival times from the shear wave source on the right and left side. The line in the center and the values presented are the average of the two values at each test depth. A tighter band around the data indicates less variability in the estimated V_s results.

Shallow refusal of the cone was encountered at every sounding location locations due to apparent dense soil layers or other obstructions. We terminated each sounding when our equipment reached 90 percent of its maximum capacity.

Table 1: CPT Summary

Sounding Name	Sounding Depth (ft)*	Comments	Seismic Test Depths (ft)
CPT-1	55.91	The Vs data collected at 7.5 feet appears anomalous. This could be due to the interface of the recompacted soil in the predrilled borehole.	7.5, 9.2, 12.3, 15.5, 18.6, 22.2, 25.5, 28.7, 32.1, 35.5, 38.6, 42, 45.3, 48.8, 51.9, 53.3, 55.9
CPT-2	14.76	This location was offset 7 feet north of the original testing location.	7, 9.2, 12.6
CPT-3	44.95	The Vs data collected at 6.8 feet appears anomalous. This could be due to the interface of the recompacted soil in the predrilled borehole.-	6.8, 9.2, 12.6, 15.7, 18.9, 22.3, 25.6, 28.9, 31.9, 35.4, 38.8, 42.4, 44.9
CPT-4	46.00	-	7.6, 8.9, 12.3, 15.6, 19, 22.1, 25.4, 28.7, 32.1, 35.4, 38.8, 42.1

Detailed CPT logs are attached with this report. All raw data and processed CPT logs will be provided electronically. Following the completion of testing, CPT sounding locations were abandoned per Minnesota Department of Health (MDH) regulations and sealing records were submitted to the MDH. A copy of these sealing records is included in the Appendix of this report.

The V_p data collected is presented in Table 2. We have omitted results from below a depth of about 12 feet because of the reasons previously discussed in this report.

Table 2: Compressions Wave Velocities

Test Depth (Feet)	Compressions Wave Velocity (feet/sec)			
	CPT-1	CPT-2	CPT-3	CPT-4
8	2066	1604	-*	2105
11	-*	3715	1857	1336

*Data from these locations was unreliable and we were unable to determine V_p.

This data was used to in conjunction with our shear wave velocity results to estimate values of Poisson's ratio at each of the test depths. These values are presented in Table 3.

Table 3: Estimated Poisson's Ratio

Test Depth (Feet)	Estimated Poisson's Ratio			
	CPT-1	CPT-2	CPT-3	CPT-4
8	0.38	0.25	-*	0.47
11	-*	0.48	0.44	0.33

*Data from these locations was unreliable and we were unable to determine V_p to calculate Poisson's Ratio.

Remarks

We believe that the CPT services described above were provided and performed according to the project specifications. In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

If you have any questions about this report, please contact Tyler Reich at 612.418.6116 (treich@braunintertec.com).

Sincerely,

BRAUN INTERTEC CORPORATION

Laurie Dudero for

Tyler J. Reich, PE
Project Engineer

Mark L. Jenkins

Mark L. Jenkins, PE
Senior Engineer

MARK L. JENKINS
LICENSED PROFESSIONAL ENGINEER
41770
STATE OF MINNESOTA

Attachments:
Seismic Cone Penetration Testing Location Plan
CPT Locations Coordinates and Elevations
CPT Logs
Seismic Data Graphics
Icone Calibration Record
Daily work log
Well Sealing Records
Data files (attached zip file)

c: Alan Wilson, alan.k.wilson@sargentlundy.com
Daniel Kocunik, daniel.c.kocunik@sargentlundy.com
Chris Kehl, ckehl@braunintertec.com

⊕ **DENOTES APPROXIMATE LOCATION OF STANDARD PENETRATION TEST BORING**

N

50' 0 100'

SCALE: 1"= 100'

F:\2018\B1806014.dwg,Geotech,8/1/2018 10:54:05 AM

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The Science You Build On.

11001 Hampshire Avenue S
Minneapolis, MN 55438
952.995.2000
braunintertec.com

Drawing Information

Project No:
B1806014

Drawing No:
B1806014

Drawn By:	JAG
Date Drawn:	7/3/18
Checked By:	MLJ
Last Modified:	8/1/18

Project Information

Prairie Island ISFSI
Expansion

1717 Wakonade Drive

Welch, Minnesota

Soil Boring Location Sketch

Points

Project : B1806014

User name	jgreenwell	**Date & Time**	1:38:06 PM 7/20/2018
Coordinate System	United States/Counties/MN	**Zone**	Goodhue
Project Datum	Goodhue		
Vertical Datum		**Geoid Model**	Minnesota GEOID12B
Coordinate Units	US survey feet		
Distance Units	US survey feet		
Height Units	US survey feet		

Point listing

Name	Northing	Easting	Elevation	Feature Code
1003	255326.839	628928.544	693.196	CPT-1
1002	255328.560	628772.791	693.216	CPT-2
1001	255330.048	628672.534	693.339	CPT-3
1000	255331.592	628516.306	693.495	CPT-4

Back to top

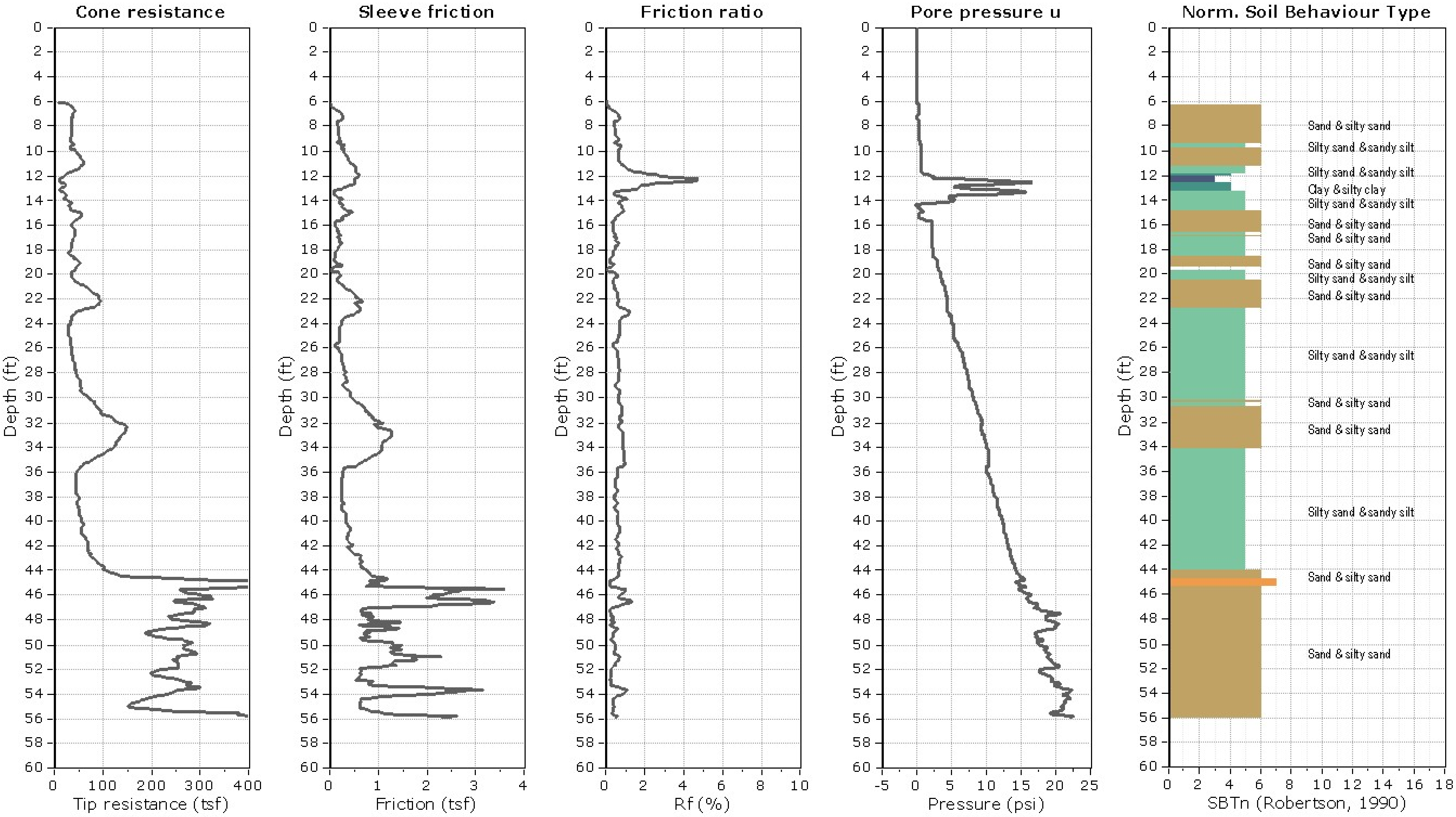
Note: CPT-2 was moved north 7 feet from these coordinates.

BRAUN INTERTEC
The Science You Build On.

Braun Intertec Corporation
11001 Hampshire Ave S
Minneapolis, MN 55438
952-995-2000

Project: **Prairie Island ISFSI Expansion**
Location: **Welch, MN** **Project Number: B1806014**

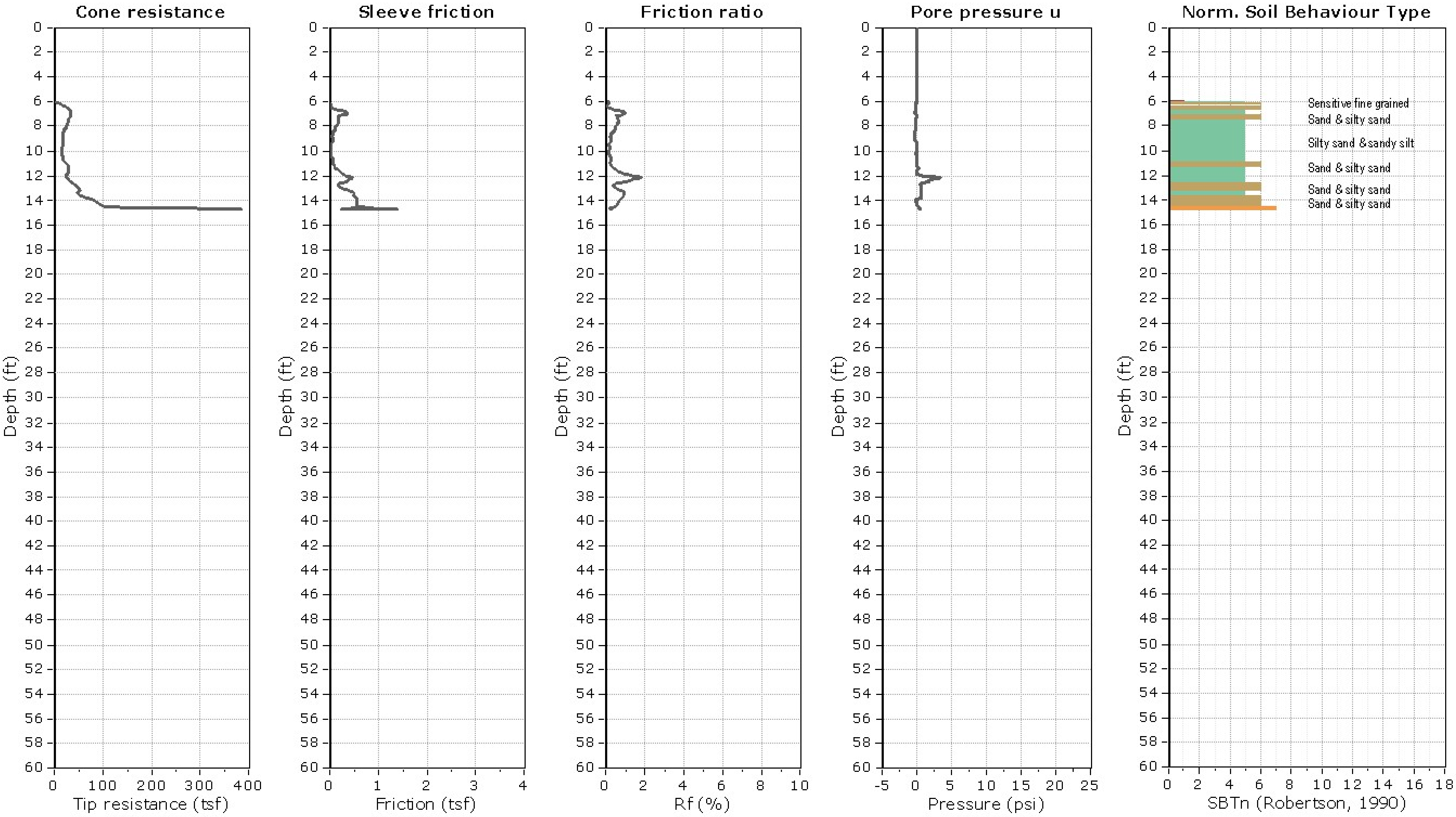
CPT: CPT-01
Total depth: 55.91 ft, Date: 7/11/2018
Cone Type: 170717
Cone Operator: Holmbo



Braun Intertec Corporation
11001 Hampshire Ave S
Minneapolis, MN 55438
952-995-2000

Project: **Prairie Island ISFSI Expansion**
Location: **Welch, MN** **Project Number: B1806014**

CPT: CPT-02
Total depth: 14.76 ft, Date: 7/11/2018
Cone Type: 170717
Cone Operator: Holmbo



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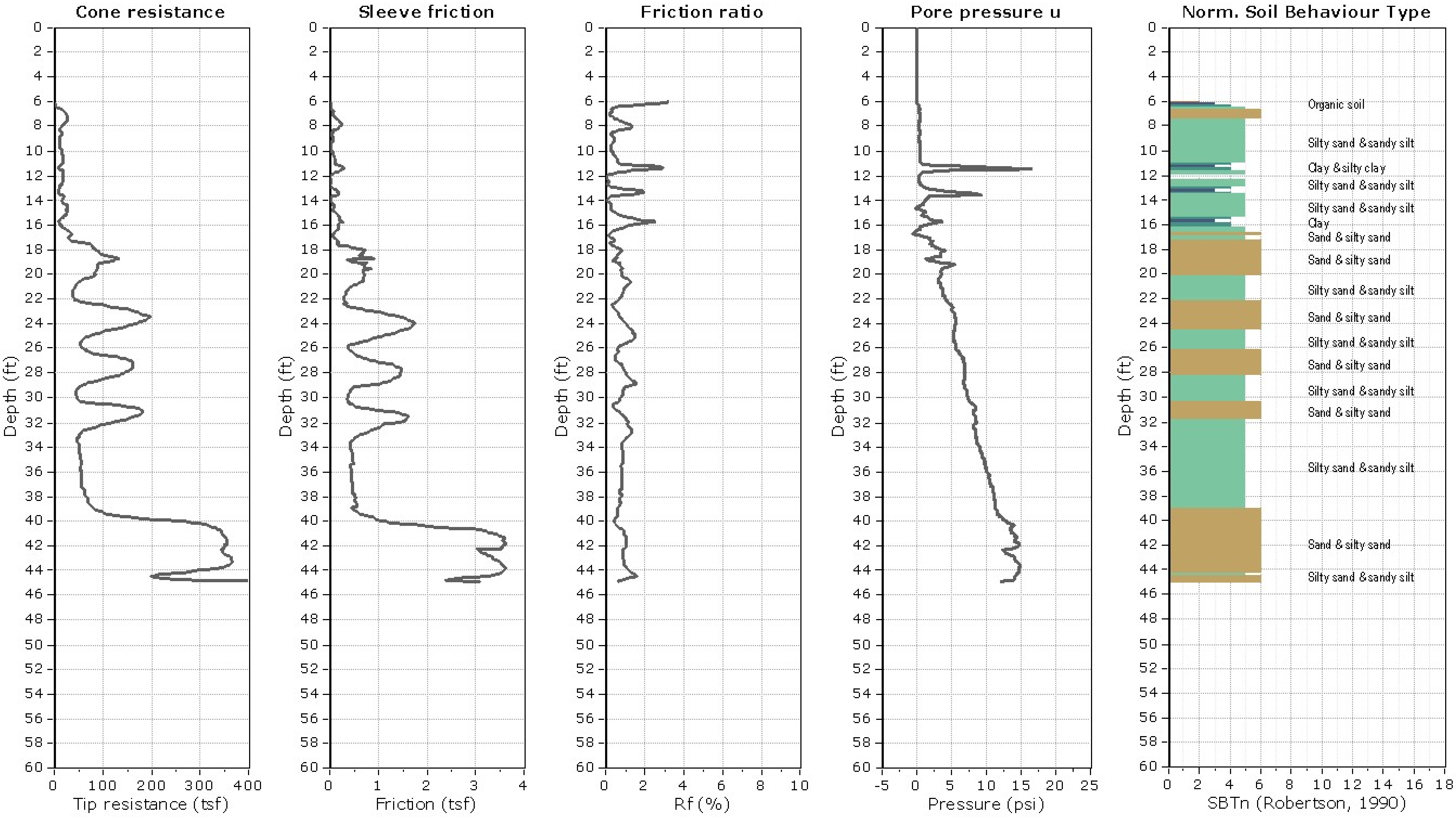
Minneapolis, MN 55438
952-995-2000

CPT: CPT-03
Total depth: 44.95 ft, Date: 7/11/2018
Cone Type: 170717
Cone Operator: Holmbo

Project: **Prairie Island ISFSI Expansion**
Location: **Welch, MN** **Project Number: B1806014**



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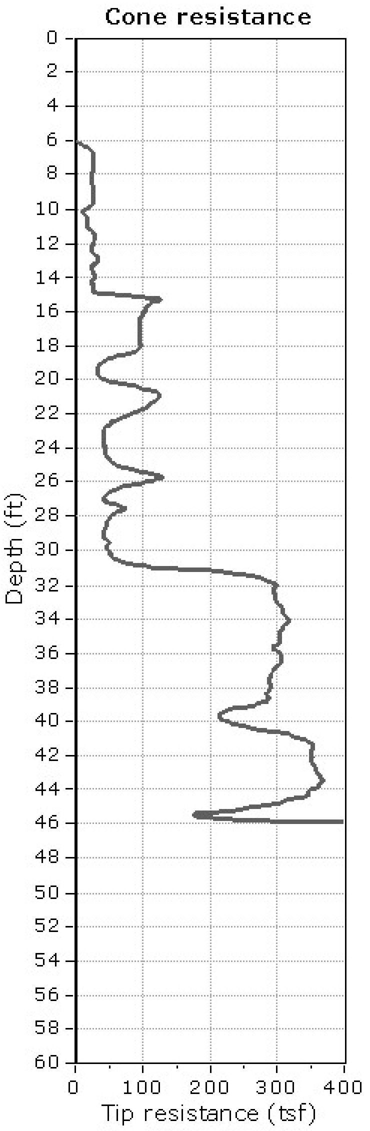
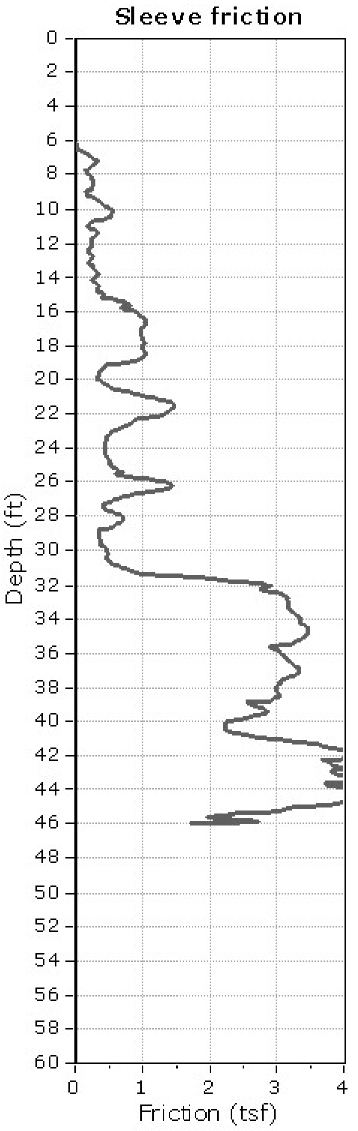
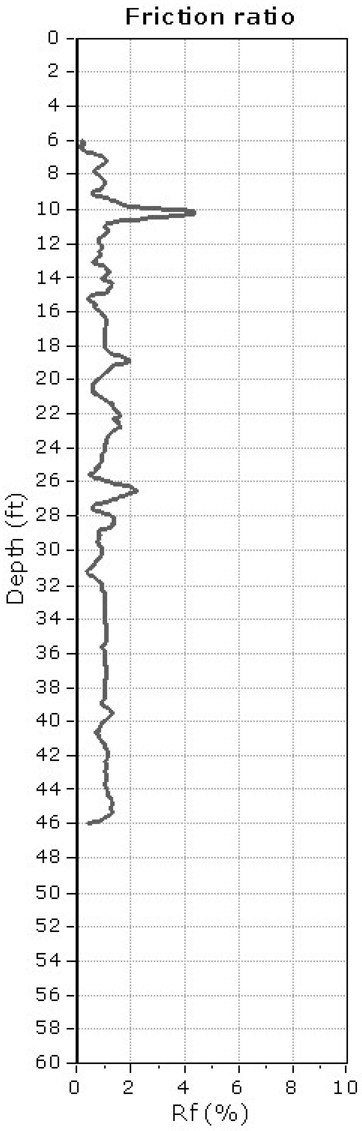
Minneapolis, MN 55438
952-995-2000

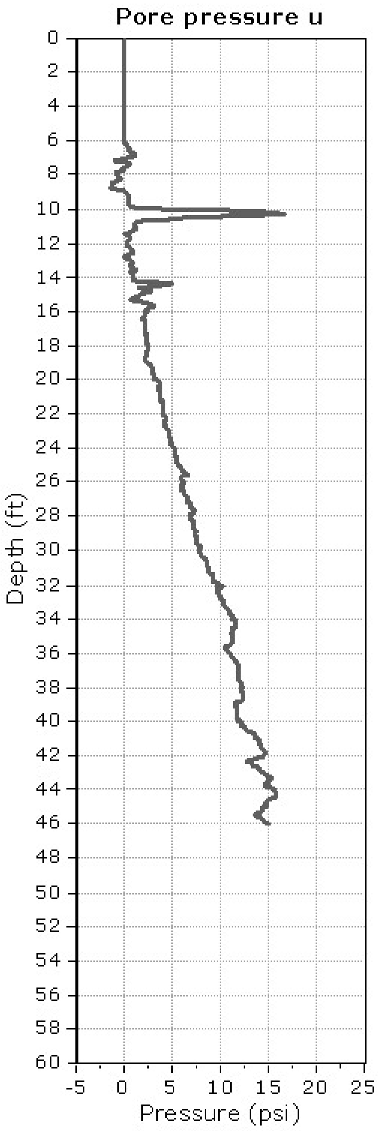
Project: **Prairie Island ISFSI Expansion**
Location: **Welch, MN** **Project Number: B1806014**

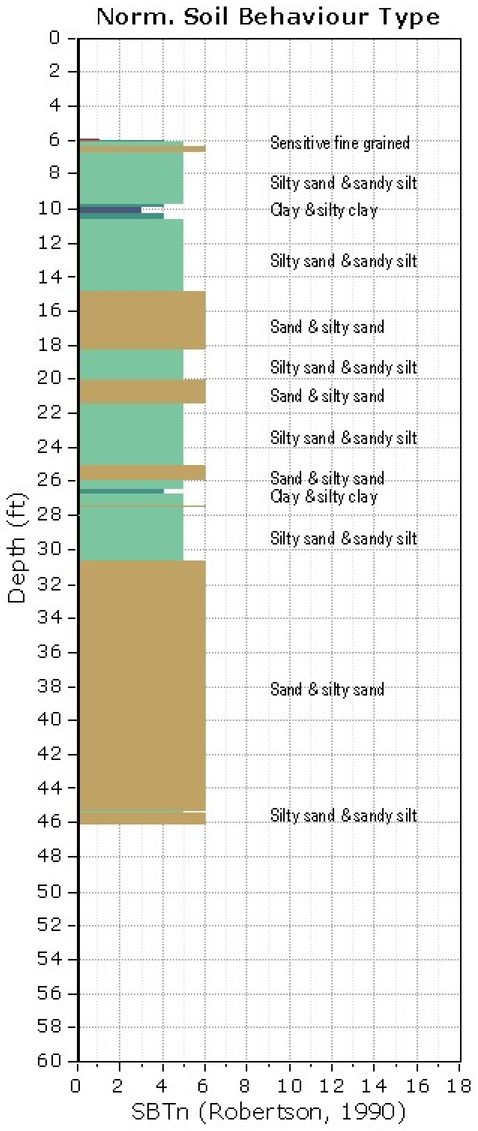
CPT: CPT-04
Total depth: 46.00 ft, Date: 7/11/2018
Cone Type: 170717
Cone Operator: Holmbo


Cone resistance


Sleeve friction

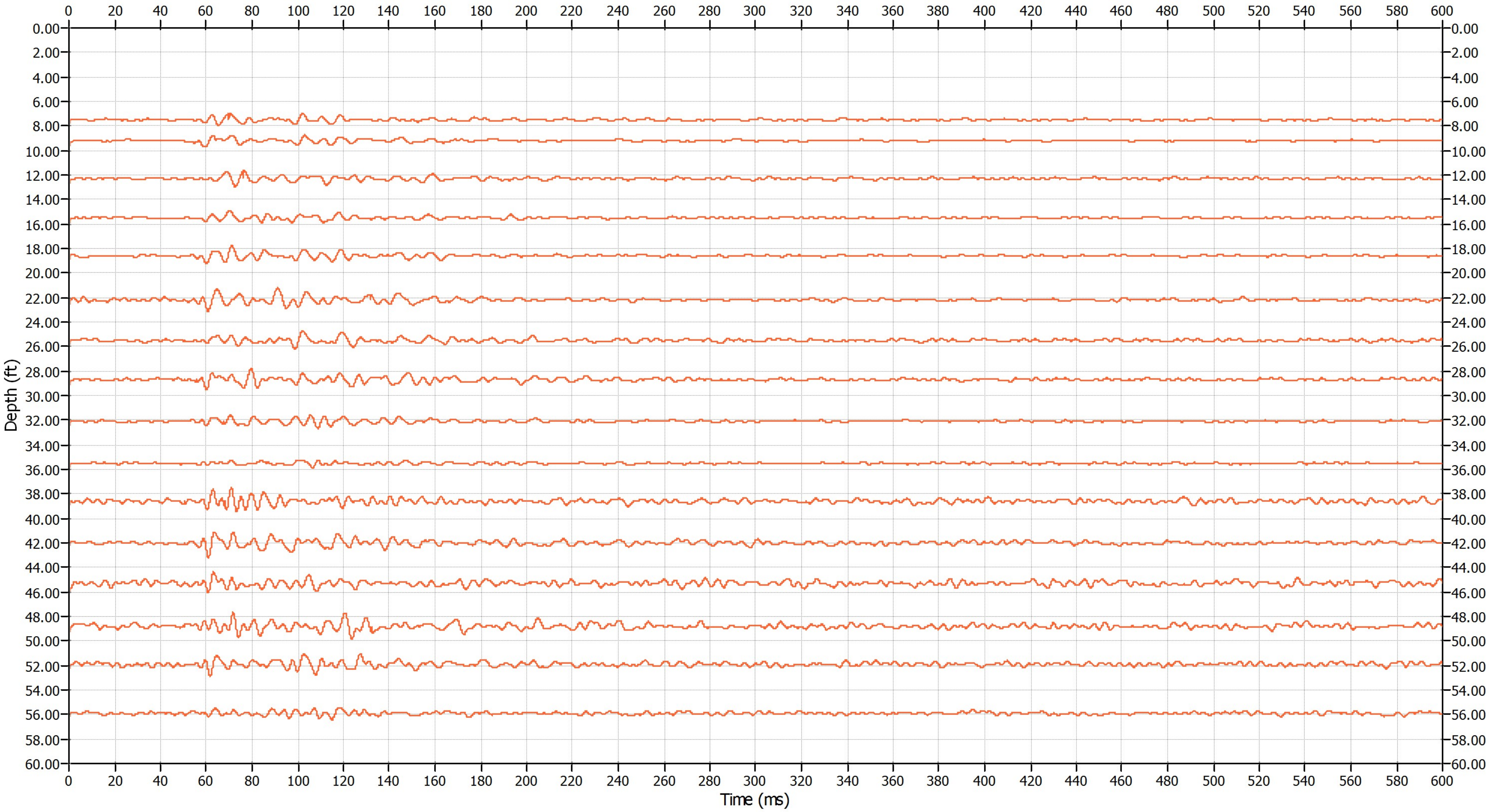

Friction ratio


Pore pressure u


Norm. Soil Behaviour Type

Project: B1806014 - Prairie Island ISFSI Expansion **Borehole ID : CPT-01**

Average P signals full graph (L signals)



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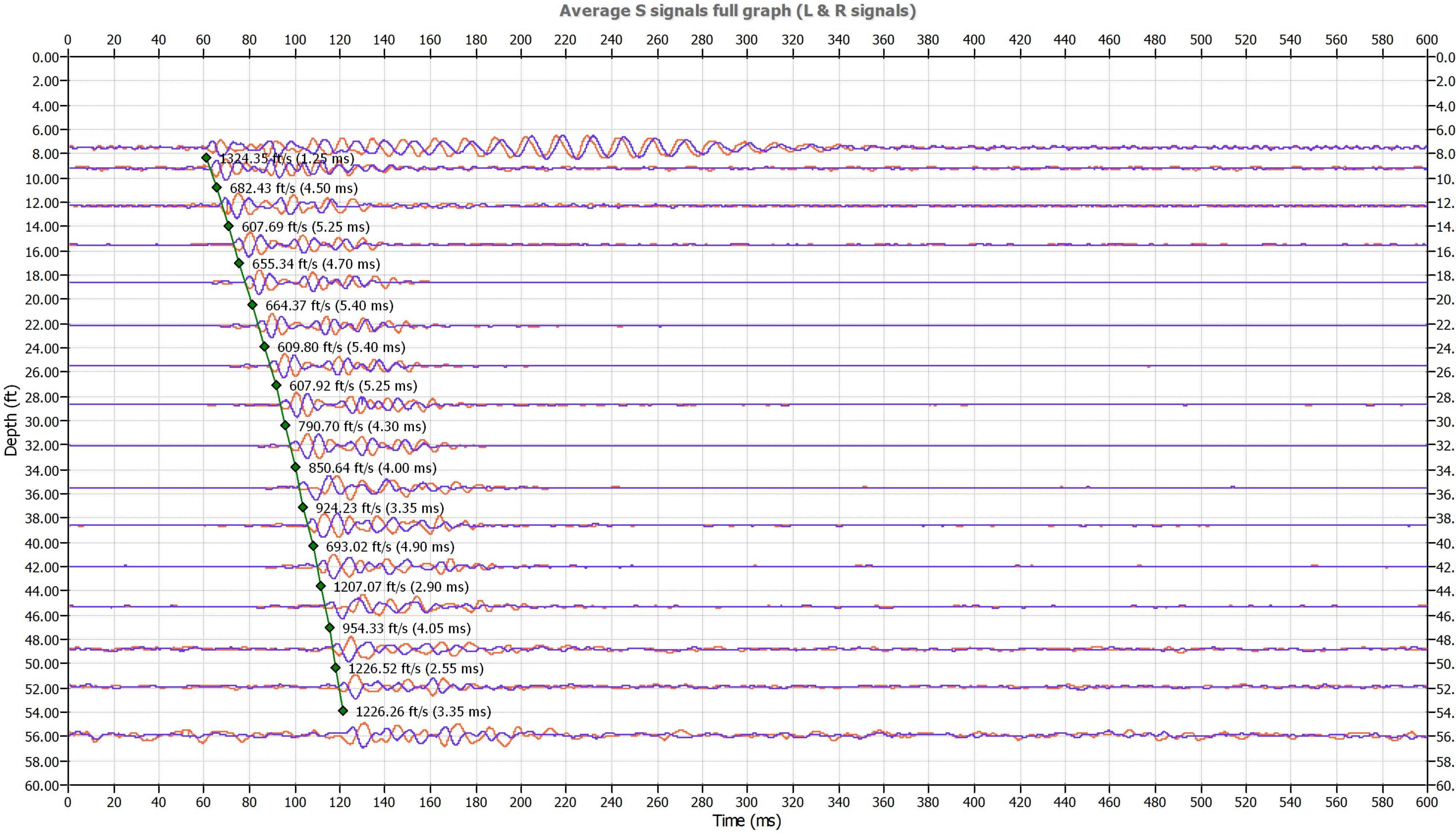
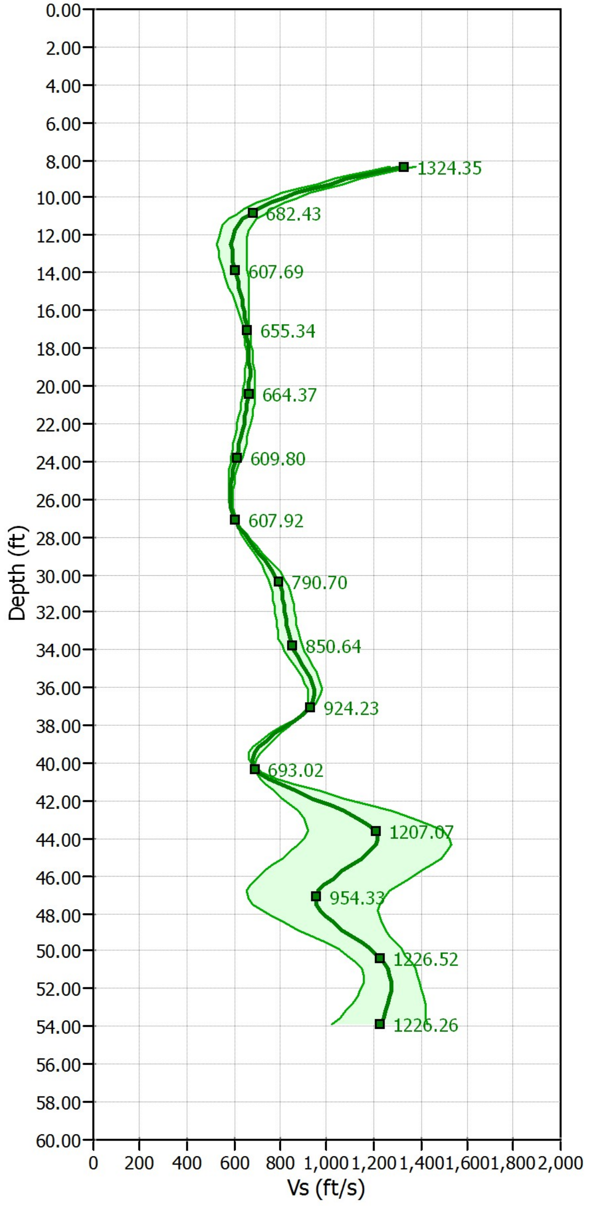
Project: B1806014 - Prairie Island ISFSI Expansion **Borehole ID : CPT-01**

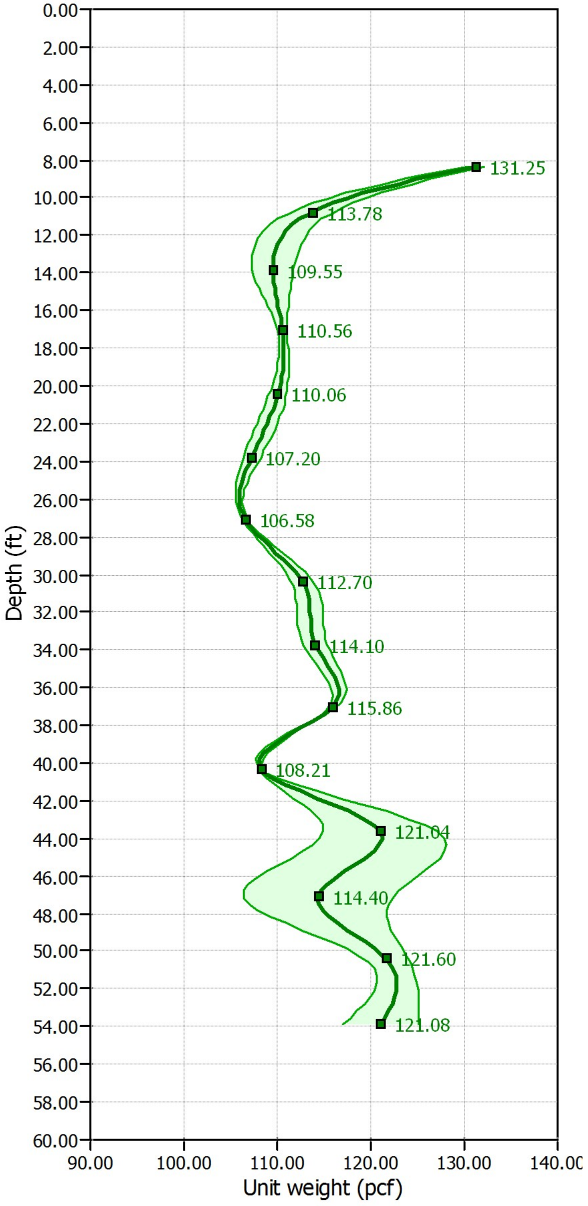


Detailed result plots over depth

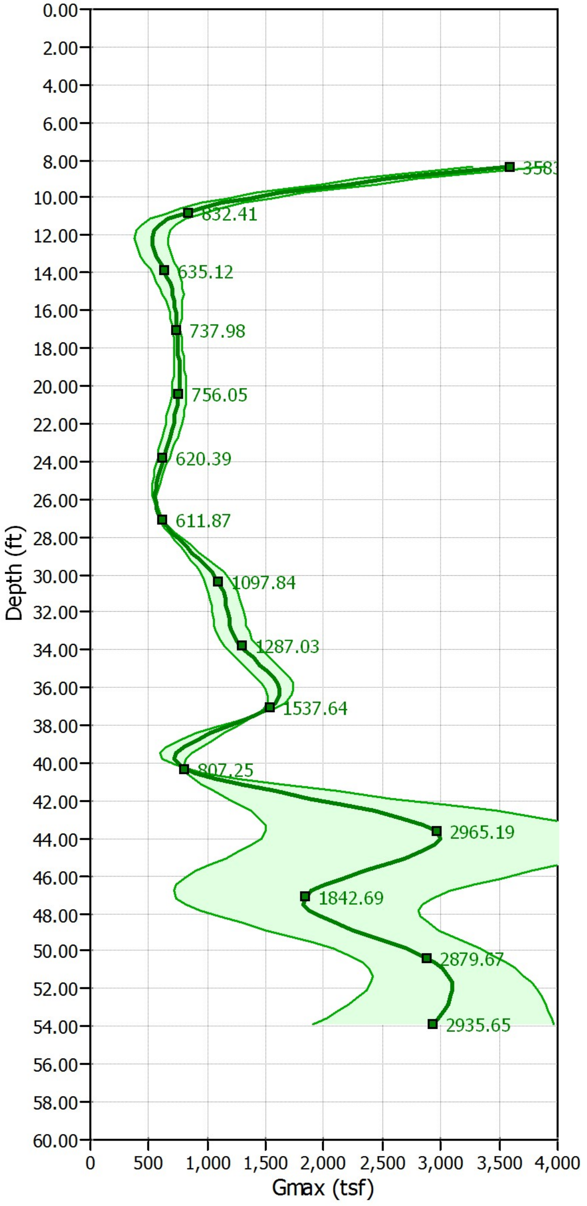
Estimated shear wave velocity



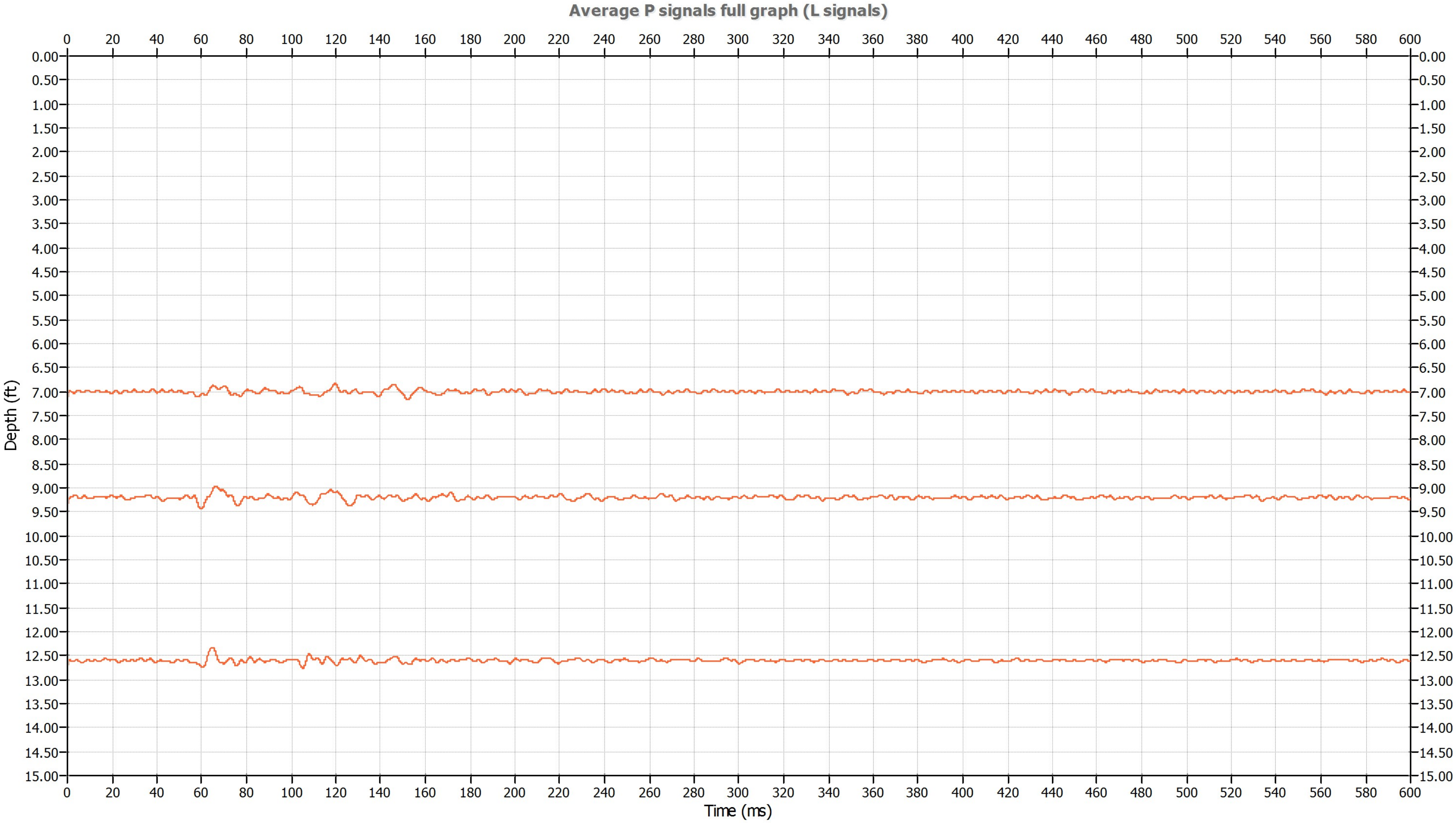
Estimated unit weight



Estimated Gmax



Project: B1806014 - Prairie Island ISFSI Expansion **Borehole I : CPT-02**



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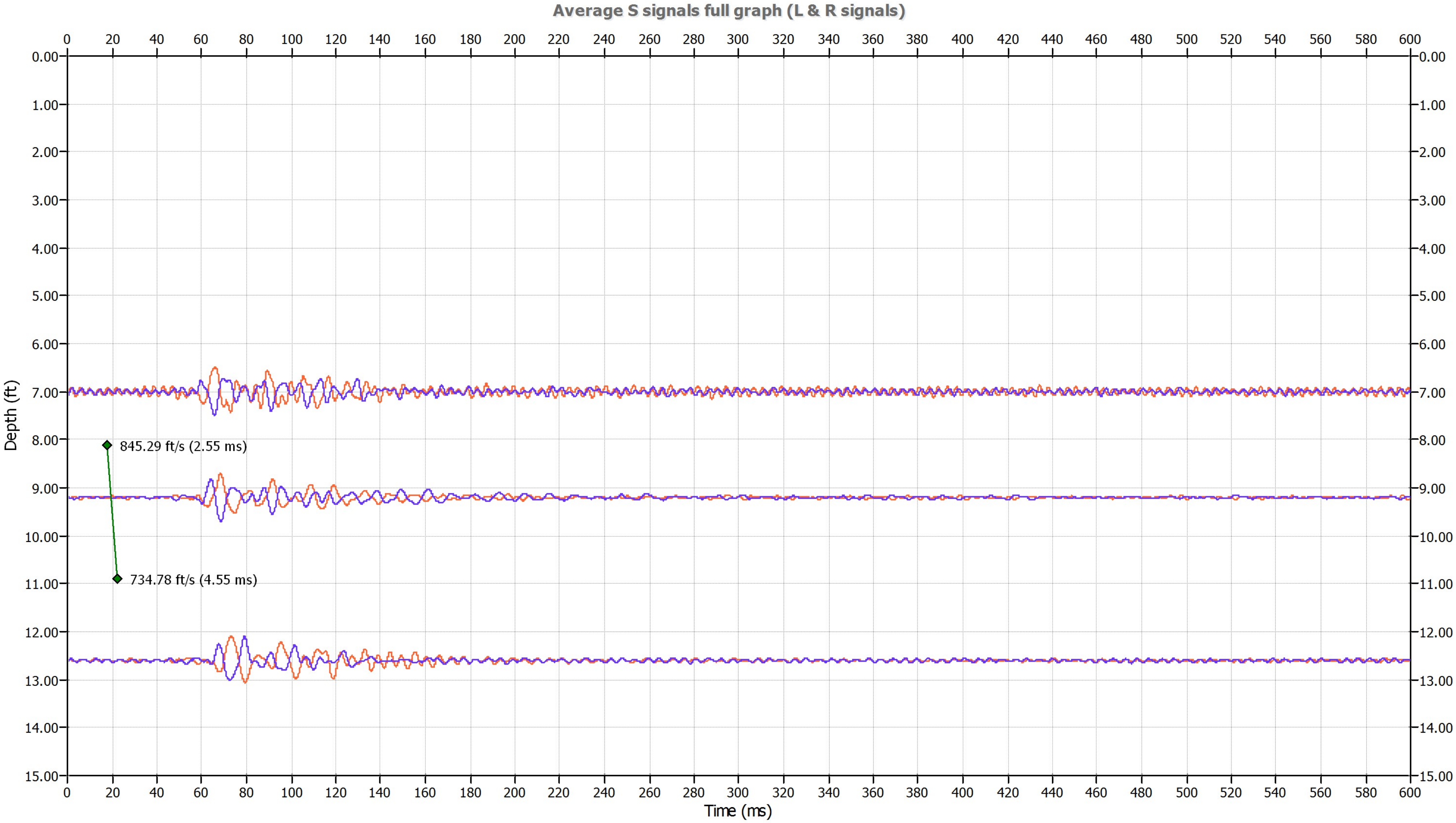
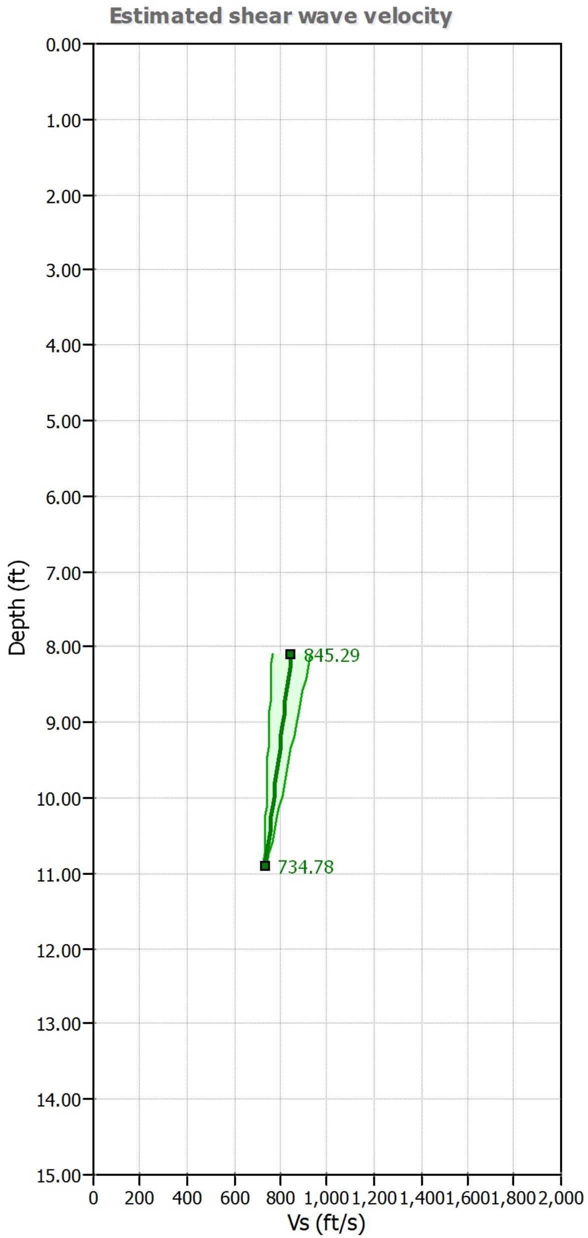
Minneapolis, MN 55438

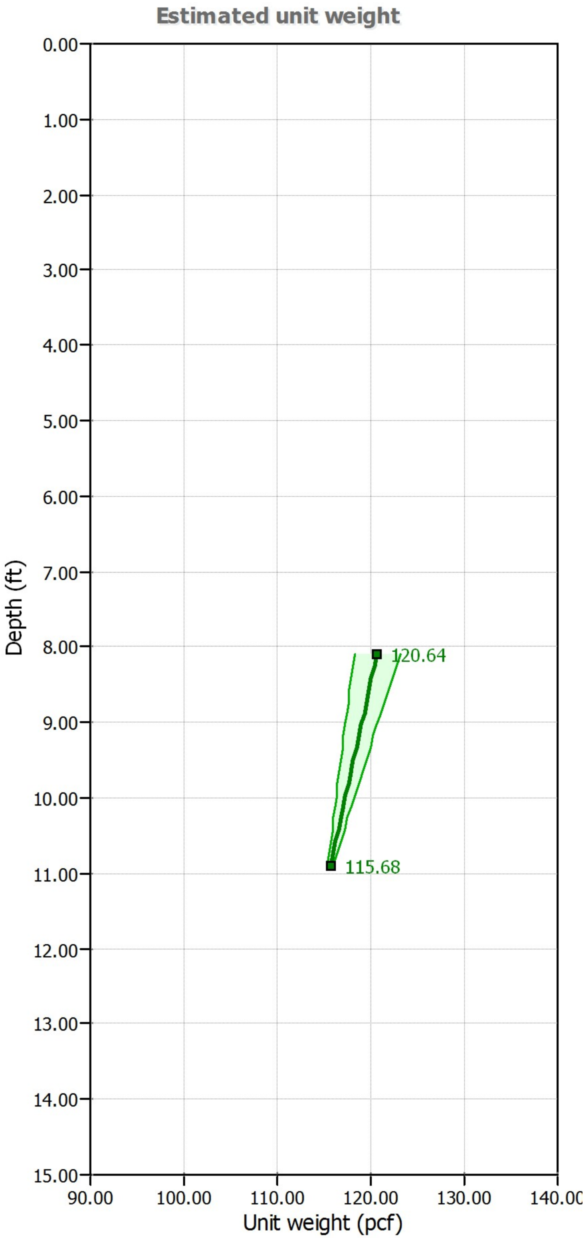
Project: B1806014 - Prairie Island ISFSI Expansion

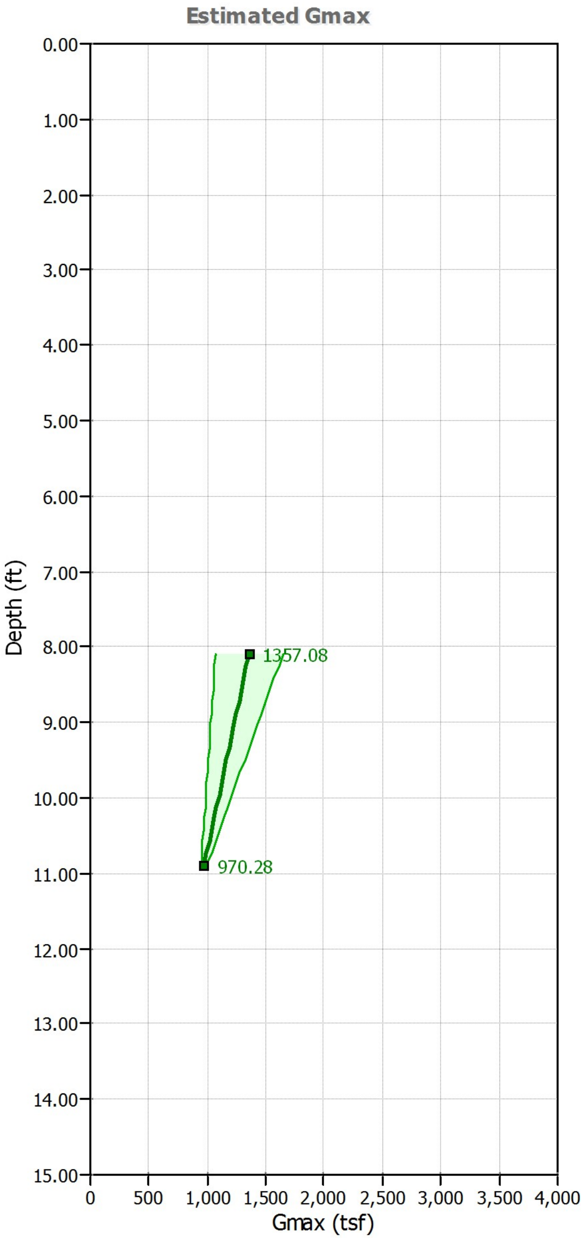
Borehole I : CPT-02



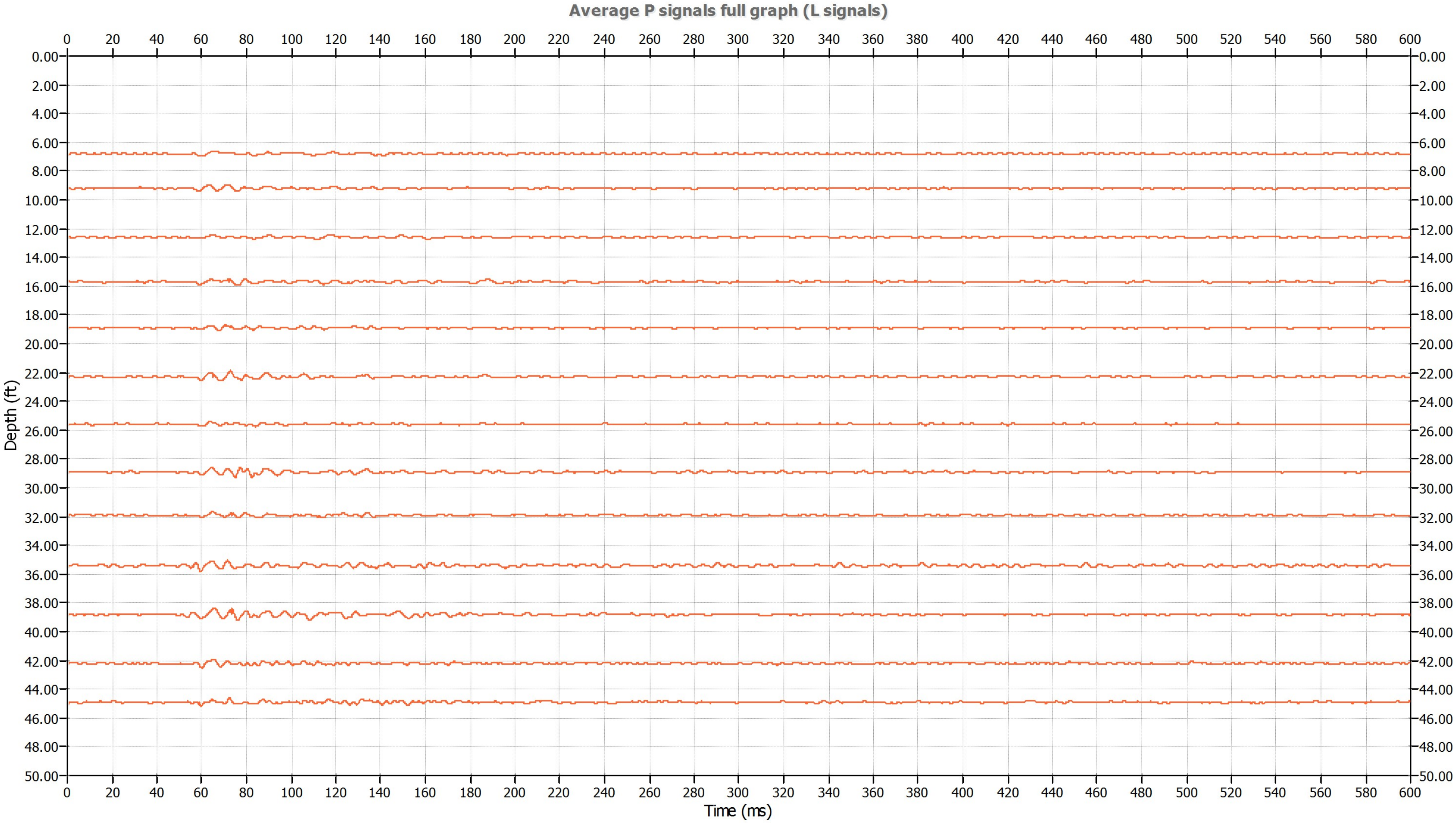
etailed result plots o er depth





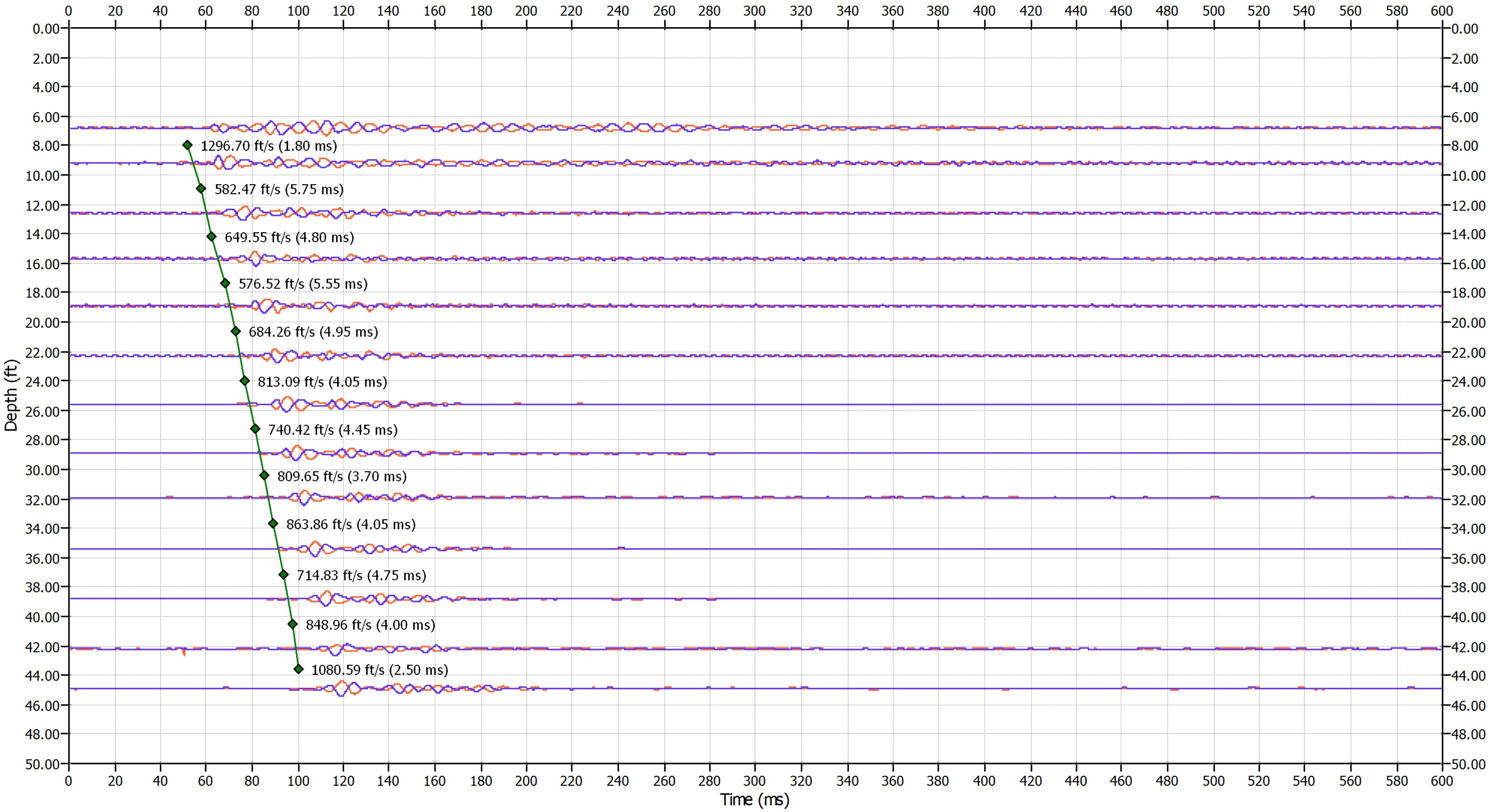


Project: B1806014 - Prairie Island ISFSI Expansion **Borehole I : CPT-03**

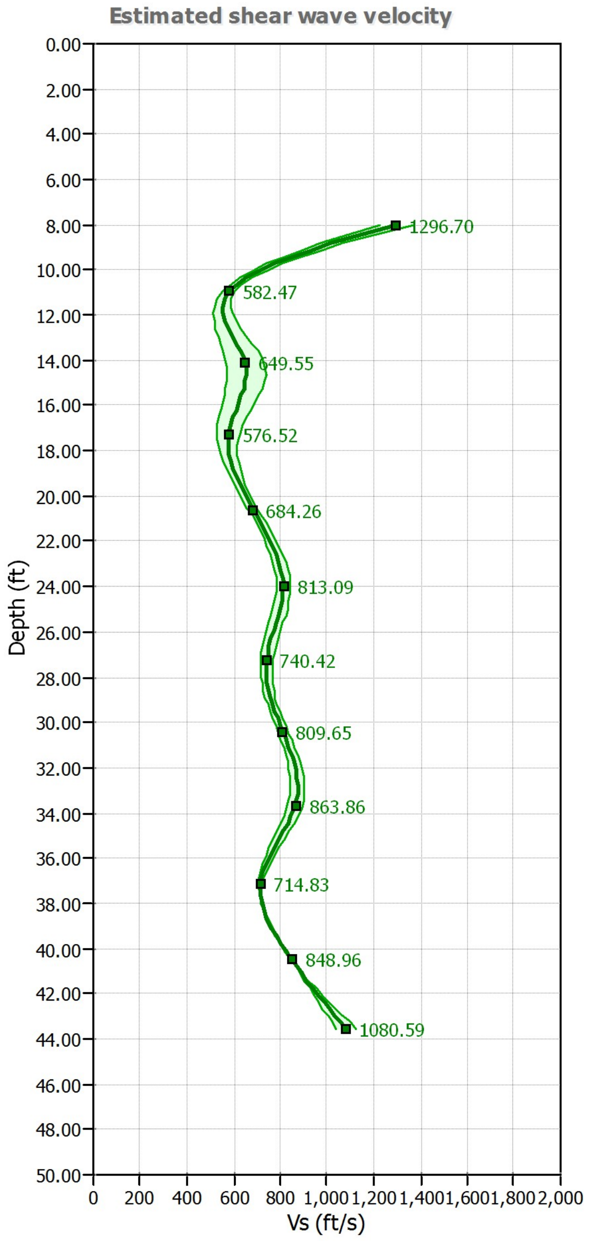


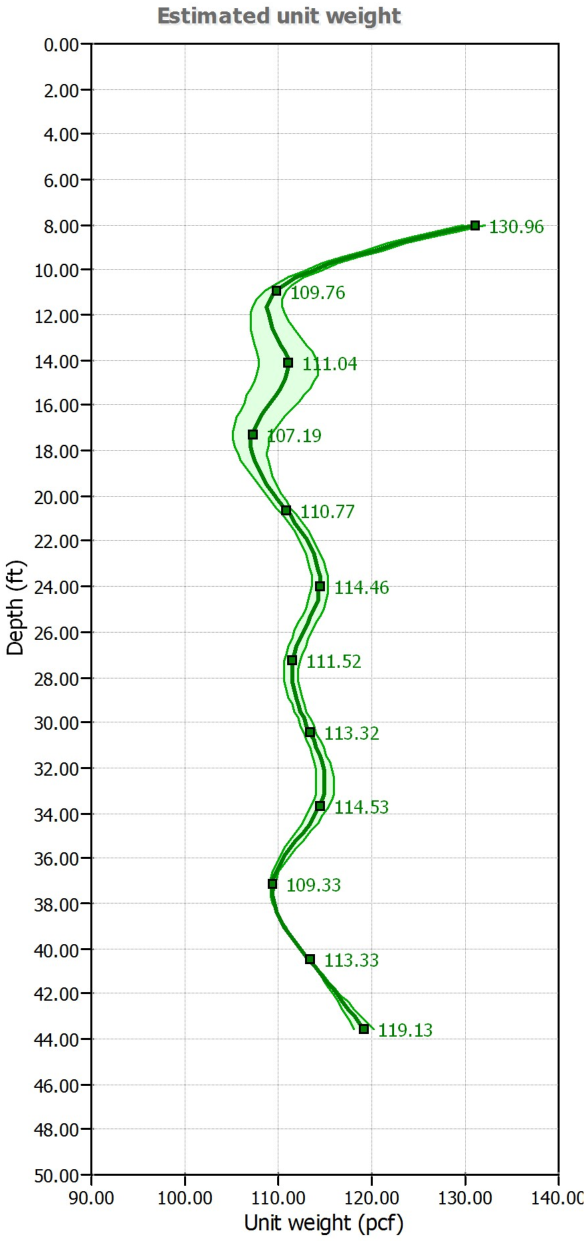
Project: B1806014 - Prairie Island ISFSI Expansion **Borehole ID: CPT-03**

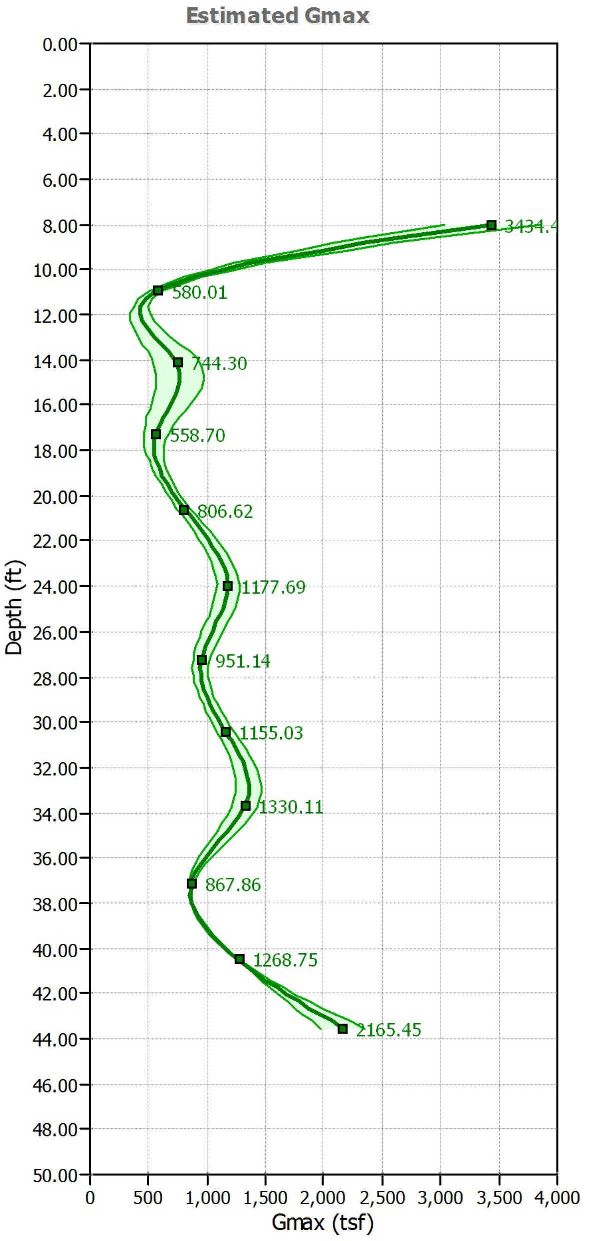
Average S signals full graph (L & R signals)



Detailed result plots over depth



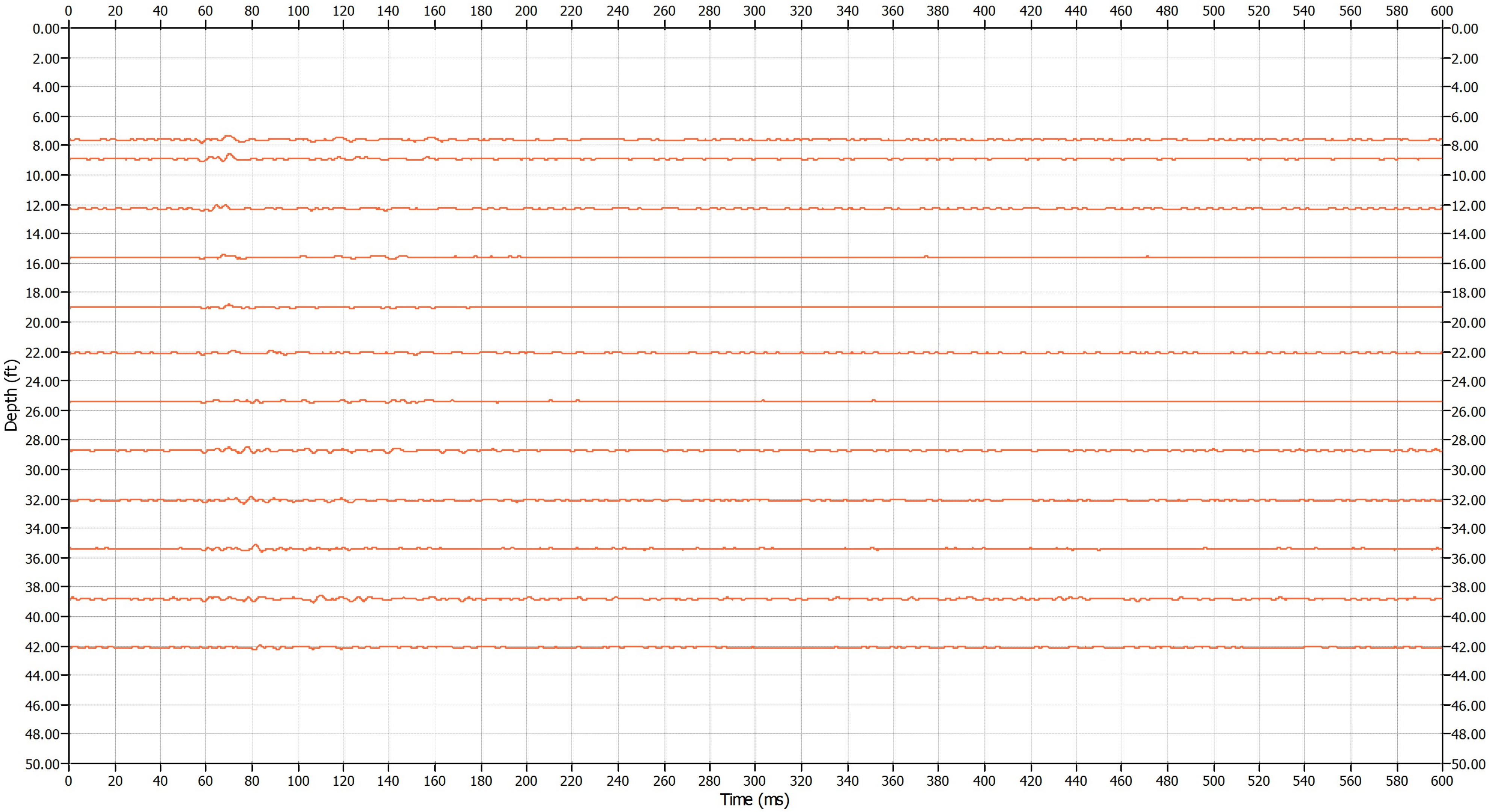




Project: B1806014 - Prairie Island ISFSI Expansion

Borehole I : CPT-04

Average P signals full graph (L signals)



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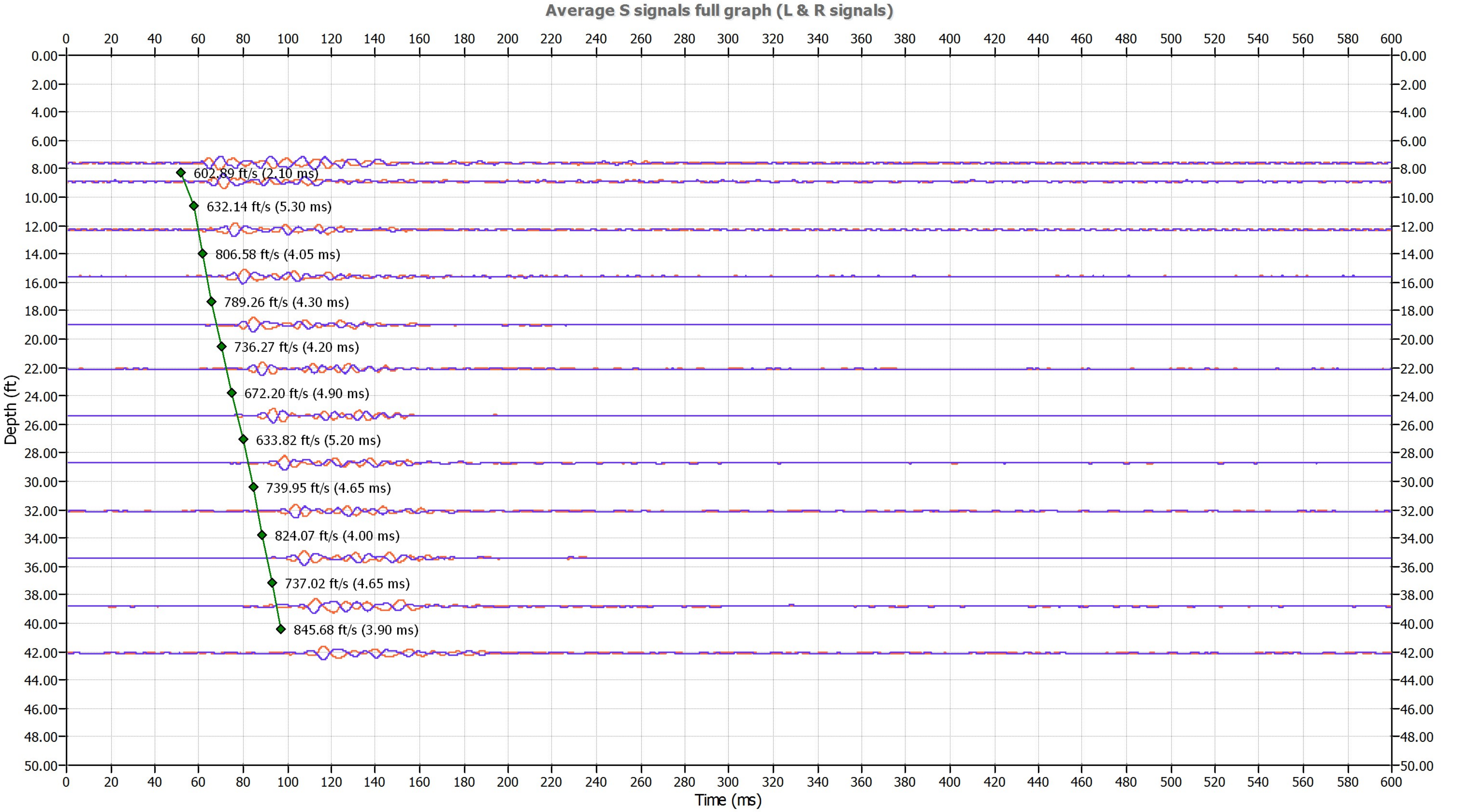
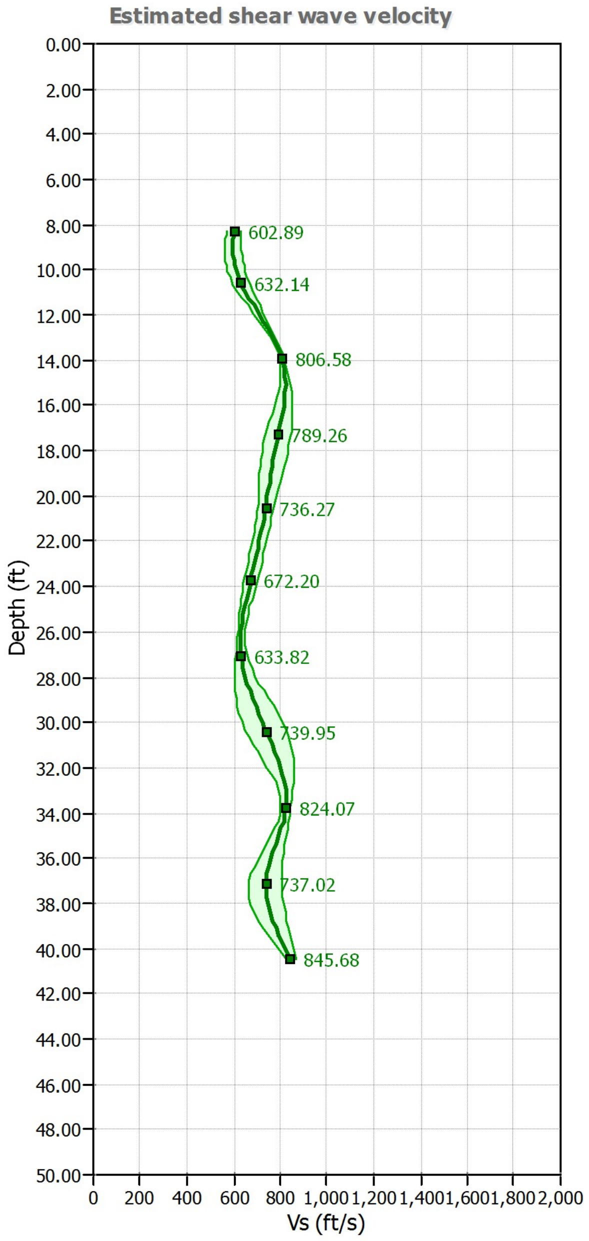
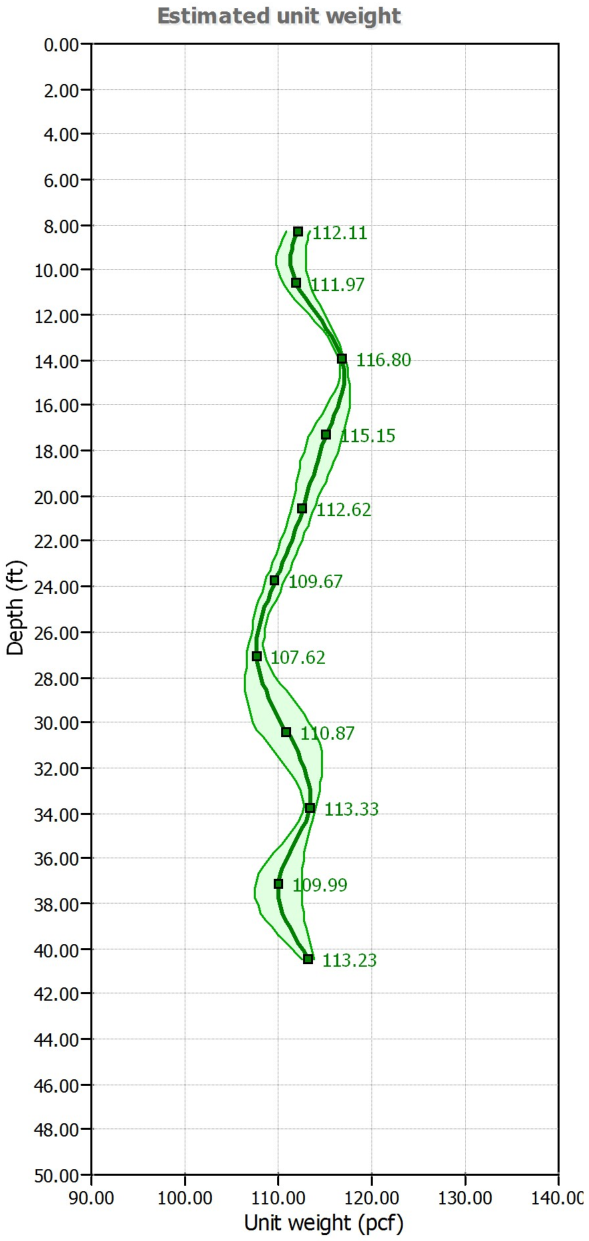
Project: B1806014 - Prairie Island ISFSI Expansion **Borehole ID : CPT-04**



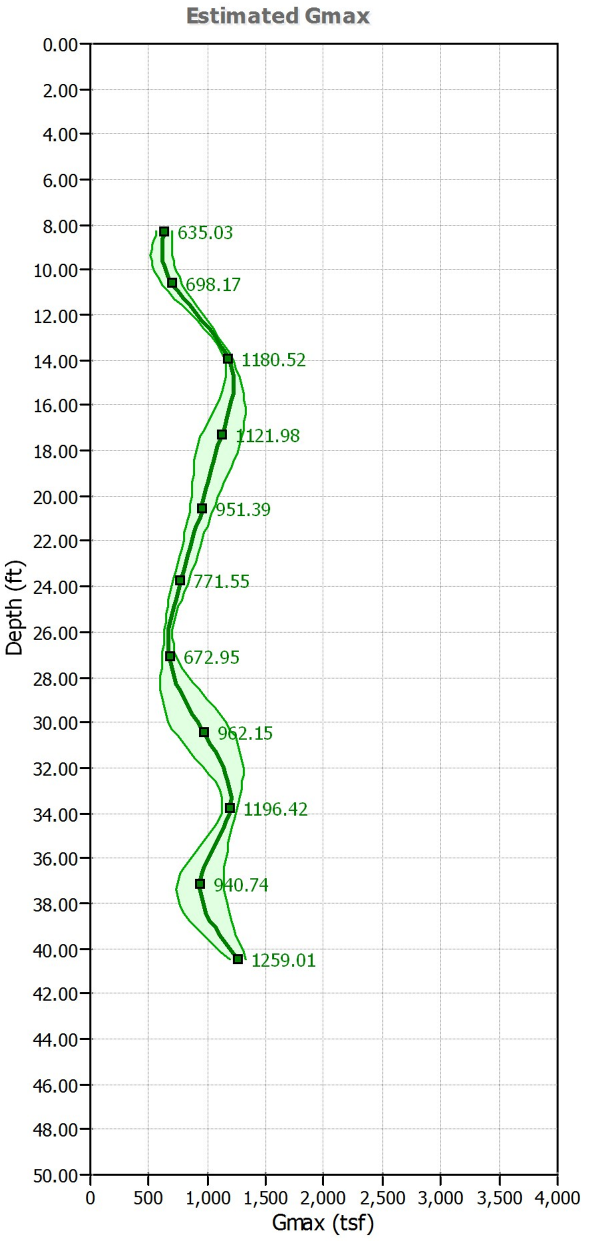
Detailed result plots over depth



Estimated shear wave velocity



Estimated unit weight



Estimated Gmax

TEST CERTIFICATE

Icone (all versions)

Supplier:	A.P. v.d. Berg Machinefabriek, Heerenveen The Netherlands
Production-order:	79499
Client:	Braun Intelec
Cone-type:	I-CFXYP20-15
Cone-number:	170717

To test / To check item	**Required value**	**Checked value**
Check Quad-ring groove behind friction sleeve with check ring; **Sample testing: 1 of every 5 Icones is tested.**	Sleeve fixed	
Isolation-resistance.	>0.5 GΩ	0,5 GΩ
Straightness: Icone 5, 10 and 15 cm^2 S < 2.2. mm. At Icone base: S < 0,2 mm	S<= 2,2 mm	0,7 mm
"Classic calibration" NOT present! Check of calibration-file: "Classic calibration" removed.	O.K.	
Check alarm-settings Icone. Alarm values are set. (Kill Shutdown).	O.K.	O.K.
Software version - check at opening screen. (from 18 Jan 2018 v. 2.3)	version: 2.3	O.K.
Calibration date of Icone; check cone data [F1]..[F1].	Yes	O.K.
Initial zero-Value Tip after calibration – within 1.0 % of nominal load.	O.K.	O.K.
Initial zero-Value Local Friction after calibration – within 1.0% of nominal load.	O.K.	O.K.
Initial zero-Value Pore Pressure after calibration – within 1.0% of nominal load.	O.K.	O.K.
Initial zero-Value Inclination X. Initial zero-Value Inclination Y.	-1°< X <+1° -1° < Y <+1°	0.3 ° 0.0 °
Measurements Tip resistance OK?	Tested range:	0-75mPa
Influence Tip load on **Local Friction and Pore Pressure:** Max. tip load: 5 cm^2: 100 MPa; 10 cm^2: 100 MPa; 15 cm^2: 75 MPa.	LF < 10 kPa PP <½% nom	7 kPa 0,2 kPa
Measurements local friction OK?	Tested range:	0-1mPa
Local friction at max. load.	Tested value:	1,5mPa
Measurements Pore Pressure OK?	Tested range:	0-2000kPa
Measure Pore Pressure to 150%.	Tested value:	3000kPa
Measurements Inclination OK?	Tested range:	24°-0-24°
Cone recognition on disconnecting and connecting Icone again?	Yes	O.K.

Remarks:

Calibrated by: Casper Ouwejan	Date: 14-06-'18	Sign.:
Final check: T. Bossche	Date: 14-06-'18	Sign.:

Calibration Certificate

a.p. van den berg

1.1 General

Cone number:	170717
Cone type:	I-CFXYP20-15
Description:	Tip 75 MPa Sleeve 1.00 MPa Inclinometer 20° Pore 2MPa
Part number:	0100297A
Certificate number:	170717-2
Client:	Braun Intertec

1.2 Calibration equipment

	calibrated
Autolog 3000	
Autolog 3000	August 2016 (Peekel: SN# 2628002)
Autolog 3000	August 2016 (Peekel: SN# 2628002)
Autolog 3000	August 2016 (Peekel: SN# 2628002)
Reference Loadcell 200kN 00287P3L	March 2016 (HBM: HBM: FT087 2016-03)
Reference Loadcell 20kN D16200	August 2016 (HBM: 56490 2016-08)
Reference Sensor 40 Bar 4318470	August 2016 (Trescal: 1607-12904)
Reference ACS-080-2-SC00-HE 08/11 470480	February 2015 (Trescal: 1502-10558)
Reference ACS-080-2-SC00-HE 08/11 470480	February 2015 (Trescal: 1502-10558)

1.3 Standard

EN ISO 22476-1 2012 Class 2

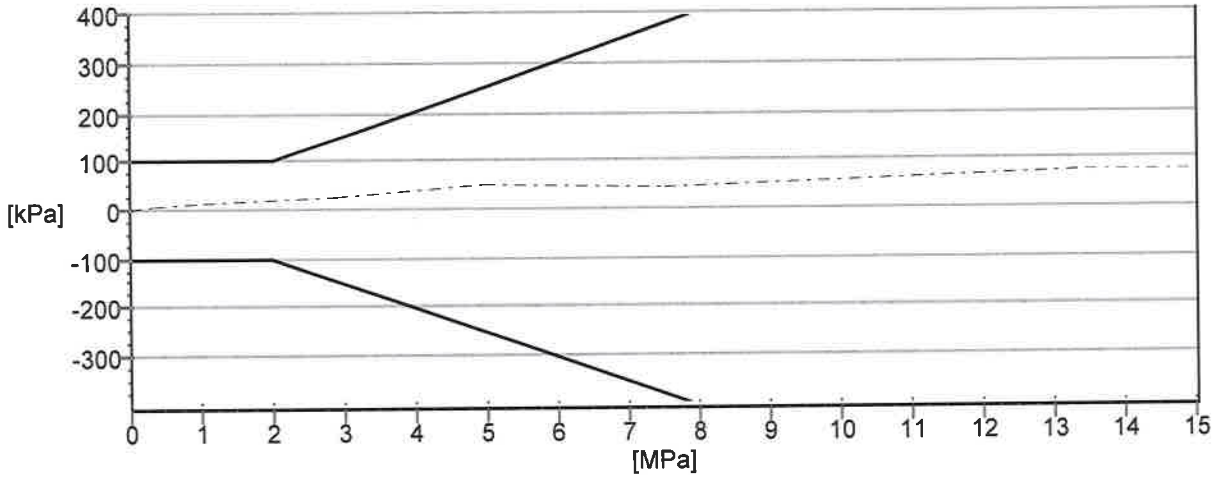
1.4 Result

The sensor complies to the above standard

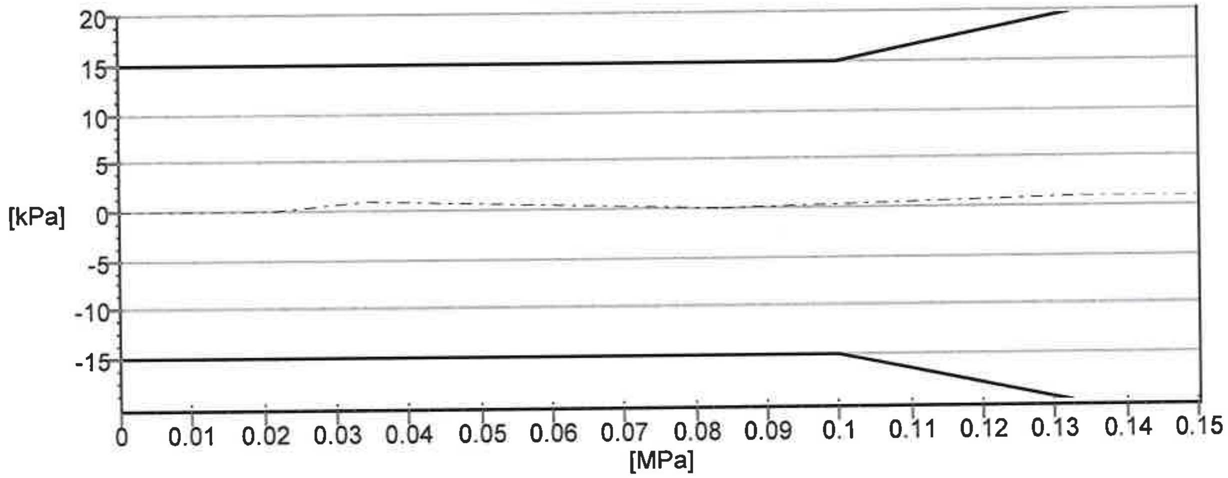
Calibrated by: C.J. Ouwejan
Date: 14/06/2018
Signature:

QA Manager: N.R.E. de Jong
Date: 14/06/2018
Signature:

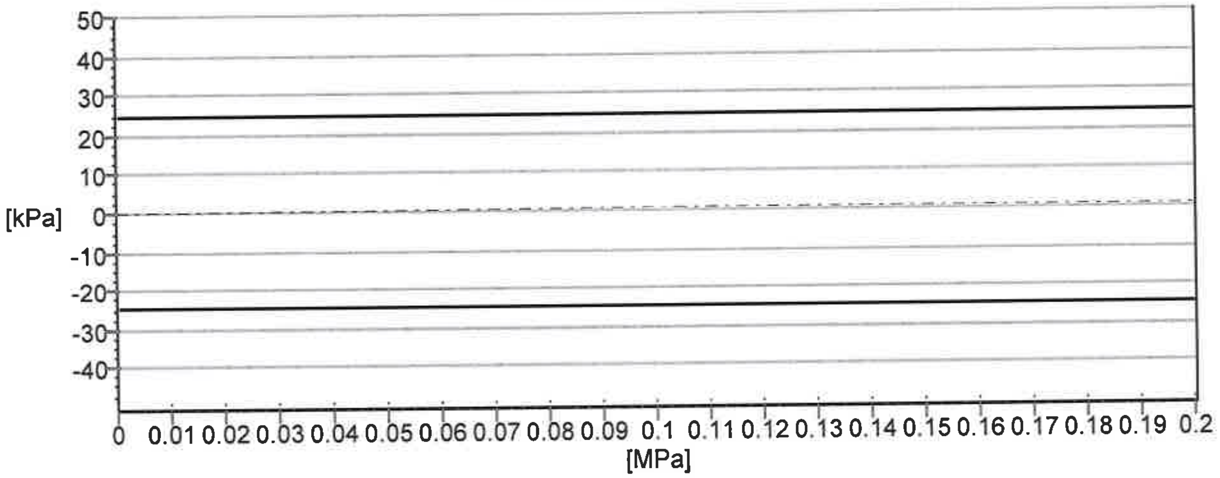
Cone Resistance (qc)



Local Friction (fs)



Pore Water Pressure (u2)



------ Deviation ——— EN ISO 22476-1 2012 Class 2

Zero Value Cone	0,015	[MPa]	**Max. Deviation from Zero Value**	Cone	3.75	[MPa]
Sleeve	0.001	[MPa]		Sleeve	0.05	[MPa]
Pore(u2)	4.1	[kPa]		Pore(u2)	100.0	[kPa]

Ref [MPa]	Cone [MPa]	Cone-Ref [kPa]
0.010	0.013	3
0.352	0.361	9
1.027	1.038	11
2.897	2.924	27
4.962	5.012	50
7.524	7.569	45
13.456	13.534	78
20.991	21.068	77
26.108	26.206	98
41.441	41.540	99
57.638	57.722	84
76.290	76.291	1

Ref [MPa]	Sleeve [MPa]	Sleeve-Ref [kPa]
0.000	0.000	0
0.021	0.021	0
0.034	0.035	1
0.084	0.084	0
0.134	0.135	1
0.178	0.179	1
0.278	0.281	3
0.360	0.361	1
0.478	0.480	2
0.636	0.637	1
0.790	0.791	1
1.013	1.014	1

Ref [MPa]	Pore(u2) [MPa]	Pore(u2)-Ref [kPa]
0.000	0.000	0
0.104	0.105	1
0.196	0.197	1
0.299	0.300	1
0.432	0.434	2
0.637	0.639	2
0.784	0.787	3
0.972	0.976	4
1.233	1.236	3
1.381	1.384	3
1.659	1.660	1
2.032	2.032	0

A:	**Cone Resistance**	
	Accuracy	100.0 kPa or 5.0%
	Nom.Cone Resistance	75 MPa
	Max.Cone Resistance	150 MPa
	Effective Area	15 cm²
B:	**Local Friction**	
	Accuracy	15.0 kPa or 15.0%
	Nom.Local Friction	1.00 MPa
	Max.Local Friction	1.5 MPa
	Effective Area	225 cm²
C:	**Pore Water Pressure**	
	Accuracy	25.0 kPa or 3.0%
	Nom.Pore Water Pressure	2 MPa
	Max.Pore Water Pressure	3 MPa
D:	**Inclination X**	
	Accuracy	1.0°
	Nom.Inclination X	20°
	Max.Inclination X	25°
E:	**Inclination Y**	
	Accuracy	1.0°
	Nom.Inclination Y	20°
	Max.Inclination Y	25°

BRAUN INTERTEC

Drilling Production Report

DrillRpt03 rev. 10/12

Project Number	B1806014	**City**	Welch	**Date**	7/11/18
Project Name	Prairie Island	**State**	Minnesota	**Day**	
Project Manager	Tyler Kaid	**Crew Chief (CC)**	Holmbo	**Assistant (DA)**	Ernste
		Dept.	Drill	**Addtnl. Person (AP)**	~~[illegible]~~

Vehicle	**Number**	**Act. Miles**	**Est. Miles**
Drill Rig			
Support Truck	—	106	
Low Boy		106	

Drilling Method	**Size**	**Footage**	**Hours**	**Est. Ftg.**	**Est. Hrs.**	**Task**	**CC Hrs.**	**DA Hrs.**	**AP Hrs.**	**Est. Hrs.**
~~Rower Auger~~ CPT	—	166	~8			Preparation	5	5		
H S A						Travel	3	3		
Mud Rotary						Stake				
Well Installation						Utility				
Rock Coring						Drilling	8	8		
Grouting						Surveying				
Continuous Sample						Standby				
Push Probe						Repairs				
GW Sampling						**Total**	16	16		

Crew Chief Comments/Notes (if no, provide additional informaton, attach additional sheet if needed)

☒ Yes ○ No Blue File provided?

☒ Yes ○ No Blue File information complete?

☒ Yes ○ No Sufficient time estimated to complete drilling?

☒ Yes ○ No PM avaliable to discuss?

CPT-1 to 55.89 ft to refusal (gravel)

CPT-2 to 14.76 ft to refusal (possible boulder/cobble)

CPT-3 to 42.86 ft to refusal (gravel)

CPT-4 to 45.98 ft to refusal (gravel)

Project Manager Comments (if no, provide additional informaton, attach additional sheet if needed)

☒ Yes ○ No Crew followed Instructions provided?

☒ Yes ○ No Communication prior to, during, or after drilling?

☒ Yes ○ No Drilling completed within estimated time?

☒ Yes ○ No Drilling informaton complete?

~5 hours of safety training & access

(to be completed by Crew Chief)
Consumables: Materials and Supplies (item 1068)

Item	Type	Qty	Item	Type	Qty
Well Screens			Redi Mix		
Riser Pipe			Portland Cement		
Couplings			Blacktop Patch		
Caps/Plugs			Thin Wall Tubes		
Protective Casing			Auger Teeth		
Locks			Bentonite	—	166
Bumper Posts			Quick Grout		
Manholes			Steam Clean		
Filter Sand			Per Diem		

(to be completed by Project Manager)
For Cost Plus Project

Item	Description	Qty	Rate	Extension
1087	Mob/DeMob/day			
1004	Per Hr. Charges			
1005	Travel Time			
1007	Per Ft. Charges			
1062	per hr. all-terrain			
1067	Tractor/Lowboy			
1070	Abandonment/ft			
1018	Overtime			
1080	Steam Clean			
1012	Well Installation			
1011	Well mtrls PVC			
1039	Well mtrls iron			
1088	Well screen			
1028	Protect. Posts			
1058	Protective casing			
1022	Thin wall			
1068	Materials/other			

(to be completed by Project Manager)
For Lump Sum Project

		$ per hour per person	
Department	**Amount**	**Reviewed by**	**(initial)**
		Project Manager	
		Drill Coordinator	
		Unit Pricing by PA	

Attach and modify Cost Estimate sheet from PAS if needed

Drilling Complete? ☒ Yes ○ No

Completed form sent to Drilling Coordinator for review.

MINNESOTA DEPARTMENT OF HEALTH
WELL AND BORING SEALING RECORD

Minnesota Statutes, Chapter 103I

Minnesota Well and Boring Sealing No.
Minnesota Unique Well No. or W-series No.
(Leave blank if not known)

H 354440

WELL OR BORING LOCATION

County Name: Goodhue

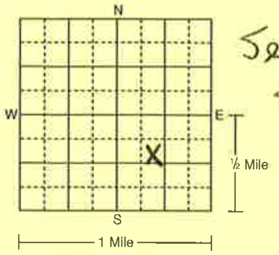
Township Name	Township No.	Range No.	Section No.	Fraction (sm. → lg.)
Welch	113	15	5	SE/NW/SE

GPS LOCATION – decimal degrees (to four decimal places)

Latitude ______ Longitude ______

Numerical Street Address or Fire Number and City of Well or Boring ~~Location~~ 55089
1717 Wakonade Dr

Show exact location of well or boring in section grid with "X."



Sketch map of well or boring location, showing property lines, roads, and buildings.

See attached site plan

Date Sealed: 7/11/18

Date Well or Boring Constructed: 7/11/18

Depth at Time of Sealing 56 ft.

Original Depth 56 ft.

AQUIFER(S)
☒ Single Aquifer ☐ Multiaquifer

WELL/BORING
☐ Water-Supply Well ☐ Monit. Well
☒ Env. Bore Hole ☐ Other ______

STATIC WATER LEVEL
☐ Measured Date Measured 7/11/18 ☑ Estimated
14' ~~NA~~ ft. ☑ below ☐ above land surface

CASING TYPE(S)
☐ Steel ☐ Plastic ☐ Tile ☐ Other NA

WELLHEAD COMPLETION

Outside: ☐ Pitless Adapter/Unit ☐ At Grade ☐ Well Pit ☐ Buried ☐ Other NA

Inside: ☐ Basement Offset ☐ Well House ☐ Well Pit ☐ Buried ☐ Other ______

PROPERTY OWNER'S NAME/COMPANY NAME
Northern States Power

Property owner's mailing address if different than well location address indicated above
1717 Wakonade Dr
Welch, MN 55089

~~WELL~~ OWNER'S NAME/COMPANY NAME
Same as Above

Well owner's mailing address if different than property owner's address indicated above

CASING(S)

Diameter	Depth	Set in oversize hole?	Annular space initially grouted?
NA in. from ______	to ______ ft.	☐ Yes ☐ No	☐ Yes ☐ No ☐ Unknown
______ in. from ______	to ______ ft.	☐ Yes ☐ No	☐ Yes ☐ No ☐ Unknown
______ in. from ______	to ______ ft.	☐ Yes ☐ No	☐ Yes ☐ No ☐ Unknown

SCREEN/OPEN HOLE
Screen from NA to ______ ft. Open Hole from ______ to ______ ft.

OBSTRUCTIONS
☐ Rods/Drop Pipe ☐ Check Valve(s) ☐ Debris ☐ Fill ☐ No Obstruction

Type of Obstructions (Describe) NA

Obstructions removed? ☐ Yes ☐ No Describe ______

GEOLOGICAL MATERIAL	COLOR	HARDNESS OR FORMATION	FROM	TO
If not known, indicate estimated formation log from nearby well or boring.				
Silty Sand			0	12
Silty Clay			12	13
Silty Sand			13	56

PUMP
☐ Not Present ☐ Present, Removed Prior to Sealing ☐ Other ______
Type NA

METHOD USED TO SEAL ANNULAR SPACE BETWEEN 2 CASINGS, OR CASING AND BORE HOLE
☑ No Annular Space Exists ☐ Annular Space Grouted with Tremie Pipe ☐ Casing Perforation/Removal

Casing Diameter
______ in. from ______ to ______ ft. ☐ Perforated ☐ Removed
______ in. from ______ to ______ ft. ☐ Perforated ☐ Removed

Type of Perforator ______

VARIANCE
Was a variance granted from the MDH for this well? ☐ Yes ☑ No TN# ______

GROUTING MATERIAL(S) **(One bag of cement = 94 lbs., one bag of bentonite = 50 lbs.)**

Grouting Material Quik Grout from 2 to 56 ft. ______ yards 1 bags
______ from ______ to ______ ft. ______ yards ______ bags
______ from ______ to ______ ft. ______ yards ______ bags

OTHER WELLS AND BORINGS
Other unsealed and unused well or boring on property? ☐ Yes ☒ No How many? ______

LICENSED OR REGISTERED CONTRACTOR CERTIFICATION
This well or boring was sealed in accordance with Minnesota Rules, Chapter 4725. The information contained in this report is true to the best of my knowledge.

Braun Intertec
Licensee Business Name

1323
License or Registration No.

Greg Scallon
Certified Representative Signature

870
Certified Rep. No.

8-6-18
Date

Adam Holmbo
Name of Person Sealing Well or Boring

REMARKS, SOURCE OF DATA, DIFFICULTIES IN SEALING
CPT-01, 03, 04

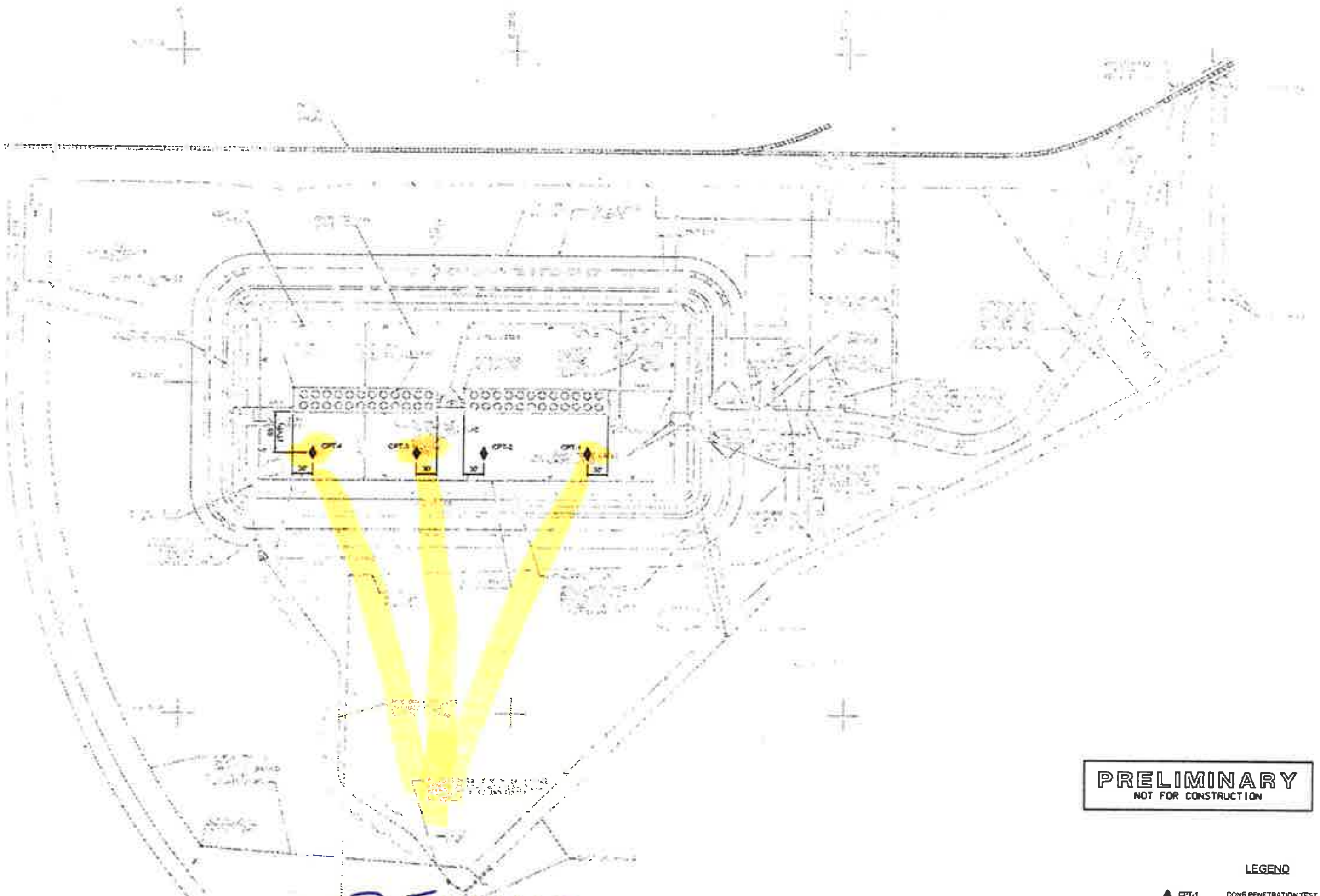
B1806014 Mark Jenkins

IMPORTANT-FILE WITH PROPERTY PAPERS-WELL OWNER COPY

H 354440

HE-01434-15 ID# 53159

8/16R

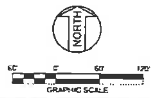


H354440

PRELIMINARY
NOT FOR CONSTRUCTION

LEGEND

◆ CPT-1 CONE PENETRATION TEST LOCATION



UNDERGROUND OR EMBEDDED UTILITIES MAY BE LOCATED WITHIN OR ADJACENT TO THE AREA IN WHICH EXCAVATION, DEMOLITION, FOUNDATION, OR MODIFICATION WORK IS TO BE PERFORMED.

REFERENCES RELATING TO THE UNDERGROUND OR EMBEDDED UTILITIES ARE PROVIDED TO ASSIST THE CONTRACTOR/INSTALLER IN THE FIELD LOCATING THOSE UTILITIES AND OTHER POSSIBLE UNDERGROUND OR EMBEDDED INTERFERENCES WITH THE WORK.

THE CONTRACTOR/INSTALLER SHALL EXERCISE DUE CAUTION DURING ALL EXCAVATION/FOUNDATION/DEMOLITION WORK.

NOTES

1. FOR INFORMATION NOT SHOWN SEE DRAWING NF-120941.

REFERENCE DRAWINGS

NF-120941	INDEPENDENT SPENT FUEL STORAGE INSTALLATION SITE PLAN

HOLD INFORMATION

NO.	DESCRIPTION

CONTRACTOR/INSTALLER SHALL TAKE ALL APPROPRIATE PRECAUTIONS TO ENSURE THE SAFETY OF ALL PEOPLE LOCATED ON THE WORK SITE, INCLUDING CONTRACTOR'S/INSTALLER'S PERSONNEL (OR THAT OF ITS SUB-CONTRACTOR(S)) PERFORMING THE WORK.

RELEASE INFORMATION

REV.	DATE	DESCRIPTION
A	05-31-2018	FOR BID

ISSUE PURPOSE: BID
SPECIFICATION: --
PROJECT NO.: 13385-051

CAD FILE NAME: P1500-1.DGN
PREPARED BY: A. PAAPE
REVIEWED BY: D. KOCUNIK
APPROVED BY: --

ANY MODIFICATION OR ADDITION TO THIS DRAWING BY AN ORGANIZATION OTHER THAN SARGENT & LUNDY, IS NOT THE RESPONSIBILITY OF SARGENT & LUNDY.

Sargent & Lundy LLC

SARGENT & LUNDY LLC
55 EAST MONROE STREET
CHICAGO, ILLINOIS 60603-5780

PROJECT

PRAIRIE ISLAND NUCLEAR
GENERATING PLANT

WELCH, MINNESOTA

DRAWING TITLE

CONE PENETRATION
TESTING LOCATION PLAN

DRAWING NUMBER	REVISION
EXHIBIT P1500-1	A
SHEET OF	

5/31/2018 7:51:05 AM ...\drawings\exhibit p1500-1.dgn

2011185/0p2962/m4Sn1!
Form GDC-0401-01-08, AHS: (Imperial) MicroStation Border - Size E - 34 x 44
Revision 11A, Revision Date: 04-30-2010

BRAUN
INTERTEC
The Science You Build On.

Braun Intertec Corporation
11001 Hampshire Avenue S
Minneapolis, MN 55438

Phone: 952.995.2000
Fax: 952.995.2020
Web: braunintertec.com

August 17, 2021 Project B2102952

Mr. Wesley Jacobs
Westinghouse Electric Company
PO Box 3700
Pittsburgh, PA 15230

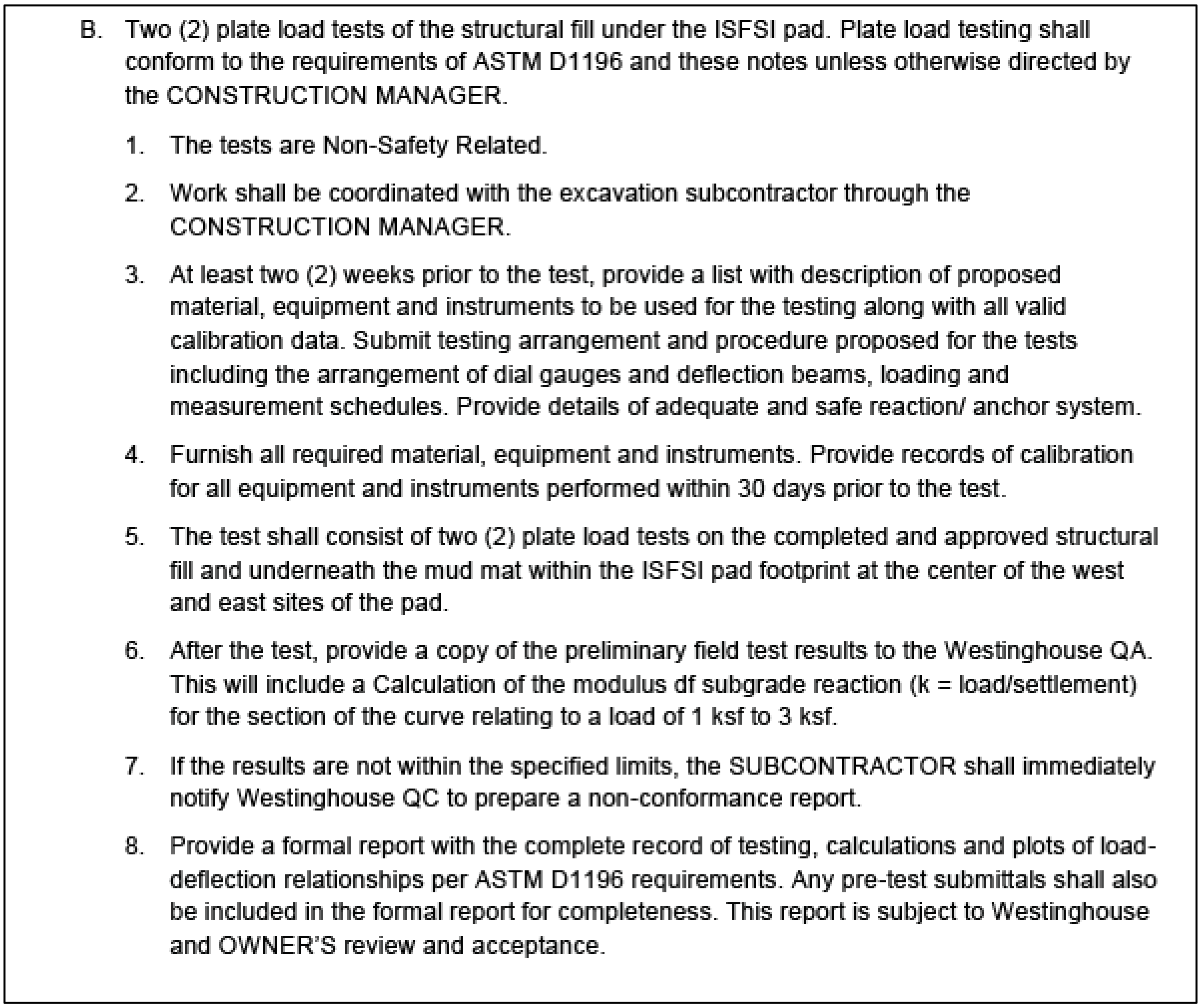
Re: Plate Load Test Results
ISFSI Expansion
Prairie Island
1717 Wakonade Drive
Welch, Minnesota

Dear Mr. Jacobs:

We are pleased to present the results of the plate load testing that has been completed for the ISFSI expansion project in Welch, Minnesota. This letter documents the procedures we used and the data we have collected.

Background Information

The purpose of our testing was to provide the load test on the subgrades as requested. The plate load testing was performed according to specifications prepared by Westinghouse. An excerpt from the specifications is shown below:



B. Two (2) plate load tests of the structural fill under the ISFSI pad. Plate load testing shall conform to the requirements of ASTM D1196 and these notes unless otherwise directed by the CONSTRUCTION MANAGER.

1. The tests are Non-Safety Related.
2. Work shall be coordinated with the excavation subcontractor through the CONSTRUCTION MANAGER.
3. At least two (2) weeks prior to the test, provide a list with description of proposed material, equipment and instruments to be used for the testing along with all valid calibration data. Submit testing arrangement and procedure proposed for the tests including the arrangement of dial gauges and deflection beams, loading and measurement schedules. Provide details of adequate and safe reaction/ anchor system.
4. Furnish all required material, equipment and instruments. Provide records of calibration for all equipment and instruments performed within 30 days prior to the test.
5. The test shall consist of two (2) plate load tests on the completed and approved structural fill and underneath the mud mat within the ISFSI pad footprint at the center of the west and east sites of the pad.
6. After the test, provide a copy of the preliminary field test results to the Westinghouse QA. This will include a Calculation of the modulus df subgrade reaction (k = load/settlement) for the section of the curve relating to a load of 1 ksf to 3 ksf.
7. If the results are not within the specified limits, the SUBCONTRACTOR shall immediately notify Westinghouse QC to prepare a non-conformance report.
8. Provide a formal report with the complete record of testing, calculations and plots of load-deflection relationships per ASTM D1196 requirements. Any pre-test submittals shall also be included in the formal report for completeness. This report is subject to Westinghouse and OWNER'S review and acceptance.

Procedures

As requested, we traveled to the site and performed testing at locations selected by Westinghouse personnel on the prepared pad. The plate load test apparatus included some of the following equipment:

- 1-inch thick, circular bearing plate in sizes of 12 inches, 18 inches, 24 inches and 30 inches.
- 100-ton hydraulic loading assembly (including hydraulic jack, hoses, spherical bearing and electric hydraulic pump), Part Number 5329.
- 20-foot reference beam for displacement measurements with stands.

- Three digital displacement sensors, or Linear Variable Differential Transformer (LVDT), item Numbers 32820, 32821, 20021 with Digital Data Acquisition (DAQ) System.
- Load cell, number 43559.
- Thermometer, number 42642.

Calibrations information for the equipment is attached.

The load tests were performed by placing the hydraulic jack in line with a resistance weight and grillage totaling a reported 140,808 pounds (not including stands) to resist the force of the system, provided by others. Stands were placed 8 feet away. The actual loading point was chosen based on access and centered between the support stands. A photograph illustrating the setup is shown below.

Photograph 1. Test Setup at Location 1

Photograph 2. Test Setup at Location 2

The testing procedure included the following:

- Spread tarps across the ground.
- Setup of the reaction measurement beam stand were located 8 feet from the bearing plate.
- Setting of the load plate using sand as needed to create level, uniform bearing.
- Setup ram, spacers, and load cell.
- Setup of the LVDT – three at equally spaced locations with same offset.
- Initialization of the DAQ.
- Pre-loading the bearing plate to achieve “zero” (ASTM 1196 – 5.4).
- Apply test loads at 5 kips, 10 kips and additional 10-kip increments to 120 kips.

- At each increment, hold the test load for a duration of approximately 5 minutes, so that the rate of deflection is at or below 0.001 inches/minute for 3 minutes. Manually record load and deflection at each increment.

- Release the load to zeroing load, and record deflection after deflections are at a stable value below 0.001 inches/minute for 3 minutes.

Data from each sensor and the current time is recorded at a sampling rate of once per 10 seconds for the entire duration of the test using the DAQ. The second test did not have the data electronically recorded. Comparing hand recorded to the electronically recorded data on the first test, they were within 0.5 percent of the calculated subgrade modulus.

Results

The tests were performed on August 12 as requested by Westinghouse. The tests were performed by Braun Intertec staff Belick Pha, assisted by Arik Westberg and observed by representatives of Xcel, Westinghouse and Sargent Lundy. The qualifications for Ms. Pha are attached.

Environmental conditions at the location of the tests generally matched ambient weather conditions at the time of the testing with weather mostly sunny with temperatures in the low 80s. Winds did increase in the afternoon, which can result in some “noise” in the data, but we did not see apparent changes in data. The tests indicate the sand was starting to fail at higher loads as noted by the creep in the data where movements were above the 0.001 inches/3-minute criteria.

The tests were performed on a subgrade of recycled aggregate base. The locations of the tests are shown in the attached sketch.

Test 1 was performed at approximately 12 pm to 1 pm. There were no significant irregularities to the routine procedure, or unusual observations during the test.

Test 2 was performed at approximately 3 pm to 4 pm. There were no significant unusual conditions or unusual observations during the test. The data was not recorded digitally, so only manual written records are available. The ASTM does not require digital recording, so the test results are still in accordance with ASTM standard.

The results of the plate load testing are attached to this report, and are summarized as follows:

- Location 1, subgrade modulus over 1 ksf (kips per square foot) to 3 ksf, 272 psi/in
- Location 1, subgrade modulus over test range, 321 psi/in
- Location 2, subgrade modulus over 1 ksf to 3 ksf, 232 psi/in
- Location 2, subgrade modulus over test range, 334 psi/in

Remarks

We note that results of plate load testing will vary with soil type, relative density, and soil moisture content. Results of plate load testing can vary with time. These factors should be taken into account as part of your design. This test does not constitute an evaluation or acceptance of subgrade conditions.

In performing its services, Braun Intertec used the degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality. No warranty, express or implied, is made.

We appreciate the opportunity to provide testing services for this project. If you have questions or if we can be of further assistance, please contact Chris Kehl at 612.282.6513 or ckehl@braunintertec.com.

Sincerely,

BRAUN INTERTEC CORPORATION

Belick Pha, EIT
Staff Engineer

Christopher R. Kehl, PE
Vice President, Principal Engineer

Attachments:
Calibration Records for Equipment
Cover Letter and Performance Qualifications for Belick Pha
Plate Load Test Location Sketch
Plate Load Test Results 1 and 2

Calibration Certificate

Date: 8/11/2021 **Certificate #: 288173**

Calibration Performed By:

BRAUN INTERTEC
The Science You Build On.

11001 Hampshire Ave S
Bloomington, MN 55438
Phone: 952-995-2000

Client:

BRAUN INTERTEC
DALLAS MINER
11001 HAMPSHIRE AVENUE SOUTH
BLOOMINGTON, MN 55438

Equipment Information

Braun I.D.:	05329	Client I.D.:	
Description:	100 TON HYDRAULIC RAM FOR LOAD FRAI	Serial Number:	
Manufacturer:	SPX POWER TEAM	Model Number:	C10010C MODEL B
Equipment Type:	HYDRAULIC	Sub-type:	RAM
Temperature:	75 F Rel. Humidity: 44 %	Performed by:	EKNUDSON
Calibration Date:	8/11/2021	Calibration Result:	LTD.
Last Cal Date:	7/15/2021	Due Date:	8/11/2022
Client PO # :		Calibration Interval:	12 months
Assigned to:		Calibration Location:	BL MML

Calibration Notes or Opinions

Y=20X+2759 Error greater than 1% at 1,000 psi
Valid only with pressure gauge ID 05329

Test Data

Seq.	Description	Standard	Tolerance -	Tolerance +	As Found	As Left	Unit	Result	Unc
1	Load at 1000 psi	0	0	0	23173	23173	lb	Limited	3600 lb
2	Load at 2000 psi	0	0	0	43098	43098	lb	Pass	3600 lb
3	Load at 3000 psi	0	0	0	62380	62380	lb	Pass	3600 lb
4	Load at 4000 psi	0	0	0	82513	82513	lb	Pass	3600 lb
5	Load at 5000 psi	0	0	0	102025	102025	lb	Pass	3600 lb
6	Load at 6000 psi	0	0	0	122398	122398	lb	Pass	3600 lb
7	Load at 7000 psi	0	0	0	142420	142420	lb	Pass	3600 lb
8	Load at 8000 psi	0	0	0	162750	162750	lb	Pass	3600 lb
9	Load at 9000 psi	0	0	0	183125	183125	lb	Pass	3600 lb

Standards Used To Calibrate Equipment

I.D.	Serial #	Manufacturer	Description	Calibration Vendor	Cal Date	Due Date
01573	PASSWORD	TINIUS OLSEN	COMPRESSION MACHINE	BRAUN INTERTEC	8/27/2020	8/27/2021

Braun Intertec Procedures Used In This Event:

3.6.IV.17 HYDRAULIC RAMS - MS WORD.docx

Calibration Certificate

Date: 8/11/2021 **Certificate #: 288173**

Work Approved by:

Erik Knudson

CALIBRATION TECHNICIAN

A2LA Certificate # 3940.01

Remarks:

This piece of equipment was calibrated according to the manufacturer specification, or industry recognized standard specification. The calibration was conducted using standards traceable to the SI through the NIST or other NMI.

Reference equipment traceability has been established through other ISO/IEC 17025 accredited calibration laboratories. Uncertainty shown is total accumulated uncertainty for the corresponding measurements at a confidence level of 95%. Uncertainty may be greater than the listed CMC when calibrations are performed in the client facilities or on client equipment. There is no warranty that the equipment will remain within tolerance until the next scheduled calibration date due to influences beyond our control. This certificate shall not be reproduced without the consent of the calibration laboratory.

Uncertainty has not been taken into account in the determination of whether the device meets the stated tolerances.

*** Indicates test result that does not fall under the laboratory accreditation.

Calibration Certificate

Date: 8/6/2021 **Certificate #: 287952**

Calibration Performed By:

BRAUN INTERTEC
The Science You Build On.

11001 Hampshire Ave S
Bloomington, MN 55438
Phone: 952-995-2000

Client:

BRAUN INTERTEC
DALLAS MINER
11001 HAMPSHIRE AVENUE SOUTH
BLOOMINGTON, MN 55438

Equipment Information

Braun I.D.: 20021
Description: LVDT 2 INCH
Manufacturer: MEASUREMENTS GROUP INC.
Equipment Type: LVDT
Temperature: 70 F Rel. Humidity: 50 %
Calibration Date: 7/19/2021
Last Cal Date: 12/3/2020
Client PO # :
Assigned to:

Client I.D.:
Serial Number: 50801270
Model Number: HS50
Sub-type: LVDT 2 INCH
Performed by: EKNUDSON
Calibration Result: PASS
Due Date: 7/19/2022
Calibration Interval: 12 months
Calibration Location: BLMML

Calibration Notes or Opinions

Valid only with model P3 SN 216039
Full Scale = 2 , 3.52 MV/V

Test Data

Seq.	Description	Standard	Tolerance -	Tolerance +	As Found	As Left	Unit	Result	Unc
1	0 inch	0.000	0.000	0.000	0.000	0.000	inch	Pass	190µin
2	0.20 inch	0.500	0.495	0.505	0.499	0.499	inch	Pass	190µin
3	0.40 inch	1.000	0.990	1.010	0.998	0.998	inch	Pass	190µin
4	0.60 inch	1.500	1.485	1.515	1.499	1.499	inch	Pass	190µin
5	0.80 inch	2.000	1.980	2.020	2.002	2.002	inch	Pass	190µin

Standards Used To Calibrate Equipment

I.D.	Serial #	Manufacturer	Description	Calibration Vendor	Cal Date	Due Date
00791	0568	BROWN & SHARPE	GAUGE BLOCKS	PRODUCTIVITY QUALITY INC	7/24/2020	7/24/2021

Braun Intertec Procedures Used In This Event:

3.6.IV.26 LVDTS - MS WORD.docx

Work Approved by:

Erik Knudson
CALIBRATION TECHNICIAN

A2LA ACCREDITED

A2LA Certificate # 3940.01

Remarks:

This piece of equipment was calibrated according to the manufacturer specification, or industry recognized standard specification. The calibration was conducted using standards traceable to the SI through the NIST or other NMI.

Reference equipment traceability has been established through other ISO/IEC 17025 accredited calibration laboratories. Uncertainty shown is total accumulated uncertainty for the corresponding measurements at a confidence level of 95%.

Uncertainty may be greater than the listed CMC when calibrations are performed in the client facilities or on client equipment. There is no warranty that the equipment will remain within tolerance until the next scheduled calibration date due to influences beyond our control. This certificate shall not be reproduced without the consent of the calibration laboratory.

Uncertainty has not been taken into account in the determination of whether the device meets the stated tolerances.

*** Indicates test result that does not fall under the laboratory accreditation.

Calibration Certificate

Date: 8/6/2021 **Certificate #: 287949**

Calibration Performed By:

BRAUN INTERTEC
The Science You Build On.

11001 Hampshire Ave S
Bloomington, MN 55438
Phone: 952-995-2000

Client:

BRAUN INTERTEC
FAITH WALTERS
4770 WASHINGTON BLVD
BEAUMONT, TX 77704

Equipment Information

Braun I.D.:	43559	Client I.D.:	
Description:	LOAD CELL	Serial Number:	1532444
Manufacturer:	GEOKON	Model Number:	3000-400-4
Equipment Type:	LOAD CELL	Sub-type:	LOAD CELL
Temperature:	72 F Rel. Humidity: 45 %	Performed by:	EKNUDSON
Calibration Date:	7/14/2021	Calibration Result:	PASS
Last Cal Date:		Due Date:	7/14/2022
Client PO # :		Calibration Interval:	12 months
Assigned to:		Calibration Location:	BL MML

Calibration Notes or Opinions

Calibration only valid with Geokon GK502 indicator SN1532444
GF= 67.41 lb/dg

Standards Used To Calibrate Equipment

I.D.	Serial #	Manufacturer	Description	Calibration Vendor	Cal Date	Due Date
00848	195	LEBOW	CLASS A RANGE 18K-500K	NATIONAL STANDARDS	7/19/2019	7/19/2021
34659	J96135	INTERFACE	INDICATOR	NATIONAL STANDARDS	7/19/2019	7/19/2021

Braun Intertec Procedures Used In This Event:

3.6.IV.10 LOAD VERIFICATION OF TESTING MACHINES - MS WORD.docx

Work Approved by:

Erik Knudson
CALIBRATION TECHNICIAN

A2LA Certificate # 3940.01

ACCREDITED

Remarks:

This piece of equipment was calibrated according to the manufacturer specification, or industry recognized standard specification. The calibration was conducted using standards traceable to the SI through the NIST or other NMI.

Reference equipment traceability has been established through other ISO/IEC 17025 accredited calibration laboratories. Uncertainty shown is total accumulated uncertainty for the corresponding measurements at a confidence level of 95%. Uncertainty may be greater than the listed CMC when calibrations are performed in the client facilities or on client equipment. There is no warranty that the equipment will remain within tolerance until the next scheduled calibration date due to influences beyond our control. This certificate shall not be reproduced without the consent of the calibration laboratory.

Uncertainty has not been taken into account in the determination of whether the device meets the stated tolerances.

*** Indicates test result that does not fall under the laboratory accreditation.

BRAUN
INTERTEC
The Science You Build On.

Calibration Test/Data Sheet

Equipment Information

Certificate Number: 287296
Braun I.D.: 43559
Manufacturer: GEOKON
Equipment Type: LOAD CELL
Client I.D.: BRAUN BEAUMONT
Serial Number: 1532444
Model Number: 3000-400-4
Capacity: 400K Load
Calibration Location: BL MML
Calibration Date: 7/14/2021

Test Data

Seq. 1	Description	Standard	Tolerance -	Tolerance +	As Found	Error	As Left Run1	Error	As Left Run 2	Error	Repeatability	Resolution	Unit lb	Result	Uncertainty
1	0 lb	0	0	0	60	60(NA%)	45	45(NA%)	115	115(NA%)	NA	0	lb	Adjusted	0 lb
2	40000 lb	40000	39600	40400	43580	3580(9%)	39783	-217(-0.5%)	39755	-245(-0.6%)	0.1	0	lb.	Adjusted	1100 lb
3	80000 lb	80000	79200	80800	88549	8549(10.7%)	80396	396(0.5%)	80421	421(0.5%)	0.0	0	lb	Adjusted	1100 lb
4	120000 lb	120000	118800	121200	133612	13612(11.3%)	121078	1078(0.9%)	120990	990(0.8%)	0.1	0	lb	Adjusted	1100 lb
5	160000 lb	160000	158400	161600	178334	18334(11.5%)	161452	1452(0.9%)	161501	1501(0.9%)	0.0	0	lb	Adjusted	1100 lb
6	200000 lb	200000	198000	202000	221540	21540(10.8%)	201665	1665(0.8%)	201643	1643(0.8%)	0.0	0	lb	Adjusted	1100 lb
9	240000 lb	240000	237600	242400	265350	25350(10.6%)	241427	1427(0.6%)	241509	1509(0.6%)	0.0	0	lb	Adjusted	1100 lb
10	280000 lb	280000	277200	282800	307550	27550(9.8%)	281552	1552(0.6%)	281475	1475(0.5%)	0.0	0	lb	Adjusted	1100 lb
11	320000 lb	320000	316800	323200	354160	34160(10.7%)	321453	1453(0.5%)	321440	1440(0.5%)	0.0	0	lb	Adjusted	1100 lb
12	360000 lb	360000	356400	363600	397550	37550(10.4%)	361442	1442(0.4%)	361335	1335(0.4%)	0.0	0	lb	Adjusted	1100 lb
13	400000 lb	400000	396000	404000	441960	41960(10.5%)	401460	1460(0.4%)	401491	1491(0.4%)	0.0	0	lb	Adjusted	1100 lb
15	0 lb	0	0	0	-31	-31(NA%)	115	115(NA%)	-43	-43(NA%)	NA	0	lb	Adjusted	0 lb
										Maximum Error	1665(0.8%)		lb		

This calibration was completed in accordance with ASTM E4-2016.

Calibration Certificate

Date: 8/11/2021 **Certificate #: 288164**

Calibration Performed By:

BRAUN INTERTEC
The Science You Build On.

11001 Hampshire Ave S
Bloomington, MN 55438
Phone: 952-995-2000

Client:

BRAUN INTERTEC
DALLAS MINER
11001 HAMPSHIRE AVENUE SOUTH
BLOOMINGTON, MN 55438

Equipment Information

Braun I.D.: 32820

Description: LVDT +-2 INCH

Manufacturer: VISHAY

Equipment Type: LVDT

Temperature: 75 F Rel. Humidity: 48 %

Calibration Date: 7/15/2021

Last Cal Date: 11/19/2020

Client PO # :

Assigned to:

Client I.D.:

Serial Number: 50906719

Model Number: HS100

Sub-type: LVDT +-2 INCH

Performed by: EKNUDSON

Calibration Result: PASS

Due Date: 7/15/2022

Calibration Interval: 12 months

Calibration Location: BL MML

Calibration Notes or Opinions

Valid only with model P3 sn 216039
Full scale = 4, 4.586 mv/v on channel 2

Test Data

Seq.	Description	Standard	Tolerance -	Tolerance +	As Found	As Left	Unit	Result	Unc
1	0	0.000	0.000	0.000	0.000	0.000	inch	Pass	190 µin
2	1	1.000	0.990	1.010	0.998	0.998	inch	Pass	190 µin
3	2	2.000	1.980	2.020	2.005	2.005	inch	Pass	190 µin
4	3	3.000	2.970	3.030	3.025	3.025	inch	Pass	190 µin
5	4	4.000	3.960	4.040	4.023	4.023	inch	Pass	190 µin

Standards Used To Calibrate Equipment

I.D.	Serial #	Manufacturer	Description	Calibration Vendor	Cal Date	Due Date
00791	0568	BROWN & SHARPE	GAUGE BLOCKS	PRODUCTIVITY QUALITY INC	8/4/2020	

Braun Intertec Procedures Used In This Event:

3.6.IV.26 LVDTS - MS WORD.docx

Work Approved by:

Erik Knudson
CALIBRATION TECHNICIAN

A2LA Certificate # 3940.01

Remarks:

This piece of equipment was calibrated according to the manufacturer specification, or industry recognized standard specification. The calibration was conducted using standards traceable to the SI through the NIST or other NMI.

Reference equipment traceability has been established through other ISO/IEC 17025 accredited calibration laboratories. Uncertainty shown is total accumulated uncertainty for the corresponding measurements at a confidence level of 95%. Uncertainty may be greater than the listed CMC when calibrations are performed in the client facilities or on client equipment. There is no warranty that the equipment will remain within tolerance until the next scheduled calibration date due to influences beyond our control. This certificate shall not be reproduced without the consent of the calibration laboratory.

Uncertainty has not been taken into account in the determination of whether the device meets the stated tolerances.

*** Indicates test result that does not fall under the laboratory accreditation.

Calibration Certificate

Date: 8/11/2021

Certificate #: 288163

Calibration Performed By:

BRAUN
INTERTEC
The Science You Build On.

11001 Hampshire Ave S
Bloomington, MN 55438
Phone: 952-995-2000

Client:

BRAUN INTERTEC
DALLAS MINER
11001 HAMPSHIRE AVENUE SOUTH
BLOOMINGTON, MN 55438

Equipment Information

Braun I.D.: 32821
Description: LVDT +-2 INCH
Manufacturer: VISHAY
Equipment Type: LVDT
Temperature: 76 F Rel. Humidity: 45 %
Calibration Date: 7/15/2021
Last Cal Date: 11/19/2020
Client PO # :
Assigned to:

Client I.D.:
Serial Number: 50906718
Model Number: HS100
Sub-type: LVDT +-2 INCH
Performed by: EKNUDSON
Calibration Result: PASS
Due Date: 7/15/2022
Calibration Interval: 12 months
Calibration Location: BL MML

Calibration Notes or Opinions

Valid only with model P3 SN 216039
Full scale = 4, 4.560 mv/v full scale channel 1

Test Data

Seq.	Description	Standard	Tolerance -	Tolerance +	As Found	As Left	Unit	Result	Unc
1	0	0.000	0.000	0.000	0.000	0.000	inch	Pass	190 µin
2	1	1.000	0.990	1.010	1.001	1.001	inch	Pass	190 µin
3	2	2.000	1.980	2.020	2.007	2.007	inch	Pass	190 µin
4	3	3.000	2.970	3.030	3.024	3.024	inch	Pass	190 µin
5	4	4.000	3.960	4.040	4.037	4.037	inch	Pass	190 µin

Standards Used To Calibrate Equipment

I.D.	Serial #	Manufacturer	Description	Calibration Vendor	Cal Date	Due Date
00791	0568	BROWN & SHARPE	GAUGE BLOCKS	PRODUCTIVITY QUALITY INC	8/4/2020	

Braun Intertec Procedures Used In This Event:

3.6.IV.26 LVDTS - MS WORD.docx

Work Approved by:

Erik Knudson
CALIBRATION TECHNICIAN

A2LA ACCREDITED

A2LA Certificate # 3940.01

Remarks:

This piece of equipment was calibrated according to the manufacturer specification, or industry recognized standard specification. The calibration was conducted using standards traceable to the SI through the NIST or other NMI.

Reference equipment traceability has been established through other ISO/IEC 17025 accredited calibration laboratories. Uncertainty shown is total accumulated uncertainty for the corresponding measurements at a confidence level of 95%.

Uncertainty may be greater than the listed CMC when calibrations are performed in the client facilities or on client equipment. There is no warranty that the equipment will remain within tolerance until the next scheduled calibration date due to influences beyond our control. This certificate shall not be reproduced without the consent of the calibration laboratory.

Uncertainty has not been taken into account in the determination of whether the device meets the stated tolerances.

*** Indicates test result that does not fall under the laboratory accreditation.

Calibration Certificate

Date: 2/26/2021 **Certificate #: 276584**

Calibration Performed By:

BRAUN INTERTEC
The Science You Build On.

11001 Hampshire Ave S
Bloomington, MN 55438
Phone: 952-995-2000

Client:

BRAUN EQUIPMENT BLOOMINGTON
DANA WATSON
11001 HAMPSHIRE AVE S
BLOOMINGTON, MN 55438

Equipment Information

Braun I.D.: 42642
Description: LOLLIPOP MAX-MIN
Manufacturer: DELTATRAK
Equipment Type: TEMPERATURE INDICATOR
Temperature: 70 F Rel. Humidity: 50 %
Calibration Date: 2/26/2021
Last Cal Date:
Client PO # :
Assigned to:

Client I.D.:
Serial Number:
Model Number: LOLLIPOP 11050REV
Sub-type: DIGITAL
Performed by: LCAAMANO
Calibration Result: PASS
Due Date: 2/26/2022
Calibration Interval: 12 months
Calibration Location: CLIENT FACILITY

Calibration Notes or Opinions

Test Data

Seq.	Description	Standard	Tolerance -	Tolerance +	As Found	As Left	Unit	% Error	Result	Unc
1	Temperature 1	70.0	69.0	71.0	69.6	69.6	F	-0.57	Pass	0.5 F
2	Temperature 2	100.0	99.0	101.0	100.2	100.2	F	0.2	Pass	0.5 F

Standards Used To Calibrate Equipment

I.D.	Serial #	Manufacturer	Description	Calibration Vendor	Cal Date	Due Date
00641	G54022	VWR	TEMPERATURE INDICATOR	BRAUN INTERTEC	1/6/2021	1/6/2022
29786	D17251489	THERMOWORKS	TEMPERATURE GAUGE	NORTHERN BALANCE	7/28/2020	7/28/2021

Braun Intertec Procedures Used In This Event:

3.6.IV.19 THERMOMETERS - MS WORD.docx

Work Approved by:

Lenit Caamano

A2LA Certificate # 3940.01

A2LA ACCREDITED

Remarks:

This piece of equipment was calibrated according to the manufacturer specification, or industry recognized standard specification. The calibration was conducted using standards traceable to the SI through the NIST or other NMI.

Reference equipment traceability has been established through other ISO/IEC 17025 accredited calibration laboratories. Uncertainty shown is total accumulated uncertainty for the corresponding measurements at a confidence level of 95%. Uncertainty may be greater than the listed CMC when calibrations are performed in the client facilities or on client equipment. There is no warranty that the equipment will remain within tolerance until the next scheduled calibration date due to influences beyond our control. This certificate shall not be reproduced without the consent of the calibration laboratory.

Uncertainty has not been taken into account in the determination of whether the device meets the stated tolerances.

*** Indicates test result that does not fall under the laboratory accreditation.

BRAUN
INTERTEC
The Science You Build On.

Braun Intertec Corporation
11001 Hampshire Avenue S
Minneapolis, MN 55438

Phone: 952.995.2000
Fax: 952.995.2020
Web: braunintertec.com

July 21, 2021 Project B2102952

Mr. Jamison Marsh
Westinghouse Electric Company
164 E. Mount Gallant Road
Rock Hill, SC 29732

Re: Plate Load Testing Qualifications
Belick Pha

Dear Mr. Marsh:

This letter is to provide you with our documentation of Plate Load Testing qualifications for Belick Pha. At Braun Intertec, our staff conducts Plate Load Testing following our internal Plate Load Testing SOP based on ASTM D1196, which is attached to this letter. Ms. Pha has been trained in performing Plate Load Testing based on our SOP and demonstrated an understanding of the procedure. She is a GeoEngineering Graduate of the University of Minnesota and has approximately 8 years of experience with engineering consulting firms and the Minnesota Department of Transportation. She has performed this test on the following projects:

- Interior concrete slab testing for Lakeview Industries, Carver, MN
- Interior concrete slab testing for Lloyds warehouse, Savage, MN
- Interior concrete slab testing for QA1 Facility, Lakeville, MN
- Interior and exterior concrete slab and foundations testing for Greenfield Nitrogen, LLC Plant, Garner, IA

Having successfully demonstrated performing static load testing in the field and an understanding of the plate load testing procedures, set up and performance of the testing as demonstrated in our facilities, we consider Ms. Pha to be an appropriate staff member to perform the plate load testing for this project and she will be working under the direction of a Licensed Engineer in the State of Minnesota.

Upon completion of the testing, the data will be reduced by an engineer and reviewed by senior staff. We will issue the results in a letter signed by a professional engineer with experience in reviewing and interpreting plate load test results.

Sincerely,

BRAUN INTERTEC CORPORATION

Christopher R. Kehl, PE
Vice President, Principal Engineer

Attachments:
ASTM D1196-12 Plate Load Bearing Test – Standard Operating Procedure – Revised for the Prairie Island Pad Expansion Project

BRAUN INTERTEC	**Quality Manual** **Materials Laboratory**	**Creation Date:** **2014**	**Issue Date:** **7/14/21**	**Rev.:** **5**
Reviewed & Approved by:	**Christopher R. Kehl, PE**	**Date Reviewed:**	**7/14/2021**	
ASTM D1196-12	**Plate Load Bearing Test – Prairie Island ISFSI Pad**		**Page 1 of 2**	

ASTM D1196-12

Background Information

The purpose of our testing is to provide the load test on the subgrades as requested. We will perform the plate load test (PLT) in general accordance with ASTM D1196, the project's plans and specifications, and the procedures described herein.

Equipment

The PLT apparatus we will use is composed of the following:

- 12-inch circular steel, 1-inch thick bearing plate.
- 18-inch circular steel, 1-inch thick bearing plate.
- 24-inch circular steel, 1-inch thick bearing plate.
- 30-inch circular steel, 1-inch thick bearing plate.
- Spherical bearing 100-ton hydraulic loading assembly (including hydraulic jack, hoses, and electric hydraulic pump), calibrated within 30 days of the test.
- 18-foot reference beam for displacement measurements.
- Three calibrated digital displacement sensors (LVDTs) with accuracy to 0.001 inches.
- A calibrated load cell.
- A digital or analog pressure gauge.
- Digital Data Acquisition (DAQ) System.
- Thermometer
- Tarp

Procedures

We will perform the PLT by placing the hydraulic jack and load cell in line with the contractor-provided reaction system. The reaction system provided by Vic's Crane and Heavy Haul will consist of 8 weights on top of a grillage weldment totaling 140.8 kips supported by stands at two ends of the assembly.

The general testing procedure included the following:

- Place the tarp over the test area.
- Setup of the reaction measurement beam.
- Setting of the load plate using small amount of silica sand to create uniform bearing. A series of four plates will be used with the lower-most plate consisting of a 30-inch diameter plate, telescoping up with each subsequent plate being 6 inches smaller in diameter. All plates will be 1-inch thick.
- Setup of the displacement sensors – three sensors evenly spaced on the plate with the same offsets.
- Initialization of the DAQ.
- Record an initial air temperature reading and record additional air temperature readings at 1/2-hour intervals.
- Pre-loading the bearing plate to achieve "zero" (ASTM 1196 – 5.4).

- Increase the test load to 5 kips for the first increment, 10 kips for the second increment, and then continue 10-kip increments (or less if directed by the owner's site representative) until either the maximum load is achieved or 1-inch of deflection has occurred.
- At each increment, hold the test load until a rate of deflection of not more than 0.001 in/min occurs for 3 min consecutively.
- At the final load increment (1-inch of deflection or 120 kips of load), hold the test load until deflections have stabilized (ASTM 1196-5.5).
- Release the load.

Data from each sensor (three LVDTs measuring deflection and one load cell measuring load) and the current time is recorded at a sampling rate of once per second for the duration of the test using the DAQ.

The test will be repeated at the second location with the same plate and sensor setup, immediately after the first test.

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Plate Load Test Performance Qualifications

ASTM D1196 -12

Prework

☒ ASTM D1196 -12 Link

☒ SOP for ASTM D1196 -12 Link

☒ Review of supplies and equipment from SOP including current calibrations

Task Items

☒ Review safety concerns- Hydraulics, loads over head

☒ Review specifcation and testing requirements,
Loads increments, timing, plate size, Modulus required, number of tests

☒ Review soil conditions on site and how they may impact test results
Saturation, Frozen, Gravel Content Cohesive/ cohesion

☒ Review site access, coordination of the load and

Do they understand the procedures/basis related to:

- ☒ ▪ Review reaction set up, sufficient load, sufficient separation from reaction beam to test location, to tires of load. Evaluate location of reaction load application to the vehicle structure
- ☒* ▪ Setting of the load plate using small amount of silica sand to create uniform bearing. Level with spirt level.
- ☒* ▪ Set of plates as required by testing protocol. Plates should telescope up with each subsequent plate being 6-inches smaller in diameter. All plates will be one-inch thick.
- ☒ ▪ Setup of the displacement sensors – two to three sensors evenly spaced on the plate with the equal offsets.
- ☒** ▪ Connect wires on DAQ and review cables for damage. Initialization of the DAQ, confirm data collection.
- ☒ ▪ Pre-loading the bearing plate to achieve "zero" (ASTM 1196 – 5.4).
- ☒ ▪ Increase the test load to five kips for the first increment, 10 kips for the second increment, and then continue 10 kip increments (or less if directed by the owner's site representative) until either the maximum load is achieved or 1-inch of deflection has occurred.
- ☒ ▪ At each increment, hold the test load for a duration of approximately 5 minutes and until the deflection measurements are less than 0.001 inches for 3 consecutive minutes.
- ☒ ▪ At the final load increment (1-inch of deflection or target load), hold the test load until deflections have stabilized (ASTM 1196-5.5).
- ☒ ▪ Release the load, repeat the test

☒ Review reporting, data analysis and presentation

Review of the individual performing the testing: Meets

Comments:-

* Telescoping plates were not used during training. **

OMEGA data logger used in training has been replaced with the P3.

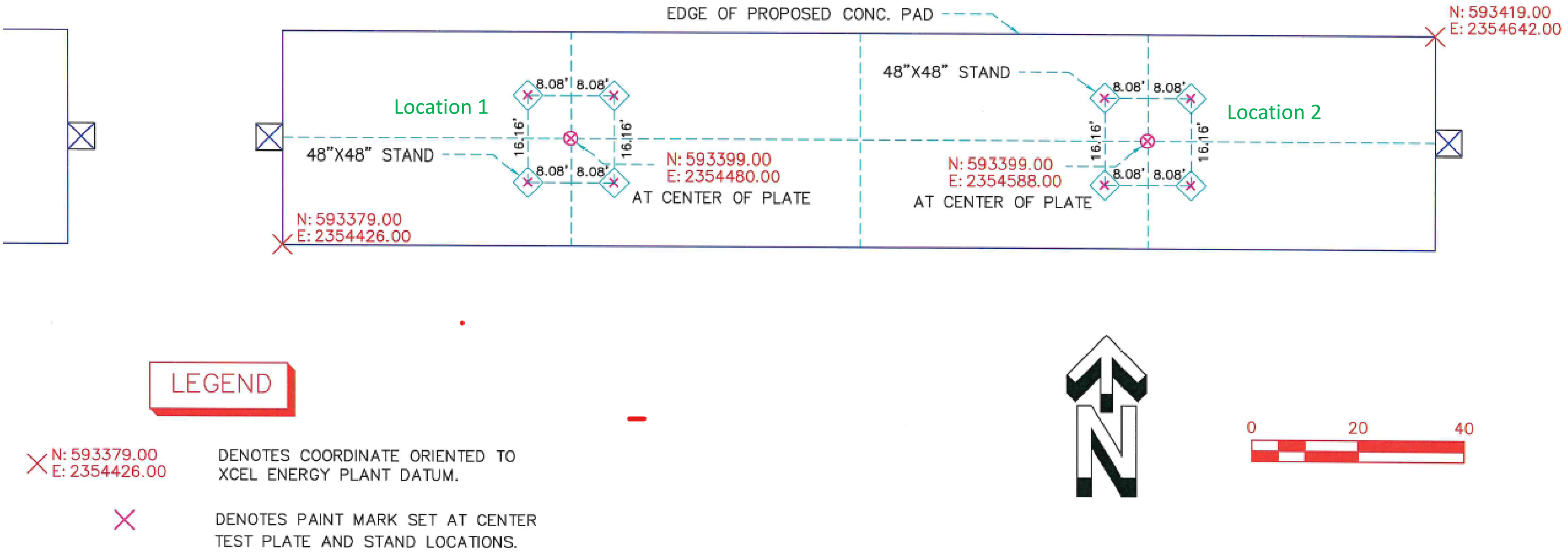
*** Training was performed in 2018, prior to this audit being created. To the best of my recollection all items were completed satisfactorily during training

Effective training includes - **Tell** Them, **Show** Them, **Watch** Them, **Ask** Them, **Check** on Them

Trainer : Ryan Drury*** Date(s): 4-Aug-21

Trainee: B. Pha

Locations of Plate Load Test
Prairie Island ISFSI
B2102952



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Plated Load Test

ASTM D1196
Location1

Prairie Island ISFSI
B2102952
8/17/2021

Entire Range Modulus 320.8 modulus pci

1 to 3 KSF Modulus 272.0 modulus pci

Corrected seating Deflection

plate area 706.9 square inches

0.015	0.038	0.043

Data	LOAD CELL (kips)	LVDT 1 Deflection (in)	LVDT 2 Deflection (in)	LVDT 3 Deflection (in)	LVDT 1 Corrected Deflection (in)	LVDT 2 Corrected Deflection (in)	LVDT 3 Corrected Deflection (in)	Average (in)	Pressure (psi)	KSF
1	2.89	0.015	0.038	0.043	0.000	0.000	0.000	0.000	4.1	0.59
2	6.06	0.027	0.081	0.076	0.012	0.043	0.033	0.029	8.6	1.23
3	5.77	0.027	0.083	0.079	0.012	0.045	0.036	0.031	8.2	1.18
4	5.69	0.027	0.084	0.080	0.012	0.046	0.037	0.032	8.0	1.16
5	5.88	0.029	0.084	0.080	0.014	0.046	0.037	0.032	8.3	1.20
6	**5.77**	**0.028**	**0.085**	**0.080**	**0.013**	**0.047**	**0.037**	**0.032**	**8.2**	**1.18**
7	10.30	0.038	0.115	0.101	0.023	0.077	0.058	0.053	14.6	2.10
8	10.72	0.039	0.120	0.105	0.024	0.082	0.062	0.056	15.2	2.18
9	10.47	0.041	0.121	0.107	0.026	0.083	0.064	0.058	14.8	2.13
10	10.33	0.041	0.121	0.107	0.026	0.083	0.064	0.058	14.6	2.10
11	**10.26**	**0.041**	**0.121**	**0.107**	**0.026**	**0.083**	**0.064**	**0.058**	**14.5**	**2.09**
12	15.47	0.054	0.146	0.126	0.039	0.108	0.083	0.077	21.9	3.15
13	15.59	0.056	0.150	0.130	0.041	0.112	0.087	0.080	22.1	3.18
14	15.41	0.056	0.151	0.131	0.041	0.113	0.088	0.081	21.8	3.14
15	15.27	0.056	0.151	0.131	0.041	0.113	0.088	0.081	21.6	3.11
16	**15.14**	**0.057**	**0.152**	**0.132**	**0.042**	**0.114**	**0.089**	**0.082**	**21.4**	**3.08**
17	21.10	0.070	0.173	0.151	0.055	0.135	0.108	0.099	29.9	4.30
18	20.60	0.071	0.176	0.154	0.056	0.138	0.111	0.102	29.1	4.20
19	21.26	0.072	0.177	0.155	0.057	0.139	0.112	0.103	30.1	4.33
20	21.05	0.072	0.181	0.155	0.057	0.143	0.112	0.104	29.8	4.29
21	**20.81**	**0.076**	**0.194**	**0.160**	**0.061**	**0.156**	**0.117**	**0.111**	**29.4**	**4.24**
22	25.51	0.083	0.197	0.170	0.068	0.159	0.127	0.118	36.1	5.20
23	25.58	0.085	0.198	0.173	0.070	0.160	0.130	0.120	36.2	5.21
24	25.30	0.086	0.198	0.174	0.071	0.160	0.131	0.121	35.8	5.15
25	25.06	0.086	0.199	0.174	0.071	0.161	0.131	0.121	35.5	5.11
26	**24.94**	**0.086**	**0.214**	**0.174**	**0.071**	**0.176**	**0.131**	**0.126**	**35.3**	**5.08**
27	30.47	0.098	0.217	0.189	0.083	0.179	0.146	0.136	43.1	6.21
28	30.90	0.100	0.219	0.191	0.085	0.181	0.148	0.138	43.7	6.29
29	30.59	0.103	0.220	0.195	0.088	0.182	0.152	0.141	43.3	6.23
30	30.36	0.103	0.220	0.195	0.088	0.182	0.152	0.141	43.0	6.18
31	**30.17**	**0.103**	**0.220**	**0.196**	**0.088**	**0.182**	**0.153**	**0.141**	**42.7**	**6.15**
32	41.17	0.127	0.250	0.223	0.112	0.212	0.180	0.168	58.2	8.39
33	40.46	0.129	0.253	0.226	0.114	0.215	0.183	0.171	57.2	8.24
34	39.95	0.131	0.255	0.228	0.116	0.217	0.185	0.173	56.5	8.14
35	40.54	0.133	0.258	0.231	0.118	0.220	0.188	0.175	57.4	8.26
36	40.17	0.134	0.260	0.233	0.119	0.222	0.190	0.177	56.8	8.18
37	**40.07**	**0.134**	**0.260**	**0.233**	**0.119**	**0.222**	**0.190**	**0.177**	**56.7**	**8.16**
38	50.02	0.154	0.286	0.255	0.139	0.248	0.212	0.200	70.8	10.19
39	50.58	0.158	0.292	0.259	0.143	0.254	0.216	0.204	71.6	10.30
40	50.06	0.161	0.295	0.262	0.146	0.257	0.219	0.207	70.8	10.20
41	49.79	0.162	0.297	0.263	0.147	0.259	0.220	0.209	70.4	10.14
42	49.46	0.163	0.298	0.264	0.148	0.260	0.221	0.210	70.0	10.08
43	**49.27**	**0.163**	**0.299**	**0.264**	**0.148**	**0.261**	**0.221**	**0.210**	**69.7**	**10.04**
44	60.13	0.185	0.326	0.286	0.170	0.288	0.243	0.234	85.1	12.25

Data	LOAD CELL (kips)	LVDT 1 Deflection (in)	LVDT 2 Deflection (in)	LVDT 3 Deflection (in)	LVDT 1 Corrected Deflection (in)	LVDT 2 Corrected Deflection (in)	LVDT 3 Corrected Deflection (in)	Average (in)	Pressure (psi)	KSF
45	61.87	0.194	0.338	0.296	0.179	0.300	0.253	0.244	87.5	12.60
46	61.24	0.197	0.341	0.300	0.182	0.303	0.257	0.247	86.6	12.48
47	60.84	0.200	0.343	0.302	0.185	0.305	0.259	0.250	86.1	12.39
48	60.48	0.204	0.346	0.308	0.189	0.308	0.265	0.254	85.6	12.32
49	60.17	0.205	0.347	0.308	0.190	0.309	0.265	0.255	85.1	12.26
50	**59.93**	**0.205**	**0.347**	**0.308**	**0.190**	**0.309**	**0.265**	**0.255**	**84.8**	**12.21**
51	70.82	0.225	0.372	0.329	0.210	0.334	0.286	0.277	100.2	14.43
52	71.06	0.233	0.377	0.337	0.218	0.339	0.294	0.284	100.5	14.48
53	70.31	0.235	0.382	0.339	0.220	0.344	0.296	0.287	99.5	14.32
54	69.74	0.239	0.387	0.347	0.224	0.349	0.304	0.292	98.7	14.21
55	70.32	0.241	0.387	0.347	0.226	0.349	0.304	0.293	99.5	14.33
56	**69.87**	**0.241**	**0.387**	**0.346**	**0.226**	**0.349**	**0.303**	**0.293**	**98.8**	**14.23**
57	81.33	0.266	0.415	0.370	0.251	0.377	0.327	0.318	115.1	16.57
58	80.52	0.272	0.421	0.377	0.257	0.383	0.334	0.325	113.9	16.40
59	79.99	0.274	0.425	0.381	0.259	0.387	0.338	0.328	113.2	16.30
60	79.64	0.280	0.429	0.385	0.265	0.391	0.342	0.333	112.7	16.22
61	79.27	0.280	0.430	0.385	0.265	0.392	0.342	0.333	112.1	16.15
62	**79.02**	**0.281**	**0.431**	**0.386**	**0.266**	**0.393**	**0.343**	**0.334**	**111.8**	**16.10**
63	90.96	0.305	0.458	0.411	0.290	0.420	0.368	0.359	128.7	18.53
64	89.97	0.315	0.466	0.420	0.300	0.428	0.377	0.368	127.3	18.33
65	91.62	0.323	0.476	0.428	0.308	0.438	0.385	0.377	129.6	18.66
66	91.18	0.335	0.483	0.441	0.320	0.445	0.398	0.388	129.0	18.58
67	90.61	0.338	0.487	0.444	0.323	0.449	0.401	0.391	128.2	18.46
68	90.27	0.338	0.488	0.444	0.323	0.450	0.401	0.391	127.7	18.39
69	**90.00**	**0.338**	**0.488**	**0.444**	**0.323**	**0.450**	**0.401**	**0.391**	**127.3**	**18.33**
70	101.97	0.360	0.515	0.465	0.345	0.477	0.422	0.415	144.3	20.77
71	100.65	0.366	0.523	0.472	0.351	0.485	0.429	0.422	142.4	20.50
72	99.76	0.372	0.529	0.477	0.357	0.491	0.434	0.427	141.1	20.32
73	99.48	0.376	0.533	0.481	0.361	0.495	0.438	0.431	140.7	20.27
74	99.13	0.379	0.536	0.484	0.364	0.498	0.441	0.434	140.2	20.19
75	101.00	0.385	0.542	0.490	0.370	0.504	0.447	0.440	142.9	20.58
76	100.58	0.386	0.543	0.491	0.371	0.505	0.448	0.441	142.3	20.49
77	100.24	0.385	0.551	0.503	0.370	0.513	0.460	0.448	141.8	20.42
78	99.96	0.399	0.553	0.503	0.384	0.515	0.460	0.453	141.4	20.36
79	99.68	0.402	0.556	0.508	0.387	0.518	0.465	0.457	141.0	20.31
80	99.50	0.402	0.557	0.508	0.387	0.519	0.465	0.457	140.8	20.27
81	**99.34**	**0.402**	**0.558**	**0.507**	**0.387**	**0.520**	**0.464**	**0.457**	**140.5**	**20.24**
82	111.45	0.420	0.582	0.531	0.405	0.544	0.488	0.479	157.7	22.70
83	110.54	0.429	0.588	0.534	0.414	0.550	0.491	0.485	156.4	22.52
84	110.20	0.434	0.596	0.541	0.419	0.558	0.498	0.492	155.9	22.45
85	109.66	0.447	0.603	0.554	0.432	0.565	0.511	0.503	155.1	22.34
86	111.66	0.447	0.604	0.554	0.432	0.566	0.511	0.503	158.0	22.75
87	111.21	0.452	0.611	0.559	0.437	0.573	0.516	0.509	157.3	22.66
88	110.81	0.455	0.614	0.562	0.440	0.576	0.519	0.512	156.8	22.57
89	110.56	0.456	0.617	0.565	0.441	0.579	0.522	0.514	156.4	22.52
90	110.27	0.460	0.619	0.566	0.445	0.581	0.523	0.516	156.0	22.46
91	**110.05**	**0.461**	**0.621**	**0.567**	**0.446**	**0.583**	**0.524**	**0.518**	**155.7**	**22.42**
92	121.62	0.478	0.641	0.585	0.463	0.603	0.542	0.536	172.1	24.78
93	120.54	0.494	0.655	0.599	0.479	0.617	0.556	0.551	170.5	24.56
94	120.08	0.504	0.662	0.614	0.489	0.624	0.571	0.561	169.9	24.46
95	119.48	0.508	0.670	0.619	0.493	0.632	0.576	0.567	169.0	24.34
96	119.08	0.513	0.674	0.623	0.498	0.636	0.580	0.571	168.5	24.26
97	**120.56**	**0.523**	**0.677**	**0.628**	**0.508**	**0.639**	**0.585**	**0.577**	**170.6**	**24.56**

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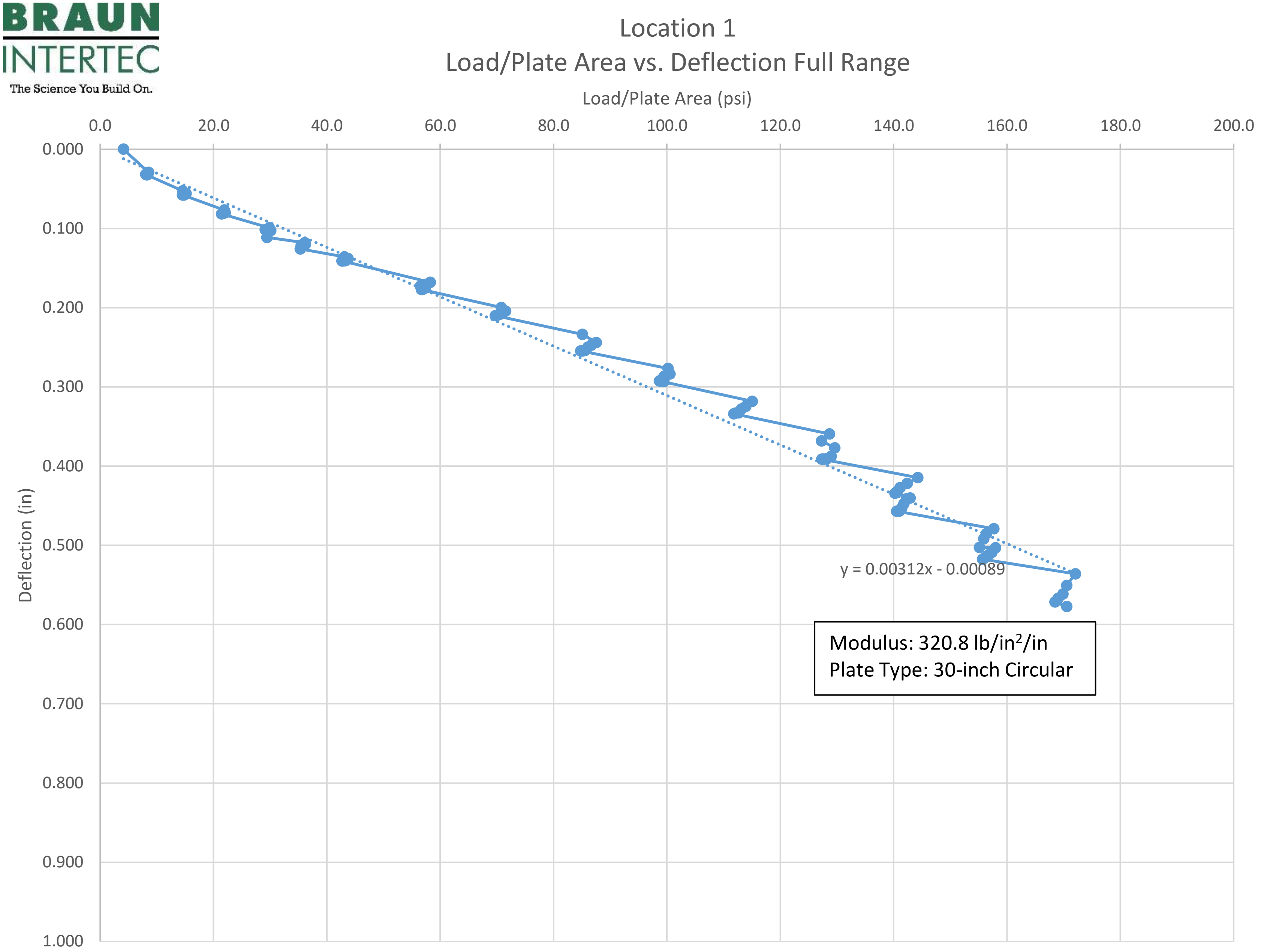
Location 1
Load/Plate Area vs. Deflection Full Range



Modulus: 320.8 lb/in^2/in
Plate Type: 30-inch Circular

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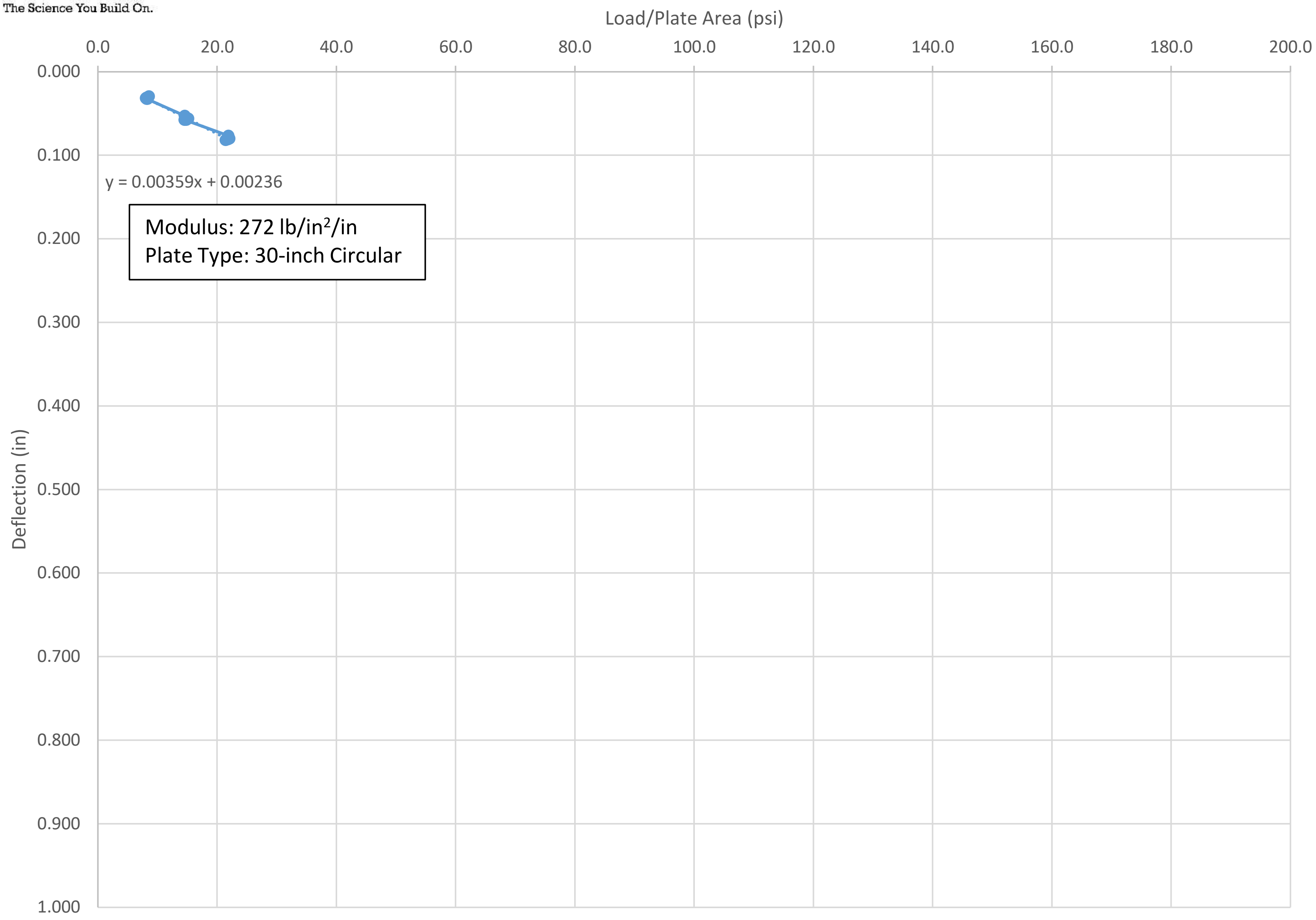
Location 1
Load/Plate Area vs. Deflection 1-3 KSF



Modulus: 272 lb/in^2/in
Plate Type: 30-inch Circular

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Plated Load Test

ASTM D1196
Loaction 2

Prairie Island ISFSI
B2102952
8/17/2021

Entire Range Modulus 333.8 modulus pci

1 to 3 KSF Modulus 232.3 modulus pci

Corrected seating Deflection

plate area 706.9 square inches 0.018 0.011 0.017

Data	LOAD CELL (kips)	LVDT 1 Deflection (in)	LVDT 2 Deflection (in)	LVDT 3 Deflection (in)	LVDT 1 Corrected Deflection (in)	LVDT 2 Corrected Deflection (in)	LVDT 3 Corrected Deflection (in)	Average (in)	Pressure (psi)	KSF
1	1.29	0.018	0.011	0.017	0.000	0.000	0.000	0.000	1.8	0.26
2	5.41	0.067	0.049	0.064	0.049	0.038	0.047	0.045	7.7	1.10
3	5.24	0.068	0.049	0.065	0.050	0.038	0.048	0.045	7.4	1.07
4	5.11	0.069	0.050	0.065	0.051	0.039	0.048	0.046	7.2	1.04
5	5.07	0.069	0.051	0.066	0.051	0.040	0.049	0.047	7.2	1.03
6	**5.05**	**0.070**	**0.051**	**0.066**	**0.052**	**0.040**	**0.049**	**0.047**	**7.1**	**1.03**
7	10.55	0.104	0.080	0.102	0.086	0.069	0.085	0.080	14.9	2.15
8	10.37	0.105	0.083	0.105	0.087	0.072	0.088	0.082	14.7	2.11
9	10.18	0.106	0.083	0.105	0.088	0.072	0.088	0.083	14.4	2.07
10	10.01	0.107	0.083	0.106	0.089	0.072	0.089	0.083	14.2	2.04
11	**9.89**	**0.107**	**0.085**	**0.106**	**0.089**	**0.074**	**0.089**	**0.084**	**14.0**	**2.01**
12	15.91	0.129	0.104	0.128	0.111	0.093	0.111	0.105	22.5	3.24
13	15.50	0.131	0.106	0.130	0.113	0.095	0.113	0.107	21.9	3.16
14	15.38	0.131	0.107	0.130	0.113	0.096	0.113	0.107	21.8	3.13
15	15.16	0.133	0.108	0.132	0.115	0.097	0.115	0.109	21.4	3.09
16	**15.10**	**0.134**	**0.108**	**0.132**	**0.116**	**0.097**	**0.115**	**0.109**	**21.4**	**3.08**
17	21.10	0.153	0.108	0.152	0.135	0.097	0.135	0.122	29.9	4.30
18	20.79	0.154	0.128	0.155	0.136	0.117	0.138	0.130	29.4	4.24
19	20.53	0.156	0.131	0.156	0.138	0.120	0.139	0.132	29.0	4.18
20	20.42	0.156	0.132	0.156	0.138	0.121	0.139	0.133	28.9	4.16
21	**20.29**	**0.156**	**0.132**	**0.157**	**0.138**	**0.121**	**0.140**	**0.133**	**28.7**	**4.13**
22	27.21	0.177	0.133	0.178	0.159	0.122	0.161	0.147	38.5	5.54
23	26.79	0.178	0.153	0.180	0.160	0.142	0.163	0.155	37.9	5.46
24	26.62	0.179	0.154	0.180	0.161	0.143	0.163	0.156	37.7	5.42
25	26.44	0.180	0.155	0.182	0.162	0.144	0.165	0.157	37.4	5.39
26	26.26	0.182	0.157	0.184	0.164	0.146	0.167	0.159	37.2	5.35
27	**26.19**	**0.182**	**0.157**	**0.184**	**0.164**	**0.146**	**0.167**	**0.159**	**37.1**	**5.34**
28	33.09	0.199	0.175	0.202	0.181	0.164	0.185	0.177	46.8	6.74
29	32.62	0.201	0.176	0.203	0.183	0.165	0.186	0.178	46.1	6.65
30	32.38	0.201	**0.176**	0.203	0.183	0.165	0.186	0.178	45.8	6.60
31	**32.20**	**0.202**	0.178	**0.204**	**0.184**	**0.167**	**0.187**	**0.179**	**45.6**	**6.56**
32	42.88	0.251	0.219	0.253	0.233	0.208	0.236	0.226	60.7	8.74
33	41.76	0.255	0.221	0.257	0.237	0.210	0.240	0.229	59.1	8.51
34	41.38	0.257	0.223	0.260	0.239	0.212	0.243	0.231	58.5	8.43
35	41.24	0.258	0.224	0.261	0.240	0.213	0.244	0.232	58.3	8.40
36	40.98	0.259	**0.224**	0.262	0.241	0.213	0.245	0.233	58.0	8.35
37	**40.88**	**0.259**	0.225	**0.262**	**0.241**	**0.214**	**0.245**	**0.233**	**57.8**	**8.33**

Data	LOAD CELL (kips)	LVDT 1 Deflection (in)	LVDT 2 Deflection (in)	LVDT 3 Deflection (in)	LVDT 1 Corrected Deflection (in)	LVDT 2 Corrected Deflection (in)	LVDT 3 Corrected Deflection (in)	Average (in)	Pressure (psi)	KSF
38	52.43	0.278	0.242	**0.278**	0.260	0.231	0.261	0.251	74.2	10.68
39	51.88	0.280	0.244	0.279	0.262	0.233	0.262	0.252	73.4	10.57
40	51.60	0.282	0.245	0.280	0.264	0.234	0.263	0.254	73.0	10.51
41	51.35	0.283	0.248	0.284	0.265	0.237	0.267	0.256	72.6	10.46
42	51.13	0.295	0.252	0.293	0.277	0.241	0.276	0.265	72.3	10.42
43	50.95	0.293	0.252	0.292	0.275	0.241	0.275	0.264	72.1	10.38
44	50.80	0.293	0.252	0.292	0.275	0.241	0.275	0.264	71.9	10.35
45	**50.73**	**0.293**	**0.253**	**0.292**	**0.275**	**0.242**	**0.275**	**0.264**	**71.8**	**10.33**
46	62.37	0.307	0.269	0.305	0.289	0.258	0.288	0.278	88.2	12.71
47	61.82	0.310	0.272	0.308	0.292	0.261	0.291	0.281	87.5	12.59
48	61.48	0.313	0.275	0.311	0.295	0.264	0.294	0.284	87.0	12.52
49	61.20	0.313	0.276	0.312	0.295	0.265	0.295	0.285	86.6	12.47
50	**61.02**	**0.314**	**0.276**	**0.312**	**0.296**	**0.265**	**0.295**	**0.285**	**86.3**	**12.43**
51	71.52	0.333	0.295	0.330	0.315	0.284	0.313	0.304	101.2	14.57
52	70.77	0.336	0.298	0.333	0.318	0.287	0.316	0.307	100.1	14.42
53	70.43	0.338	0.300	0.335	0.320	0.289	0.318	0.309	99.6	14.35
54	70.14	0.340	0.302	0.337	0.322	0.291	0.320	0.311	99.2	14.29
55	69.89	0.342	0.305	0.340	0.324	0.294	0.323	0.314	98.9	14.24
56	69.64	0.343	0.306	0.342	0.325	0.295	0.325	0.315	98.5	14.19
57	**69.52**	**0.344**	**0.306**	**0.342**	**0.326**	**0.295**	**0.325**	**0.315**	**98.4**	**14.16**
58	82.10	0.365	0.328	0.362	0.347	0.317	0.345	0.336	116.1	16.73
59	81.52	0.367	0.329	0.363	0.349	0.318	0.346	0.338	115.3	16.61
60	81.08	0.371	0.334	0.367	0.353	0.323	0.350	0.342	114.7	16.52
61	80.62	0.373	0.337	0.369	0.355	0.326	0.352	0.344	114.1	16.42
62	**80.28**	**0.375**	**0.338**	**0.372**	**0.357**	**0.327**	**0.355**	**0.346**	**113.6**	**16.35**
63	80.17	0.376	0.339	0.373	0.358	0.328	0.356	0.347	113.4	16.33
64	92.17	0.396	0.358	0.390	0.378	0.347	0.373	0.366	130.4	18.78
65	91.45	0.402	0.364	0.396	0.384	0.353	0.379	0.372	129.4	18.63
66	90.75	0.404	0.366	0.399	0.386	0.355	0.382	0.374	128.4	18.49
67	90.32	0.407	0.369	0.400	0.389	0.358	0.383	0.377	127.8	18.40
68	90.11	0.408	0.370	0.401	0.390	0.359	0.384	0.378	127.5	18.36
69	**89.78**	**0.408**	**0.370**	**0.406**	**0.390**	**0.359**	**0.389**	**0.379**	**127.0**	**18.29**
70	103.42	0.434	0.395	0.424	0.416	0.384	0.407	0.402	146.3	21.07
71	102.12	0.440	0.400	0.429	0.422	0.389	0.412	0.408	144.5	20.80
72	101.64	0.445	0.403	0.433	0.427	0.392	0.416	0.412	143.8	20.71
73	101.20	0.448	0.407	0.436	0.430	0.396	0.419	0.415	143.2	20.62
74	100.73	0.450	0.409	0.438	0.432	0.398	0.421	0.417	142.5	20.52
75	100.53	0.451	0.411	0.438	0.433	0.400	0.421	0.418	142.2	20.48
76	**100.27**	**0.452**	**0.411**	**0.440**	**0.434**	**0.400**	**0.423**	**0.419**	**141.9**	**20.43**
77	112.26	* Data not recorded place holder for illustration only						0.450	158.8	22.87
78	112.26	0.482	0.441	0.466	0.464	0.430	0.449	0.448	158.8	22.87
79	111.73	0.487	0.445	0.472	0.469	0.434	0.455	0.453	158.1	22.76
80	111.29	0.489	0.447	0.473	0.471	0.436	0.456	0.454	157.4	22.67
81	110.96	0.490	0.448	0.474	0.472	0.437	0.457	0.455	157.0	22.60
82	110.80	0.492	0.450	0.476	0.474	0.439	0.459	0.457	156.8	22.57
83	110.47	0.493	0.452	0.477	0.475	0.441	0.460	0.459	156.3	22.50
84	110.37	0.494	0.453	0.478	0.476	0.442	0.461	0.460	156.1	22.48
85	**110.15**	**0.495**	**0.458**	**0.483**	**0.477**	**0.447**	**0.466**	**0.463**	**155.8**	**22.44**
86	123.84	0.518	0.478	0.501	0.500	0.467	0.484	0.484	175.2	25.23
87	123.24	0.522	0.484	0.505	0.504	0.473	0.488	0.488	174.3	25.11
88	122.72	0.528	0.489	0.511	0.510	0.478	0.494	0.494	173.6	25.00
89	122.30	0.531	0.492	0.515	0.513	0.481	0.498	0.497	173.0	24.91
90	122.01	0.533	0.495	0.516	0.515	0.484	0.499	0.499	172.6	24.86
91	121.78	0.535	0.497	0.518	0.517	0.486	0.501	0.501	172.3	24.81
92	121.50	0.534	0.499	0.519	0.516	0.488	0.502	0.502	171.9	24.75
93	121.36	0.538	0.500	0.520	0.520	0.489	0.503	0.504	171.7	24.72
94	**121.31**	**0.538**	**0.502**	**0.521**	**0.520**	**0.491**	**0.504**	**0.505**	**171.6**	**24.71**

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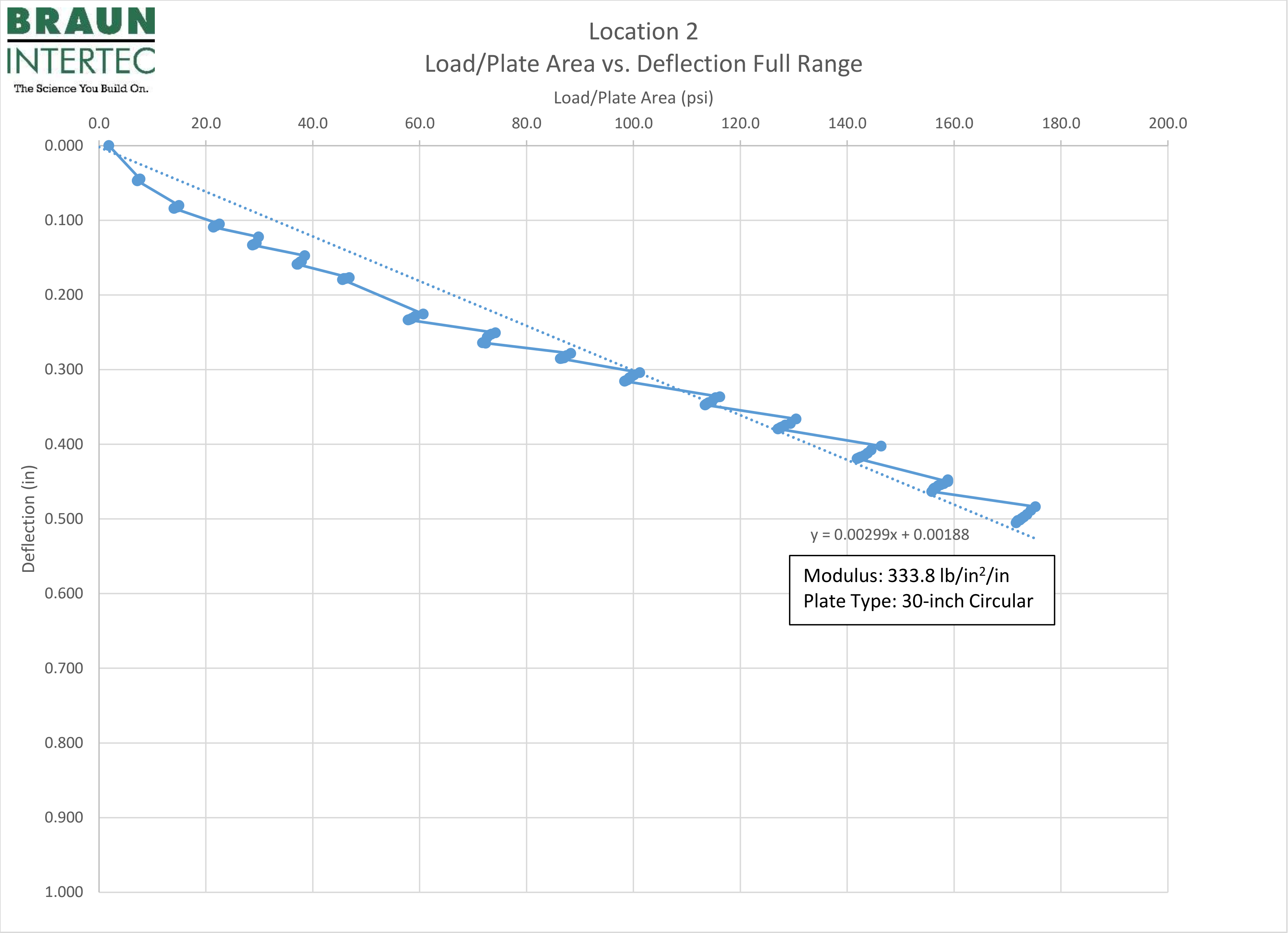

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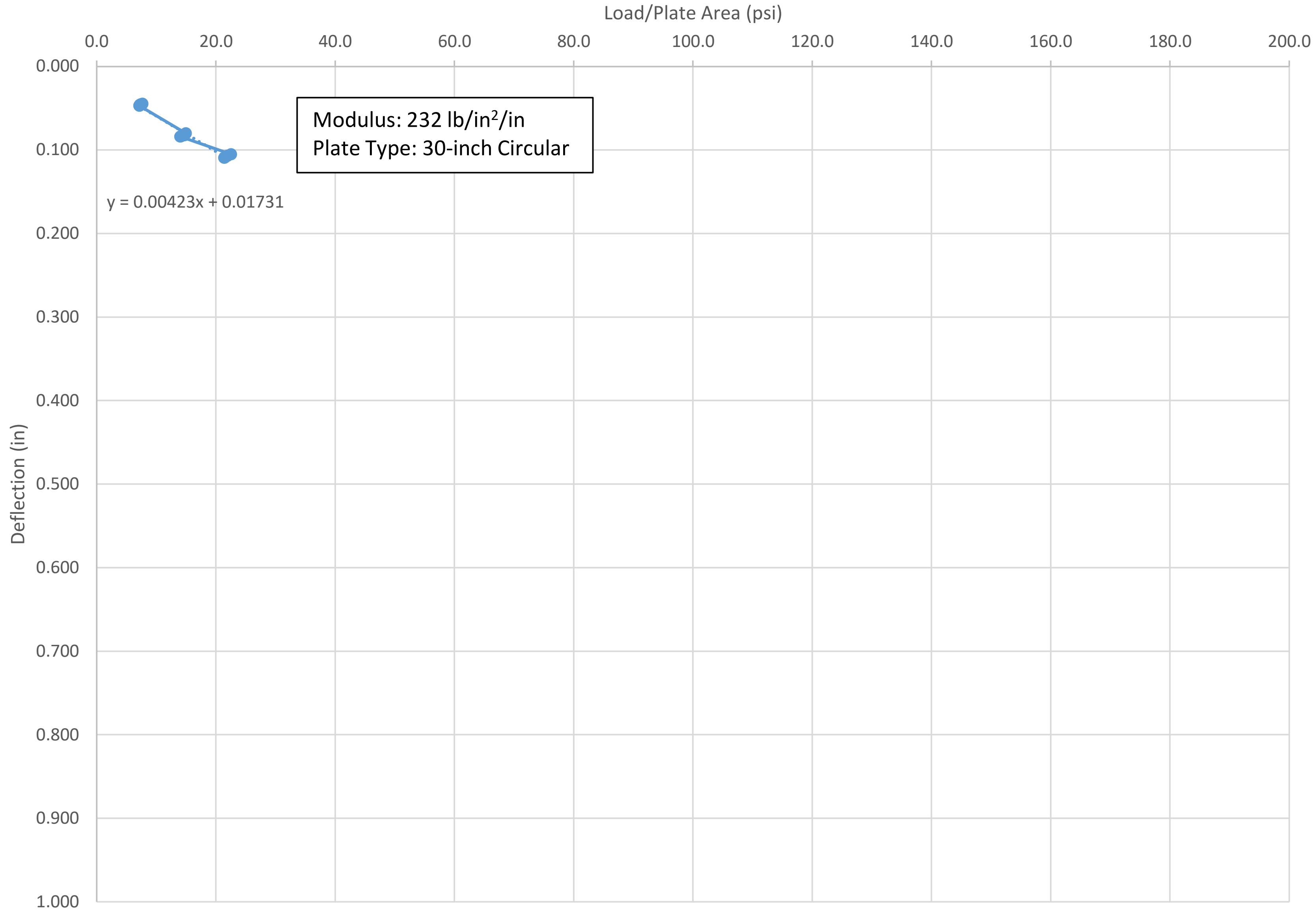
Location 2
Load/Plate Area vs. Deflection 1-3 KSF



Modulus: 232 lb/in^2/in
Plate Type: 30-inch Circular