Final Report

NDIC Brine Remediation Study
Bottineau County, North Dakota

May 31, 2019

Terracon Project No. M1177088

Prepared for:
NDIC Oil and Gas Division
Bismarck, North Dakota

Prepared by:
Terracon Consultants, Inc.
West Fargo, North Dakota

Terracon

May 31, 2019

Mr. Cody VanderBusch
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Re: Final Report
NDIC Brine Remediation Study
NE ¼ S26-T161N-82W (48.746589, -101.256850)
Bottineau County, North Dakota
Terracon Project No. M1177088

Dear Mr. VanderBusch:

Terracon Consultants, Inc. (Terracon) is pleased to submit the attached Final Report for the NDIC Brine Remediation Study at the above-referenced site located near Renville in Bottineau County, North Dakota. Below, we summarize the progress of the project achieved during Quarters 1-6 (Q1-Q6) with more detailed description for Quarter 7 (Q7) followed by our final report with findings and recommendations based on the data and final observations made in our study.

Sincerely,
Terracon Consultants, Inc.

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Environmental ■ Facilities ■ Geotechnical ■ Materials

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EXECUTIVE SUMMARY

The goal of this project was to gain valuable knowledge of techniques and results for remediating salt from the soil surrounding historical brine ponds. The objectives were to reclaim these impacted areas and return the areas back to productive crop land by researching test methods for remediation to minimize removing soil from the site, determine which methods work were successful to re-establish selected growing crops, ranking the methods based on the cost, reduction in soil salinity, and the health and vigor of the crops. A secondary objective was to provide criteria for guidance for methods and application rates for consideration in remediating brine impacts of varying concentrations at future sites.

Upon completion of the subsurface exploration and soil sampling/testing, Terracon designed and implemented 12 field test plots (test plots) at various locations within the selected brine-impacted site which contained different brine concentrations measured as electrical conductivity (EC) and chlorides. As part of the field study, nine of the test plots installed were to analyze the impact of various applied remediation techniques and three test plots were installed as phytoremediation cells (PRCs) to assess potential brine-impacts to water removed from specified test plots using phytoremediation.

The study progressed from field testing and construction to laboratory-based experimentation using different potential brine-reducing soil additives. During our field testing program, bulk sampling of brine-impacted soils was performed. For our laboratory-based experimentation, 156 total soil cells, containing various combinations and concentrations of selected potential brine-reducing additives, were prepared.

Another aspect of our study included constructing a larger scale test column to test the effectiveness of a gravel capillary break and/or installing drain tile. This experiment was performed to determine salt transport mechanisms through a soil column when watered from above, simulating to rainfall, and watering up from the bottom (simulating rising groundwater level).

Based on the observations of our activities conducted for the test plots, test cells, and test columns, Terracon recommends a full-scale pilot study on small, medium, and large sites to test amending soil with gypsum and flushing with clean water as in Plot 3B.

FINAL REPORT

NDIC Brine Remediation Study
Bottineau County, North Dakota

Terracon Project No. M1177088

May 31, 2019

1.0 INTRODUCTION

1.1 Previous Work

Per our original work plan, our baseline assessment of the site included subsurface exploration and soil sampling/testing to determine approximate boundaries of the original brine pond and the extent of the brine release. Field-testing methods, as previously discussed in our Baseline Site Assessment Report, dated December 21, 2017, were also used to assess impacted areas.

Upon completion of the subsurface exploration and soil sampling/testing, Terracon designed and implemented 12 field test plots (test plots) at various locations which contained different brine concentrations (refer to Baseline Site Assessment Report) measured as electrical conductivity (EC) and chlorides. As part of the field study, nine of the test plots installed were to analyze the impact of various applied remediation techniques and three test plots were installed as phytoremediation cells (PRCs) to assess potential brine-impacts to water removed from specified test plots using phytoremediation.

After completion of the fieldwork during the end of Quarter 1 (Q1) (July 1, 2017 to September 30, 2017) and at the beginning of Quarter 2 (Q2) (October 1, 2017 to December 31, 2017), a Baseline Site Assessment Report was prepared for the project which included the results of our subsurface exploration/sampling and field/laboratory soil and water testing. The Baseline Site Assessment Report also contained commentary on various test plot designs and implementation, including photographs taken during construction of the test plots.

Quarter 3 (Q3) (January 1, 2018 to March 31, 2018) focused on collecting and analyzing data obtained from testing and observing laboratory test cells (test cells), planting crop seeds in the test cells, and salt migration in larger-scale test columns (test columns). A total of 156 test cells were constructed with seven different amendments to measure EC. A set of control test cells containing no alterations were also constructed.

Each test cell was watered weekly and tested for EC for 12 weeks. Based upon of the results of the EC measurements, the test cells appeared to indicate reduction in EC with some amendments performing better than others.

Two larger-scale test columns were designed and constructed to simulate and test a drainage layer separating amended soil from deeper impacted soils and deeper non-impacted soil stratum.

Approximately 40 inches of water was added to the test columns over a 5-week span and allowed to drain through each test column. As expected, EC values decreased at the top of the test columns as more water was added; however, the efficiency of the drainage layers appeared to be less successful due to an increase in EC levels in the bottom, non-impacted soil layer. The dissolved chloride in the brine appears to be mobilized and transported from the upper test column and deposited in the lower stratum of the test column.

Q3 also included planting and monitoring germination of crop plants in the test cells. Each test cell was planted with five types of crop seeds including: alfalfa, barley, canola, soybeans, and sunflowers. During the latter part of Q3 and into Quarter 4 (Q4) (April 1, 2018 to June 30, 2018) the test cells were monitored for germination and data was collected and analyzed to indicate plant type(s), if germination occurred, germination success in impacted soils, and if the addition of amendments increased or decreased the observed germination rate.

Q4 focused on planting crop seeds within the tests plots and observing germination rates. Please refer to the Q4 Quarterly Progress Report (April 1, 2018 to June 30, 2018) for details of activities and findings related to germination rates in test cells in the laboratory, test plot updates, and additional observation from amended test cells.

Quarter 5 (Q5) focused on ongoing monitoring of test plots and observations on germination rates within the test cells, flushing test plots Plot 3A and Plot 3B with high volumes of water and evaluating reduction in EC, collecting final EC measurements for the test plots and planting winter wheat. Please refer to the Q5 Quarterly Progress Report (July 1, 2018 to September 30, 2018) for a detailed reporting of the activities during this period.

Quarter 6 (Q6) focused on ongoing monitoring of test plots and observations on second-planting germination rates in the test plots, collecting and analyzing choloride data from the laboratory test cells, and comparing the costs for each method utilized for the construction of the test plots. Please refer to the Preliminary Final Report (October 1, 2018 to December 31, 2018) for a detailed reporting of the activities during this period.

Quarter 7 (Q7) focused on the following:

- Collecting and analyzing EC data from test plots following winter melt run-off;
- Observation of winter wheat germination in Plots 1A, 1B, 2A, 3A, 4, 5A and 5B and second crop germination in Plot 3B following winter;
- Observing natural vegetation community changes
- Compiling data for the Final Report.

1.2 Summary of Q7 Activities and Results

Test plot ECs were recorded as a baseline prior to test plot construction, immediately following construction of the test plots, prior to flushing in Plots 3A and 3B, following removal of the first planting of crops in September 2018, and following winter in May 2019.

1.2.1 EC Data Observations

Terracon field screened EC using an EC meter (Spectrum Technologies, Inc. Model No. 2265FSTP) with a stainless-steel probe inserted directly into soil to assess the presence of salts in the soil. The EC meter provides a direct reading in microsiemens per centimeter (µS/cm). Based on our experience, the measurements within a one square foot area of similar soil type can typically vary by as much as 500 µS/cm from the average tested values.

Baseline EC readings were collected in a grid spacing at approximate 20-foot on center during the Baseline Assessment. Subsequent EC readings were collected in a grid spacing at approximately 2-foot on center upon construction of the test plots in 2017 and 2018. Spring 2019 EC readings were taking in a grid spacing approximately 10-foot on center. EC readings were limited to the surface, one-foot below surface, and two feet below surface. The table below presents average EC for each test plot.

Table No. 1 –Test Plot Average EC Observations

Period	1A	1B	2A	2B	3A	3B	4	5A	5B
2017 Baseline (µS/cm)	13,545	16,679	3,290	8,857	11,342	9,945	7,284	14,640	15,390
2017 Post-Construction (µS/cm)	2,452	2,474	5,555	5,529	14,993	9,429	4,935	1,319	1,388
2018 Pre-Flush (µS/cm)	-	-	-	-	10,258	8,946	-	-	-
Fall 2018 (µS/cm)	2,665	4,206	4,290	-	10,371	4,332	4,899	1,279	1,457
Spring 2019 (µS/cm)	2,838	3,529	4,267	4,841	4,867	3,771	2,521	1,829	1,850

-Data not collected

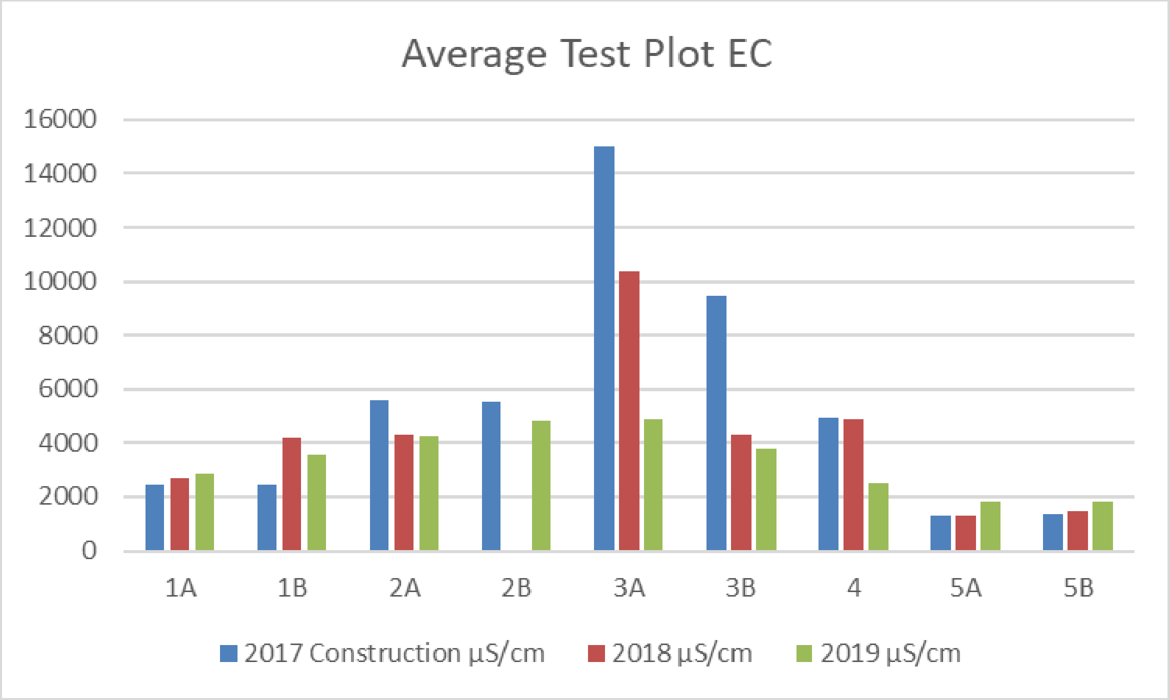


Figure 1: Average EC of each test plot in Fall 2017, Fall 2018, and Spring 2019

The observations made from the EC measured during the study:

- Plots 1A and 1B increases indicated recontamination of the test plots in Fall 2018. Recontamination determined to be attributable to surface waters infiltrating the test plots by higher than normal precipitation in June; little change was noted in 2019
- Plot 2A decreased from 2017 to 2018, however did not change in 2019;
- Plot 2B was inundated by higher than normal precipitation in June and fall 2018 EC measurements were not made and little change was noted in Spring 2019;
- Plots 3A and 3B EC decreased throughout the study;
- Plot 4 EC remained approximately the same from 2017 to 2018, however decreased in 2019; and
- Plot 5A and 5B remained approximately the same from 2017 to 2018, however EC increased in 2019.

For the purposes of this study, statistical confidence was not calculated. Generalizations are made from observed data from field measurements.

1.2.2 Spring Germination Observations

The test plots were tilled and replanted in September, 2018 to observe germination of winter wheat except Plot 3B. Plot 3B was replanted with the five crops planted during the original planting period to test the effectiveness of flushing with fresh water. Initial second planting observations were made on October 30, 2018 and details can be found in the Preliminary Final Report. Final germination observations made on May 29, 2019:

- Winter wheat germinated in Plots 1A, 1B, 4, 5A, and 5B;
- Winter wheat did not germinate in Plots, 2A, 2B, and 3A; and
- Alfalfa and barley germinated in Plot 3B.

1.2.3 Native Vegetation Community Observation

Native vegetation plant communities were recorded and observed. A comparison to previous years is presented in section 3.1 below.

2.0 SCOPE OF SERVICES

The objective of this Preliminary Final Report is to summarize project results and achievements which also provides a data result package, cost summary analysis, and photographs of before and after conditions.

2.1 Standard of Care

Terracon's services were performed in a manner consistent with generally accepted practices of the profession undertaken in similar studies in the same geographical area during the same time. Terracon makes no warranties, either express or implied, regarding the findings, conclusions, or recommendations. Please note that Terracon does not warrant the work of laboratories, regulatory agencies, or other third parties supplying information used in the preparation of the report. These reporting services were performed in accordance with the scope of services agreed with you, our client, as reflected in our proposal (Terracon Proposal No. PM1177088 dated August 25, 2017) and were not restricted by American Society of Testing and Materials (ASTM) E1903-11.

2.2 Additional Scope Limitations

Findings, conclusions, and recommendations resulting from these services are based upon information derived from the on-site activities and other services performed under this scope of services; such information is subject to change over time. Certain indicators of the presence of hazardous substances, petroleum products, or other constituents may have been latent, inaccessible, unobservable, non-detectable, or not present during these services. We cannot represent that the site contains no hazardous substances, toxic materials, petroleum products, or other latent conditions beyond those identified during this assessment. Subsurface conditions may vary from those encountered at specific borings or wells or during other surveys, tests, assessments, investigations, or exploratory services. The data, interpretations, findings, and our recommendations are based solely upon data obtained at the time and within the scope of these services.

2.3 Reliance

This report has been prepared for the exclusive use of NDIC Oil and Gas Division and any authorization for use or reliance by any other party (except a governmental entity having jurisdiction over the site) is prohibited without the express written authorization of NDIC Oil and Gas Division and Terracon. Any unauthorized distribution or reuse is at NDIC Oil and Gas Division's sole risk. Notwithstanding the foregoing, reliance by authorized parties will be subject to the terms, conditions, and limitations stated in the proposal, Preliminary Final Report, and Contract between the State of North Dakota and Terracon. The limitation of liability defined in the terms and conditions is the aggregate limit of Terracon’s liability to NDIC Oil and Gas Division and all relying parties unless otherwise agreed in writing.

3.0 FIELD ACTIVITIES

Terracon conducted the fieldwork under a site-specific health and safety plan (HASP) developed for this project. Work was performed using Occupational Safety and Health Agency (OSHA) Level D work attire consisting of hard hats, safety glasses, reflective vests, hearing protection, protective gloves, and protective boots.

3.1 Vegetation Study

A vegetation study was conducted to determine if the presence of specific plant species or plant communities at the site could potentially delineate the extent of contaminated soils. A survey of plant species was conducted at the southern portion of the site in Fall 2017. EC for identified plant species was determined by field testing surface and 1-foot depth soils. Observed EC was not evaluated above or below the thriving threshold, determined as a species having an apparent tolerance or preference to site conditions. However, the range of EC can be estimated based on plant species present. The table below presents general observations of EC for the plant species identified.

Table No. 2: Plant Species EC Observations

Species	Root System	Surface EC (µS/cm)	1-foot depth (µS/cm)
Alfalfa	Tap: Deep	300	3,300
Curly Dock	Tap: Shallow	400	2,600
Dogbane[2]	Rhizomatous/Branched: Deep	500	1,700
Cattail[2]	Rhizomatous and Fibrous: Shallow	2,200	2,300
Sweet Clover	Fibrous: Deep	2,300	4,100
Western Wheatgrass	Rhizomatous	2,400	3,500
Swtichgrass	Fibrous: Deep	2,400	3,500
Foxtail Barley[2]	Fibrous: Shallow	2,400	4,000
Spearscale[1]	Tap: Deep	3,300	8,000
Perennial Sow Thistle	Tap: Deep	3,500	3,500
Diffuse Knapweed	Tap with Laterals: Deep	3,500	3,500
Russian Thistle/Tumbleweed[1]	Tap with Extensive Laterals: Deep	6,800	9,800

[1] Salt/Alkaline Thriving [2] Water Thriving

Four plant species communities were selected from the overall grouping of plant species, observed soil EC, and aerial photography. Community A contained observed soil EC of 0-2,300 µS/cm and plant species with EC tolerance within this range. Community B contained observed soil EC between 2,200-4,000 µS/cm and plant species with EC tolerance within this range. Community C soil EC tolerance between 3,300-9,800 µS/cm and plant species with EC tolerance within this range. Community D contained observed soil EC of 9,500+ µS/cm and was populated nearly exclusively with Russian Thistle.

Observations on potential changes the plant community delineations were made on May 24, 2019. Positive plant growth was noted along the edges of the plant communities, however no major changes were noted to the borders or delineations of the plant communities. Further, no new plant species were observed on site.

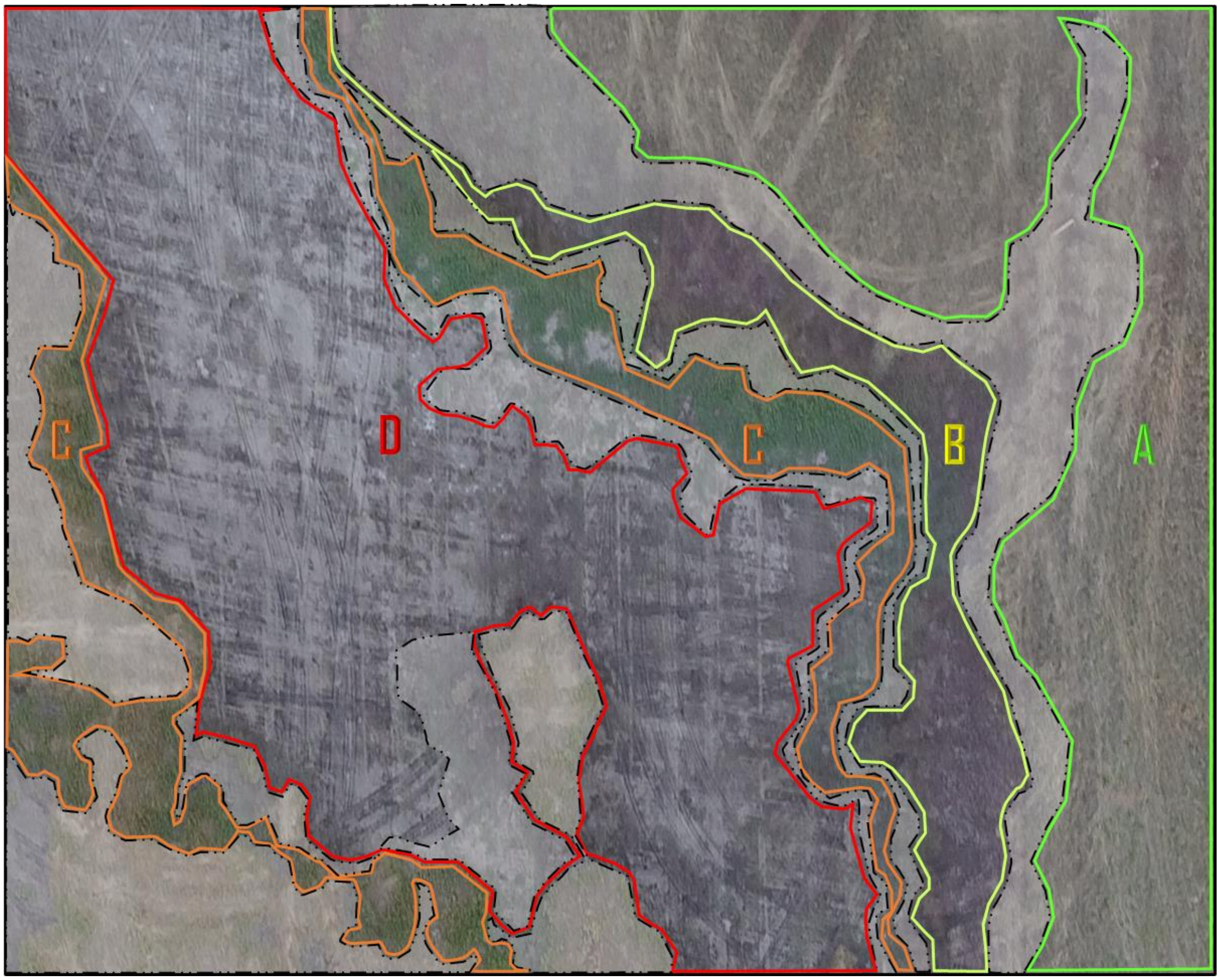


Figure 2: Plant species community illustration

3.2 Crop Planting

The test plots were planted with the same five crops planted in the laboratory test cells. Five rows of each crop were planted. Crop growth was monitored over the course of three months. Following the 2018 growing season, the crops were removed and EC was measured. Plots 1A, 1B, 2A, 4, 5A, and 5B were tilled and replanted with winter wheat for germination observations. Plot 3B was tilled and replanted with the five crops previously planted for germination observations. Second planting germination rates were observed in Fall 2018 and Spring 2019.

3.3 Electrical Conductivity

Nine test plots were tested for initial baseline EC prior to construction, after construction in Fall 2017, after one growing season in Fall 2018, and after winter in Spring 2019. Surface EC readings were collected during the baseline study in a grid spacing at approximate 20-foot on center and were limited to the surface, one-foot depth, and 2-feet depth. Surface EC readings were collected in Fall 2017 and Fall 2018 in a grid spacing at approximate 2-foot on center and were limited to the surface, one-foot depth, and 2-feet depth. Surface EC readings for plots 3A and 3B were collected in July 2018 prior to flushing in a grid spacing at approximate 2-foot on center and were limited to the surface, one-foot depth, and 2-feet depth. Surface EC readings were collected in Spring 2019 in a grid spacing approximately 10-foot on center and were limited to the surface, one-foot depth, and 2-feet depth.

3.4 Test Plots

Nine test plots were constructed in November 2017 to evaluate EC reduction efficiency of different methods and associated costs. The methods tested include excavating and replacing brine-impacted/contaminated soil with off-site imported soil, homogenizing higher EC soil with lower EC soil from the site, amending contaminated soil with gypsum, mixing contaminating soil with imported uncontaminated soil, and adding clean soil over unexcavated contaminated soil. Uncontaminated soil was imported from Bottineau, North Dakota and field screened for EC prior to use.

Capillary breaks consisting of either gravel or composite geotextile were installed to evaluate the efficacy of these systems at mitigating capillary suction and resulting recontamination from surrounding impacted soils. Flushing with flush water obtained from PRC-3 and clean potable water was performed to observe the efficacy of contaminant removal. Clean potable water was imported from the Westhope Water Depot in Westhope, North Dakota. The full EC value data set can be found in Appendix C.

Please refer to the Baseline Assessment report for details of construction for the nine test plots. The following table summarizes construction details for the nine test plots.

Table No. 3: Test Plot Construction

	1A	1B	2A	2B	3A	3B	4	5A	5B
Remedial Approach:	Excavate and replace	Excavate and replace	Excavate and homogenize	Excavate and homogenize	Excavate and amend (gypsum)	Excavate and amend (gypsum)	Excavate and mix with clean	Above grade fill	Above grade fill
Capillary Break:	No	Yes (gravel)	No	Yes (gravel)	Yes (gravel)	Yes (gravel)	Yes (gravel)	Yes (gravel)	Yes (composite geotextile)
Amendment:	No	No	No	No	Yes	Yes	No	No	No
Irrigation:	No	No	No	No	No	Yes	No	No	No

Further discussion of the activities and results for each test plot are presented below. A summary of EC data, germination observations, and cost comparisons of each remediation technique are presented in Section 5 of the report.

3.4.1 Plot 1A

Plot 1A consisted of excavating approximately 30 inches of the existing soil and replacing with non-brine impacted imported backfill up to grade. The excavation slopes within the test plot were approximately 2:1 (H:V).

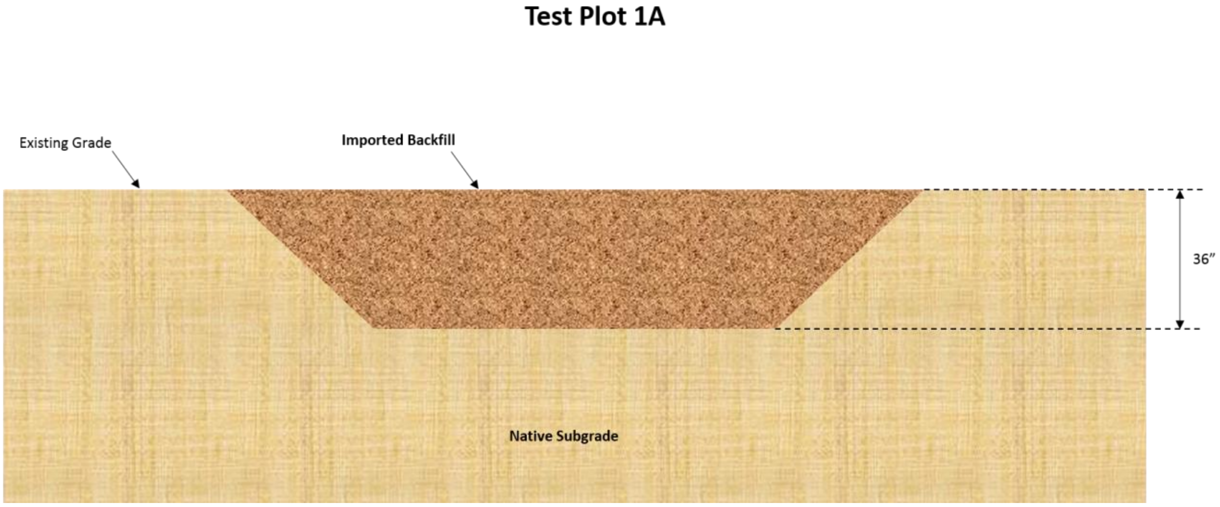


Figure 3: Test Plot 1A construction cross-section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, after one growing season in September 2018, and after winter in May 2019. Two planting periods were conducted for Plot 1A. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 4: Plot 1A EC Averages

Depth	Baseline (µS/cm)	Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change	Fall 2018 to Spring 2019 Percent Change
Surface EC	14,785	1,947	2,336	2,300	**+19%**	**-2%**
1-Foot EC	17,997	1,881	2,904	2,775	**+54%**	**-4%**
2-Foot EC	7,852	3,529	2,756	2,825	**-22%**	**+6%**

-Data not collected as of the writing of this report

EC measurements following test plot construction decreased as the contaminated soil had been removed and replaced with non-impacted imported soil. Increases in EC at the surface and 1-foot depths and decreases at 2-foot depths were observed between post-construction measurements and Fall 2018 measurements which indicate potential recontamination from the surface.

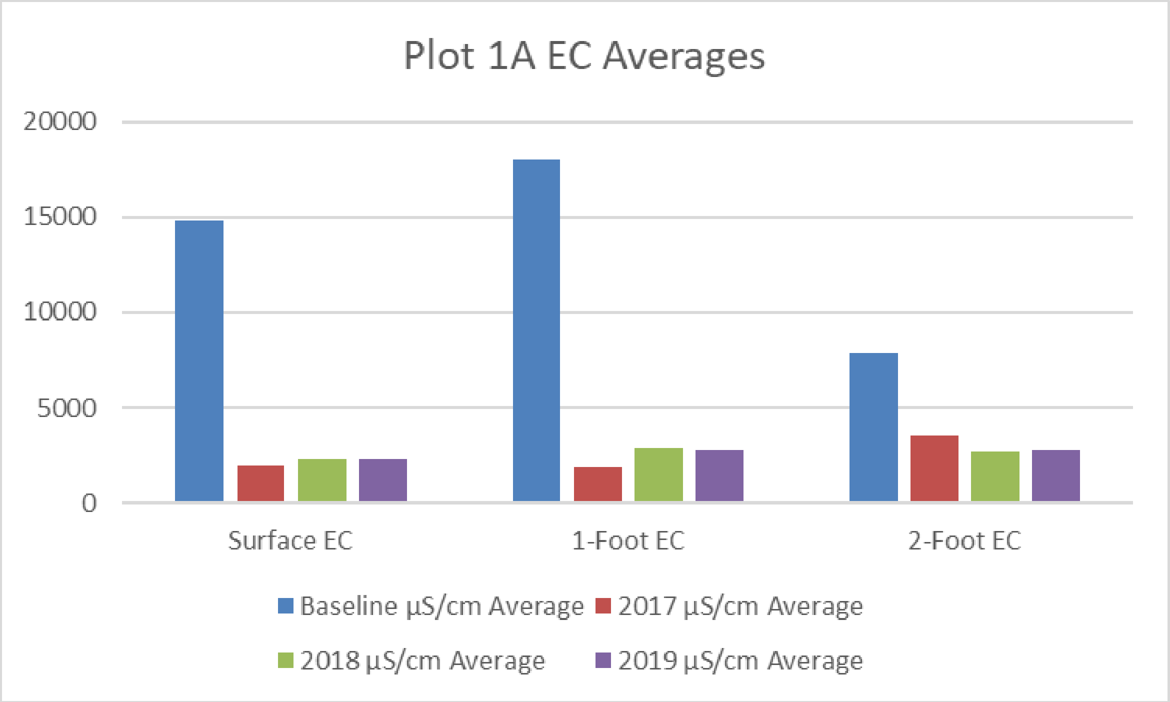


Figure 4: Plot 1A EC averages pre- and post-impacted soil replacement

Evidence of flooding from above normal precipitation at the site was observed in early July which caused surface water runoff from outside the test plot. However, decreases in EC following overland flooding from rain are likely attributable to the relatively high soil EC following construction in Fall 2017. EC remained relatively unchanged from Fall 2018 to Spring 2019 following winter snow melt. Germination of the five crops planted was observed after the first planting. Germination of winter wheat was observed after the second planting in Fall 2018 and Spring 2019.

May 9, 2018: 1st planting

July 10, 2018: 1st germination (germination of five crops observed)

October 30, 2018: 2nd germination (winter wheat germination observed)

May 29, 2019

Please refer to Appendix A, Exhibits 1-3 for Plot 1A EC mapping.

3.4.2 Plot 1B

Plot 1B consisted of excavating approximately 36 inches of the existing soil. Excavation slopes were approximately 2:1 (H:V). A layer of geotextile (base separation layer) was placed at the base of the excavation. Six inches of gravel was placed at the base and up the sides of the excavation; a second layer of geotextile was placed above the gravel (upper separation layer). Approximately 30 inches of imported non-impacted backfill was placed, bringing the plot up to grade. A sump pit/drainage system drained into Phytoremediation Cell 3 (PRC-3).

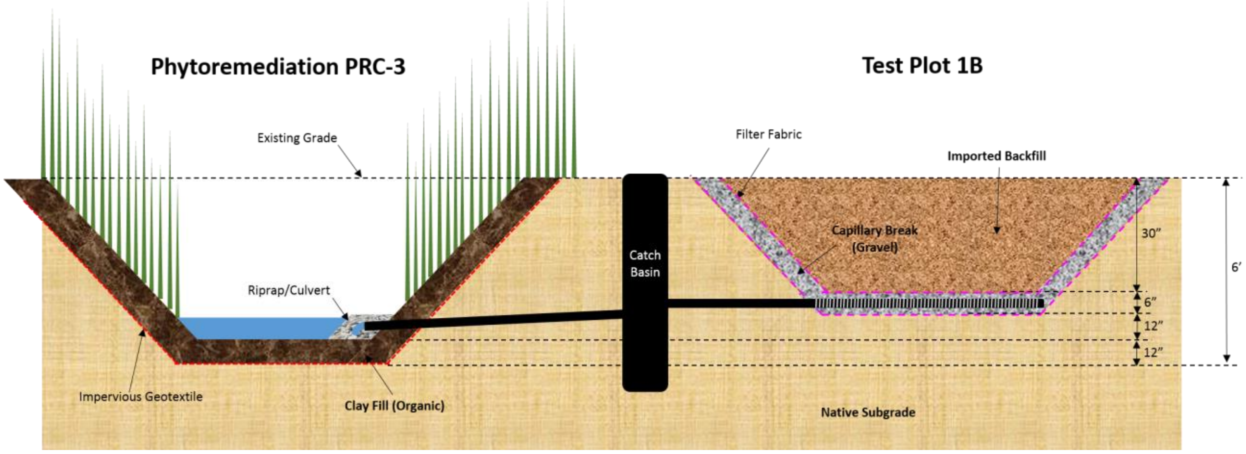


Figure 5: Test Plot 1B construction cross-section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, after one growing season in September 2018, and after winter in May 2019. Two planting periods were conducted for Plot 1B. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 5: Plot 1B EC Averages

Depth	Baseline (µS/cm)	Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change	Fall 2018 to Spring 2019 Percent Change
Surface EC	19,503	1,113	5,571	4,150	**+401%**	**-26%**
1-Foot EC	14,907	3,249	3,722	3,588	**+15%**	**-4%**
2-Foot EC	15,627	3,062	3,326	2,863	**+9%**	**-14%**

-Data not collected

EC measurements following test plot construction decreased as the contaminated soil had been removed and replaced with non-impacted imported soil. Increases in EC at the surface, 1-foot, and 2-foot depths were observed between post-construction measurements and Fall 2018 measurements which indicate potential recontamination from the surface. EC measurements remained relatively unchanged from Fall 2018 to Spring 2019, with a small decrease observed in surface EC.

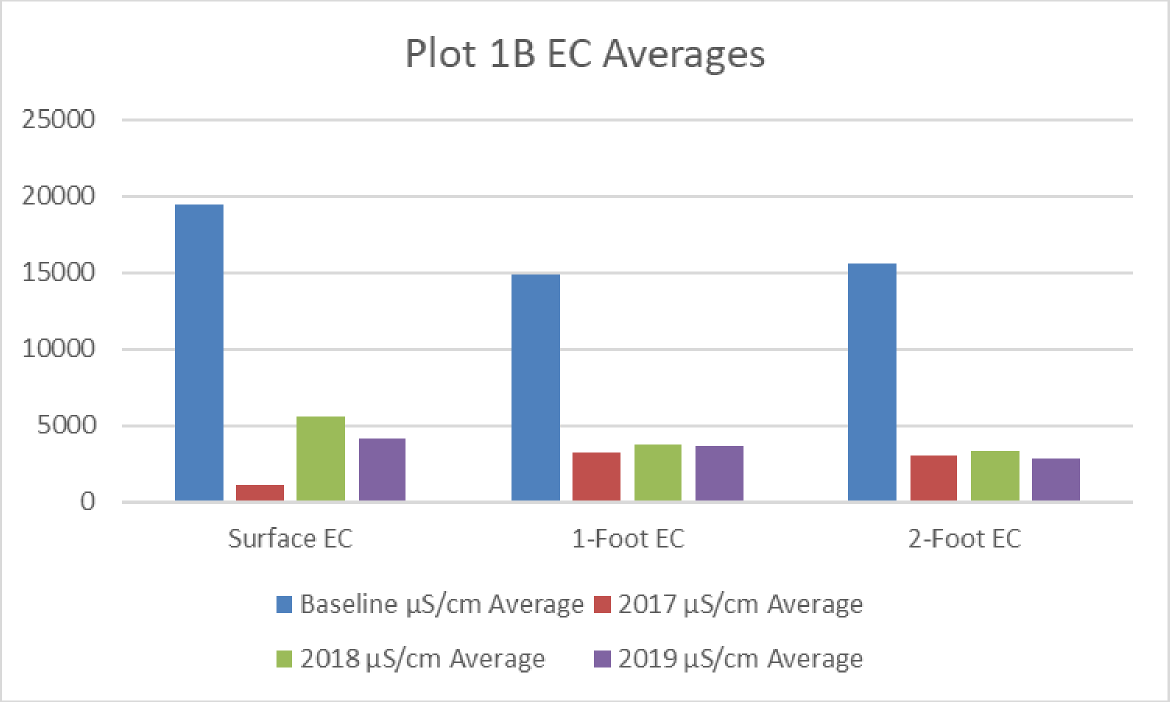


Figure 6: Plot 1B EC averages pre- and post-soil excavation and capillary break installation

Evidence of flooding from above normal precipitation at the site was observed in early July which caused surface water runoff from outside the test plot. However, increases in EC following overland flooding from rain are likely attributable to the relatively low soil EC following construction in Fall 2017. Germination of the five crops was observed after the first planting. Germination of winter wheat was observed after the second planting in Fall 2018 and Spring 2019.

May 9, 2018: 1st planting

July 5, 2018: 1st germination (germination of five crops observed)

October 30, 2018: 2nd germination (winter wheat germination not observed)

May 29, 2019

Please refer to Appendix A, Exhibits 4-6 for Plot 1B EC mapping.

3.4.3 Plot 2A

Plot 2A consisted of excavating approximately 36 inches of existing soil with slopes of approximately 2:1 (H:V). Approximately 30 inches of homogenized soil was placed, bringing the excavation up to grade. The homogenized soil consisted of mixing the excavated soils with less more brine-impacted soils obtained from just north of this plot area.

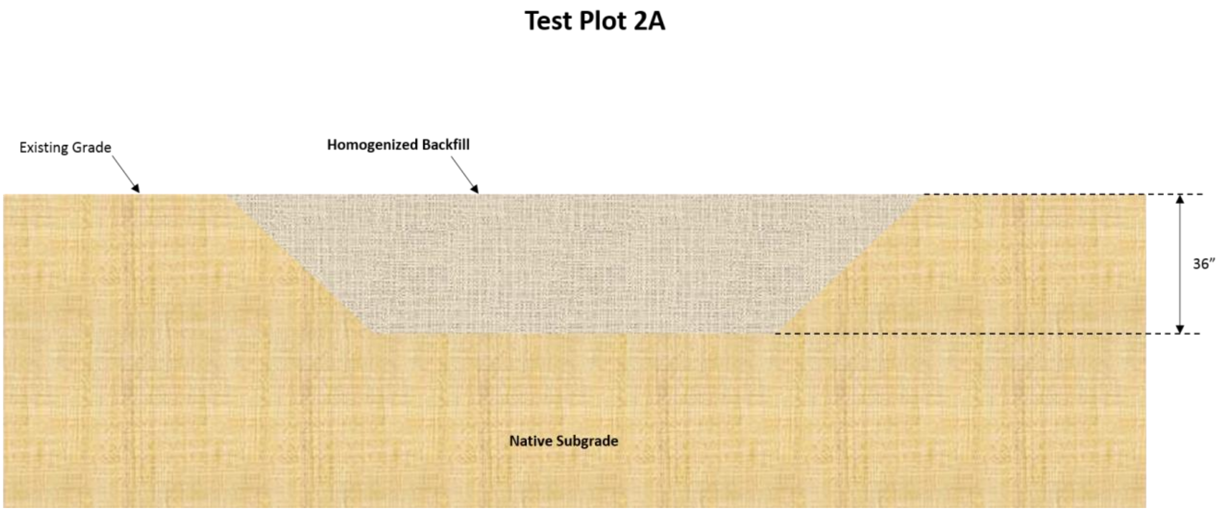


Figure 7: Test Plot 2A construction cross-section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, after one growing season in September 2018, and after winter in May 2019. Two planting periods were conducted for Plot 2A. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 6: Plot 2A EC Averages

Depth	Baseline (µS/cm)	Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change	Fall 2018 to Spring 2019 Percent Change
Surface EC	2,792	7,171	4,295	3,938	**-40%**	**-8%**
1-Foot EC	3,700	5,044	4,204	4,313	**-17%**	**3%**
2-Foot EC	3,377	4,451	4,370	4,563	**-2%**	**4%**

-Data not collected

EC measurements following test plot construction increased as the contaminated soil had been homogenized with higher EC soil. Decreases in EC at the surface, 1-foot depth, and 2-foot depth were observed between post-construction measurements and Fall 2018 measurements. EC from Fall 2018 to Spring 2019 decreased at the surface and increased at 1-foot and 2-foot levels.

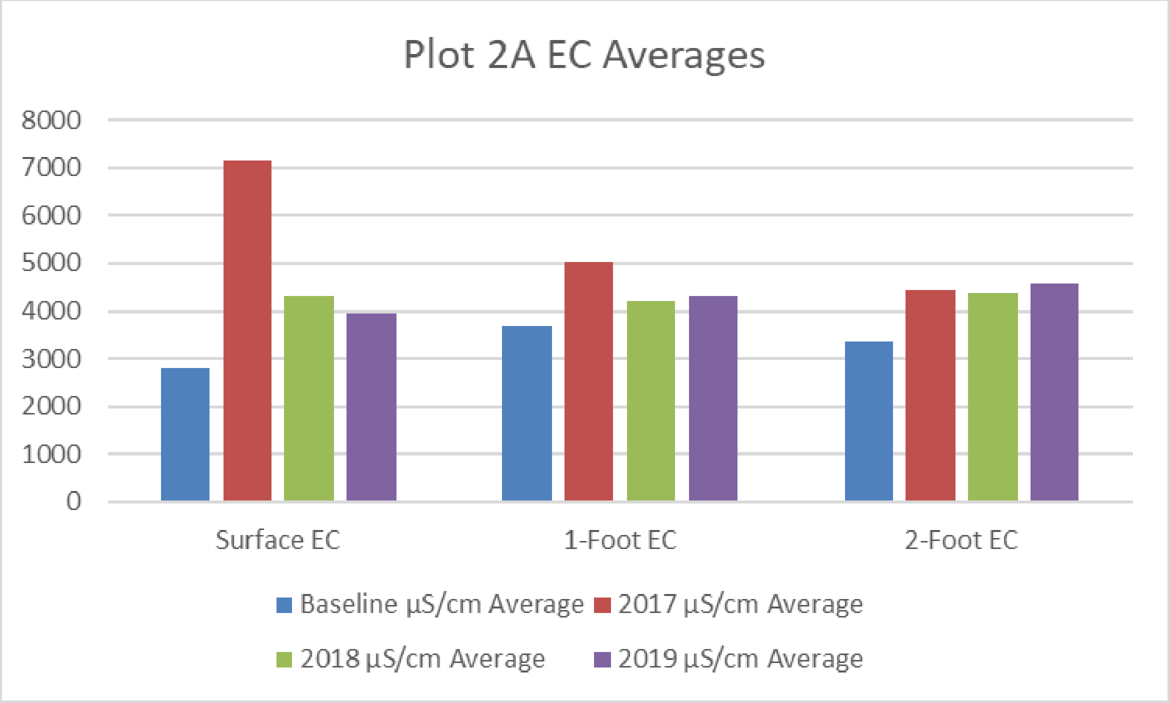


Figure 8: Plot 2A EC averages pre- and post-soil homogenizing without capillary break constructed

Evidence of flooding from above normal precipitation at the site was observed in early July. However, decreases in EC following overland flooding from rain are likely attributable to the relatively high soil EC compared to Plots 1A and 1B following construction in Fall 2017. Germination of barley was observed after the first planting. Germination of winter wheat was not observed after the second planting in Fall 2018 or in Spring 2019.

May 9, 2018: 1st planting

June 13, 2018: 1st germination (germination of barley observed)

October 30, 2018: 2nd germination (no germination observed)

May 29, 2019

Please refer to Appendix A, Exhibits 7-9 for Plot 2A EC mapping.

3.4.4 Plot 2B

Plot 2B consisted of excavating approximately 36 inches of existing soil, with slopes of approximately 2:1 (H:V). A layer of geotextile was placed over the excavated area, and six inches of gravel was placed at the base and up the sides of the excavation. A layer of geotextile was placed over the gravel, then approximately 30 inches of homogenized soil was placed, bringing the excavation up to grade. The homogenized soil consisted of mixing the excavated soils with less brine-impacted soils obtained from just south of this plot area (Plot 2A area). A sump pit/drainage system drained into PRC-3.

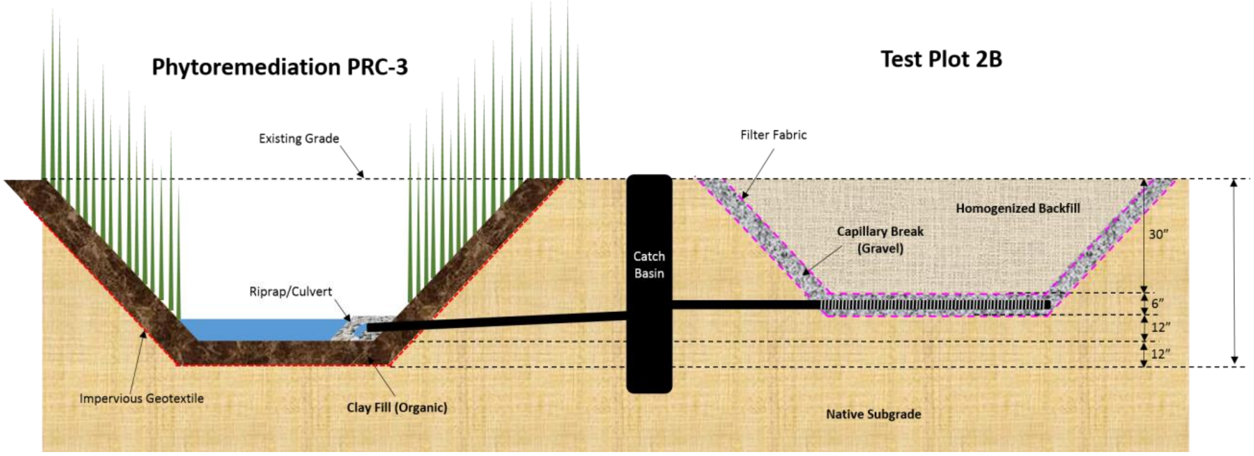


Figure 9: Test Plot 2B construction cross-section

Baseline EC measured prior to test plot construction and after test plot construction in 2017, and EC measurements were measured after winter in May 2019. Two planting periods were conducted for Plot 2B. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 7: Plot 2B EC Averages

Depth	Baseline (µS/cm)	Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change	Fall 2018 to Spring 2019 Percent Change
Surface EC	8,566	6,645	-	4,950	-	-
1-Foot EC	9,478	4,891	-	5,088	-	-
2-Foot EC	8,526	5,051	-	4,488	-	-

-Data not collected; data not collected for 2018 due to disturbances of the test plot

EC measurements following test plot construction decreased as the contaminated high EC soil had been homogenized with low EC soil. Fall 2018 EC measurements were not taken due to disturbances to the test plot from hauling water to the site for flushing Plot 3B, poor germination observations from the first planting, and evidence of significant flooding from above normal precipitation in early July 2018. EC measurements in Spring 2019 decreased from Fall 2017 measurements at the surface and 2-foot levels.

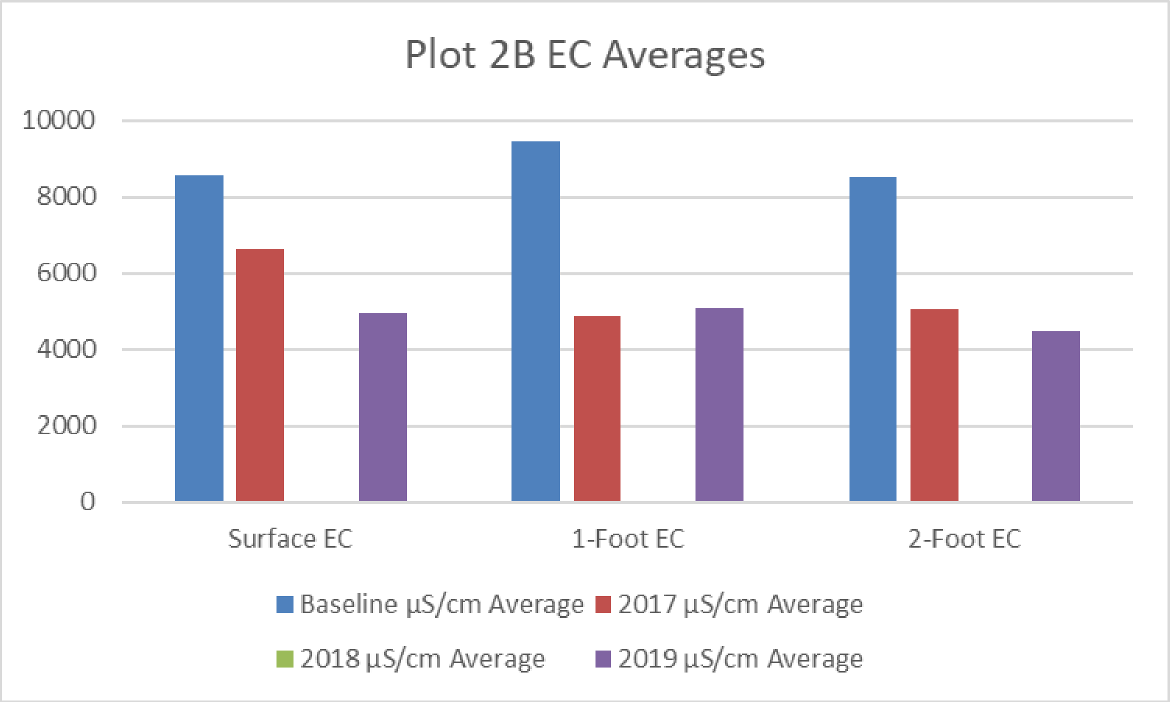


Figure 10: Plot 2B EC averages pre- and post-soil homogenizing with capillary break constructed

Germination of barley was observed after the first planting. Germination of winter wheat was not observed after the second planting in fall 2018 or Spring 2019.

May 9, 2018: 1st planting

July 5, 2018 1st germination (germination of barley observed)

May 29, 2019

Plot 2B EC mapping was not created due to lack of 2018 data.

3.4.5 Plot 3A

Plot 3A consisted of excavating approximately 36 inches of existing soil, with slopes of approximately 2:1 (H:V). A layer of geotextile was placed over the excavated area, and six inches of gravel was placed at the base and sides of the excavation. A second layer of geotextile was placed over the gravel and approximately 30 inches of amended soil was placed, bringing the excavation up to grade. The amended soil consisted of excavated soil from the plot mixed with gypsum. A sump pit/drainage system drained to PRC-3.

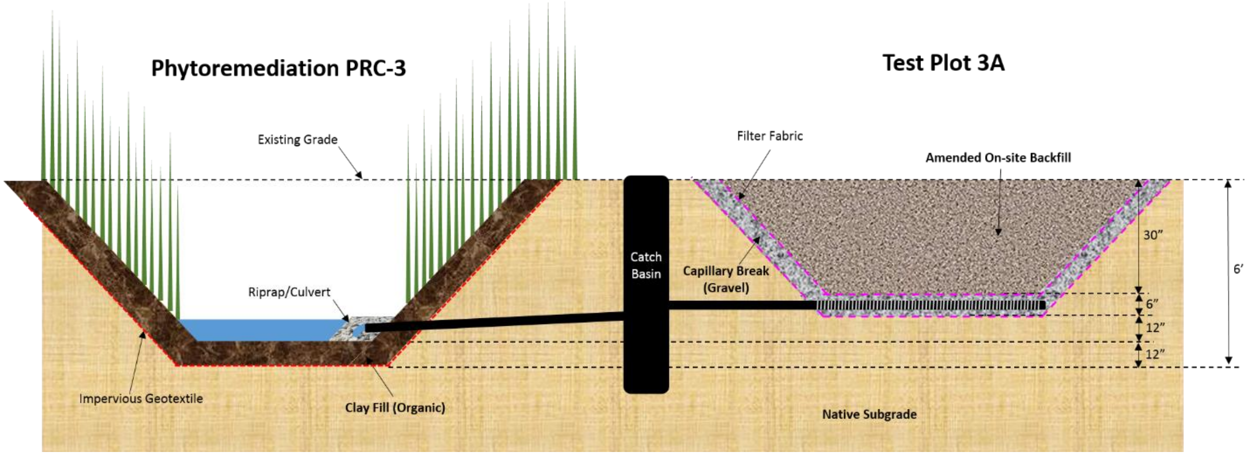


Figure 12: Test Plot 3A construction cross-section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, after one growing season in September 2018, after flushing with water obtained from PRC-3 in September 2018, and following winter in May 2019. Two planting periods were conducted for Plot

3A. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 8: Plot 3A EC Averages

Period	Baseline (µS/cm)	Fall 2017 (µS/cm)	2018 Pre-Flush (µS/cm)	Post-Flush 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change	Fall 2018 to Spring 2019 Percent Change
Surface EC	13,618	15,115	9,174	9,233	3,950	**-32%**	**-57%**
1-Foot EC	10,837	15,976	10,258	11,596	5,438	**-27%**	**-53%**
2-Foot EC	9,570	13,889	9,174	10,285	5,125	**-26%**	**-50%**

-Data not collected

EC measurements following test plot construction increased at the surface, 1-foot depth, and 2-foot depth due to the addition of gypsum as an amendment. The addition of gypsum is known to increase EC in soil until flushed with water. EC increases were observed between post-construction measurements and Summer 2018 pre-flush measurements. Negligible change in EC at the surface and an increase in EC at the 1-foot and 2-foot depths was observed following flushing of the test plot with water from PRC-3. EC from PRC-3 water was 16,300 µS/cm prior to flushing. EC decreases were observed at surface, 1-foot, and 2-foot depths from Fall 2018 to Spring 2019.

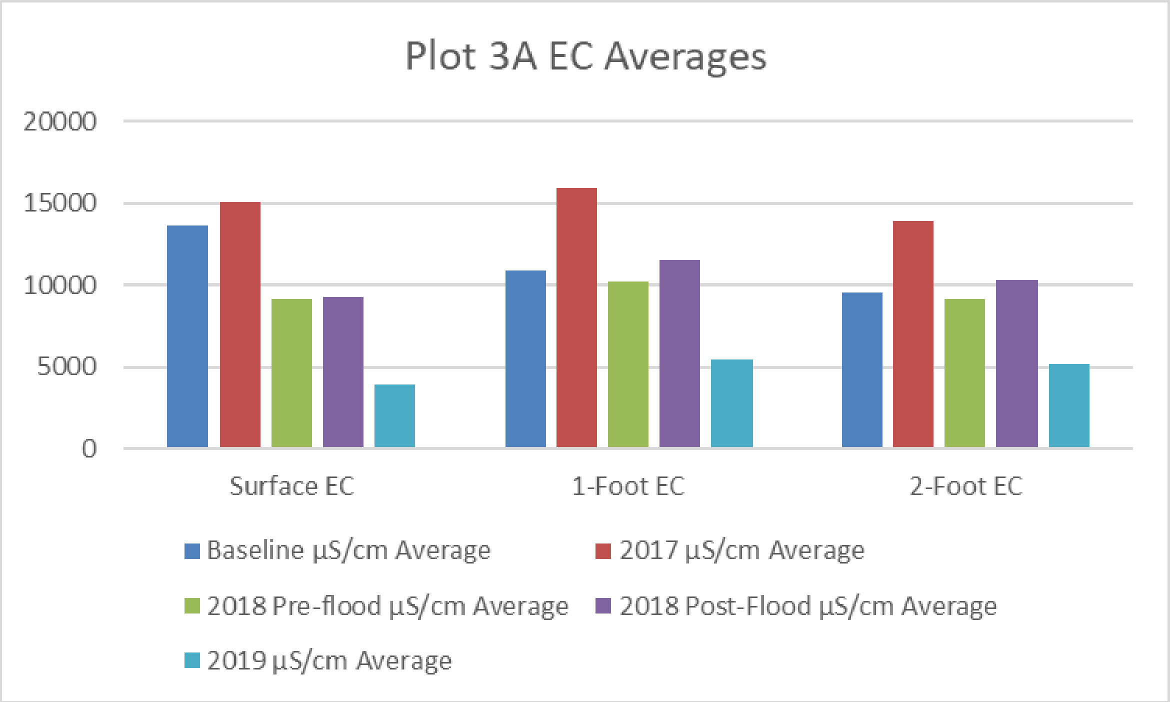


Figure 13: Plot 3A EC averages pre- and post-soil excavation and capillary layer construction pre- and post-potable water flushing

Germination of the five crops was not observed after the first planting. Germination of winter wheat was not observed after the second planting in Fall 2018 nor Spring 2019.


May 9, 2018: 1st planting


July 17, 2018: 1st germination (no germination observed)


October 30, 2018: 2nd germination (no germination observed)


May 29, 2019

Please refer to Appendix A, Exhibits 10-15 for Plot 3A EC mapping.

3.4.6 Plot 3B

Plot 3B consisted of excavating approximately 36 inches of existing soil with slopes of approximately 2:1 (H:V). A layer of geotextile was placed over the excavated area, and six inches of gravel was placed at the base and sides of the excavation. A second layer of geotextile was placed over the gravel and approximately 30 inches of amended soil was placed up to grade. The amended soil consisted of mixing excavated soil with gypsum. An 8-inch berm was constructed around the edge of the plot to maintain irrigation water within the plot area. A sump pit/drainage system drained to PRC-3.

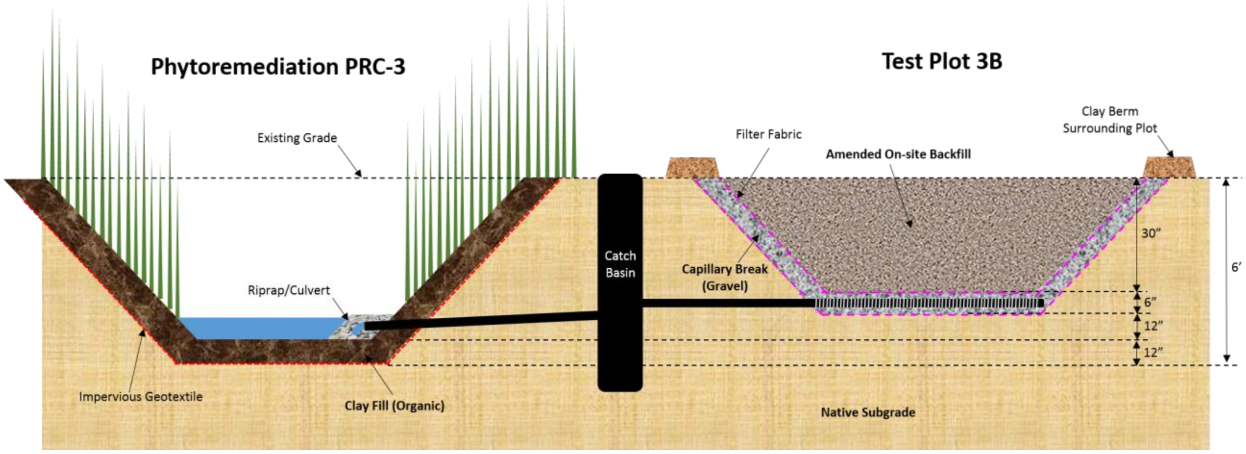


Figure 14: Test Plot 3B construction cross- section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, after one growing season in September 2018, after flushing with non-impacted, imported water in September 2018, and following winter in May 2019. Two planting periods were conducted for Plot 3B. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with the five crops.

Table No. 9: Plot 3B EC Averages

Depth	Baseline (µS/cm)	Fall 2017 (µS/cm)	2018 Pre-Flush (µS/cm)	Fall 2018 Post-Flush 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change	Fall 2018 to Spring 2019 Percent Change
Surface EC	13,165	9,685	8,178	2,194	3,000	**-77%**	**+37%**
1-Foot EC	8,367	9,350	8,946	4,921	3,650	**-47%**	**-26%**
2-Foot EC	8,302	6,253	10,452	5,880	4,650	**-36%**	**-21%**

-Data not collected

EC measurements following test plot construction decreased at the surface and 2-foot depth and increased at the 1-foot depth. An increase in EC similar to Plot 3A with the addition of gypsum as an amendment was not observed due to water irrigation of the test plot. EC decreases at the surface and 1-foot depth and increases at the 2-foot depth were observed between post-construction measurements and Summer 2018 pre-flushing measurements. Decreases in EC at the surface, 1-foot depth, and 2-foot depth were observed following flushing of the test plot with non-impacted imported water. Field tested EC from the imported water was observed at 1,500 µS/cm prior to flushing. EC increases at the surface and decreases at 1-foot and 2-foot depths were observed in Spring 2019.

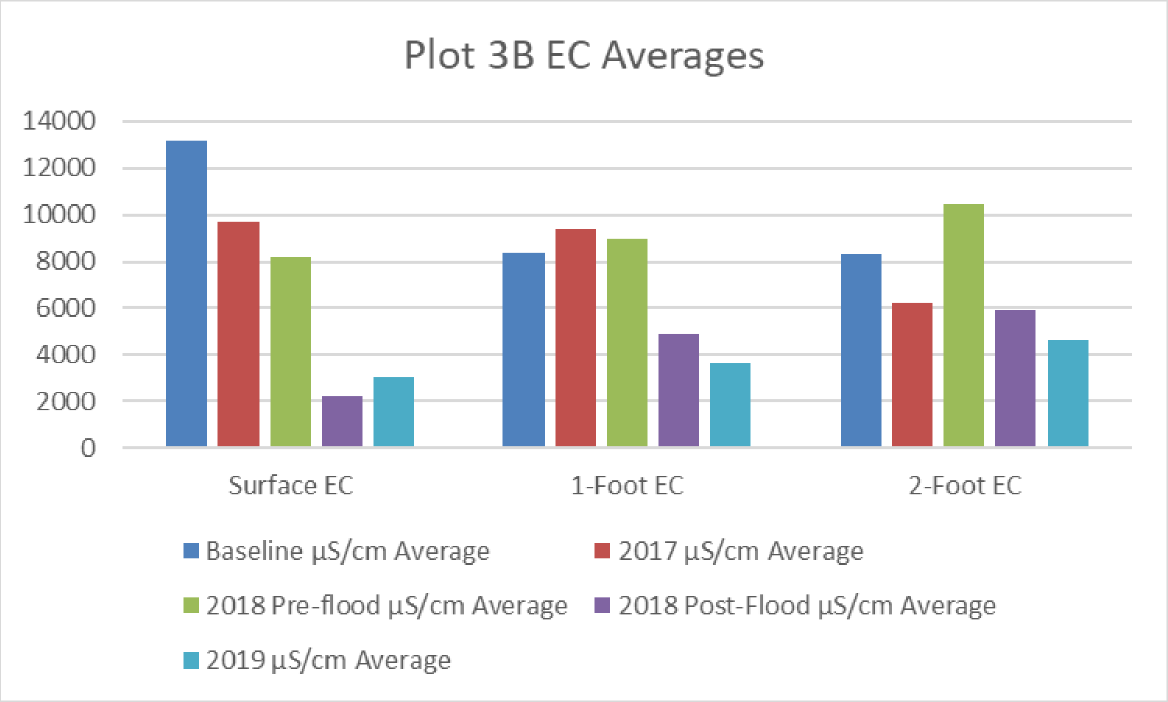


Figure 15: Plot 3B EC averages pre- and post-soil excavation and capillary layer construction pre- and post-potable water flushing

Germination of barley was observed after the first planting. Germination of alfalfa and barley was observed after the second planting in Fall 2018 and Spring 2019

May 9, 2018: 1st planting

June 13, 2018: 1st germination (barley germination observed)

October 30, 2018: 2nd germination (alfalfa and barley germination observed)

May 29, 2019

Please refer to Appendix A, Exhibits 16-21 for Plot 3B EC mapping.

3.4.7 Plot 4

Plot 4 consisted of removing approximately 36 inches of the most highly impacted soil within the center of the test plot. The remaining soil within the test plot area was excavated and mixed with non-impacted soil from onsite borrow sources, with slopes should 2:1 (H:V). A layer of geotextile was placed over the excavated area, and six inches of gravel was placed at the base and sides of the excavation. A second layer of geotextile was placed over the gravel, then the approximately 30 inches of mixed soil was placed bring the plot up to grade. A sump pit/drainage system drained into PRC-3.

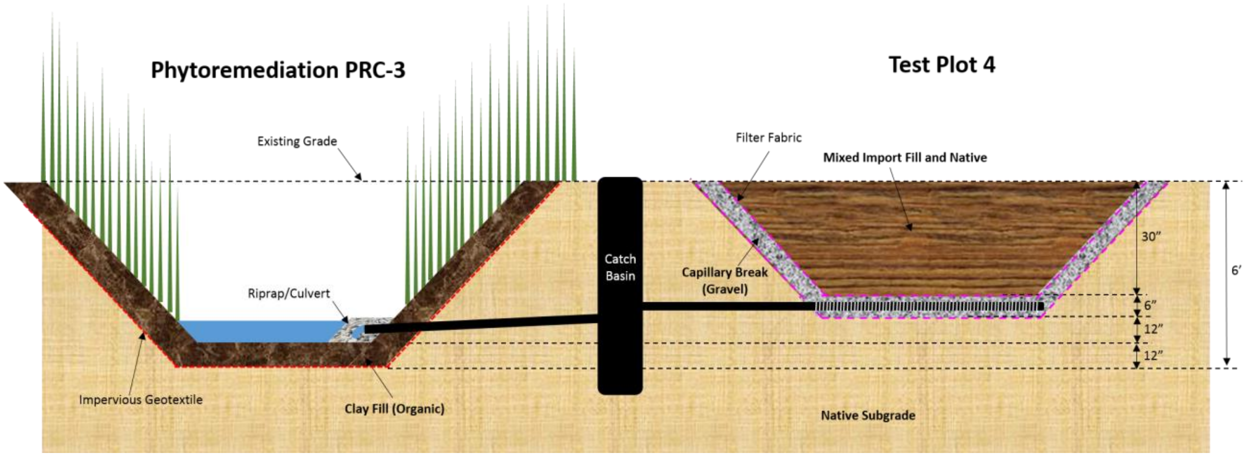


Figure 16: Test Plot 4 construction cross-section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, after one growing season in September 2018, and following winter in May 2019. Two planting periods were conducted for Plot 4. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 10: Plot 4 EC Averages

Depth	Baseline (µS/cm)	Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change	Fall 2018 to Spring 2019 Percent Change
Surface EC	9,173	4,348	6,061	3,188	**+39%**	**-47%**
1-Foot EC	6,745	4,956	4,850	2,325	**-2%**	**-52%**
2-Foot EC	5,935	5,501	3,785	2,050	**-36%**	**-46%**

-Data not collected

EC measurements following test plot construction decreased as imported soil was homogenized with contaminated soil. An increase in EC at the surface and decreases at 2-foot depth and 1-foot depth were observed between post-construction measurements and Fall 2018 measurements which indicate potential recontamination from the surface. A decrease in EC at surface, 1-foot depth, and 2-foot depth was observed in Spring 2019.

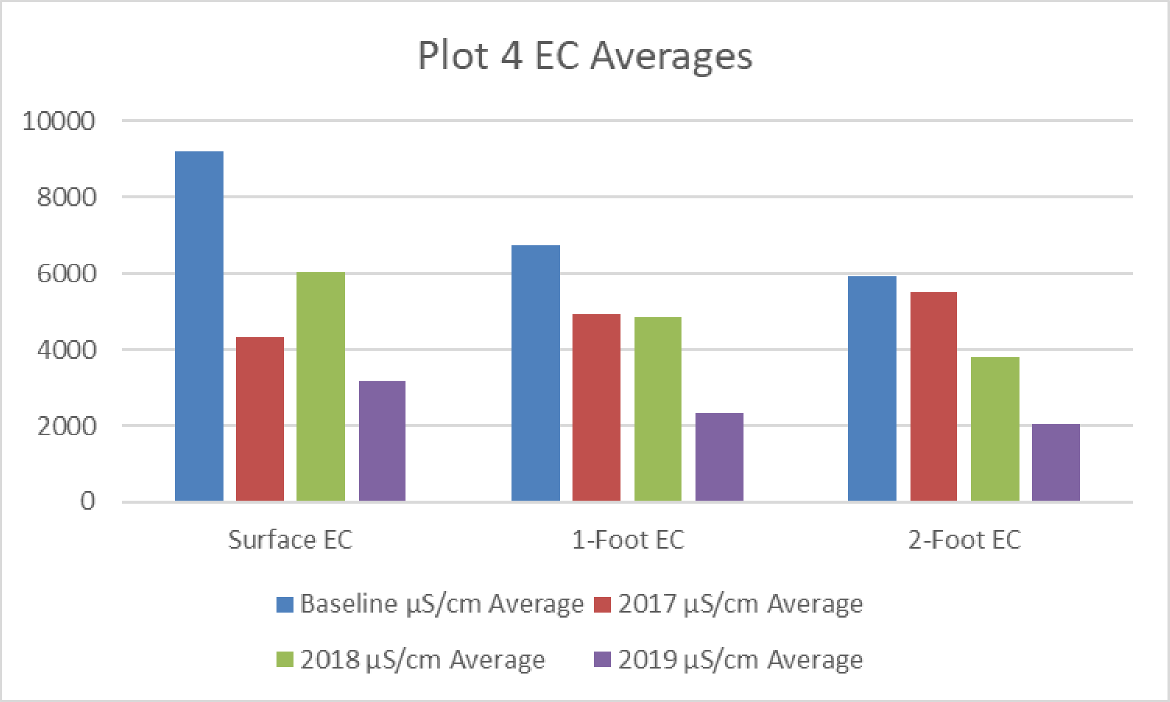


Figure 17: Plot 4 EC averages pre- and post-soil homogenization with imported soil and capillary layer construction

Evidence of flooding from above normal precipitation at the site was observed in early July which caused surface water runoff from outside the test plot. This runoff is most likely the source of recontamination. Germination of the five crops was observed after the first planting. Germination of winter wheat was observed after the second planting in Fall 2018 and Spring 2019.

May 9, 2018: 1st planting

June 13, 2018: 1st germination (germination of five crops observed)

October 30, 2018: 2nd germination (winter wheat germination observed)

May 29, 2019

Please refer to Appendix A, Exhibits 22-24.

3.4.8 Plot 5A

Plot 5A consisted of grading the ground level approximately 2.5 percent sloping downward towards PRC-2. A layer of geotextile was placed at grade over the contaminated soil; six inches of gravel was placed and extended laterally to PRC-2; a layer of geotextile was placed; approximately 30 inches of imported (non-impacted) soil was placed on top of the geofabric/gravel section with side slopes of 2:1 (H:V). The gravel layer and geotextile extended approximately 24 inches further than the imported (non-impacted) soil extent on the sides not in contact with PRC-2. The remaining side sloped into PRC-2 for drainage.

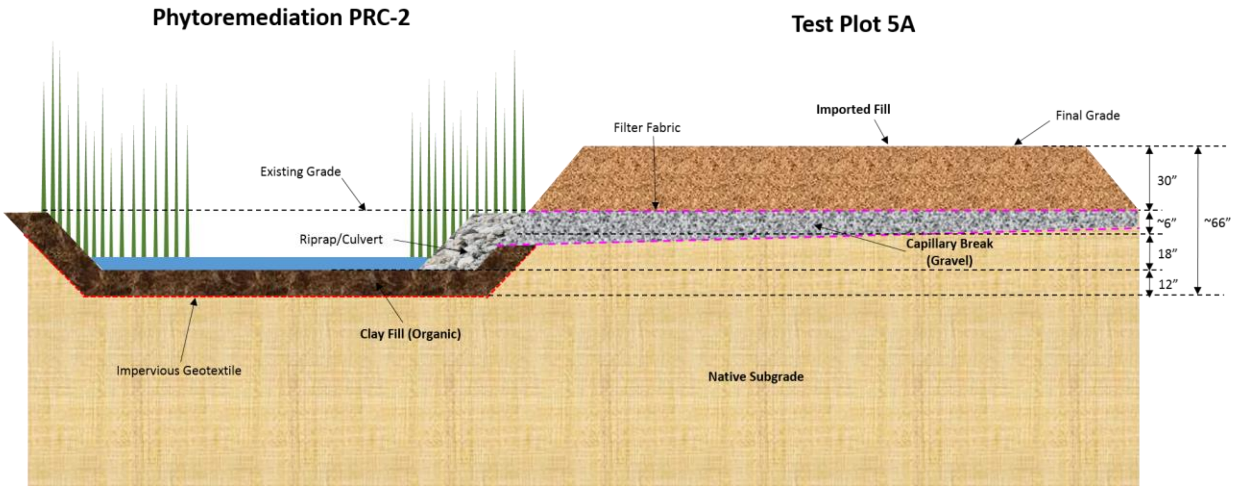


Figure 18: Test Plot 5A construction cross-section

EC of in-place soils was measured prior to test plot construction. EC of the imported soils were measured after test plot construction in 2017, after one growing season in September 2018, and after winter in. Two planting periods were conducted for Plot 2A. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 11: Plot 5A EC Averages

Depth	Contaminated Soil 2017 (µS/cm)	Post-construction Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change	Fall 2017 to Spring 2018 Percent Change
Surface EC	17,982	1,256	1,215	2,325	**-3%**	**+91%**
1-Foot EC	15,405	1,236	1,352	1,838	**+9%**	**+36%**
2-Foot EC	10,533	1,464	1,268	1,388	**-13%**	**+9%**

-Data not collected

EC measurements following test plot construction were collected from the imported soil placed over the geotextile. Negligible change in EC at the surface, 1-foot depth, and 2-foot depth was observed between post-construction measurements and Fall 2018 measurements of the soils placed over the geotextile. Increases in EC were observed at the surface and negligible change was observed at 1-foot and 2-foot depths in Spring 2019. Impact on contaminated soil below the imported soil is not known as tests were limited to the imported soil.

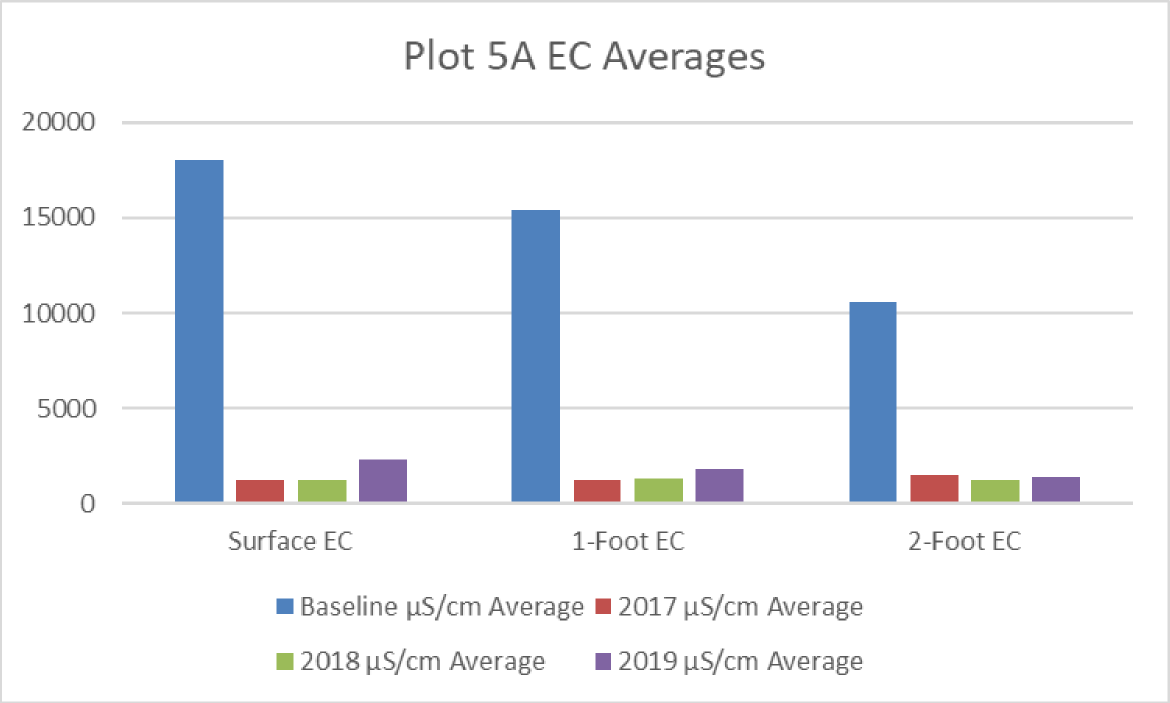


Figure 19: Plot 5A EC averages pre- and post-placing soil over contaminated soil and capillary layer construction

Germination of the five crops was observed after the first planting. Germination of winter wheat was observed after the second planting in Fall 2018 and Spring 2019.

May 9, 2018: 1st planting

June 13, 2018: 1st germination (germination of five crops observed)

October 30, 2018: 2nd germination (winter wheat germination observed)

May 29, 2019

Please refer to Appendix A, Exhibits 25-27 for Plot 5A EC mapping.

3.4.9 Plot 5B

Plot 5B consisted of grading the ground approximately 2.5 percent sloping downward towards PRC-2. A layer of composite geotextile (i.e. geonet, RoaDrain, etc.) was placed at grade and extended laterally to PRC-2 over the contaminated soil. Approximately 30 inches of imported (non-impacted) soil was placed on top of the geofabric/gravel section with side slopes of 2:1 (H:V). The composite geotextile extended approximately 24 inches further than the imported soil on the sides not in contact with PRC-2. The remaining side was extended into PRC-2 approximately 6-12 inches.

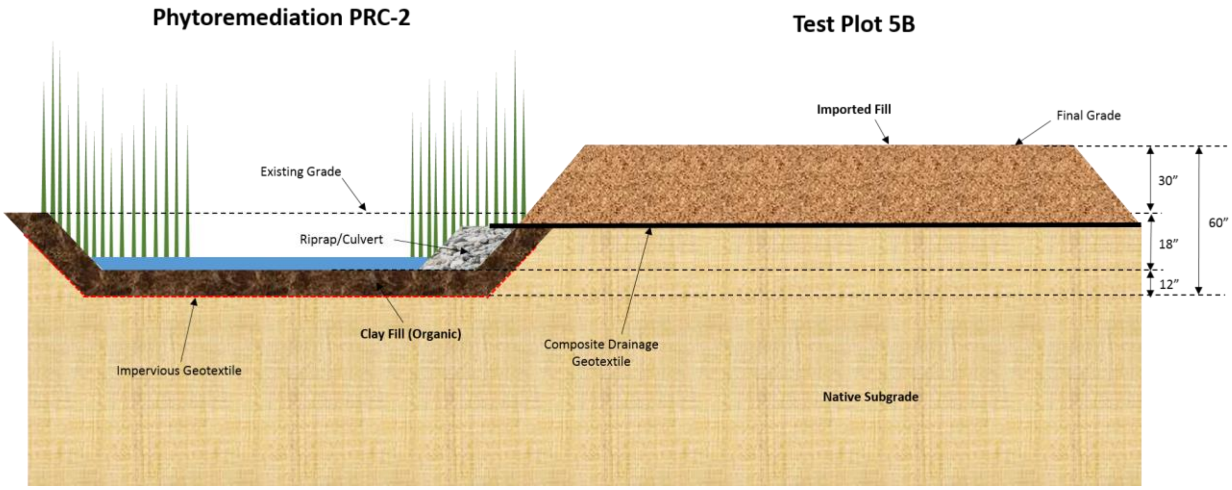


Figure 20: Test Plot 5B construction cross-section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, after one growing season in September 2018, and following winter in May 2019. Two planting periods were conducted for Plot 5B. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 12: Plot 5B EC Averages

Depth	Contaminated Soil 2017 (µS/cm)	Post-Construction Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change	Fall 2018 to Spring 2019 Percent Change
Surface EC	18,153	1,322	1,421	2,238	**+7%**	**+57%**
1-Foot EC	14,502	1,358	1,487	1,763	**+10%**	**+19%**
2-Foot EC	13,515	1,484	1,462	1,375	**-1%**	**-7%**

-Data not collected

EC measurements following test plot construction were collected from the imported soil placed over the geotextile. Negligible change in EC at the surface, 1-foot depth, and 2-foot depth was observed between post-construction measurements and Fall 2018 measurements of the soils placed over the geotextile. Increases in EC was observed at the surface and negligible changes in EC were observed at 1-foot depth and 2-foot depth. Impact on contaminated soil below the imported soil is not known as tests were limited to the imported soil.

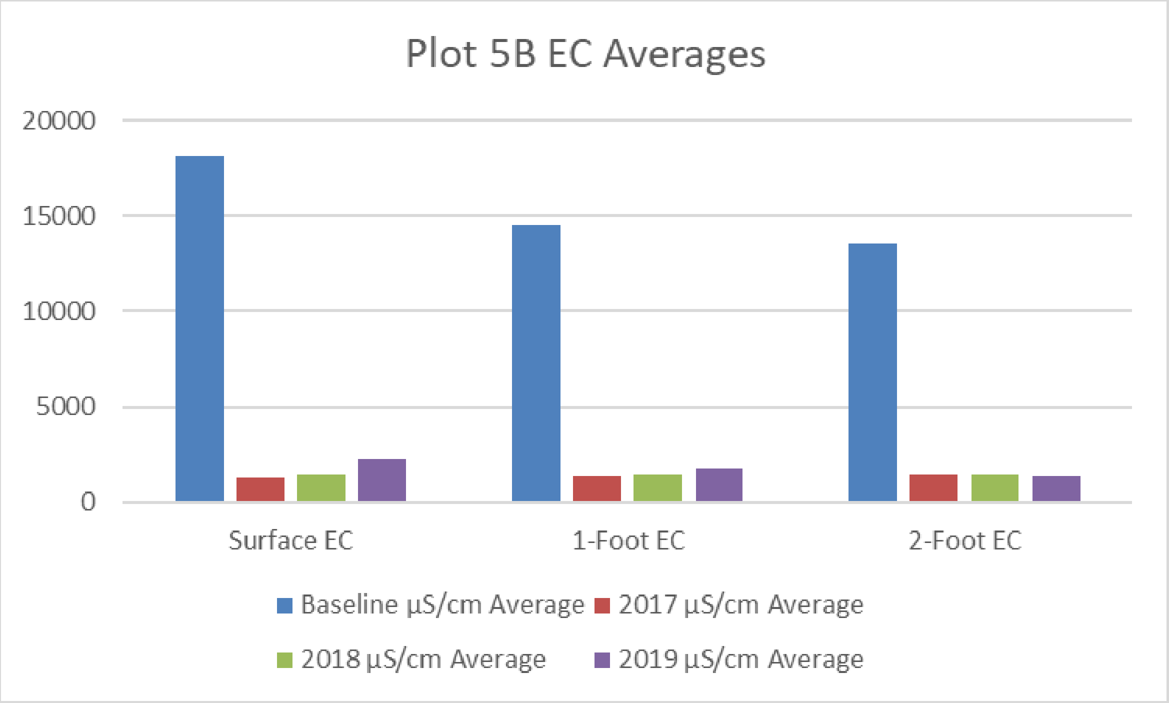


Figure 21: Plot 5B EC averages pre- and post-placing soil over contaminated soil and geotextile placement

Germination of the five crops was observed after the first planting and germination of winter wheat was observed after the second planting.

May 9, 2018: 1st planting

June 13, 2018: 1st germination (germination of five crops observed)

October 30, 2018: 2nd germination (winter wheat germination observed)

May 29, 2019

Please refer to Appendix A, Exhibits 28-30 for Plot 5B EC mapping.

3.4.10 PRC-1

Phytoremediation Cell 1 (PRC-1) consisted of excavating approximately 30 inches of soil, with slopes of approximately 2:1 (H:V). Approximately six inches of imported non-impacted clay was placed at the bottom and sides of the excavation leaving a 24-inch deep subsurface depression. No test plots drained into PRC-1. Cattails were planted in three sections (thirds) in this plot: transplanted rhizomes spaced every 2-4 feet in a third; rhizomes that were split up and spread out evenly in a third; and the remaining third of the PRC was planted with cattail seeds.

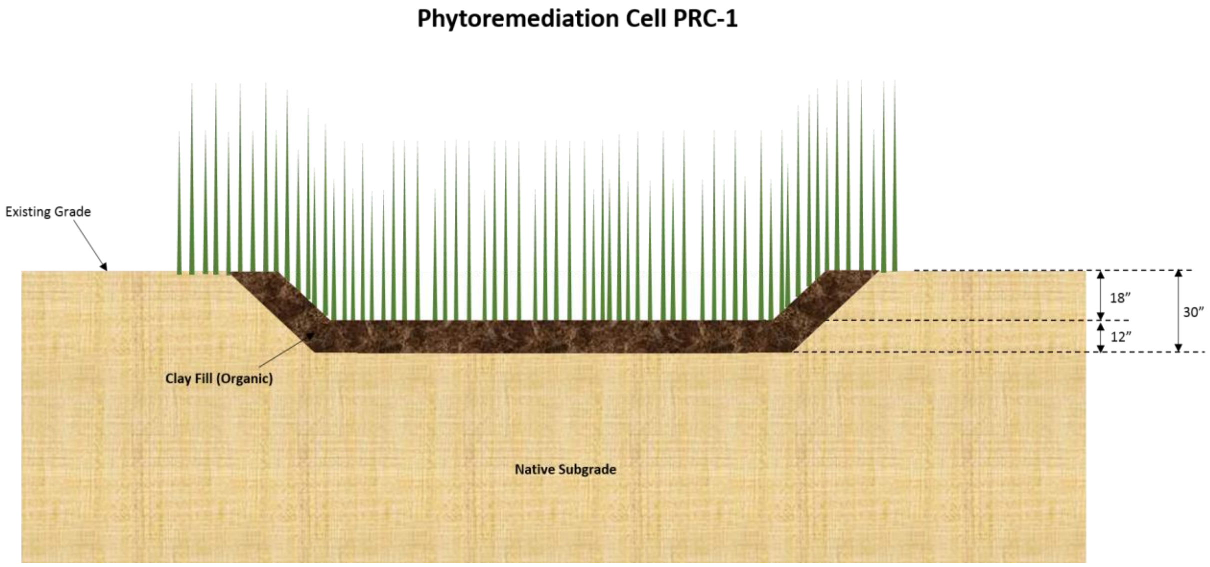


Figure 22: PRC-1 construction cross-section

May 9, 2018

September 10, 2018

October 30, 2018

May 29, 2019

3.4.11 PRC-2

Phytoremediation Cell 2 (PRC-2) consisted of excavating approximately 30 inches of soil, with slopes of approximately 2:1 (H:V). A layer of impermeable geotextile was placed at the bottom and sides of the excavated area, and 12 inches of imported non-impacted clay was placed at the bottom and sides of the excavation leaving an 18-inch deep subsurface depression. Test Plots 5A and 5B drained into PRC-2.

Please refer to test plot diagrams for Plots 5A and 5B above for a detailed representation of the PRC-2 construction cross-section.

May 9, 2018

September 10, 2018

3.4.12 PRC-3

Phytoremediation Cell 3 (PRC-3) consisted of excavating approximately 72 inches of soil, with slopes of approximately 1:1 (H:V). A layer of impermeable geotextile was placed at the bottom and sides of the excavation, and 12 inches of imported non-impacted clay was placed at the bottom and up the sides of the excavation leaving a 60-inch deep low-lying area. Plots 1B, 2, 3A, 3B, and 4 drained into PRC-3. Water from PRC-3 was used to flush Plot 3A in August 2018. EC from field testing was observed to be 16,300 µS/cm prior to 2018 flushing.

Please refer to test plot diagrams for Plots 1B, 2B, 3A, 3B, and 4 above for a detailed representation of the PRC-3 construction cross-section.

May 9, 2018

September 10, 2018

October 30, 2018

May 29, 2019

4.0 LABORATORY ANALYTICAL RESULTS

Soil and/or water sample(s) were analyzed for the following constituents and characteristics:

- Specific conductance (USEPA method 9050A Mod)
- Chlorides (USEPA method 9056A)
- Sodium (and selected metals) (USEPA method 6010C)

Analytical results from laboratory test cell amendments in Table 1 [Test Cell Soil Samples], water drained from test plots following flooding with water in Table 2 [Test Cell Post-Flood Water], and water prior to flushing in Table 3 [Test Plot Pre-Flush Water (PRC-3)] are located in Appendix D.

After collecting each sample in laboratory-provided containers, Terracon recorded the sample time on each container label in permanent ink and place the filled containers in an ice-filled cooler for transport. The samples and completed chain-of-custody forms were shipped via overnight courier to Environmental Science Corporation Laboratory Services (ESC) in Mt. Juliet, Tennessee, a National Environmental Laboratory Accreditation Program (NELAP)-accredited laboratory provided the analytical services.

Data summary tables and laboratory analytical/test reports and chain-of custodies recorded are attached in Appendix D. The following sections present the results of the laboratory testing.

4.1 Laboratory Test Cells - Soil

Composite soil samples were collected for EC and chlorides from test cells after flushing with water. Please see results and data tables in Appendix D.

Non-amended test cell samples (Control EC 5,000, Control EC 12,0000, and Control EC 18,000) acted as control samples. EC measurements were reported at 242 micromhos per centimeter (µmhos/cm), 13,900 µmhos/cm, and 562 µmhos/cm, respectively. Chlorides were reported at 59 mg/L, 10,400 mg/L, and 179 mg/L, respectively.

Amendment 1 test cell samples (Amend 1 EC 5,000, Amend 1 EC 12,0000, and Amend 1 EC 18,000) contained added BioFlora® and fertilizer. EC measurements were reported at 664 µmhos/cm, 1,670 µmhos/cm, and 1,030 µmhos/cm, respectively. Chlorides were reported at 92 mg/L, 121 mg/L, and 193 mg/L, respectively.

Amendment 2 test cell samples (Amend 2 EC 5,000, Amend 2 EC 12,0000, and Amend 2 EC 18,000) contained added straw, gypsum, sugar beet molasses, and fertilizer. EC measurements were reported at 2,380 µmhos/cm, 2,870 µmhos/cm, and 3,170 µmhos/cm, respectively. Chlorides were reported at 63 mg/L, 220 mg/L, and none detected, respectively.

Amend 3 test cell samples (Amend 3 EC 5,000, Amend 3 EC 12,0000, and Amend 3 EC 18,000) contained added straw, gypsum, sugar beet molasses, BioFlora®, and fertilizer. EC measurements were reported at 1,910 µmhos/cm, 4,060 µmhos/cm, and 2,790 µmhos/cm, respectively. Chlorides were reported at 48 mg/L, 242 mg/L, and 140 mg/L, respectively.

Amendment 4 test cell samples (Amend 4 EC 5,000, Amend 4 EC 12,0000, and Amend 4 EC 18,000) contained added straw, gypsum, beet pulp, BioFlora®, and fertilizer. EC measurements were reported at 2,400 µmhos/cm, 2,730 µmhos/cm, and 1,330 µmhos/cm, respectively. Chlorides were reported at 42 mg/L, 99 mg/L, and 120 mg/L, respectively.

Amendment 5 test cell samples (Amend 5 EC 5,000, Amend 5 EC 12,0000, and Amend 5 EC 18,000) contained added straw, sulfuric acid, BioFlora®, and fertilizer. EC measurements were reported at 2,570 µmhos/cm, 1,180 µmhos/cm, and 1,780 µmhos/cm, respectively. Chlorides were reported at 55 mg/L, 204 mg/L, and 172 mg/L, respectively.

Amendment 6 test cell samples (Amend 6 EC 5,000, Amend 6 EC 12,0000, and Amend 6 EC 18,000) contained an added straw, gypsum, BioFlora®, and fertilizer. EC measurements were reported at 3,010 µmhos/cm, 641 µmhos/cm, and 2,390 µmhos/cm, respectively. Chlorides were reported at 47 mg/L, 68 mg/L, and 68 mg/L, respectively.

Amendment 7 test cell samples (Amend 7 EC 5,000, Amend 7 EC 12,0000, and Amend 7 EC 18,000) contained added straw, a solution of sulfuric acid and gypsum, BioFlora, and fertilizer. EC measurements were reported at 1,050 µmhos/cm, 2,180 µmhos/cm, and 2,070 µmhos/cm, respectively. Chlorides were reported at 54 mg/L, 126 mg/L, and 176 mg/L, respectively.

Amendment 8 test cell samples (Amend 7 EC 5,000, Amend 7 EC 12,0000, and Amend 7 EC 18,000) contained added clean, coarse sand. EC measurements were reported at 246 µmhos/cm, 499 µmhos/cm, and 764 µmhos/cm, respectively. Chlorides were reported at 54 mg/L, 78 mg/L, and 535 mg/L, respectively.

4.2 Laboratory Test Cell - Water

An effluent composite water sample from the test cells following the 12-week simulated flooding period was analyzed for EC and chlorides for characterization. EC of the sample was reported at 30,700 µmhos/cm. Sodium concentration of the sample was reported at 5,480 mg/L. Chloride concentration of the sample was reported at 8,930 mg/L.

4.3 PRC-3 Effluent Sample - Water

An effluent water sample from PRC-3 prior to being utilized for flushing of Plot 3A was analyzed for EC and concentrations of chlorides and sodium. EC of the sample measured 4,510 µmhos/cm.

Chloride concentration of the sample was 1,130 mg/L. Sodium concentration of the sample was 665 mg/L.

5.0 FIELD RESULTS AND OBSERVATIONS

5.1 Electrical Conductivity (EC) Results

Terracon field screened electrical conductivity as mentioned in Section 1.2.1. EC measurements for each test plot were averaged and compared.

5.1.1 Surface EC Measurements

Surface EC measurements for the nine test plots were collected and are presented below.

Table No. 13 – Surface EC Measurement Averages

Period and Change	1A	1B	2A	2B	3A	3B	4	5A	5B
Baseline (µS/cm)	17,997	19,503	2,792	8,566	13,618	13,165	9,173	17,982	18,153
2017 post-construction (µS/cm)	1,881	1,112	7,171	6,645	15,115	9,685	4,348	1,256	1,322
2018 pre-flush (µS/cm)	-	-	-	-	9,174	8,178	-	-	-
Fall 2018 (µS/cm)	2,904	5,571	4,295	-	9,233	2,194	6,061	1,215	1,421
Spring 2019 (µS/cm)	2,300	4,150	3,938	4,950	3,950	3,000	3,188	2,325	2,238
2017/18 percent change	54%	401%	-40%	-	-39%	-77%	39%	-3%	7%
2018/19 percent change	-2%	-26%	-8%		-57%	37%	-47%	91%	57%
2017/19 percent change	22%	273%	-49%	26%	-74%	69%	-26%	85%	69%

- Data not collected

The following observations were made from Fall 2017 post-construction to Spring 2019:

- EC was observed to increase Plot 1A by approximately 22%;
- EC was observed to increase in Plot 1B by approximately 273%;
- EC was observed to decrease in Plot 2A by approximately 49%;
- EC was observed to increase in Plot 2B by approximately 26%;
- EC was observed to decrease in Plot 3A by approximately 74%;
- EC was observed to decrease in Plot 3B by approximately 69%;
- EC was observed to decrease in Plot 4 by approximately 26%;
- EC was observed to increase in Plot 5A by approximately 85%; and
- EC was observed to increase in Plot 5B by approximately 69%.

Recontamination most likely occurred from surface water runoff and resulting infiltration. Surface EC increased at Plots 1A, 1B, 2B, 5A and 5B. Surface EC decreased in Plot 2A, 3A, 3B, and 4. EC value data set can be found in Appendix C.

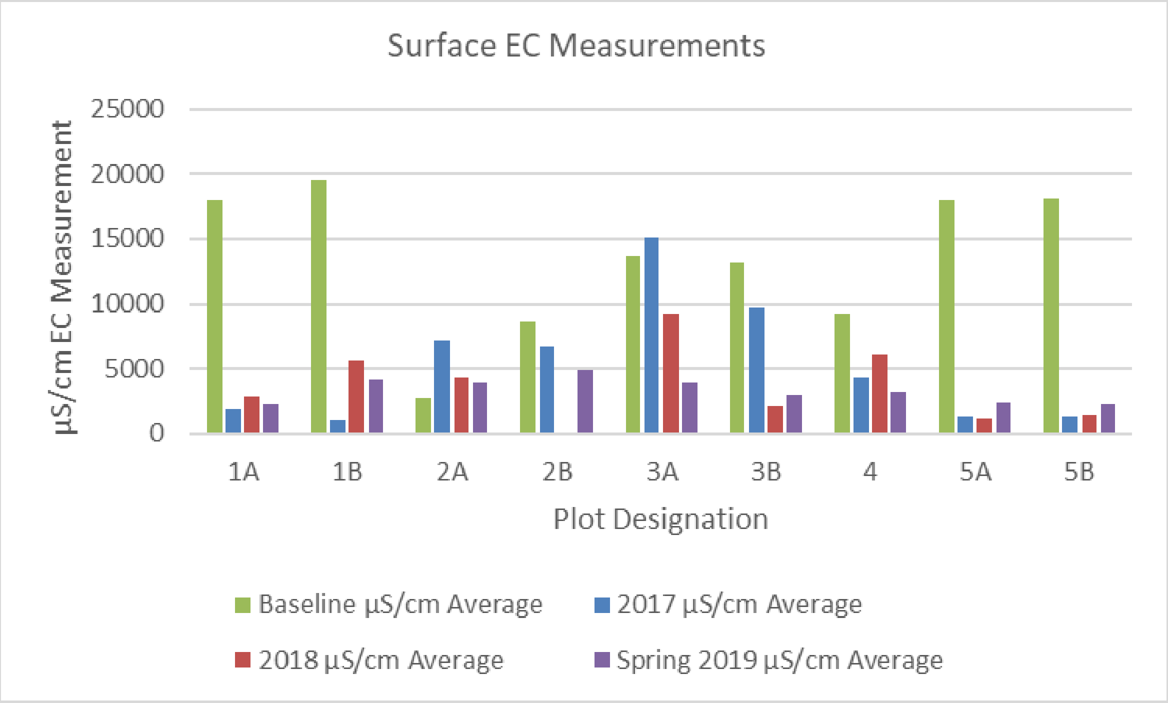


Figure 23: Average surface EC for the nine test plots

5.1.2 1-Foot EC Measurements

One-foot depth EC measurements for the nine test plots were collected and are presented below.

Table No. 14 – 1-Foot Depth EC Averages

Period and Change	1A	1B	2A	2B	3A	3B	4	5A	5B
Baseline (µS/cm)	14,785	14,907	3,700	9,478	10,837	8,367	6,745	15,405	14,502
2017 post-construction (µS/cm)	1,947	3,249	5,044	4,891	15,976	9,350	4,956	1,236	1,358
2018 pre-flush (µS/cm)	-	-	-	-	10,258	8,946	-	-	-
Fall 2018 (µS/cm)	2,336	3,722	4,204	-	11,596	4,921	4,850	1,353	1,487
Spring 2019 (µS/cm)	2,775	3,588	4,313	5,088	5,438	3,650	2,325	1,838	1,763
2017/18 percent change	20%	15%	-17%	-	-27%	-47%	-2%	9%	10%
2018/19 percent change	-4%	-4%	3%		-53%	-26%	-52%	36%	19%
2017/19 percent change	43%	10%	-15%	4%	-66%	-61%	-53%	49%	29%

- Data not obtained

The following observations were made from Fall 2018 post-construction to Fall 2018:

- EC was observed to increase in Plot 1A by approximately 43%;

- EC was observed to <u>increase</u> in Plot 1B by approximately 10%;
- EC was observed to <u>decrease</u> in Plot 2A by approximately 15%;
- EC was observed to <u>increase</u> in Plot 2B by 4%;
- EC was observed to <u>decrease</u> in Plot 3A by approximately 66%;
- EC was observed to <u>decrease</u> in Plot 3B by approximately 61%;
- EC was observed to <u>decrease</u> in Plot 4 by approximately 53%;
- EC was observed to <u>increase</u> in Plot 5A by 49%; and
- EC was observed to <u>increase</u> in Plot 5B by 29%.

Recontamination most likely occurred from surface water runoff infiltrating to 1-foot depths. 1-foot depth EC increased at Plots 1A, Plot 1B, 5A and 5B. Plot 2A, 3A, 3B and Plot 4 1-foot EC decreased. This difference in EC change from runoff is likely attributable to Plot 2A and Plot 4 having a higher Fall 2017 EC than Plot 1A or Plot 1B. EC value data set can be found in Appendix C.

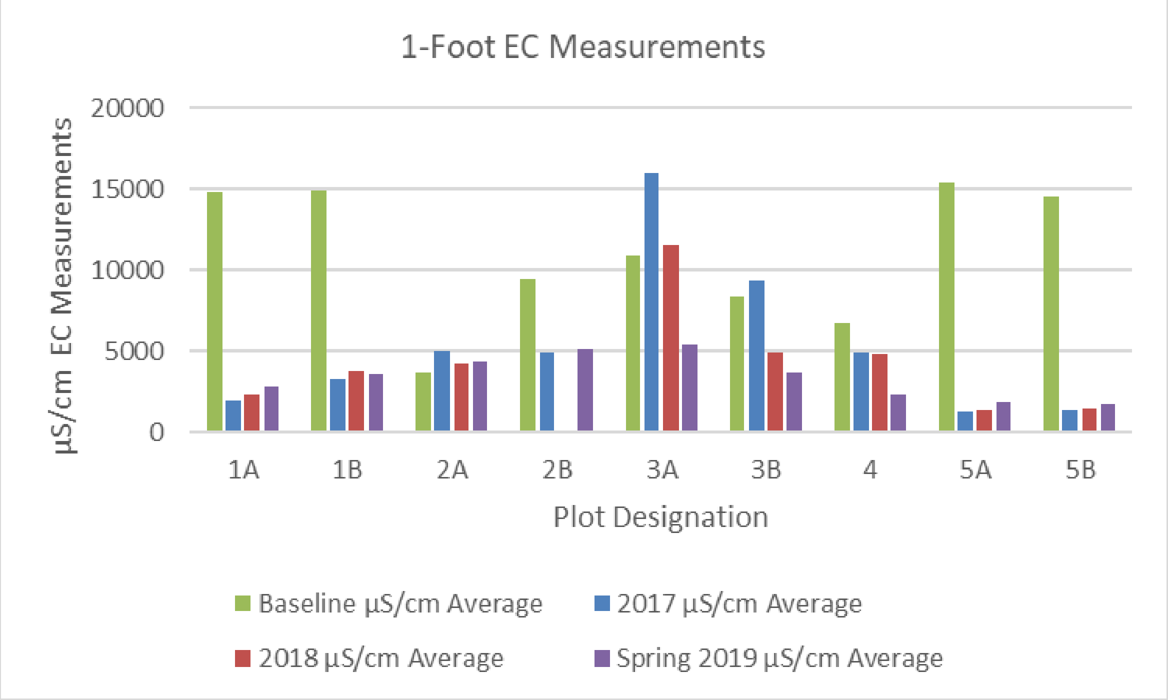


Figure 24: Average 1-foot depth EC for the nine test plots

5.1.3 2-Foot EC Measurements

Two-foot depth EC measurements for the nine test plots were collected and are presented below.

Table No. 15 – 2-Foot Depth EC Averages

Period and Change	1A	1B	2A	2B	3A	3B	4	5A	5B
Baseline (µS/cm)	7,852	15,627	3,377	8,526	9,570	8,302	5,935	10,533	13,515
2017 post-construction (µS/cm)	3,529	3,062	4,451	5,051	13,889	9,253	5,501	1464	1,484
2018 pre-flush (µS/cm)	-	-	-	-	9,174	10,452	-	-	-
Fall 2018 (µS/cm)	2,756	3,326	4,370	-	10,285	5,880	3,785	1,268	1,462
Spring 2019 (µS/cm)	2,825	2,863	4,563	4,488	5,125	4,650	2,050	1,388	1,375
2017/18 percent change	-22%	9%	-2%	-	-26%	-36%	-31%	-13%	-1%
2018/19 percent change	6%	-14%	4%		-50%	-21%	-46%	9%	-7%
2017/19 percent change	-22%	7%	-3%	-11%	-63%	-50%	-63%	-5%	-7%

-Data not collected

The following observations were made from Fall 2017 post-construction to Spring 2019:

- EC was observed to decrease in Plot 1A by approximately 22%;
- EC was observed to increase in Plot 1B by approximately 7%;
- EC was observed to decrease in Plot 2A by approximately 3%;
- EC was observed to decrease in Plot 2B by approximately 11%;
- EC was observed to decrease in plot 3A by approximately 63%;
- EC was observed to decrease in plot 3B by approximately 50%;
- EC was observed to decrease in Plot 4 by approximately 63%;
- EC was observed to decrease in Plot 5A by approximately 5%; and
- EC was observed to decrease in Plot 5B by approximately 7%.

EC value data set can be found in Appendix C.

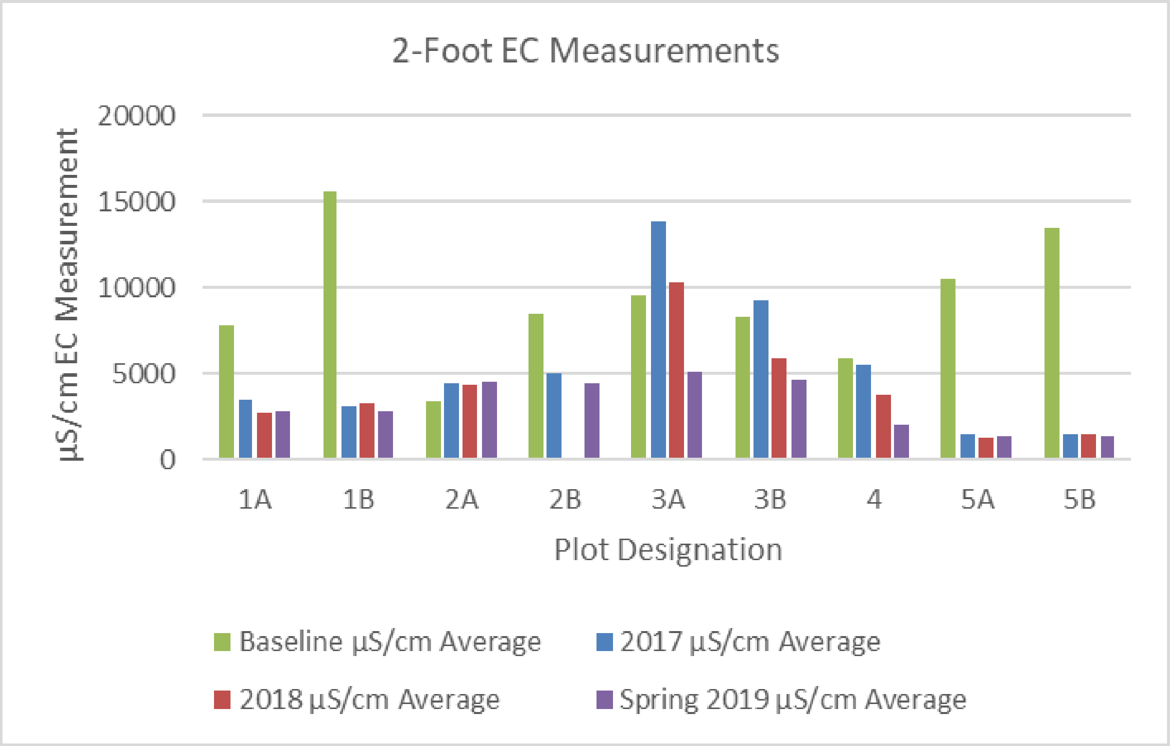


Figure 25: Average 2-foot depth EC for the nine test plots

5.2 Germination Observations

Following the construction of the test plots, each test plot was planted in spring of 2018 with five rows each of the five crops (alfalfa, barley, canola, soybean, and sunflower). Germination observations were made in June 2018 and growth observations were made through the growing season. The test plots were cleared, tilled, and replanted. Germination observations for the second planting period were made in Fall 2018 and May 2019. Data is presented in Table 16 below.

Table No. 16 – Germination Observations by Planting

Planting Period	1A	1B	2A	2B	3A	3B	4	5A	5B
First Planting Germination	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Second Planting Germination	Yes	Yes	No	No	No	Yes	Yes	Yes	Yes

Germination and growth of alfalfa, barley, canola, and soybeans was observed in Plot 1A and Plot 1B (Table 17). Germination of barley was observed in test plots Plot 2A and 2B. No germination was observed for the five crops in Plot 3A. Germination of a small amount of barley and no other crops was observed in Plot 3B. Germination and growth of barley, canola, and sunflower was observed in Plot 4. Germination and growth for the five crops was observed in Plots 5A and 5B, however soybean growth was sparse.

Table No. 17 – First Planting Germination Observations

Crop Type	1A	1B	2A	2B	3A	3B	4	5A	5B
Alfalfa	Yes	Yes	No	No	No	No	No	Yes	Yes
Barley	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Canola	Yes	Yes	No	No	No	No	Yes	Yes	Yes
Soybean	Yes	Yes	No	No	No	No	No	Yes	Yes
Sunflower	Yes	Yes	No	No	No	No	Yes	Yes	Yes

Crops were removed from the test plots following germination and plant growth observations over one growing season. Plots 1A, 1B, 2A, 2B, 3A, 4, 5A and 5B were tilled and planted with winter wheat. Test plot 3B was replanted with the original five crops types to test the effectiveness of flushing on germination (Table 18).

Germination of winter wheat in Fall 2018 was observed in Plots 1A, 4, 5A, and 5B. Germination was not observed in Plots 1B, 2A, 2B, and 3A. Germination of alfalfa and barley was observed in Plot 3B in Fall 2018, with no germination of the other crops observed.

Table No. 18 – Second Planting Germination Observations – Fall 2018

Crop Type	1A	1B	2A	2B	3A	3B	4	5A	5B
Alfalfa	-	-	-	-	-	Yes	-	-	-
Barley	-	-	-	-	-	Yes	-	-	-
Canola	-	-	-	-	-	No	-	-	-
Soybean	-	-	-	-	-	No	-	-	-
Sunflower	-	-	-	-	-	No	-	-	-
Winter Wheat	Yes	No	No	No	No	-	Yes	Yes	Yes

-Crops types not planted during second planting

Germination of winter wheat in Spring 2019 was observed in Plots 1A, 1B, 4, 5A, and 5B. Germination was not observed in Plots 2A, 2B, and 3A. Germination of alfalfa and barley was observed in Plot 3B in Spring 2019, with no germination of the other crops observed.

Table No. 19 – Second Planting Germination Observations - Spring 2019

Crop Type	1A	1B	2A	2B	3A	3B	4	5A	5B
Alfalfa	-	-	-	-	-	Yes	-	-	-
Barley	-	-	-	-	-	Yes	-	-	-
Canola	-	-	-	-	-	No	-	-	-
Soybean	-	-	-	-	-	No	-	-	-
Sunflower	-	-	-	-	-	No	-	-	-
Winter Wheat	Yes	Yes	No	No	No	-	Yes	Yes	Yes

-Crops types not planted during second planting

5.3 Cost Summary Analysis

Approximate cost of construction for each test plot was calculated (Table 19). A detailed breakdown of the costs of each test plot and construction component is presented in Appendix B.

Table No. 20 – Cost Estimates (USD)

Cost ($$)	1A	1B	2A	2B	3A	3B	4	5A	5B
Per Plot	15,208	19,984	8,405	13,594	13,949	16,449	13,594	14,925	14,292
Per 1-Acre Site	468,875	615,762	258,992	418,875	429,813	506,842	418,875	459,866	440,362

The cost of each test plot is listed below from least to most expensive. Please refer to Table 3 above for test plot construction details.

- $8,405 for the method used in Plot 2A;
- $13,594 for the method used in Plots 2B and 4;
- $13,949 for the method used in Plot 3A;
- $14,292 for the method used in Plot 5B;
- $14,925 for the method used in Plot 5A;
- $15,208 for the method used in Plot 1A;
- $16,449 for the method used in Plot 3B; and
- $19,984 for the method used in Plot 1B.

The costs for remediation per acre were extrapolated from test plot costs and scale of the NDIC Site 3 project. Variable costs (such as disposal, excavation, material, etc.) were based on costs observed during NDIC Site 3 and other remediation projects for NDIC by Terracon.

The cost of each test plot is listed below from least expensive to most expensive for the test plots that were selected for water flooding/flushing. The cost of water used for flushing in Plot 3B was based on scaling up the cost of procuring and transporting water to the site via trucking. The final report will consider reducing this cost by obtaining suitable water from a local well or rural water source.

- $258,992 for the method used in Plot 2A;
- $418,875 for the method used in Plots 2B and 4;
- $429,813 for the method used in Plot 3A;
- $440,362 for the method used in Plot 5B;
- $459,866 for the method used in Plot 5A;
- $468,875 for the method used in Plot 1A;
- $506,842 for the method used in Plot 3B; and
- $615,762 for the method used in Plot 1B.

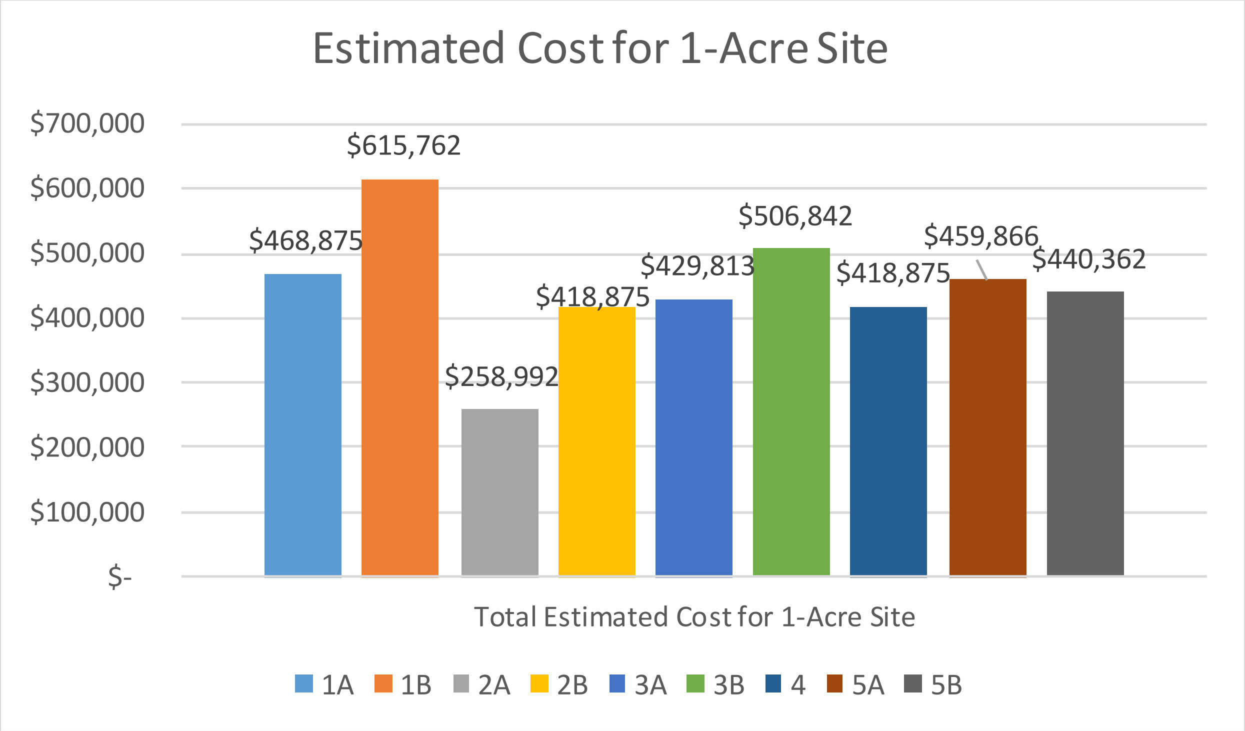


Figure 26: Cost comparison for 1-acre site

6.0 FINDINGS

Homogenizing contaminated soils in Plots 2A and 2B was the least expensive remedial construction method and least expensive method with a drainage system, respectively. EC increased in Plot 2A baseline readings and 2018, however flooding of the plots from above normal precipitation most likely recontaminated the soils in the test plots. EC changed negligibly in 2019.

Germination was only observed for Barley in Plot 2A, and no germination was observed for other crops planted for the first planting period, the second planting period in 2018, or the second planting period in 2019.

Replacing contaminated soil with clean soil in Plots 1A and 1B were the third and first most expensive methods, respectively. Germination was successful for the five crop types for both test plots and winter wheat for the two planting periods at test plot 1A. However, construction of a drainage system increased the cost above other methods. These methods require disposal of contaminated soil and importing non-impacted soil.

Amending contaminated soil and flushing with water obtained from PRC-3 did not reduce EC in Plot 3A. Flushing with clean water reduced EC in Plot 3B to near the maximum optimal EC for germination of ~3,000 µS/cm. EC continued to decrease from 2017 to Spring 2019, indicating a prevention of subsurface recontamination. Importing water for flushing amended soil is the second most expensive method of those tested, however does not require importing clean soil or disposal of contaminated soil. The cost of water used for flushing in Plot 3B was based on scaling up the cost of transporting water to the site via trucking. Less expensive sources of water may lower the price of this remedial construction methods.

Homogenizing contaminated soil with non-impacted soil in Plot 4 decreased EC from 2017 to 2019. Germination was observed for every planting period. EC decreased to below the optimal maximum EC for germination of ~3,000 µS/cm in Spring 2019. Negligible change in EC was observed between post-construction and Fall 2018, however a larger decrease was noted between Fall 2018 and Spring 2019. This method was the least expensive for germination and growth observations, however observed EC reduction was less than in Plots 2A, 2B, and 3A.

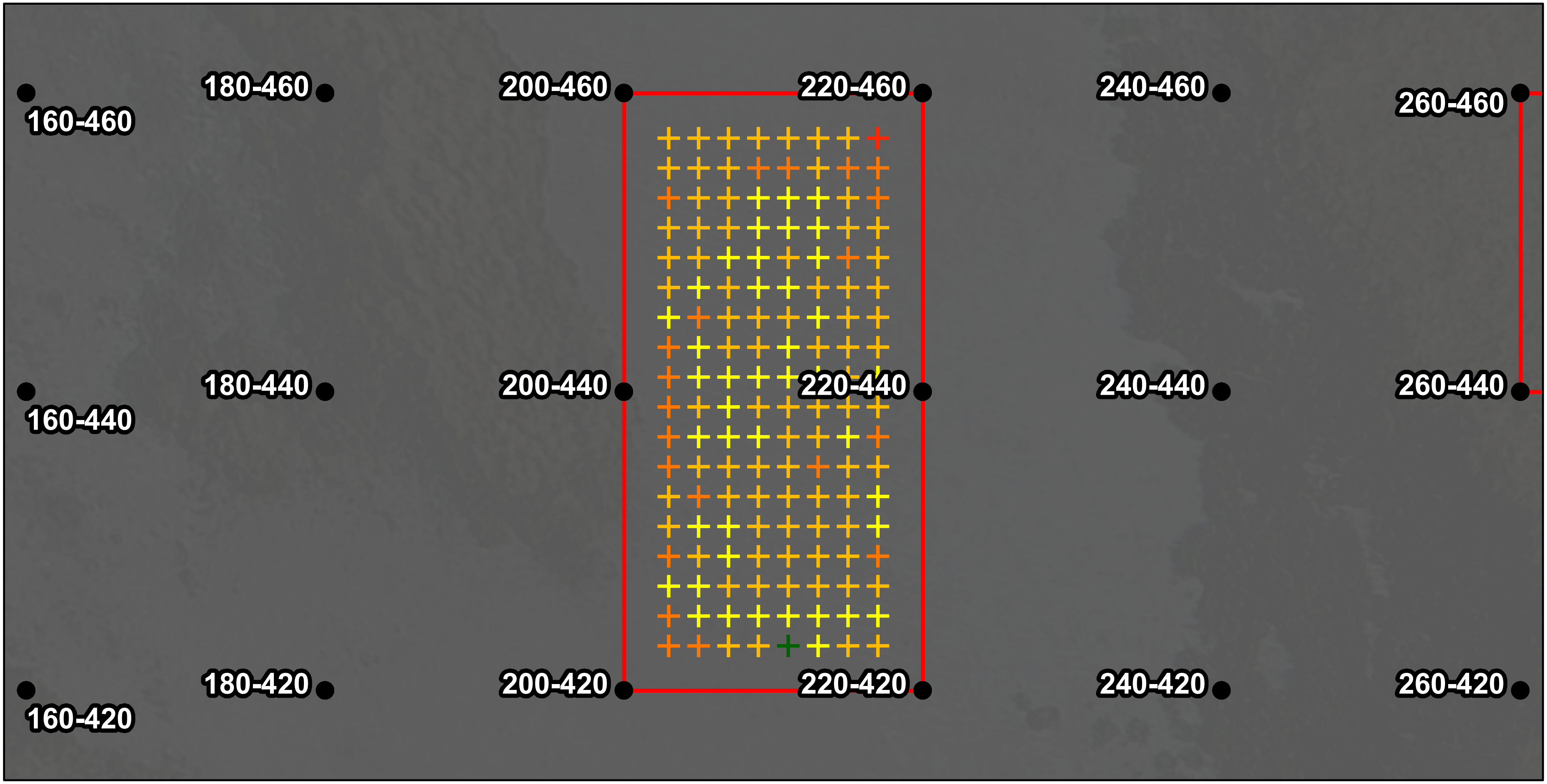
Placing non-impacted soil above contaminated soil in Plots 5A and 5B was less expensive than excavating and replacing contaminated soil with non-impacted soil. EC in Plots 5A and 5B maintained well below the lab-tested optimal maximum of ~3,000 µS/cm from 2017 to 2019. Negligible changes were observed in EC between the gravel capillary break system used in Plot 5A and the geosynthetic material used in Plot 5B, however the cost of the geosynthetic material for a 1-acre site was $19,504 less expensive than a gravel break for similar EC observations. These methods were the third and fourth most expensive. This method requires non-impacted soil to be imported. Contaminated soils are not removed from the site or treated onsite.

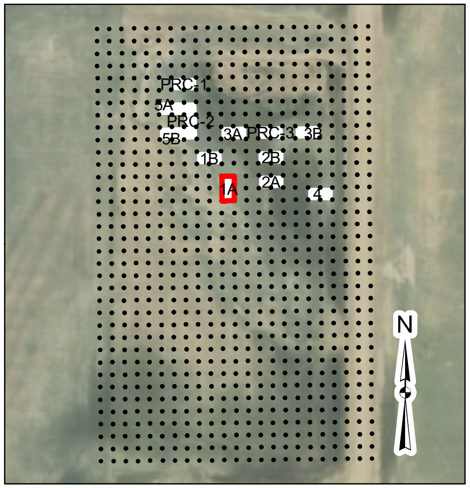
7.0 RECOMMENDATIONS

Based on the observations of our activities conducted for the test plots, test cells, and test columns, Terracon recommends a full-scale pilot study on small, medium, and large sites to test amending soil with gypsum and flushing with clean water as in Plot 3B.

APPENDIX A – EXHIBITS

Exhibits 1-3 – Test 1A EC Maps
Exhibits 4-6 – Test Plot 1B EC Maps
Exhibits 7-9 – Test Plot 2A EC Maps
Exhibits 10-15 – Test Plot 3A EC Maps
Exhibits 16-21 – Test Plot 3B EC Maps
Exhibits 22-24 – Test Plot 4 EC Maps
Exhibits 25-27 – Test Plot 5A EC Maps
Exhibits 28-30 – Test Plot 5B EC Maps





N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

▭ Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

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+ -8999 - -5100
+ -5099 - -2100
+ -2099 - 100
+ 101 - 2300
+ 2301 - 5600
+ 5601 - 31900

Project No.:	M1177088
Date:	Dec 2018
Drawn By:	NOW
Reviewed By:	JRG

Terracon

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Test Plot 1A

2017-2018 EC Change At Surface

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Renville, Bottineau Co., ND

Exhibit

1

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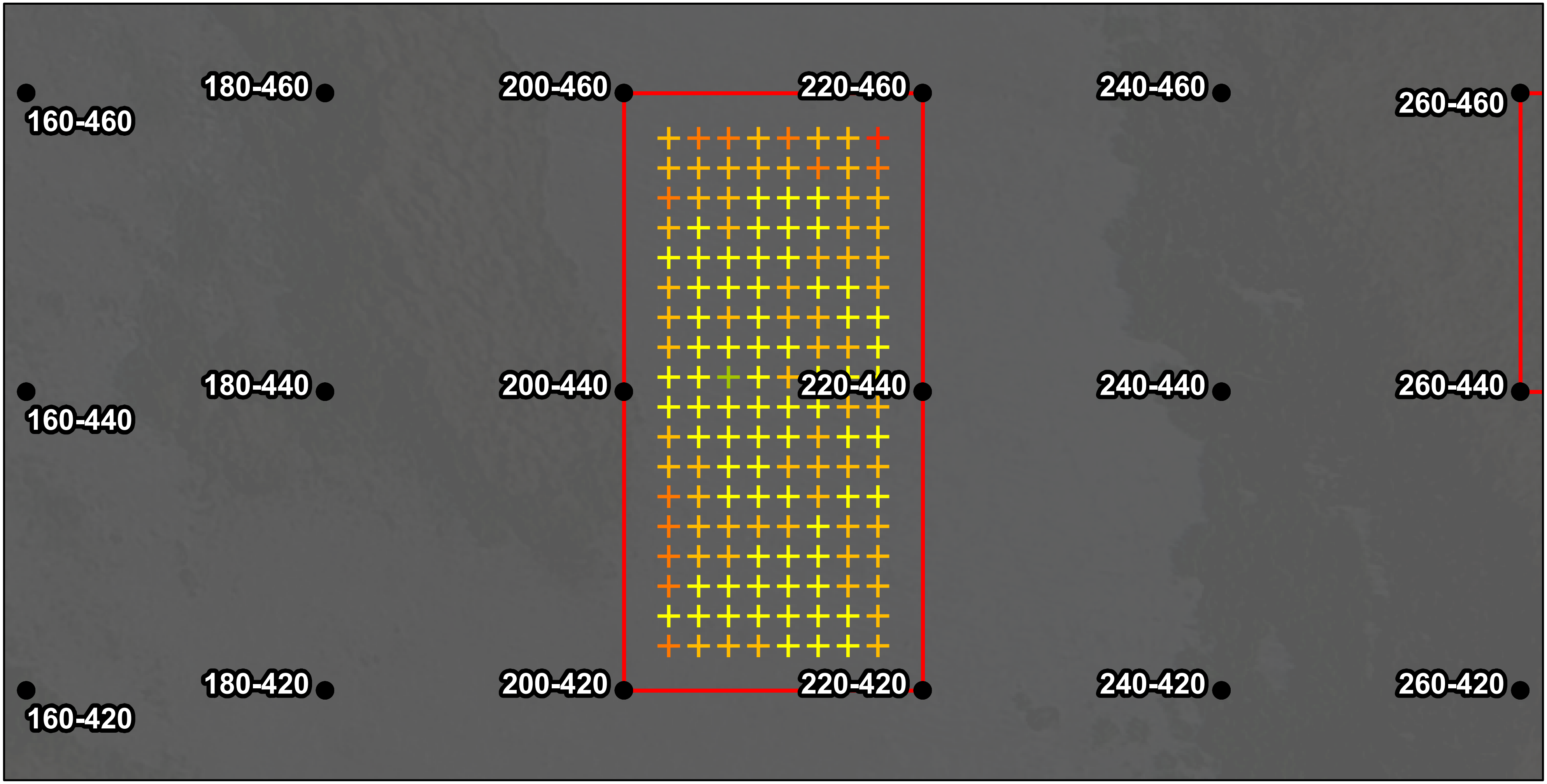

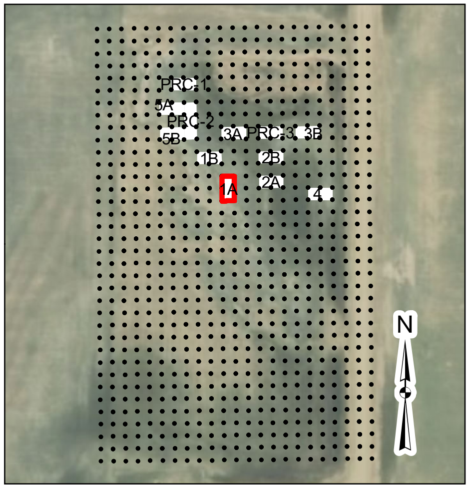

N

Feet
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● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

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+ -8999 - -5100
+ -5099 - -2100
+ -2099 - 100
+ 101 - 2300
+ 2301 - 5600
+ 5601 - 31900

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Test Plot 1A

2017-2018 EC Change At 1-Foot Depth

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Exhibit
2

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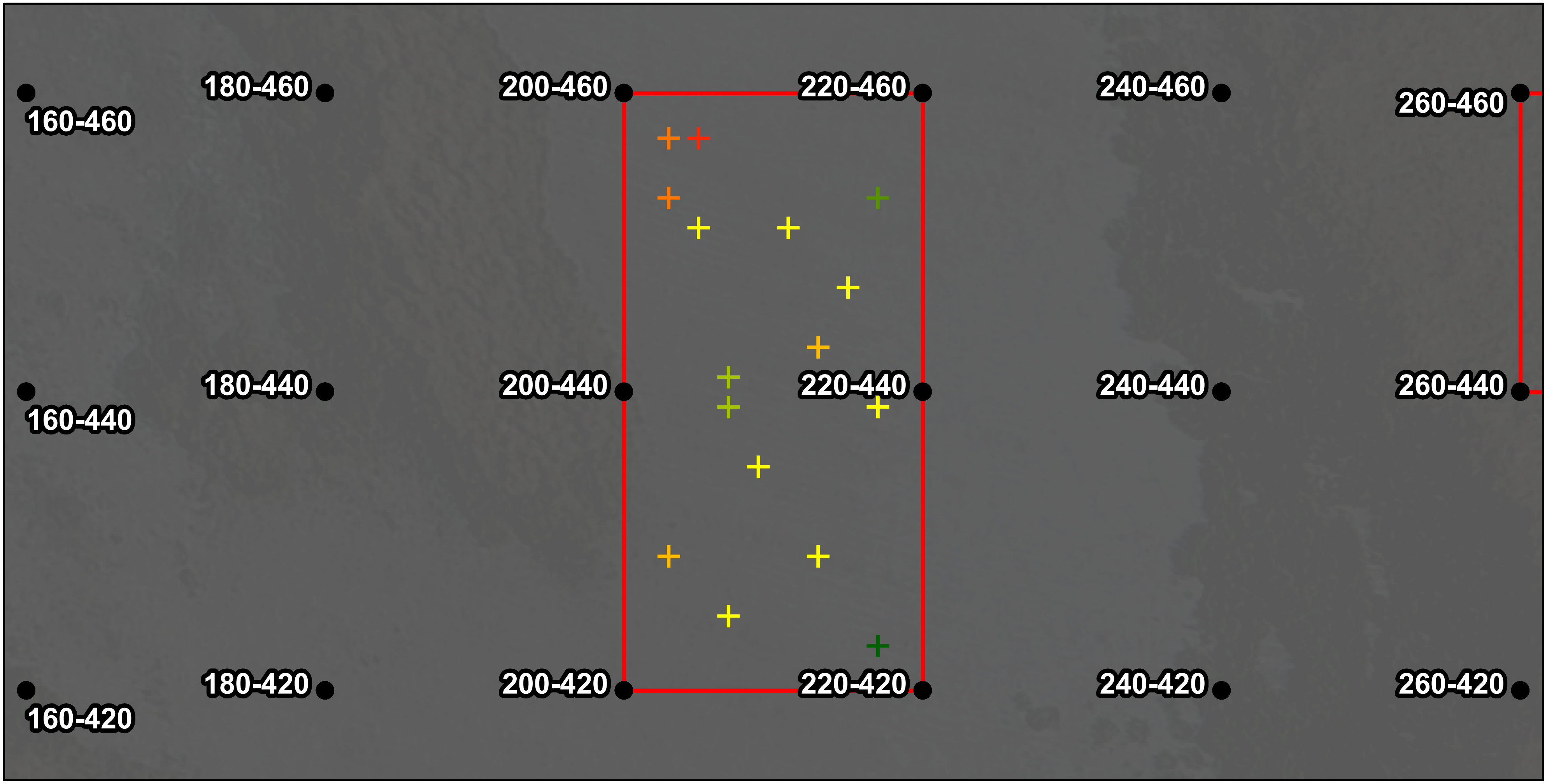

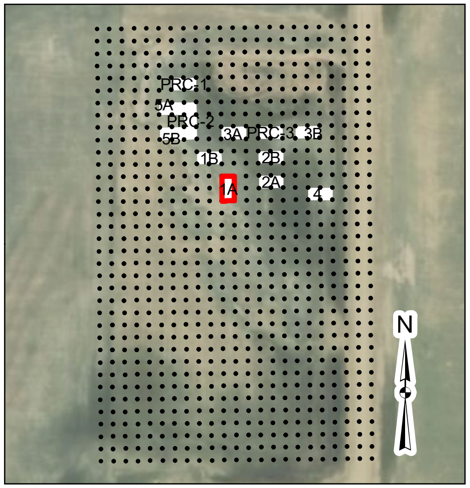

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Feet
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● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

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- + -8999 - -5100
- + -5099 - -2100
- + -2099 - 100
- + 101 - 2300
- + 2301 - 5600
- + 5601 - 31900

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Test Plot 1A

2017-2018 EC Change At 2-Foot Depth

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Exhibit

3

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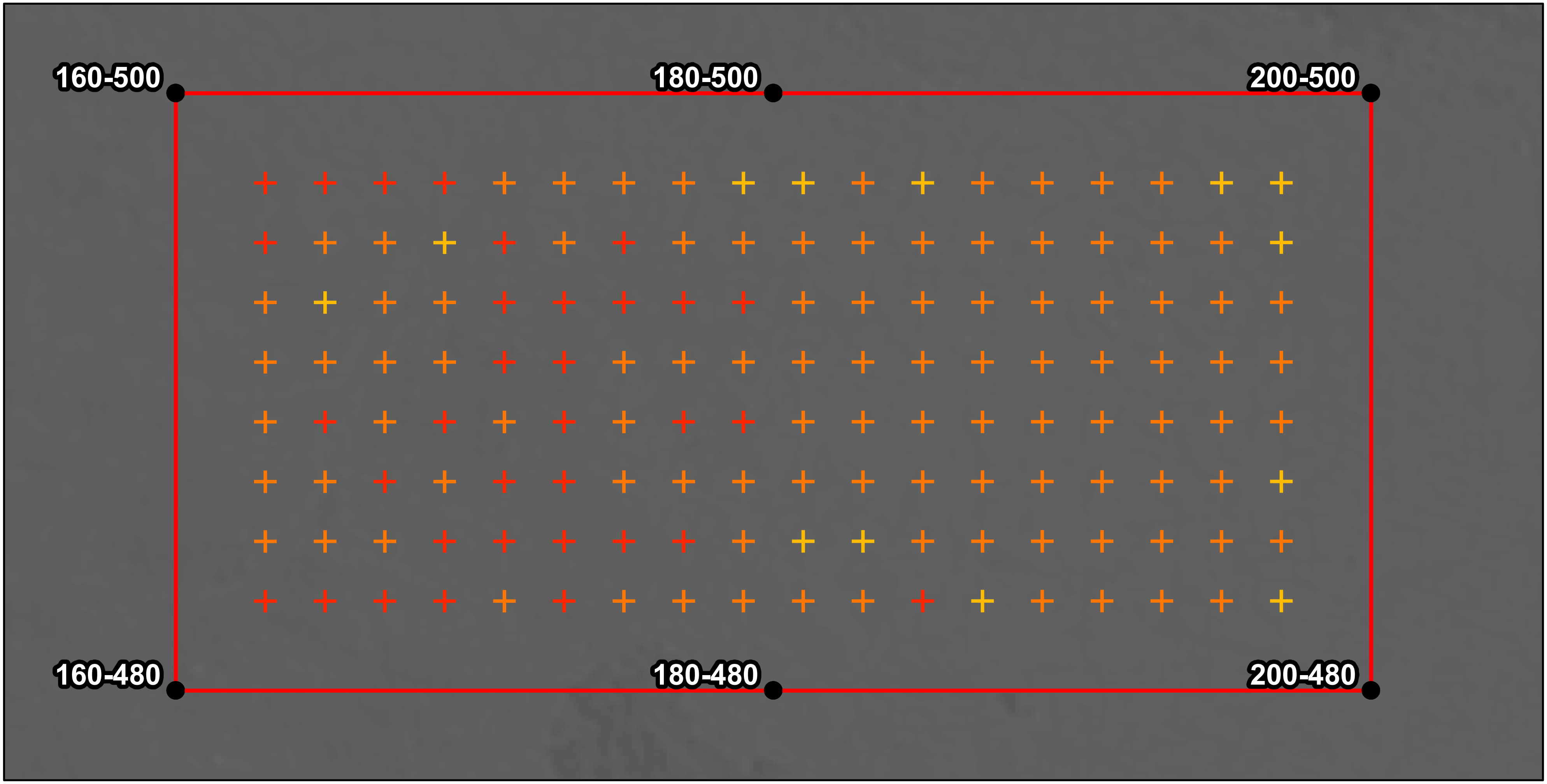

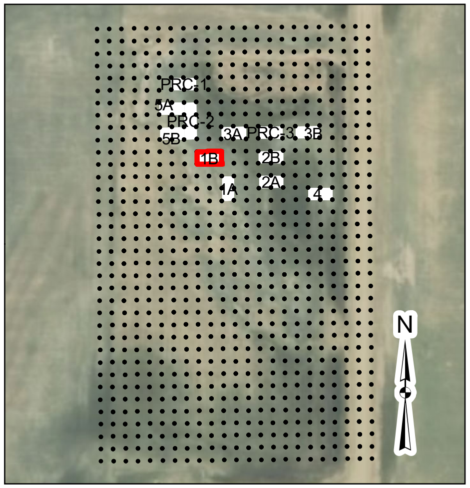

● Site Reference Grid Points (20'x20')

▭ Test Plot Boundaries

Test Plot Points (2'x2' spacing)

EC Change

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+ -8999 - -5100
+ -5099 - -2100
+ -2099 - 100
+ 101 - 2300
+ 2301 - 5600
+ 5601 - 31900

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Test Plot 1A

2017-2018 EC Change At Surface

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Exhibit

4

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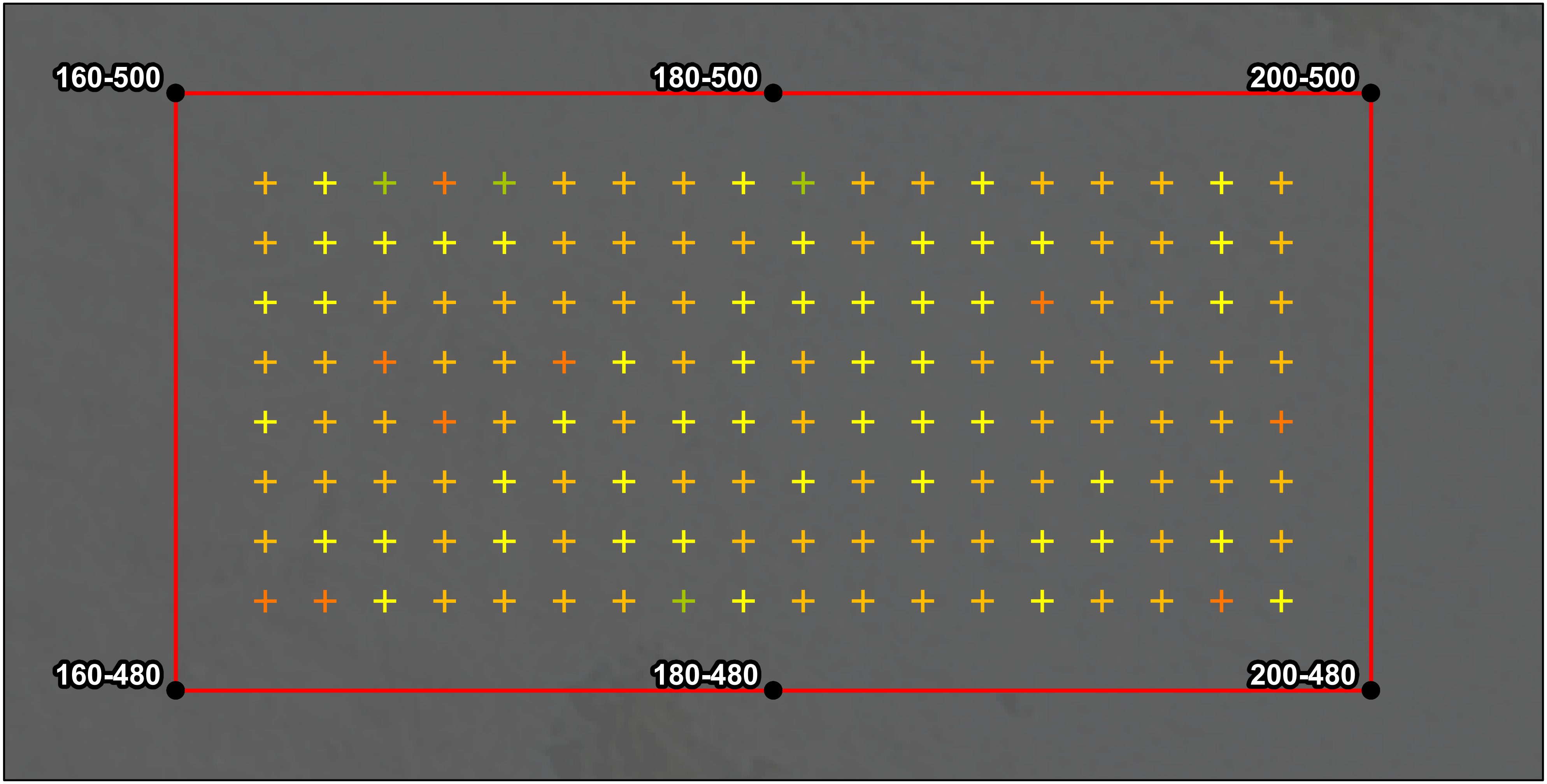

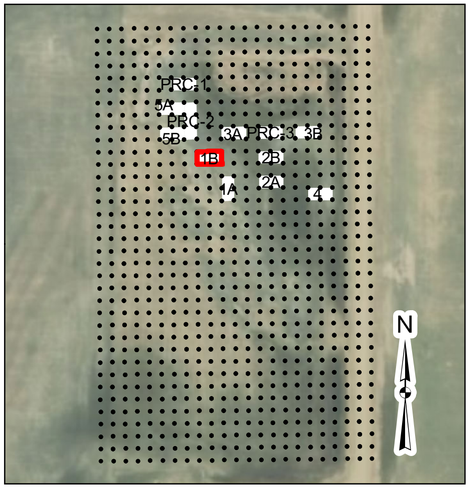

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Feet
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● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+	-16700 - -9000
+	-8999 - -5100
+	-5099 - -2100
+	-2099 - 100
+	101 - 2300
+	2301 - 5600
+	5601 - 31900

Project No.:	M1177088
Date:	Dec 2018
Drawn By:	NOW
Reviewed By:	JRG

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Test Plot 1B

2017-2018 EC Change At 1-Foot Depth

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Exhibit

5

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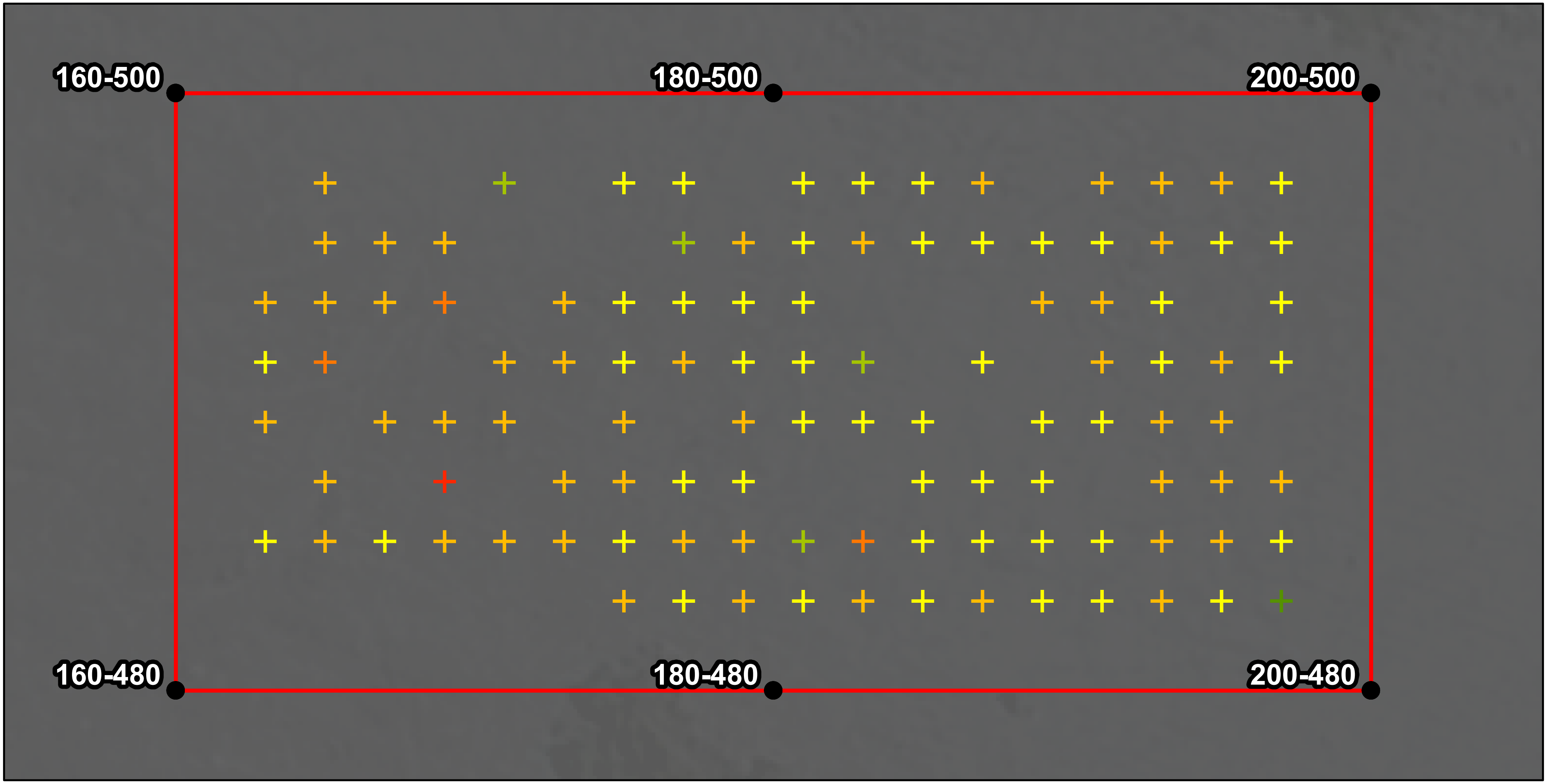

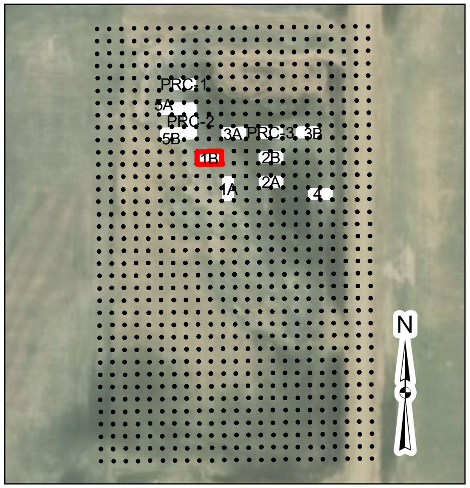

● Site Reference Grid Points (20'x20')

▭ Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

- + -16700 - -9000
- + -8999 - -5100
- + -5099 - -2100
- + -2099 - 100
- + 101 - 2300
- + 2301 - 5600
- + 5601 - 31900

Project No.: M1177088

Date: Dec 2018

Drawn By: NOW

Reviewed By: JRG

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Test Plot 1B

2017-2018 EC Change At 2-Foot Depth

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Exhibit

6

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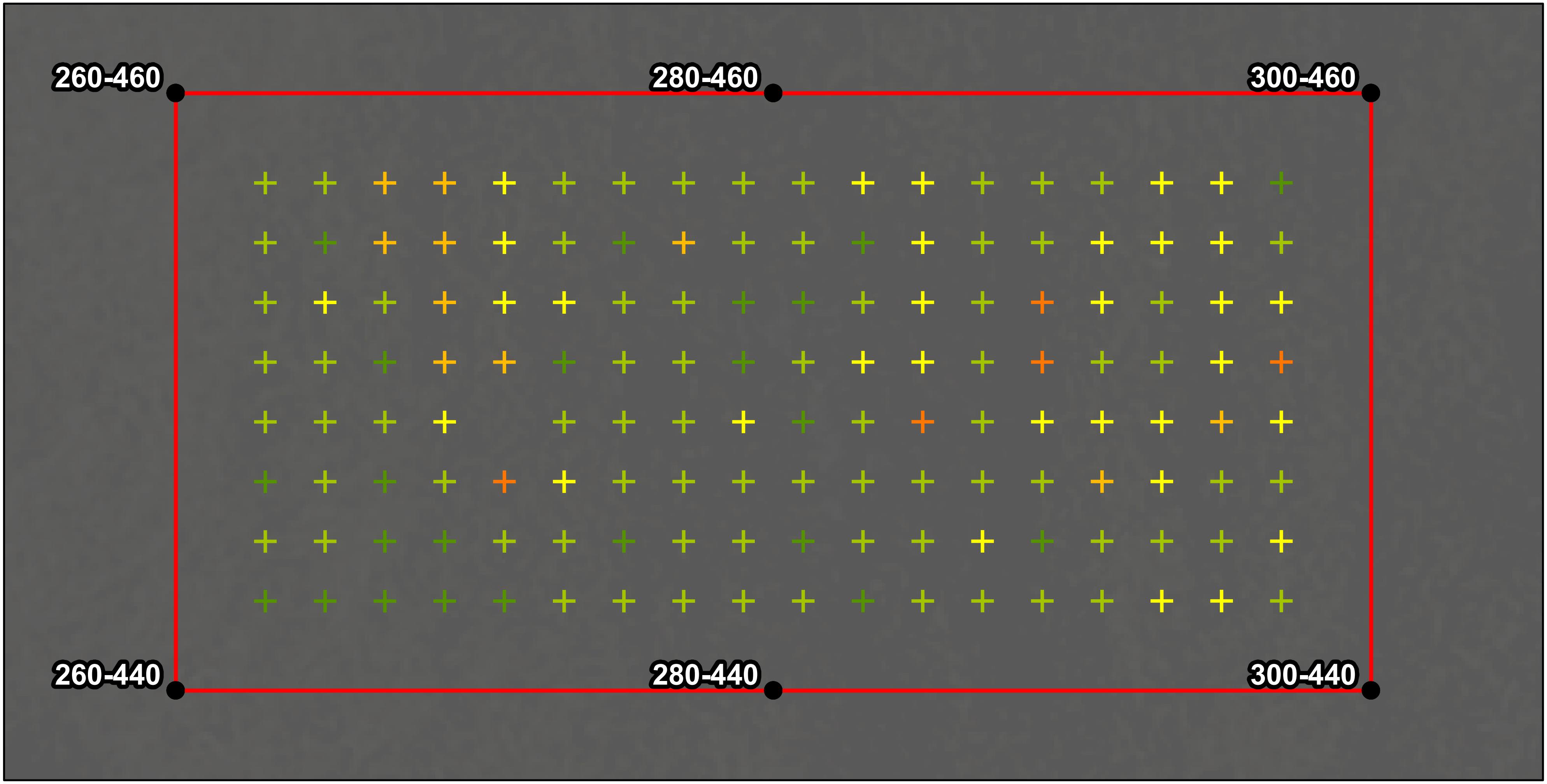

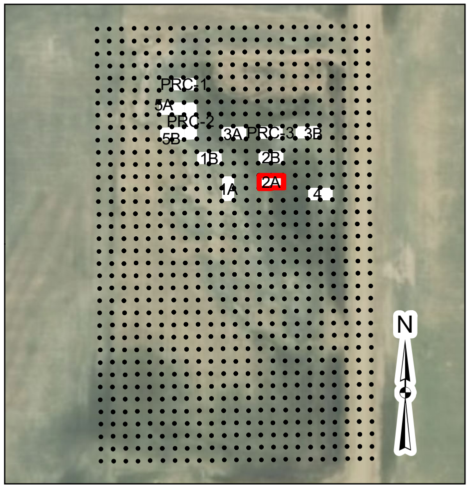

N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+	-16700 - -9000
+	-8999 - -5100
+	-5099 - -2100
+	-2099 - 100
+	101 - 2300
+	2301 - 5600

Project No.:	M1177088
Date:	Dec 2018
Drawn By:	NOW
Reviewed By:	JRG

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Test Plot 2A

2017-2018 EC Change At Surface

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Exhibit

7

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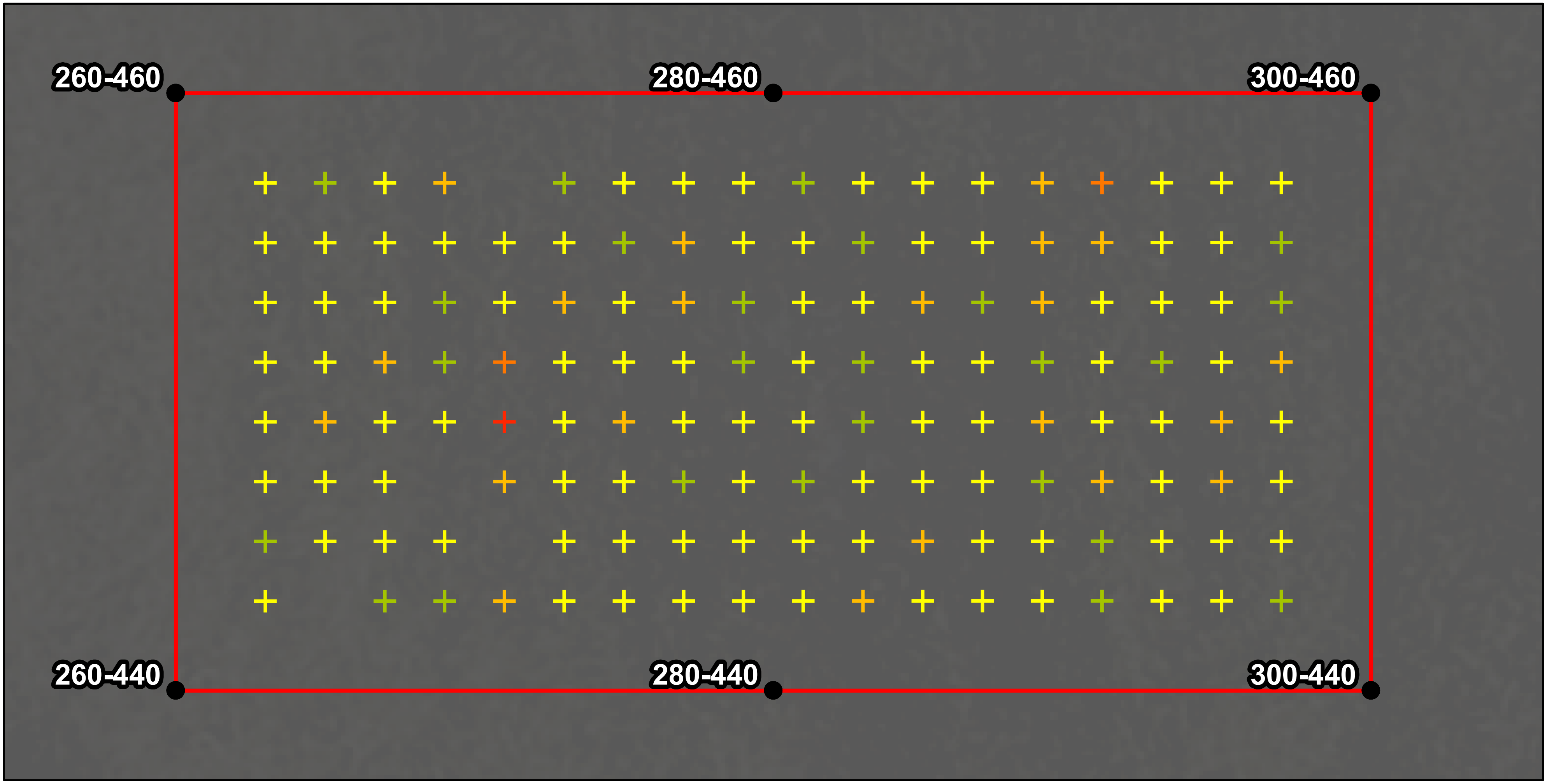

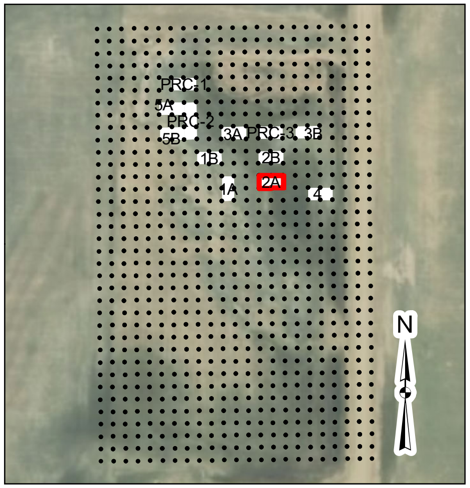

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

- + -16700 - -9000
- + -8999 - -5100
- + -5099 - -2100
- + -2099 - 100
- + 101 - 2300
- + 2301 - 5600
- + 5601 - 31900

Project No.: M1177088
Date: Dec 2018
Drawn By: NOW
Reviewed By: JRG

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Test Plot 2A

2017-2018 EC Change At 1-Foot Depth
NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit
8

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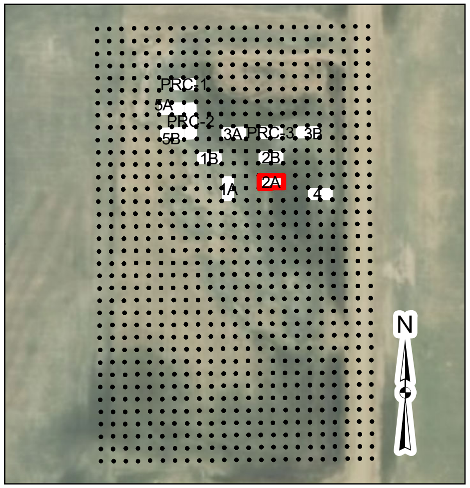

N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+ -16700 - -9000
+ -8999 - -5100
+ -5099 - -2100
+ -2099 - 100
+ 101 - 2300
+ 2301 - 5600
+ 5601 - 31900

Project No.: M1177088
Date: Dec 2018
Drawn By: NOW
Reviewed By: JRG

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Test Plot 2A

2017 to 2018 EC Change At 2-Foot Depth

NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit
9

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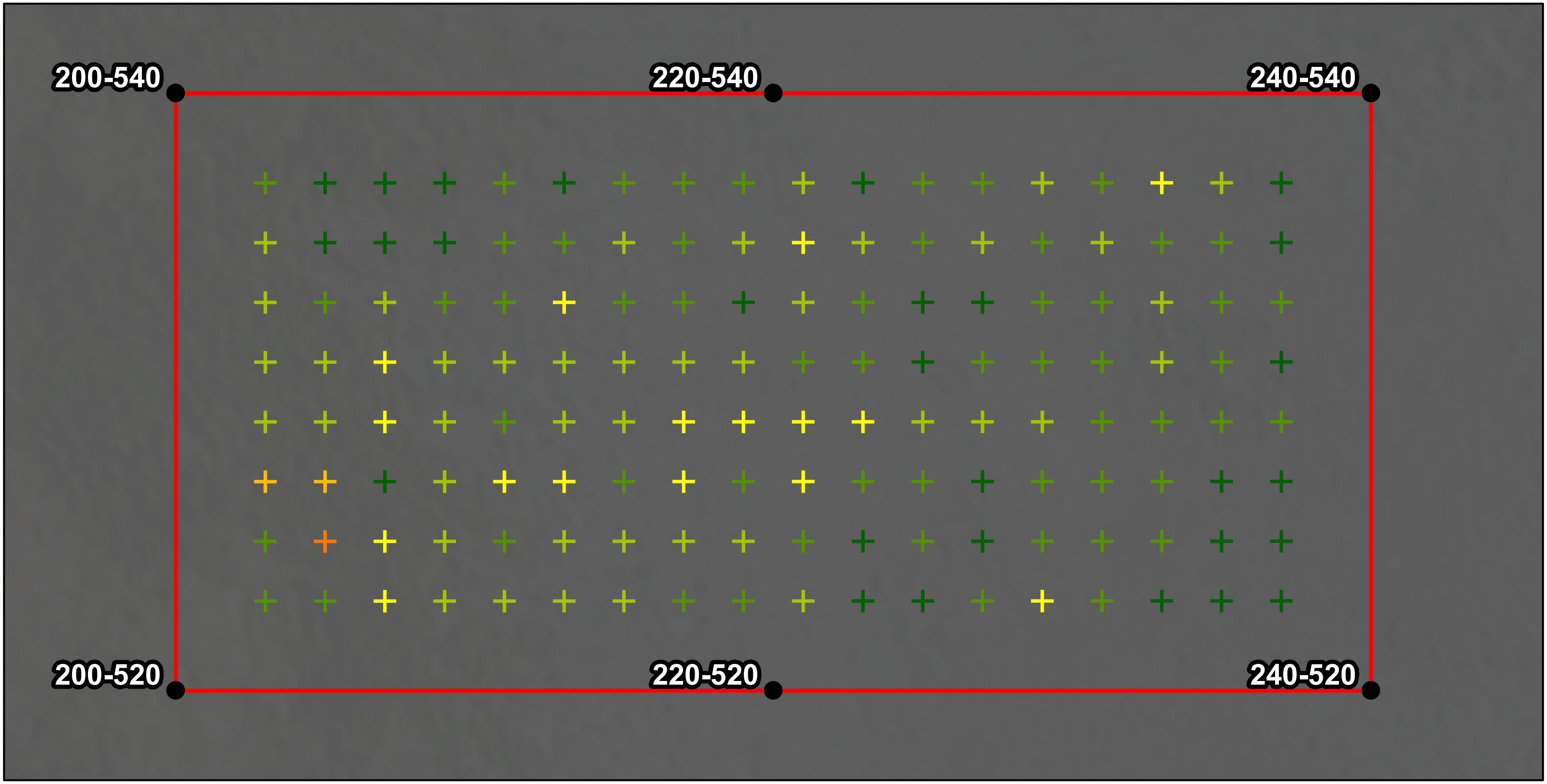

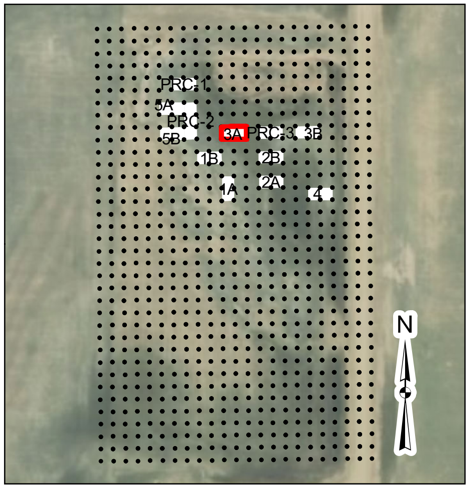

N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+	-16700 - -9000
+	-8999 - -5100
+	-5099 - -2100
+	-2099 - 100
+	101 - 2300
+	2301 - 5600
+	5601 - 31900

Project No.:
M1177088
Date:
Dec 2018
Drawn By:
NOW
Reviewed By:
JRG

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Test Plot 3A

2017 to 2018 Pre-Flush EC Change At Surface

NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit

10

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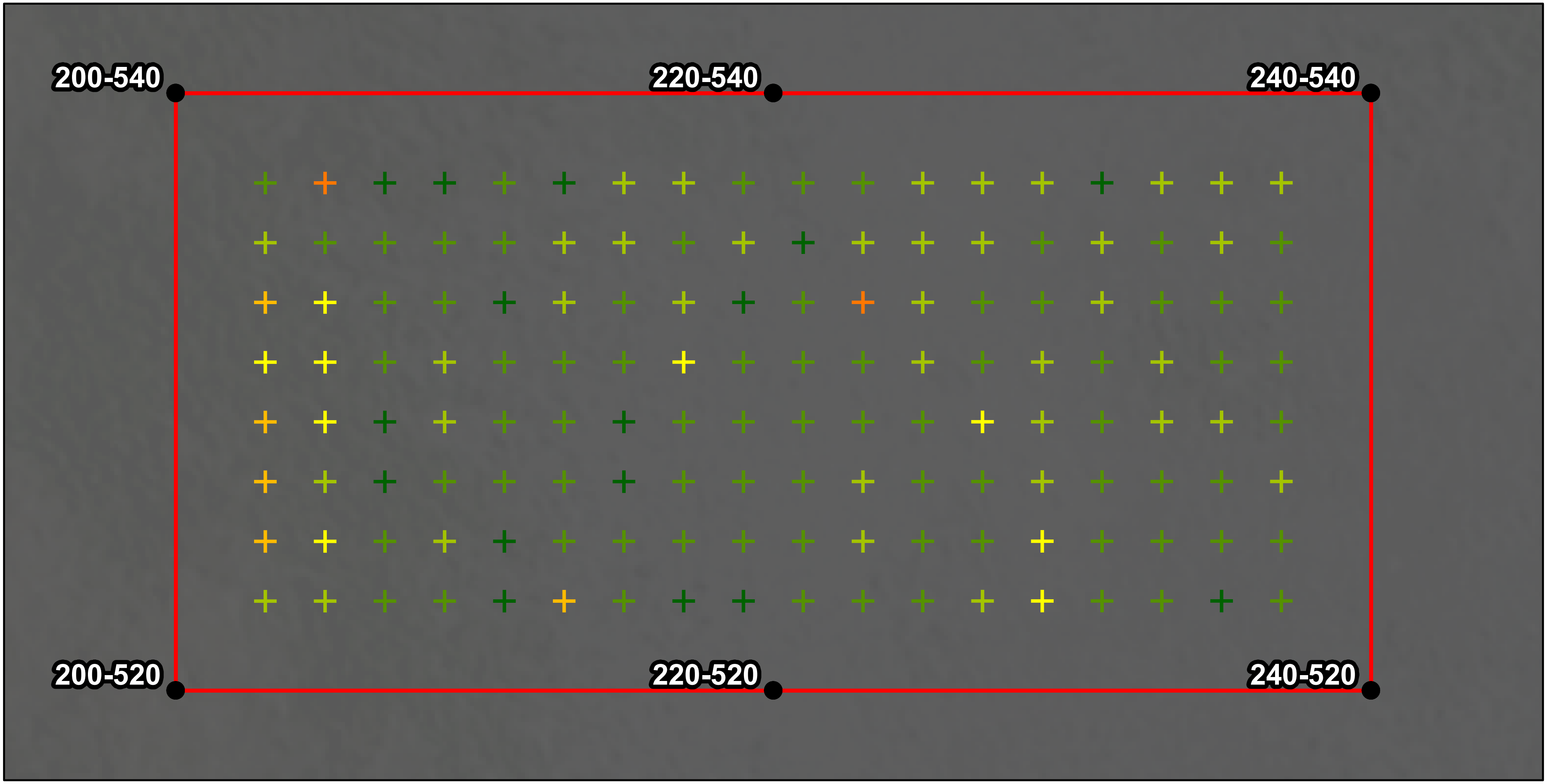

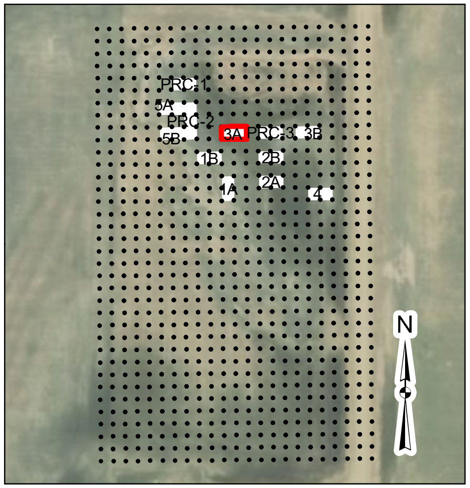

● Site Reference Grid Points (20'x20')

▭ Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

- + -16700 - -9000
- + -8999 - -5100
- + -5099 - -2100
- + -2099 - 100
- + 101 - 2300
- + 2301 - 5600
- + 5601 - 31900

Project No.:	M1177088
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Test Plot 3A

2017 to 2018 Pre-Flush EC Change At 1-Foot Depth

NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit

11

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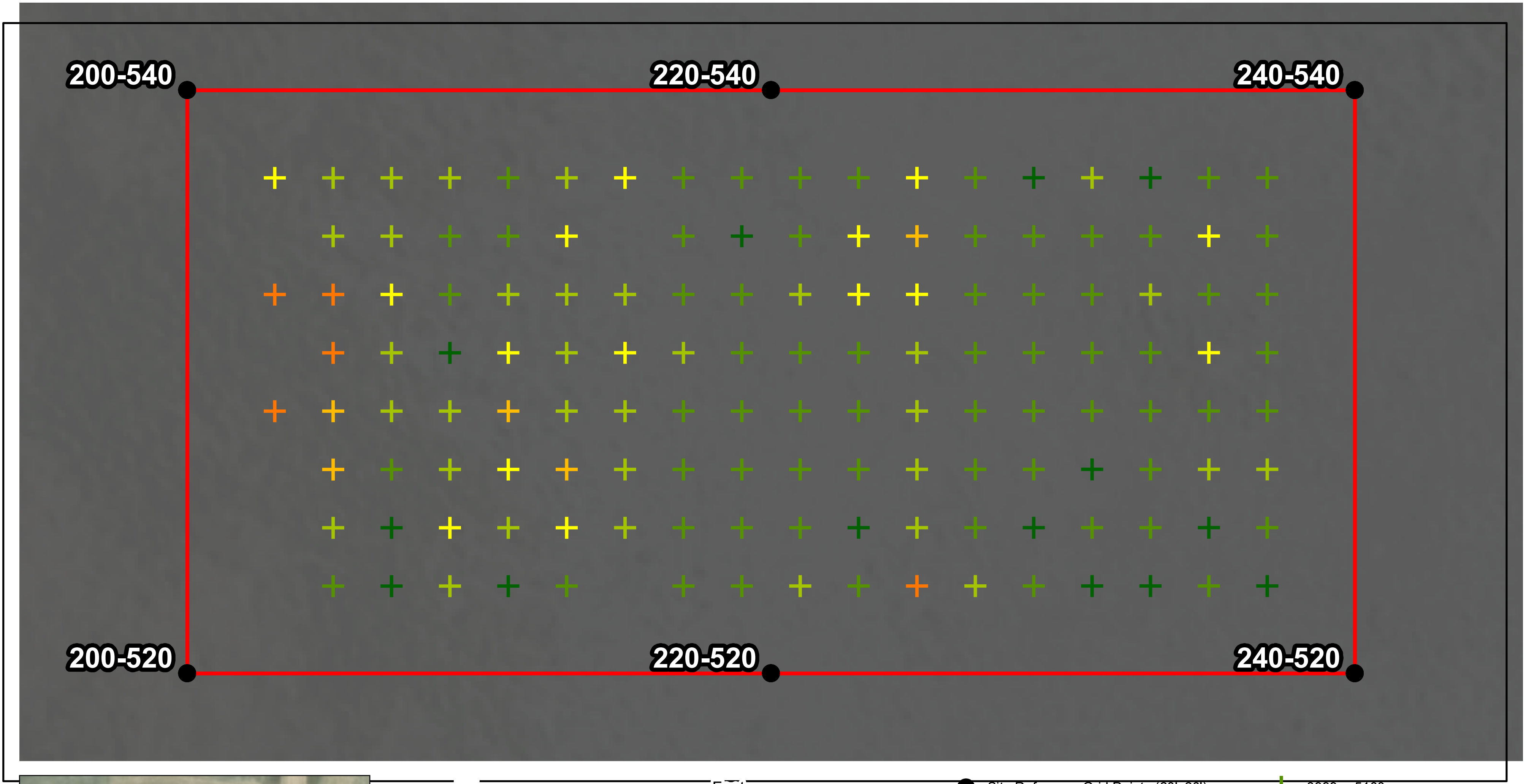

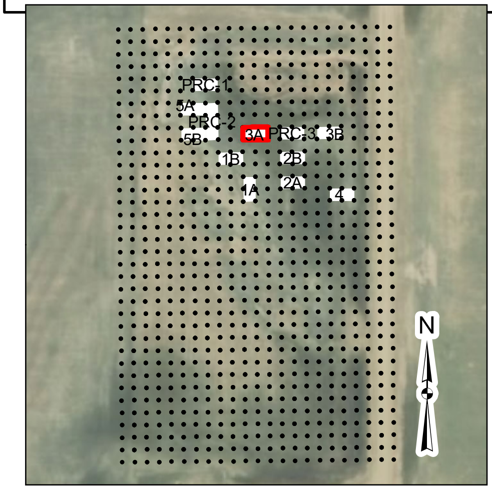

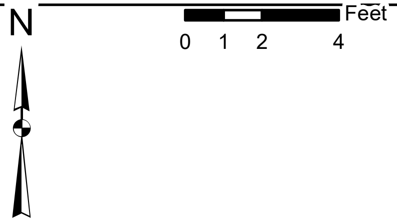

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

- -16700 - -9000
- -8999 - -5100
- -5099 - -2100
- -2099 - 100
- 101 - 2300
- 2301 - 5600
- 5601 - 31900

Project No.:	M1177088
Date:	Dec 2018
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Test Plot 3A

2017 to 2018 Pre-Flush EC Change At 2-Foot Depth

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Anderson Parcel
Renville, Bottineau Co., ND

Exhibit

12

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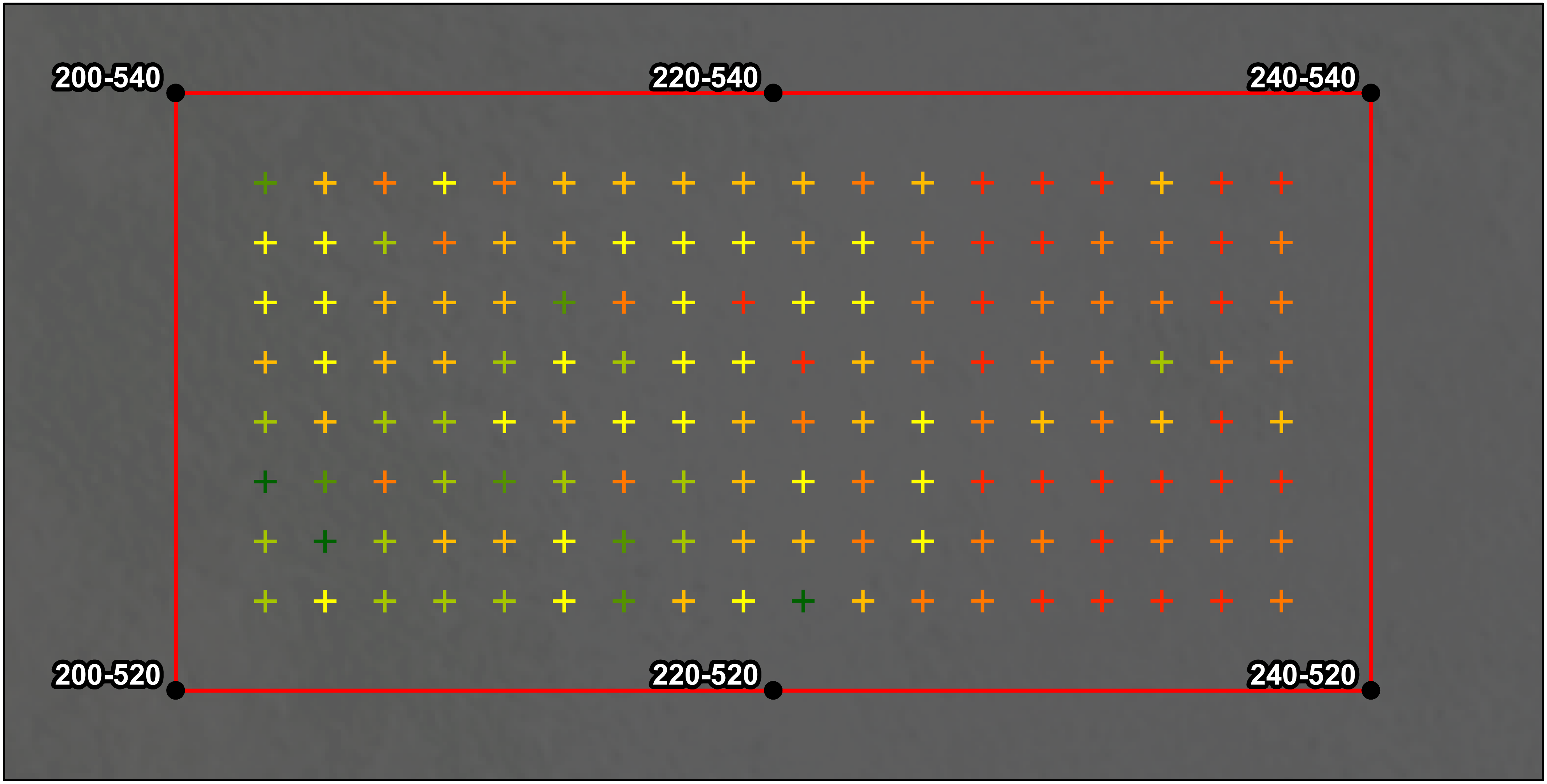

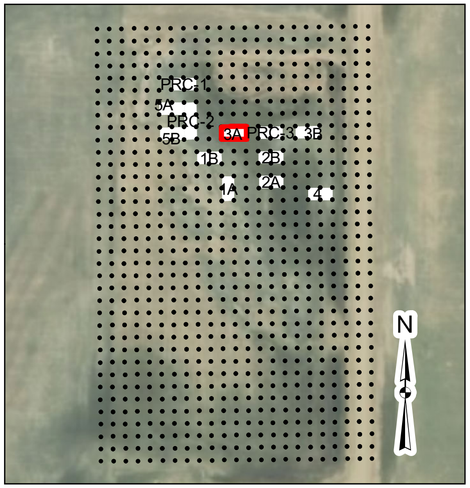

N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

▭ Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

- + -15800 - -11000
- + -10999 - -7200
- + -7199 - -4100
- + -4099 - -1900
- + -1899 - 800
- + 801 - 4900
- + 4901 - 9200

Project No.:	M1177088
Date:	Dec 2018
Drawn By:	NOW
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Test Plot 3A

2018 Pre-Flush to Post-Flush EC Change at Surface

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Anderson Parcel
Renville, Bottineau Co., ND

Exhibit

13

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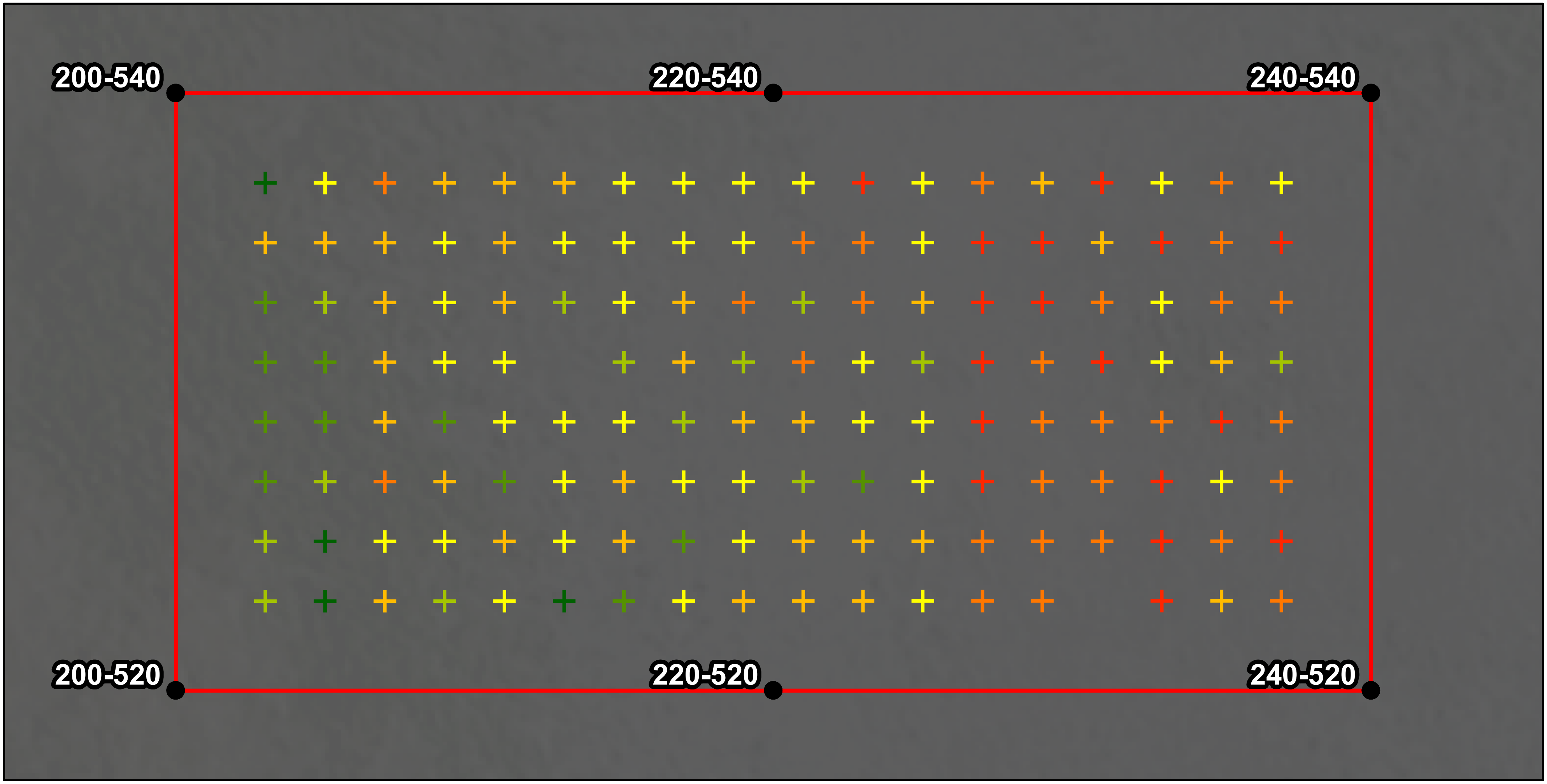

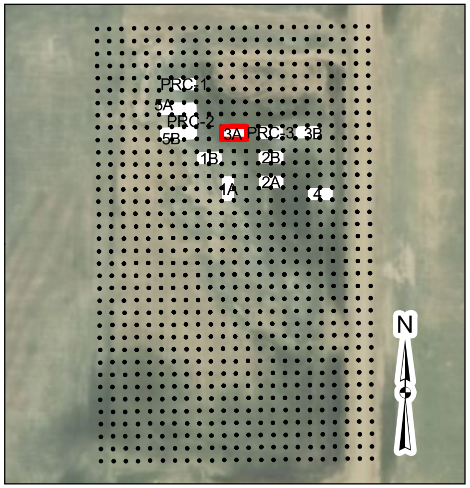

N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+ -10000 - -7900
+ -7899 - -4900
+ -4899 - -2800
+ -2799 - -700
+ -699 - 2400
+ 2401 - 6400
+ 6401 - 12000

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Date: Dec 2018
Drawn By: NOW
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Test Plot 3A

2018 Pre-Flush to Post-Flush EC Change at 1-Foot Depth

NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit

14

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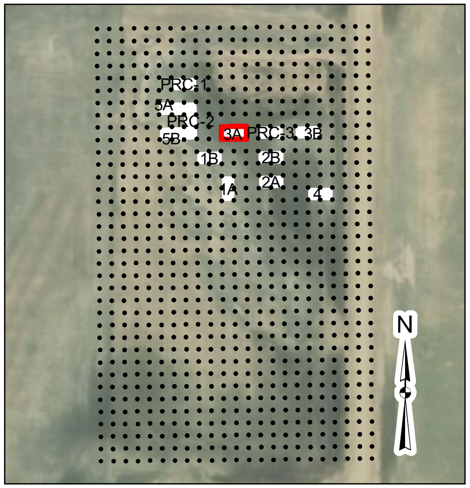

N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+ -11300 - -8200
+ -8199 - -5600
+ -5599 - -3400
+ -3399 - -1100
+ -1099 - 2200
+ 2201 - 6500
+ 6501 - 11300

Project No.: M1177088
Date: Dec 2018
Drawn By: NOW
Reviewed By: JRG

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Test Plot 3A

2018 Pre-Flush to Post-Flush EC Change at 2-Foot Depth
NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit
15

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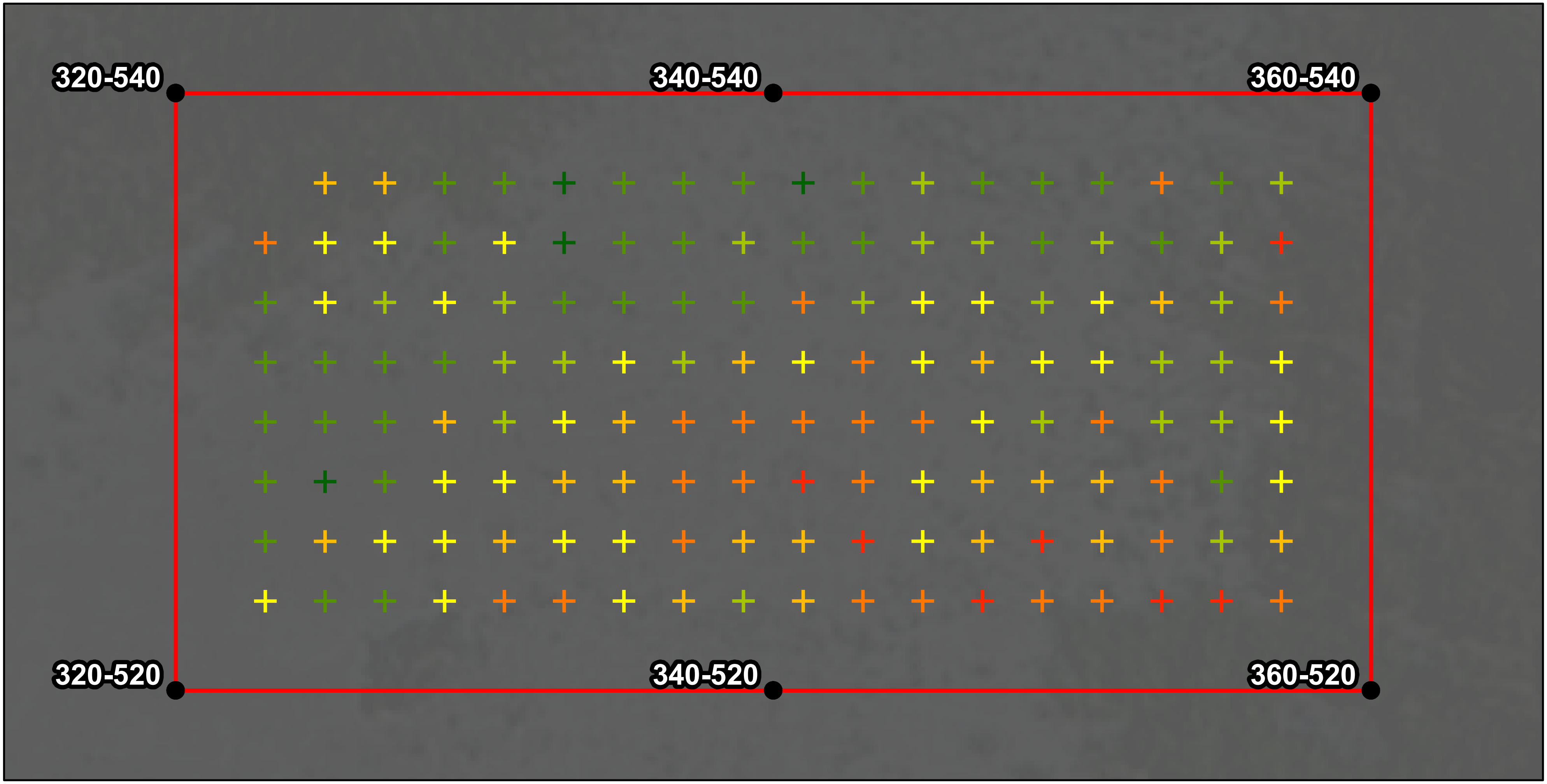

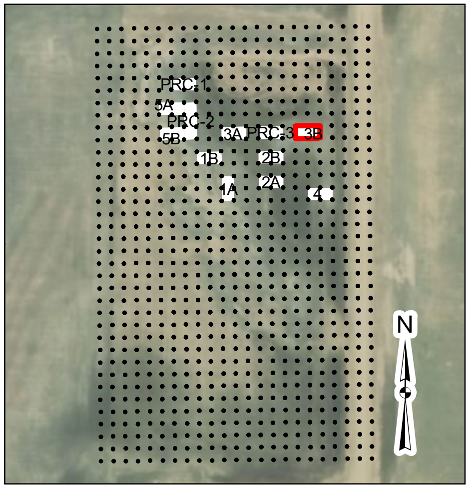

● Site Reference Grid Points (20'x20')

🟥 Test Plotl Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+ -16700 - -9000
+ -8999 - -5100
+ -5099 - -2100
+ -2099 - 100
+ 101 - 2300
+ 2301 - 5600
+ 5601 - 31900

Project No.:
M1177088
Date:
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Drawn By:
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Test Plot 3B

2017 to 2018 Pre-Flush EC Change At Surface

NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit

16

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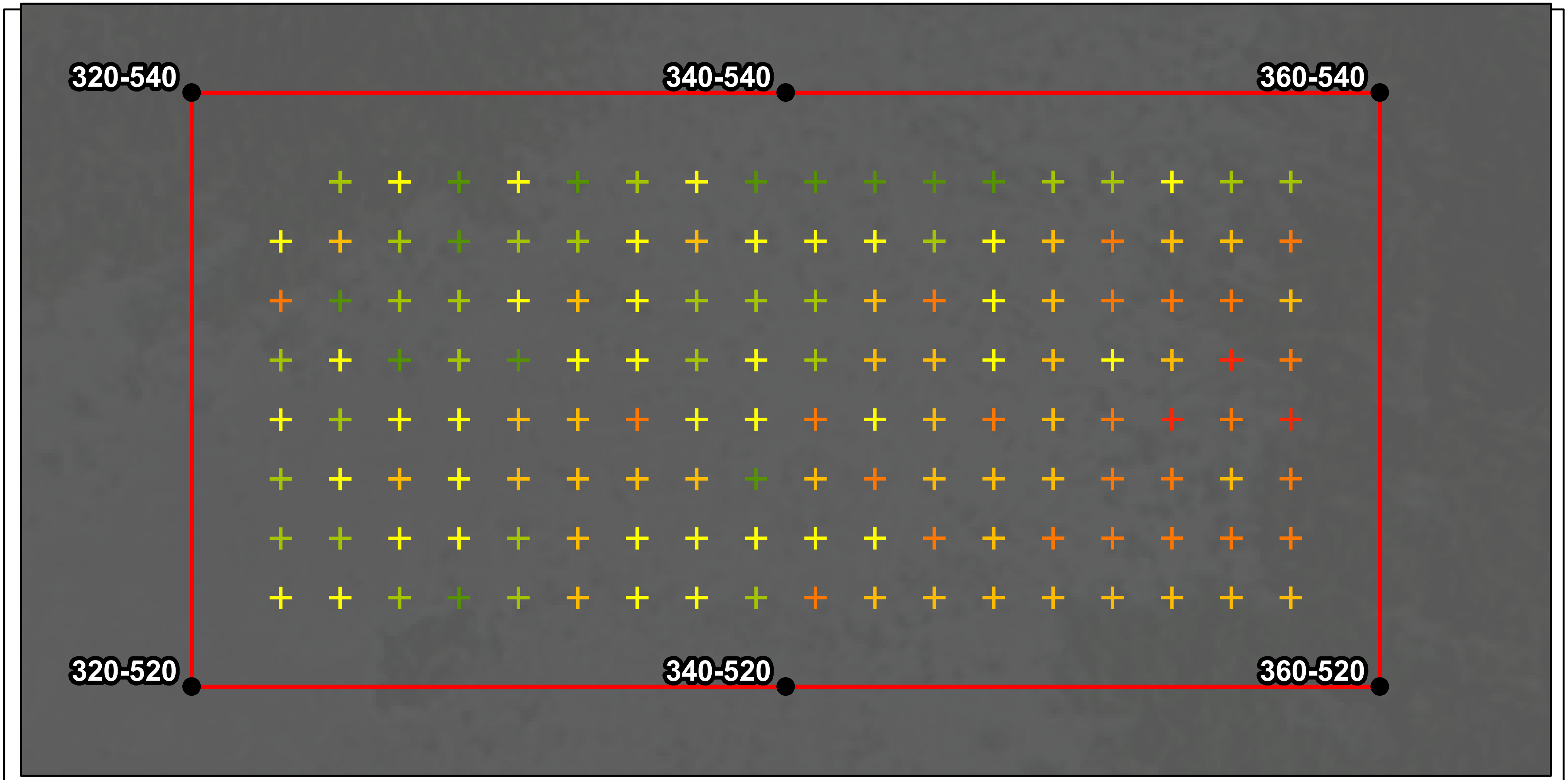

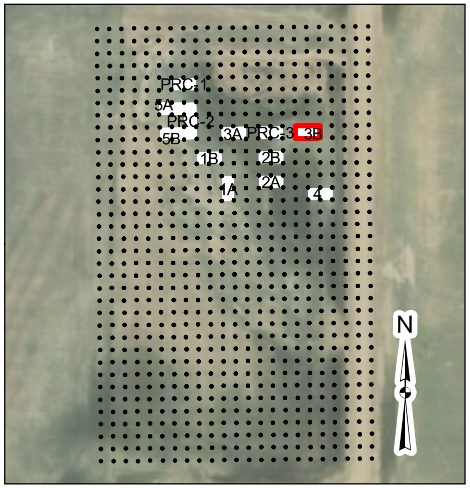

N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+ -16700 - -9000
+ -8999 - -5100
+ -5099 - -2100
+ -2099 - 100
+ 101 - 2300
+ 2301 - 5600
+ 5601 - 31900

Project No.:	M1177088
Date:	Dec 2018
Drawn By:	NOW
Reviewed By:	JRG

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Test Plot 3B

2017 to 2018 Pre-Flush EC Change At 1-Foot Depth

NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit

17

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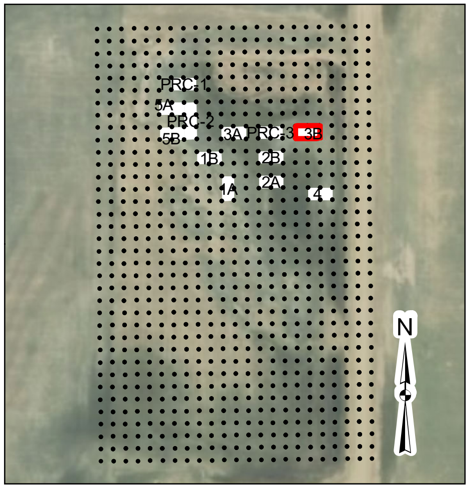

N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+ -11300 - -8200
+ -8199 - -5600
+ -5599 - -3400
+ -3399 - -1100
+ -1099 - 2200
+ 2201 - 6500
+ 6501 - 11300

Project No.: M1177088
Date: Dec 2018
Drawn By: NOW
Reviewed By: JRG

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Test Plot 3B

2017 to 2018 Pre-Flush EC Change At 2-Foot Depth

NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit

18

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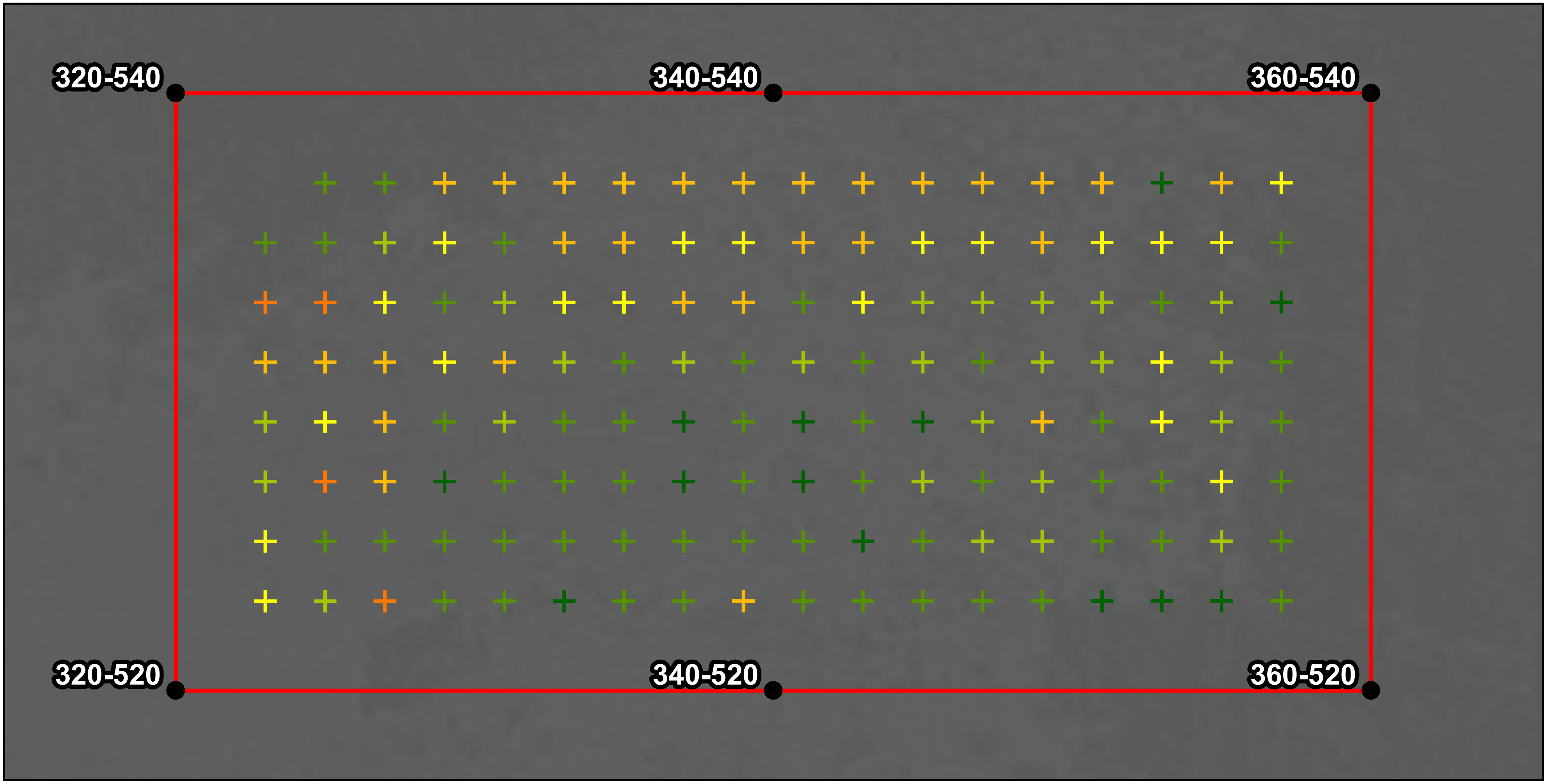

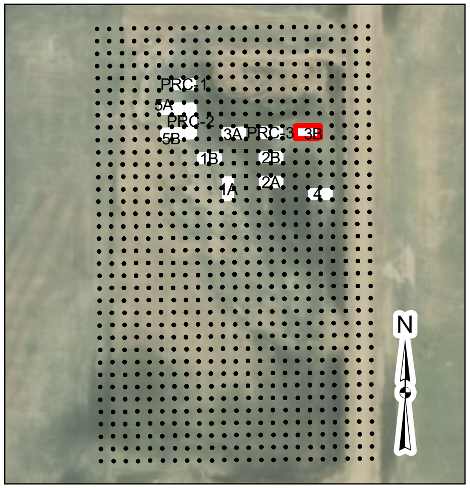

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+	-15800 - -11000
+	-10999 - -7200
+	-7199 - -4100
+	-4099 - -1900
+	-1899 - 800
+	801 - 4900
+	4901 - 9200

Project No.:	M1177088
Date:	Dec 2018
Drawn By:	NOW
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Test Plot 3B

2018 Pre-Flush to Post-Flush EC Change at Surface

NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit

19

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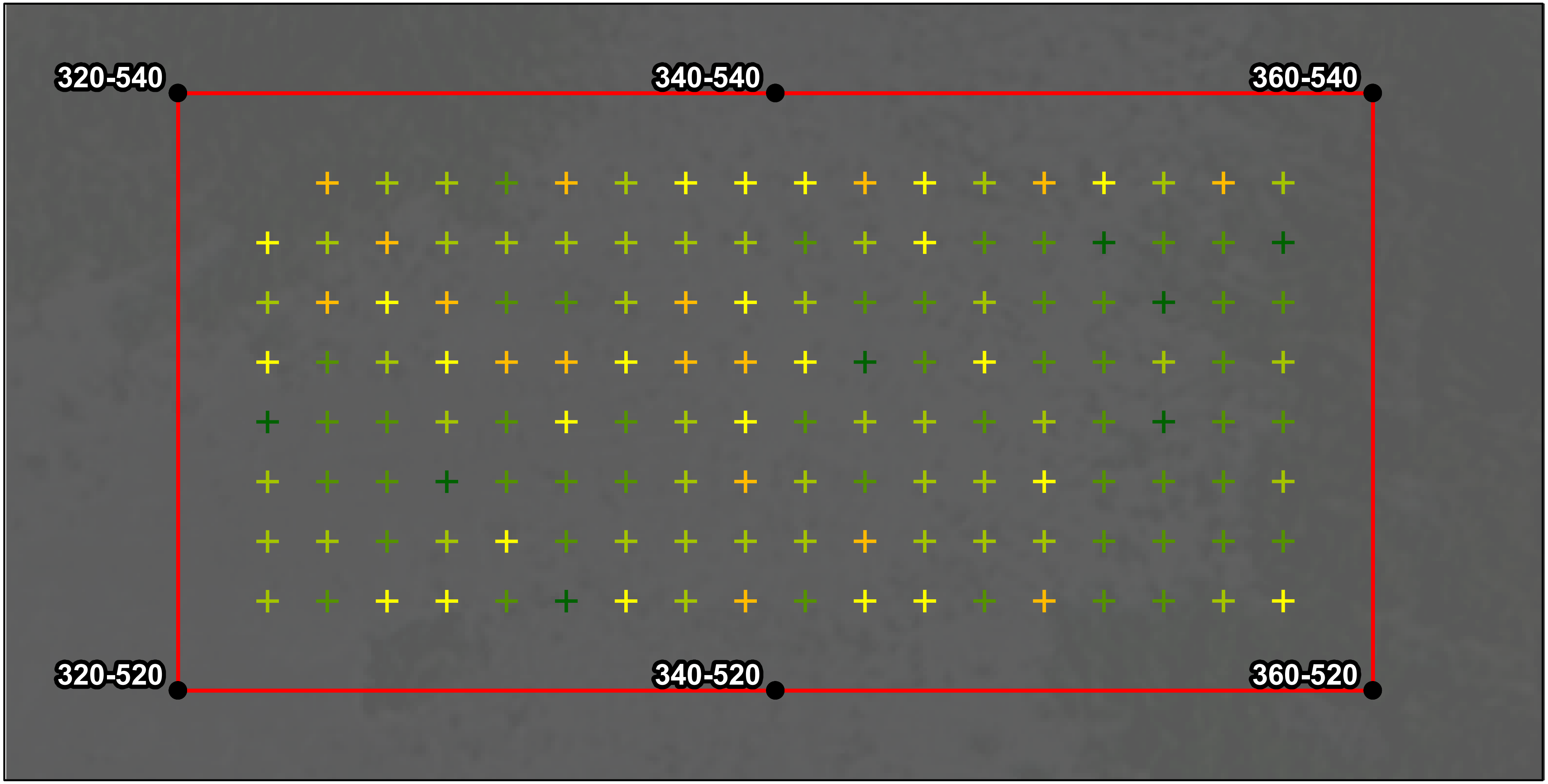

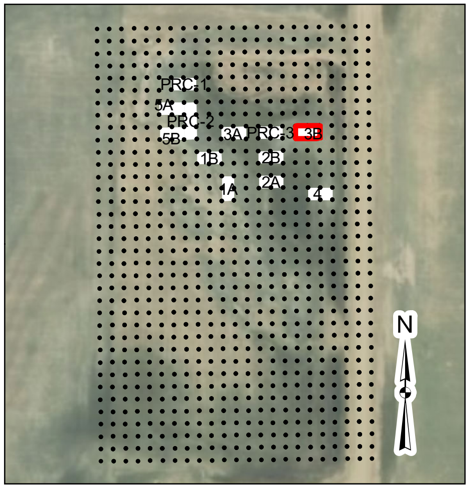

N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+ -10000 - -7900
+ -7899 - -4900
+ -4899 - -2800
+ -2799 - -700
+ -699 - 2400
+ 2401 - 6400
+ 6401 - 12000

Project No.:	M1177088
Date:	Dec 2018
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Test Plot 3B

2018 Pre-Flush to Post-Flush EC Change at 1-Foot Depth
NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit

20

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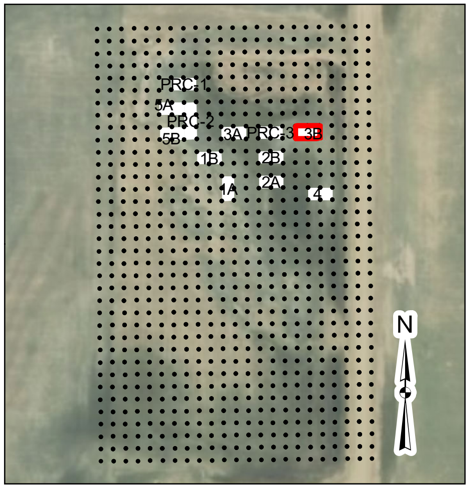

N

0 1 2 4 Feet

● Site Reference Grid Points (20'x20')

▭ Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+ -11300 - -8200

+ -8199 - -5600

+ -5599 - -3400

+ -3399 - -1100

+ -1099 - 2200

+ 2201 - 6500

Project No.:	M1177088
Date:	Dec 2018
Drawn By:	NOW
Reviewed By:	JRG

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Test Plot 3B

2018 Pre-Flush to Post-Flush EC Change at 1-Foot Depth

NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit

21

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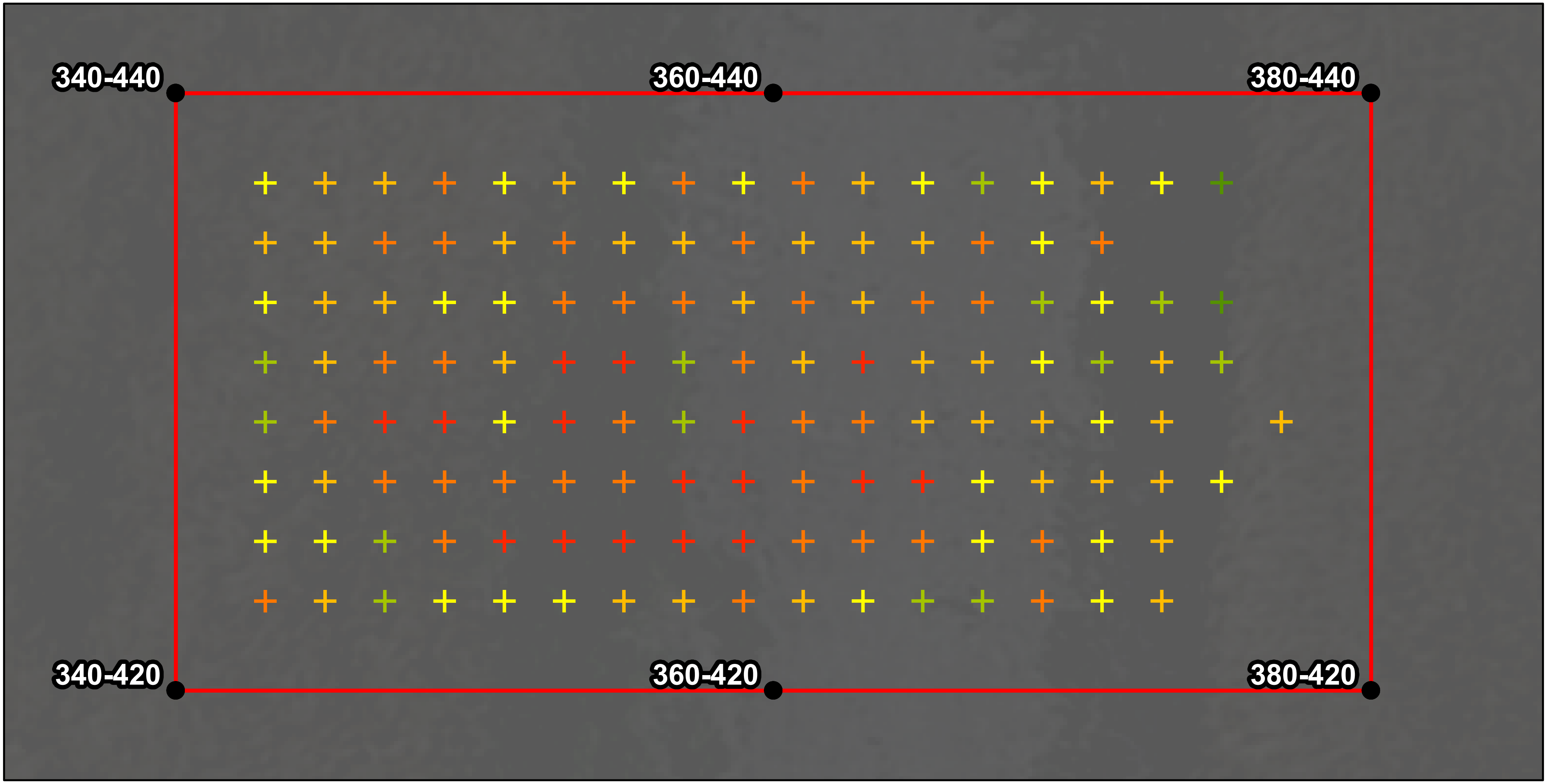

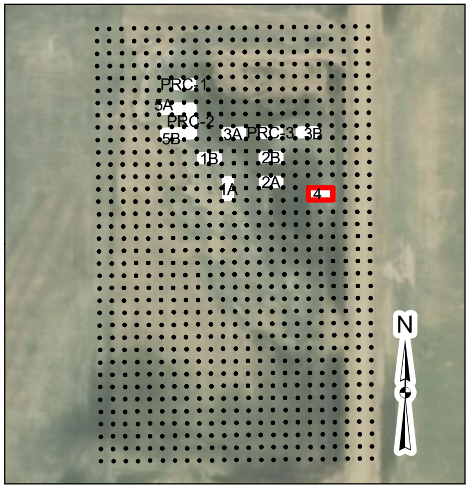

N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

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+	-5099 - -2100
+	-2099 - 100
+	101 - 2300
+	2301 - 5600
+	5601 - 31900

Project No.:
M1177088
Date:
Dec 2018
Drawn By:
NOW
Reviewed By:
JRG

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Test Plot 4

2017-2018 EC Change At Surface

NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit

22

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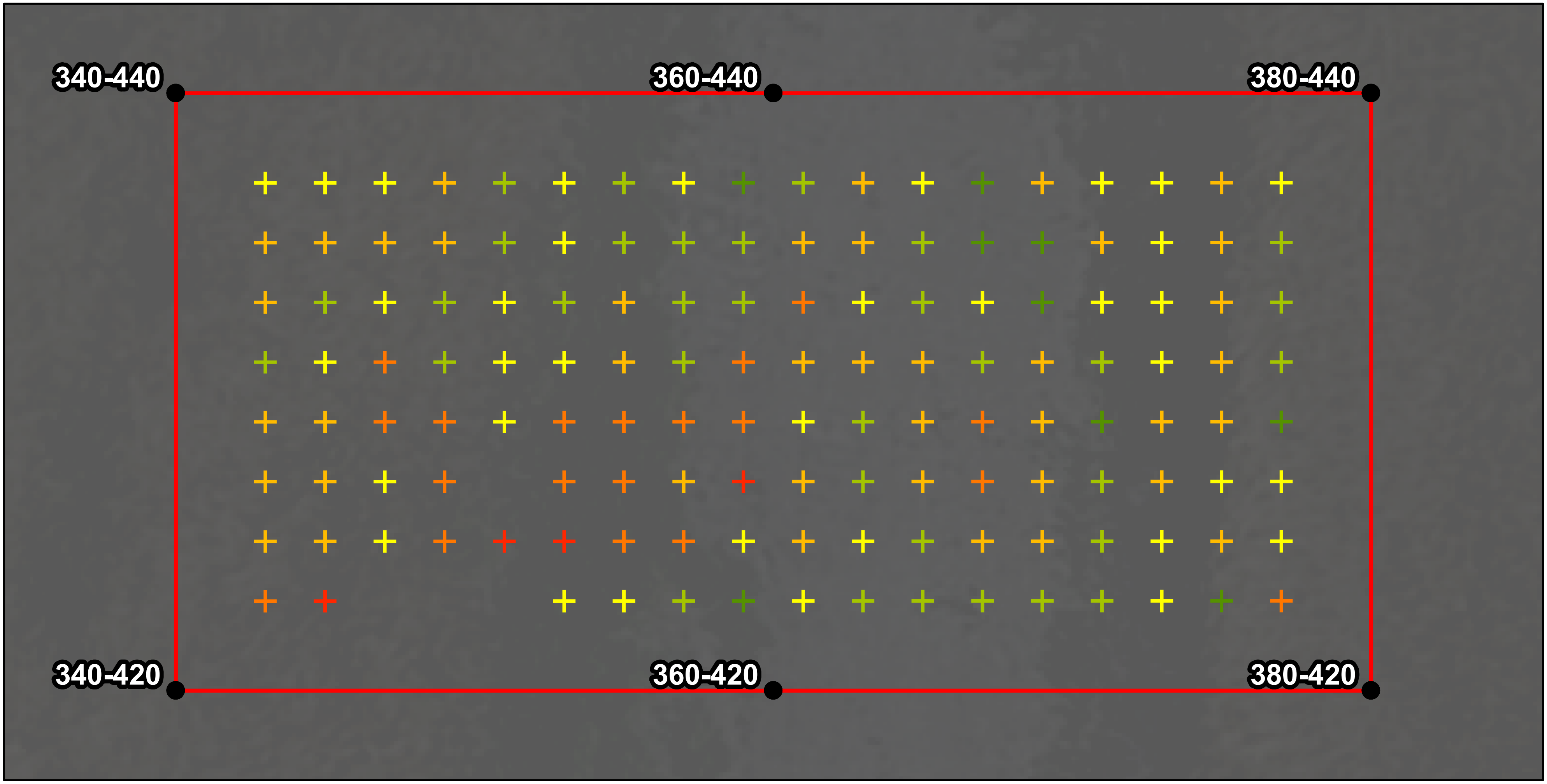

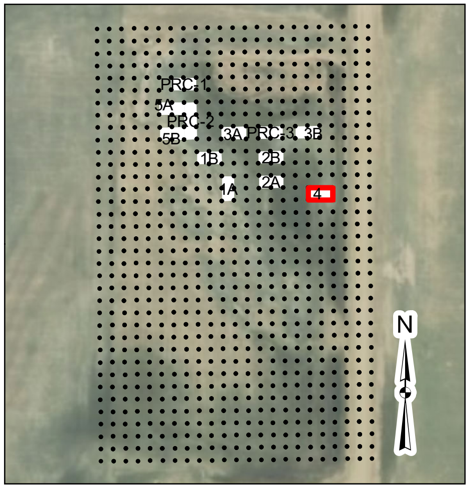

● Site Reference Grid Points (20'x20')

▭ Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

- + -16700 - -9000
- + -8999 - -5100
- + -5099 - -2100
- + -2099 - 100
- + 101 - 2300
- + 2301 - 5600
- + 5601 - 31900

Project No.:	M1177088
Date:	Dec 2018
Drawn By:	NOW
Reviewed By:	JRG

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Test Plot 4

2017-2018 EC Change At 1-Foot Depth

NDIC Brine Remedial Technology Study
Anderson Parcel
Renville, Bottineau Co., ND

Exhibit

23

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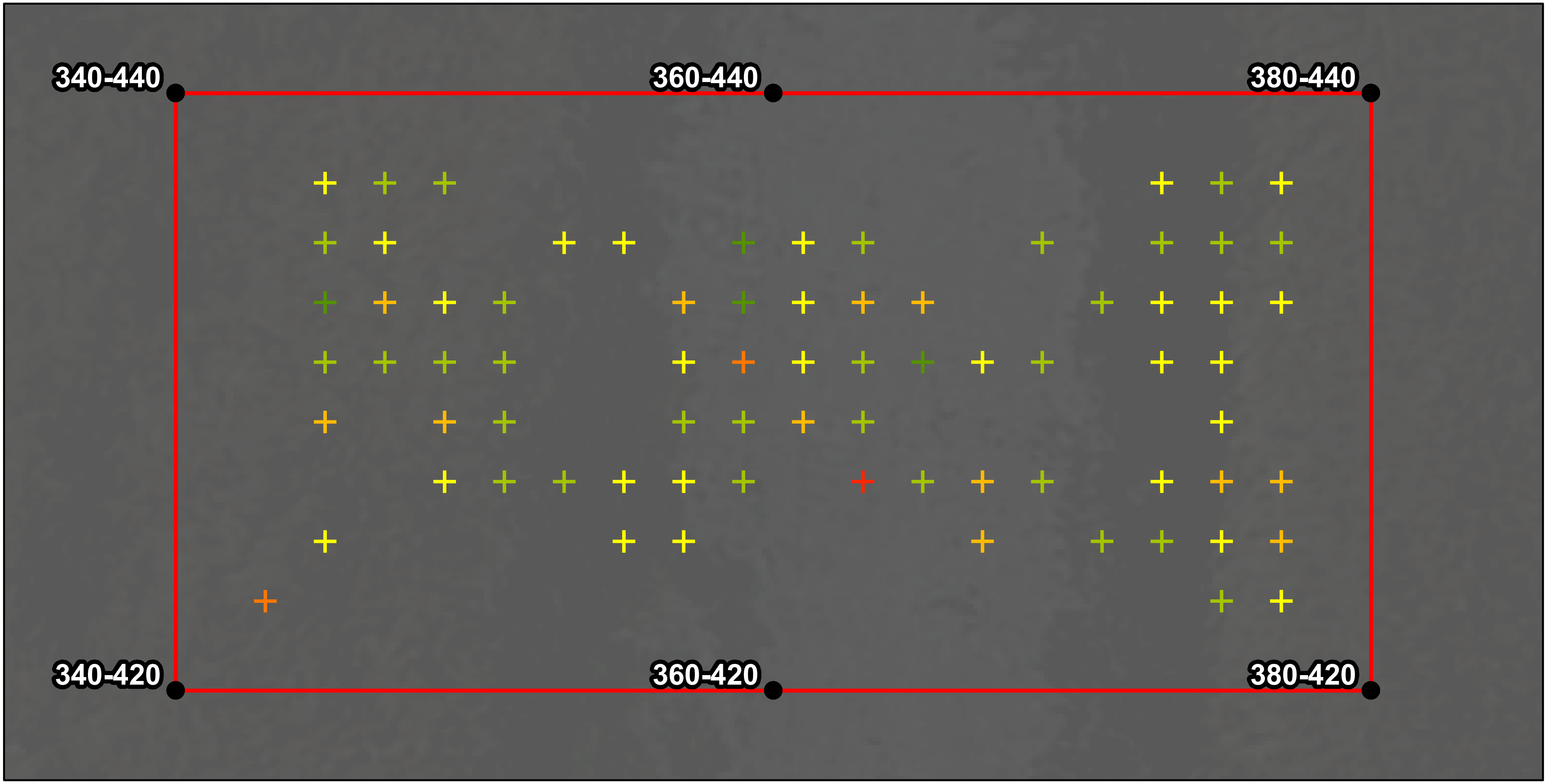

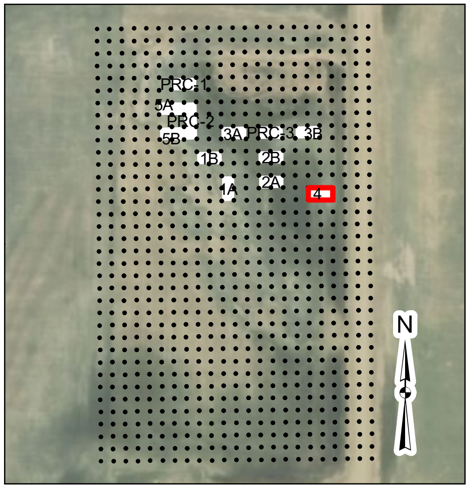

N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

🟥 Test Plotl Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+ -16700 - -9000
+ -8999 - -5100
+ -5099 - -2100
+ -2099 - 100
+ 101 - 2300
+ 2301 - 5600
+ 5601 - 31900

Project No.: M1177088
Date: Dec 2018
Drawn By: NOW
Reviewed By: JRG

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Test Plot 4

2017-2018 EC Change At 2-Foot Depth

NDIC Brine Remedial Technology Study
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Exhibit

24

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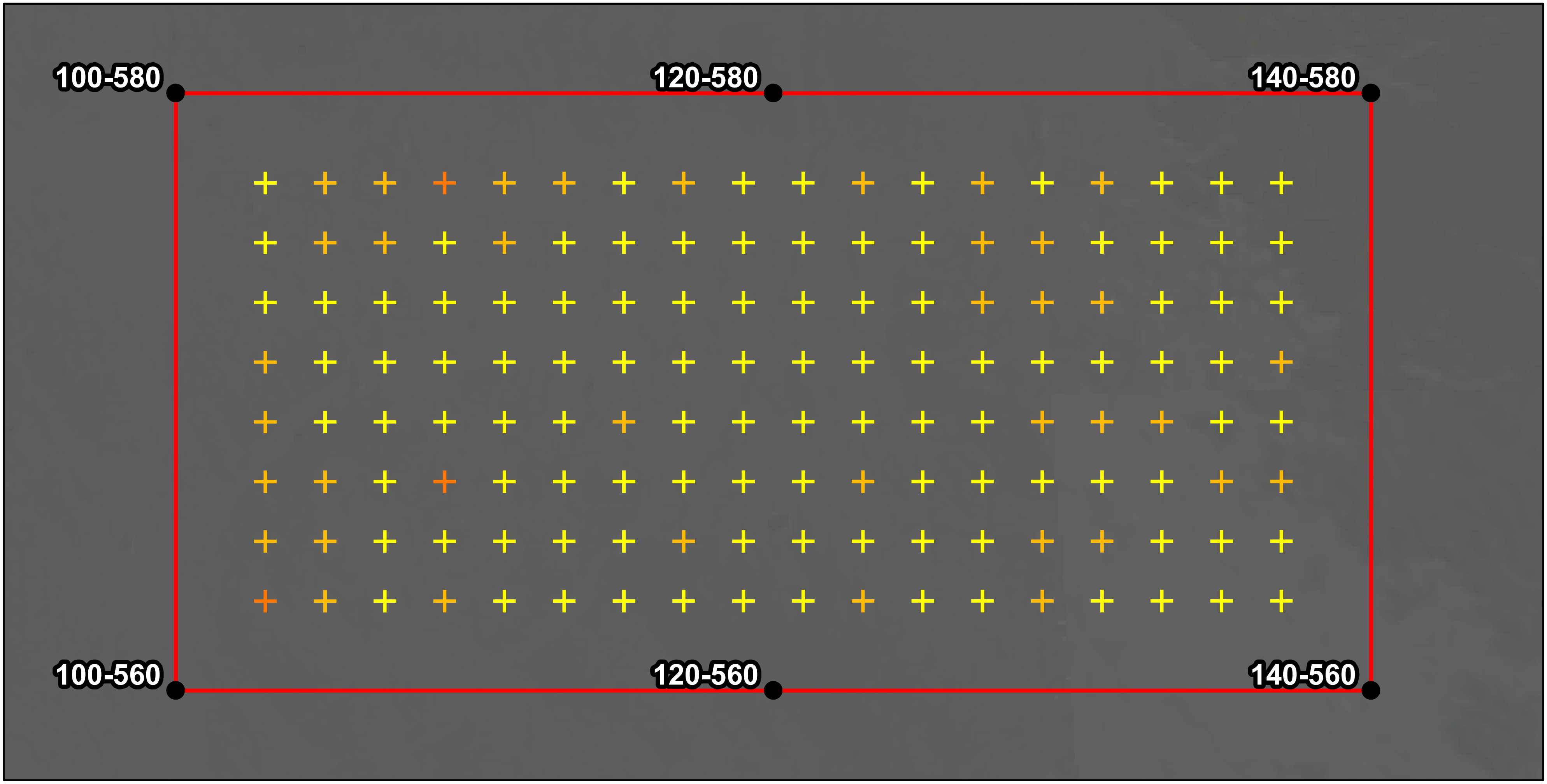

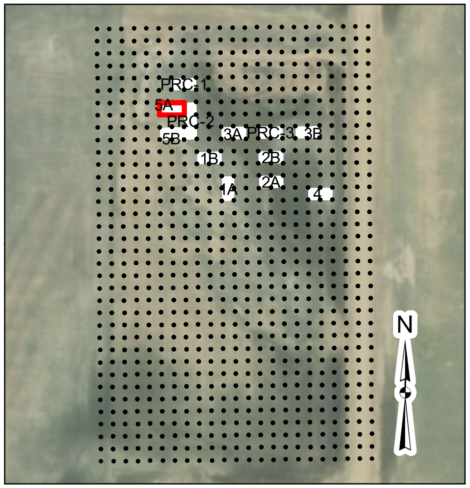

N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+ -16700 - -9000
+ -8999 - -5100
+ -5099 - -2100
+ -2099 - 100
+ 101 - 2300
+ 2301 - 5600
+ 5601 - 31900

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Date:	Dec 2018
Drawn By:	NOW
Reviewed By:	JRG

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Test Plot 5A

2017-2018 EC Change At Surface

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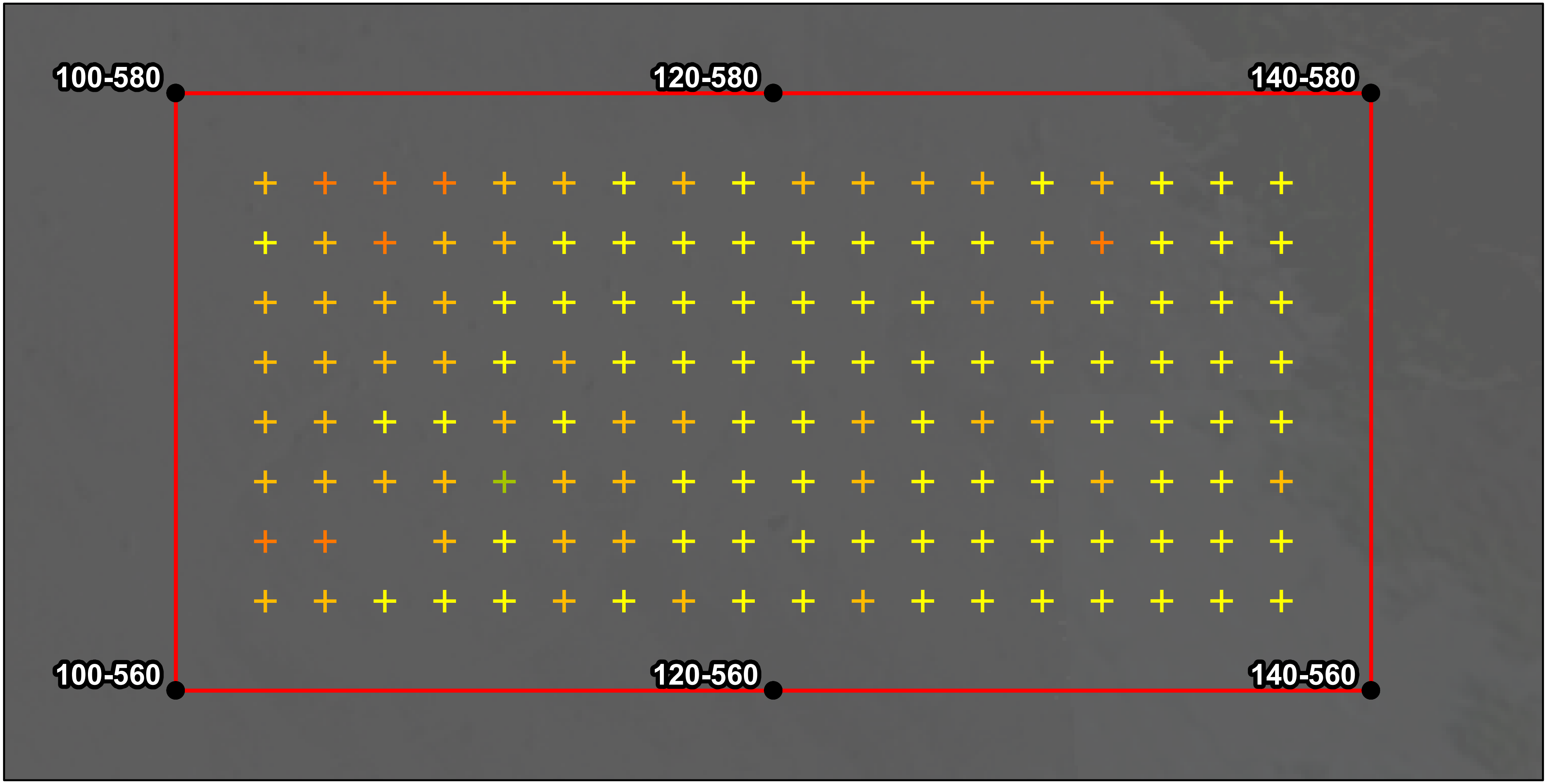

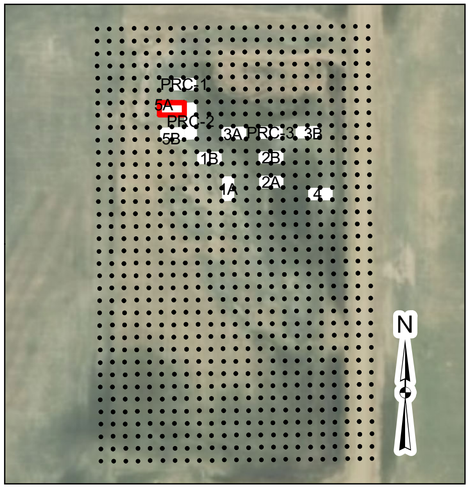

N

Feet
0 1 2 4

● Site Reference Grid Points (20'x20')

🟥 Treatment Cell Boundaries

Treatment Cell Sample Points (2'x2' spacing)

EC Change

- + -16700 - -9000
- + -8999 - -5100
- + -5099 - -2100
- + -2099 - 100
- + 101 - 2300
- + 2301 - 5600
- + 5601 - 31900

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2017-2018 EC Change At 1-Foot Depth

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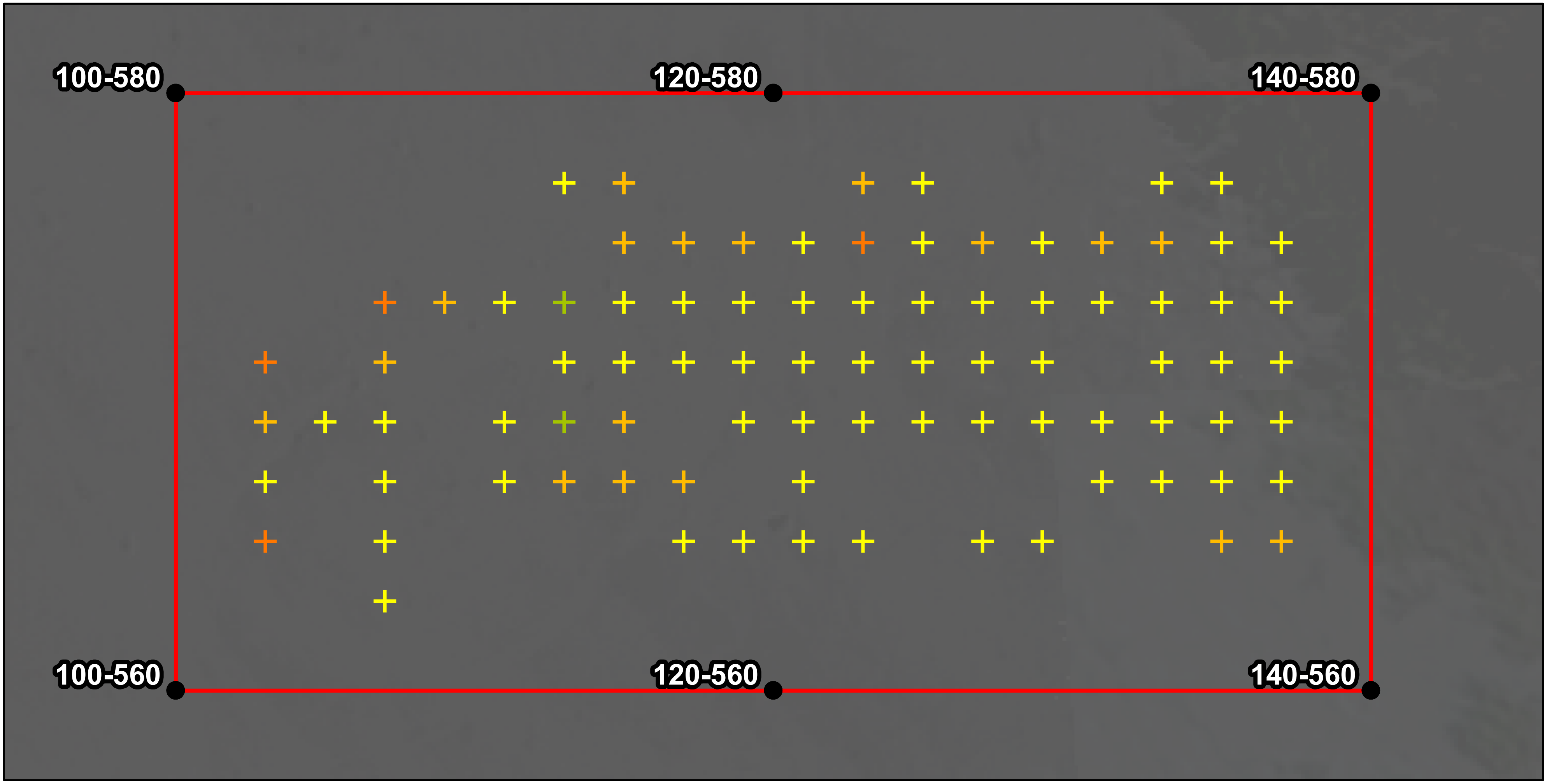

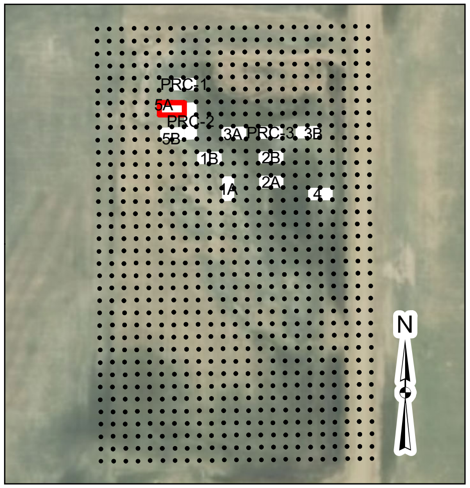

N

Feet
0 1 2 4

- ● Site Reference Grid Points (20'x20')
- ▭ Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

- + -16700 - -9000
- + -8999 - -5100
- + -5099 - -2100
- + -2099 - 100
- + 101 - 2300
- + 2301 - 5600
- + 5601 - 31900

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2017-2018 EC Change At 2-Foot Depth

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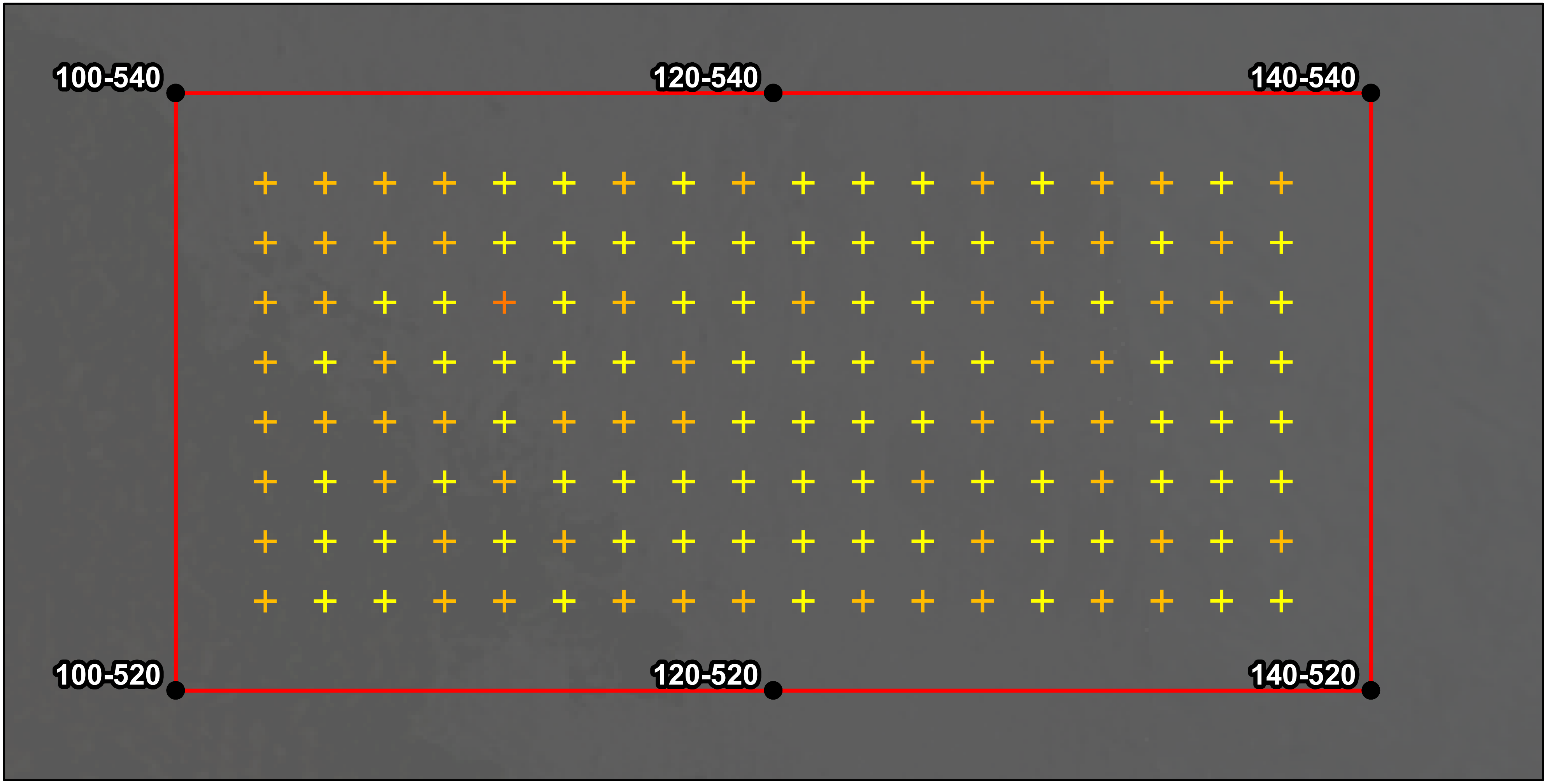

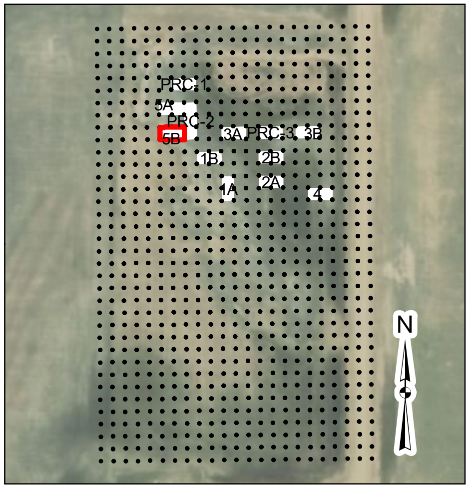

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

- + -16700 - -9000
- + -8999 - -5100
- + -5099 - -2100
- + -2099 - 100
- + 101 - 2300
- + 2301 - 5600
- + 5601 - 31900

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2017-2018 EC Change At Surface

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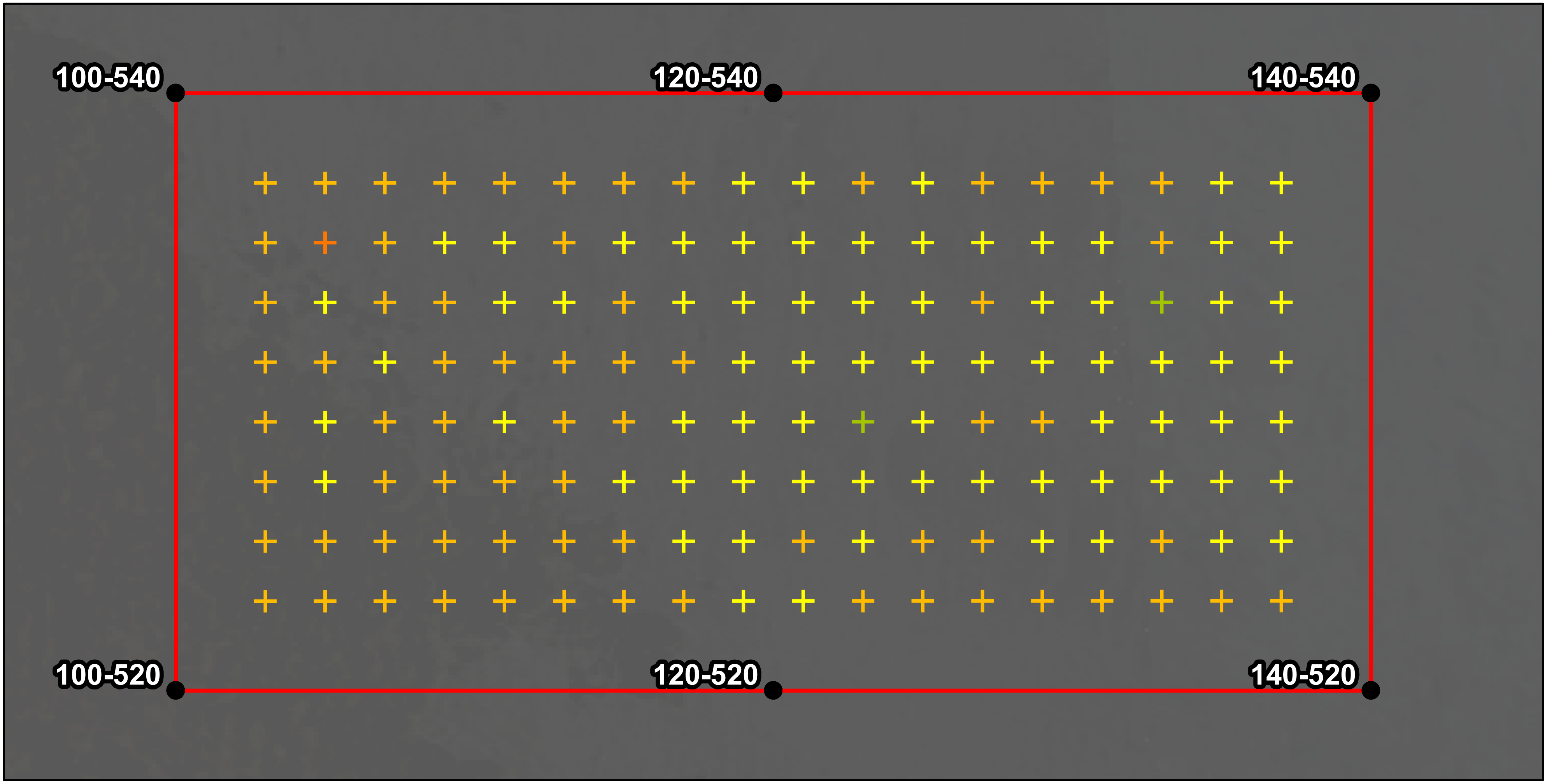

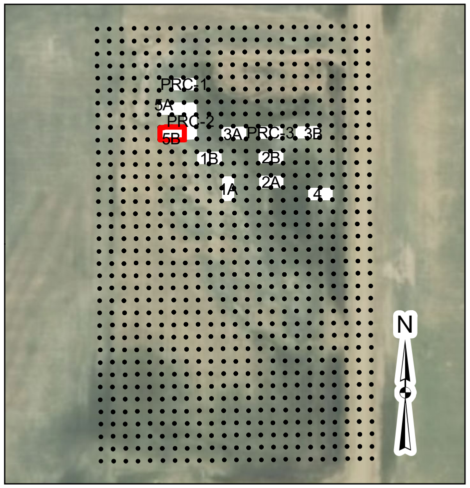

● Site Reference Grid Points (20'x20')

🟥 Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

+	-16700 - -9000
+	-8999 - -5100
+	-5099 - -2100
+	-2099 - 100
+	101 - 2300
+	2301 - 5600
+	5601 - 31900

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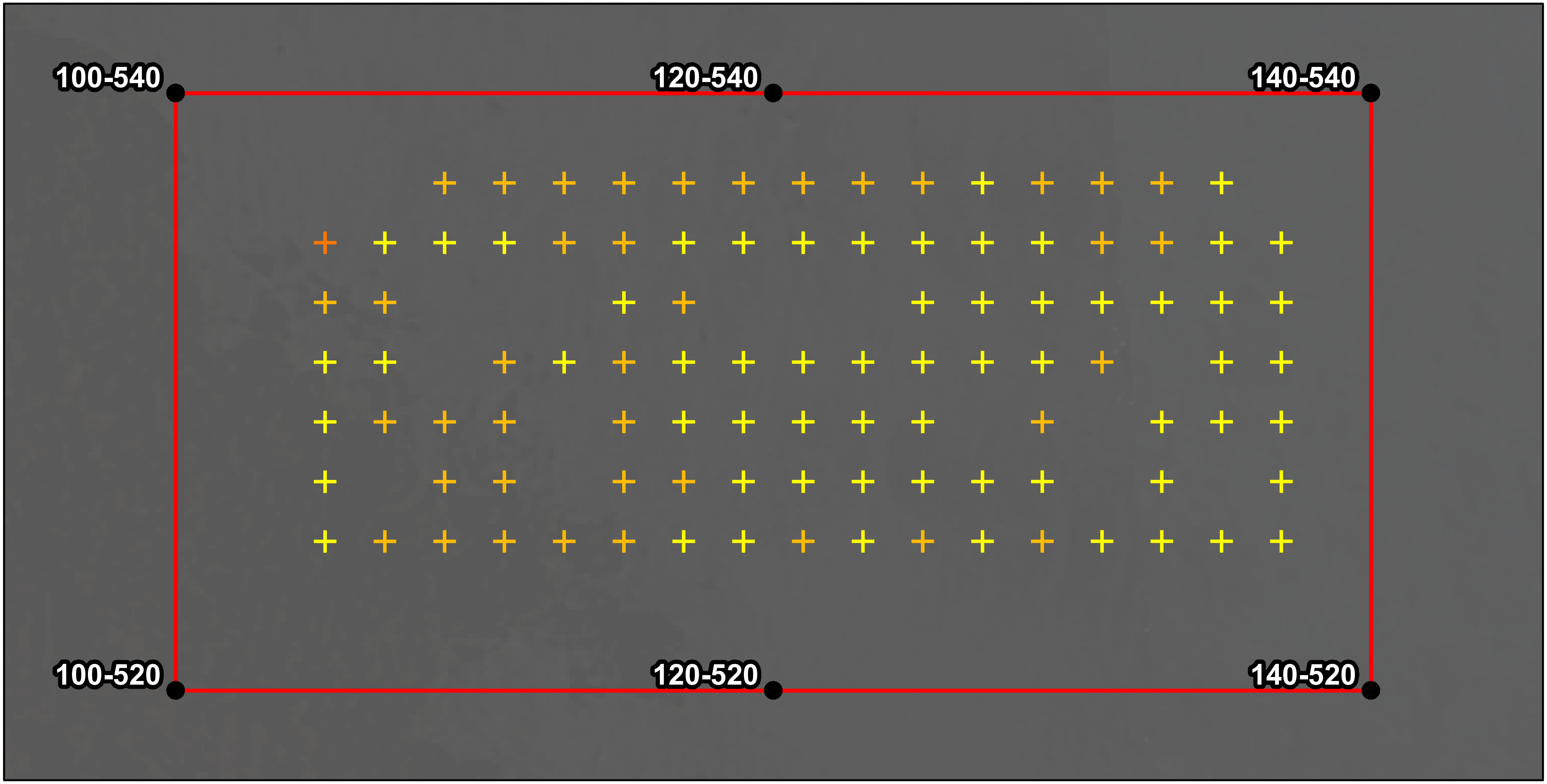

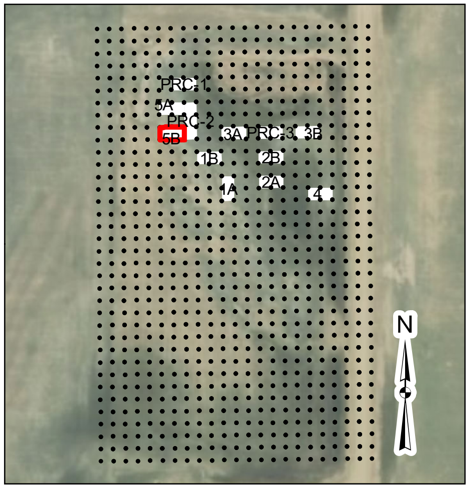

● Site Reference Grid Points (20'x20')

▭ Test Plot Boundaries

Test Plot Sample Points (2'x2' spacing)

EC Change

- + -16700 - -9000
- + -8999 - -5100
- + -5099 - -2100
- + -2099 - 100
- + 101 - 2300
- + 2301 - 5600
- + 5601 - 31900

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2017-2018 EC Change At 2-Foot Depth

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APPENDIX B – DATA TABLES

Table 1 – Test Cell - Field Chlorides

Table 2 – Plot 1A Field Screening Results

Table 3 – Plot 1B Field Screening Results

Table 4 – Plot 2A Field Screening Results

Table 5 – Plot 2B Field Screening Results

Table 6 – Plot 3A Field Screening Results

Table 7 – Plot 3B Field Screening Results

Table 8 – Plot 4 Field Screening Results

Table 9 – Plot 5A Field Screening Results

Table 10 – Plot 5B Field Screening Results

Test Cell Sample	LowCl QU	ppm(mg/L)
1T	1.6	43
1B	2	57
2T	0	0
2B	1.4	37
3T	0.4	-
3B	0.8	-
4T	0.2	-
4B	0	-
5T	0	-
5B	0	-
6T	0.4	-
6B	0	-
7T	5.2	212
7B	5.6	348
8T	1.4	32
8B	2.6	68
9T	1.4	32
9B	2.4	61
10T	0.8	-
10B	1	-
11T	1.4	32
11B	1.8	46
12T	0.2	-
12B	0.4	-
13T	1.2	28
13B	1	-
14T	5.6	263
14B	5.6	263
15T	1.8	46
15B	2.8	82
16T	0	-
16B	0	-
17T	0	-
17B	0	-
18T	0.8	-
18B	0.8	-
19T	0.4	-
19B	0.8	-
20T	1.4	34
20B	0.4	-
21T	1	-
21B	1.4	34
22T	0	-
22B	0.2	-
23T	0	-
23B	0.2	-

Table 1 - Test Cell - Field Chlorides

Test Cell Sample	LowCl QU	ppm(mg/L)
24T	1.2	28
24B	1.4	34
25T	1.6	40
25B	2.8	82
26T	3.6	114
26B	5.6	263

Plot 1A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
203	423	0	1300	6600	-
203	423	1	2400	7800	-
203	423	2	1700	-	-
203	425	0	1700	5300	-
203	425	1	2100	1800	-
203	425	2	2200	-	-
203	427	0	1500	300	-
203	427	1	1100	4900	-
203	427	2	900	-	-
203	429	0	1800	6700	-
203	429	1	2100	5300	-
203	429	2	1700	2200	-
203	431	0	1200	3300	-
203	431	1	1500	4500	-
203	431	2	1400	-	-
203	433	0	1400	3700	-
203	433	1	1700	4100	-
203	433	2	1900	-	-
203	435	0	1100	6400	-
203	435	1	1800	3200	-
203	435	2	2100	-	-
203	437	0	1300	4200	-
203	437	1	2100	2900	-
203	437	2	1800	-	-
203	439	0	1100	4300	-
203	439	1	1800	1900	-
203	439	2	1400	-	-
203	441	0	1200	5100	2100
203	441	1	1900	1600	2400
203	441	2	1800	-	2200
203	443	0	900	3400	-
203	443	1	1900	3400	-
203	443	2	1500	-	-
203	445	0	1800	1500	-
203	445	1	1600	2600	-
203	445	2	2000	-	-
203	447	0	1100	2400	-
203	447	1	2100	3300	-
203	447	2	2200	-	-
203	449	0	1600	3800	-
203	449	1	1800	1800	-
203	449	2	2400	-	-
203	451	0	1800	4100	-
203	451	1	1600	2900	-

Plot 1A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
203	451	2	9300	-	-
203	453	0	1400	4900	-
203	453	1	1900	5300	-
203	453	2	1900	6200	-
203	455	0	1000	2900	-
203	455	1	2100	3800	-
203	455	2	2400	-	-
203	457	0	1400	3700	-
203	457	1	2400	4100	-
203	457	2	1900	4900	-
205	423	0	2100	4900	-
205	423	1	2600	3000	-
205	423	2	2300	-	-
205	425	0	2500	1500	2600
205	425	1	2400	2000	2700
205	425	2	9000	-	2700
205	427	0	1900	800	-
205	427	1	2200	1300	-
205	427	2	1900	-	-
205	429	0	1300	1900	-
205	429	1	1900	2600	-
205	429	2	2600	-	-
205	431	0	1600	900	-
205	431	1	2100	2600	-
205	431	2	2100	-	-
205	433	0	1700	4100	-
205	433	1	2500	2700	-
205	433	2	2000	-	-
205	435	0	1700	2100	-
205	435	1	2300	2700	-
205	435	2	2400	-	-
205	437	0	1600	900	-
205	437	1	2200	2200	-
205	437	2	2600	-	-
205	439	0	1400	1900	-
205	439	1	2100	1200	-
205	439	2	2300	-	-
205	441	0	1200	1200	-
205	441	1	2000	1300	-
205	441	2	2200	-	-
205	443	0	1400	1500	-
205	443	1	2300	1200	-
205	443	2	2500	-	-
205	445	0	1600	4200	-

Plot 1A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
205	445	1	2600	1900	-
205	445	2	2800	-	-
205	447	0	1900	1800	-
205	447	1	2700	2700	-
205	447	2	3100	-	-
205	449	0	1700	2000	-
205	449	1	2800	1900	-
205	449	2	3200	-	-
205	451	0	1600	2500	-
205	451	1	1900	1600	-
205	451	2	2800	1100	-
205	453	0	1000	3000	-
205	453	1	1300	2400	-
205	453	2	2100	-	-
205	455	0	1500	3500	2400
205	455	1	1200	3000	3300
205	455	2	1900	-	3100
205	457	0	1700	2200	-
205	457	1	1000	5100	-
205	457	2	1700	7700	-
207	423	0	1100	1900	-
207	423	1	1600	2200	-
207	423	2	8400	-	-
207	425	0	1400	700	-
207	425	1	1900	1100	-
207	425	2	3900	2600	-
207	427	0	1000	3200	-
207	427	1	2500	1800	-
207	427	2	2600	-	-
207	429	0	2100	1800	-
207	429	1	2400	2700	-
207	429	2	1500	-	-
207	431	0	2100	1400	-
207	431	1	2400	2800	-
207	431	2	1500	-	-
207	433	0	1900	3100	-
207	433	1	2600	1200	-
207	433	2	700	-	-
207	435	0	1700	2000	-
207	435	1	3000	1700	-
207	435	2	1200	-	-
207	437	0	2200	2200	-
207	437	1	2800	1500	-
207	437	2	1000	-	-

Plot 1A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
207	439	0	1700	1700	-
207	439	1	2400	500	-
207	439	2	4100	800	-
207	441	0	1900	1300	-
207	441	1	2800	600	-
207	441	2	2600	100	-
207	443	0	2000	2500	-
207	443	1	2800	2200	-
207	443	2	700	-	-
207	445	0	2100	3200	-
207	445	1	2300	2900	-
207	445	2	900	-	-
207	447	0	2200	2400	-
207	447	1	2700	2000	-
207	447	2	1400	-	-
207	449	0	2900	1500	-
207	449	1	2100	1600	-
207	449	2	1800	-	-
207	451	0	1400	3600	-
207	451	1	2000	3200	-
207	451	2	1100	-	-
207	453	0	2000	3800	-
207	453	1	1900	3300	-
207	453	2	2900	-	-
207	455	0	2200	4400	-
207	455	1	2500	2800	-
207	455	2	11900	-	-
207	457	0	3200	3800	-
207	457	1	2200	4600	-
207	457	2	9500	-	-
209	423	0	1600	3400	-
209	423	1	1700	1900	-
209	423	2	8400	-	-
209	425	0	1800	1900	-
209	425	1	1700	1400	-
209	425	2	10100	-	-
209	427	0	1400	3600	-
209	427	1	1600	1300	-
209	427	2	2000	-	-
209	429	0	1000	1200	-
209	429	1	1800	1800	-
209	429	2	1700	-	-
209	431	0	1700	3900	-
209	431	1	2000	2600	-

Plot 1A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
209	431	2	1800	-	-
209	433	0	1900	3500	-
209	433	1	2200	1800	-
209	433	2	2400	-	-
209	435	0	2000	4200	-
209	435	1	2700	2700	-
209	435	2	2900	1600	-
209	437	0	2200	1300	-
209	437	1	3000	1300	-
209	437	2	3200	-	-
209	439	0	2100	2300	-
209	439	1	2900	1400	-
209	439	2	1500	-	-
209	441	0	2000	1800	-
209	441	1	2800	1000	-
209	441	2	4100	-	-
209	443	0	2200	3900	-
209	443	1	2900	2100	-
209	443	2	3200	-	-
209	445	0	2400	3700	-
209	445	1	3000	1200	-
209	445	2	1500	-	-
209	447	0	2000	1900	-
209	447	1	3700	2600	-
209	447	2	1300	-	-
209	449	0	1800	1700	-
209	449	1	3000	2100	-
209	449	2	700	-	-
209	451	0	2100	1500	-
209	451	1	2800	1800	-
209	451	2	700	-	-
209	453	0	2700	1500	-
209	453	1	2100	2100	-
209	453	2	1700	-	-
209	455	0	2000	5200	-
209	455	1	1700	3100	-
209	455	2	19700	-	-
209	457	0	2200	3100	-
209	457	1	2600	4800	-
209	457	2	1800	-	-
211	423	0	18000	2700	-
211	423	1	2100	1100	-
211	423	2	3400	-	-
211	425	0	1400	1300	-

Plot 1A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
211	425	1	1700	1100	-
211	425	2	2600	-	-
211	427	0	2100	2600	-
211	427	1	1600	1200	-
211	427	2	1700	-	-
211	429	0	1800	3200	-
211	429	1	2500	1100	-
211	429	2	1800	-	-
211	431	0	2200	3400	-
211	431	1	1400	2300	-
211	431	2	700	-	-
211	433	0	1700	2100	-
211	433	1	1500	1200	-
211	433	2	1000	-	-
211	435	0	2000	3800	-
211	435	1	1800	2600	-
211	435	2	3000	-	-
211	437	0	2200	3400	-
211	437	1	1500	1000	-
211	437	2	2100	-	-
211	439	0	1900	3100	-
211	439	1	1900	1600	-
211	439	2	3300	-	-
211	441	0	1600	1500	-
211	441	1	1100	1300	-
211	441	2	4100	-	-
211	443	0	1900	300	-
211	443	1	2200	1100	-
211	443	2	800	-	-
211	445	0	1500	3800	-
211	445	1	1800	3400	-
211	445	2	1200	-	-
211	447	0	1800	1300	-
211	447	1	2200	2900	-
211	447	2	1200	-	-
211	449	0	2100	3100	2200
211	449	1	1900	1200	3200
211	449	2	3200	-	2800
211	451	0	1900	700	-
211	451	1	1100	800	-
211	451	2	2700	1100	-
211	453	0	2600	1300	-
211	453	1	1900	1600	-
211	453	2	14700	-	-

Plot 1A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
211	455	0	1700	5700	-
211	455	1	1400	2200	-
211	455	2	7500	-	-
211	457	0	2000	3100	-
211	457	1	1200	4100	-
211	457	2	1600	-	-
213	423	0	1700	1800	-
213	423	1	1300	900	-
213	423	2	2300	-	-
213	425	0	1800	1400	-
213	425	1	2400	1000	-
213	425	2	800	-	-
213	427	0	1700	3900	-
213	427	1	1600	1700	-
213	427	2	1300	-	-
213	429	0	2100	2800	-
213	429	1	1400	1300	-
213	429	2	2000	1700	-
213	431	0	1800	3700	-
213	431	1	1300	1400	-
213	431	2	1900	-	-
213	433	0	1500	3400	2800
213	433	1	1400	1900	2400
213	433	2	2400	-	2100
213	435	0	1800	4200	-
213	435	1	1500	3300	-
213	435	2	1100	-	-
213	437	0	2300	3400	-
213	437	1	1400	1700	-
213	437	2	900	-	-
213	439	0	1600	2500	-
213	439	1	1100	1200	-
213	439	2	2000	-	-
213	441	0	1800	1700	-
213	441	1	1800	1800	-
213	441	2	2100	-	-
213	443	0	1100	1800	-
213	443	1	1600	2300	-
213	443	2	1200	1900	-
213	445	0	1300	1200	-
213	445	1	1900	3800	-
213	445	2	2200	-	-
213	447	0	2000	2300	-
213	447	1	2200	2200	-

Plot 1A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
213	447	2	1500	-	-
213	449	0	1700	1000	-
213	449	1	1100	2200	-
213	449	2	1300	-	-
213	451	0	1900	1800	-
213	451	1	2200	2200	-
213	451	2	1500	-	-
213	453	0	2100	1900	-
213	453	1	1700	800	-
213	453	2	1300	-	-
213	455	0	1400	3700	-
213	455	1	1500	3900	-
213	455	2	10400	-	-
213	457	0	2400	4600	-
213	457	1	1900	2700	-
213	457	2	8000	-	-
215	423	0	1400	1800	-
215	423	1	1800	800	-
215	423	2	9200	-	-
215	425	0	2300	1900	2300
215	425	1	1900	800	2000
215	425	2	1200	-	3000
215	427	0	1700	2700	-
215	427	1	1000	1800	-
215	427	2	1100	-	-
215	429	0	1400	2800	-
215	429	1	1400	2400	-
215	429	2	1000	-	-
215	431	0	2100	2700	-
215	431	1	1700	2300	-
215	431	2	2900	-	-
215	433	0	1800	2400	-
215	433	1	1400	1200	-
215	433	2	1500	-	-
215	435	0	1700	2400	-
215	435	1	1400	1800	-
215	435	2	2100	-	-
215	437	0	2500	2300	-
215	437	1	2200	1900	-
215	437	2	2500	-	-
215	439	0	1800	2000	-
215	439	1	1100	1400	-
215	439	2	2900	-	-
215	441	0	1500	3500	2600

Plot 1A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
215	441	1	1600	1200	2500
215	441	2	2100	-	4400
215	443	0	1900	2800	-
215	443	1	1400	2300	-
215	443	2	2700	-	-
215	445	0	1400	3400	-
215	445	1	1800	1600	-
215	445	2	1700	-	-
215	447	0	1400	2300	-
215	447	1	1800	1800	-
215	447	2	2500	1800	-
215	449	0	1700	4100	-
215	449	1	2300	3400	-
215	449	2	1600	-	-
215	451	0	2100	4100	-
215	451	1	2000	2200	-
215	451	2	1600	-	-
215	453	0	1800	2900	-
215	453	1	1800	3600	-
215	453	2	5400	-	-
215	455	0	1400	3800	4200
215	455	1	1900	4200	3700
215	455	2	14600	-	4400
215	457	0	1300	2900	-
215	457	1	1700	2000	-
215	457	2	15300	-	-
217	423	0	1500	2800	-
217	423	1	1300	2700	-
217	423	2	13700	3100	-
217	425	0	1900	900	-
217	425	1	1100	1300	-
217	425	2	9700	-	-
217	427	0	1600	2700	-
217	427	1	1500	2500	-
217	427	2	2800	-	-
217	429	0	1200	3700	-
217	429	1	2100	2600	-
217	429	2	1900	-	-
217	431	0	1800	800	-
217	431	1	1200	1700	-
217	431	2	1400	-	-
217	433	0	2600	2600	-
217	433	1	2200	1600	-
217	433	2	2400	-	-

Plot 1A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
217	435	0	1800	4100	-
217	435	1	1300	2300	-
217	435	2	1300	-	-
217	437	0	1500	4200	-
217	437	1	2100	2100	-
217	437	2	2700	-	-
217	439	0	2600	3500	-
217	439	1	2400	3100	-
217	439	2	2700	1100	-
217	441	0	2300	2400	-
217	441	1	1700	700	-
217	441	2	700	-	-
217	443	0	2100	2700	-
217	443	1	2000	800	-
217	443	2	2400	-	-
217	445	0	1400	2900	-
217	445	1	1700	900	-
217	445	2	3900	-	-
217	447	0	1600	3400	-
217	447	1	1300	1600	-
217	447	2	13200	-	-
217	449	0	1900	3900	-
217	449	1	1900	2600	-
217	449	2	11700	-	-
217	451	0	1900	3900	-
217	451	1	1800	3200	-
217	451	2	9200	-	-
217	453	0	2700	7000	-
217	453	1	2100	4100	-
217	453	2	12200	6200	-
217	455	0	1400	6300	-
217	455	1	1800	5500	-
217	455	2	17800	-	-
217	457	0	1300	8600	-
217	457	1	1500	10000	-
217	457	2	9400	-	-

Plot 1B EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
163	483	0	900	7700	-
163	483	1	1100	5800	-
163	483	2	3600	-	-
163	485	0	1200	5600	-
163	485	1	3600	3900	-
163	485	2	3100	2600	-
163	487	0	1300	6400	-
163	487	1	2900	3200	-
163	487	2	2100	-	-
163	489	0	1000	6300	-
163	489	1	3200	2900	-
163	489	2	2000	2900	-
163	491	0	1500	5100	-
163	491	1	1200	3300	-
163	491	2	1500	270	-
163	493	0	900	5700	-
163	493	1	3500	3400	-
163	493	2	1200	2900	-
163	495	0	1100	7200	-
163	495	1	3600	4200	-
163	495	2	2500	-	-
163	497	0	1800	8700	-
163	497	1	3000	3700	-
163	497	2	1500	-	-
165	483	0	1000	8300	-
165	483	1	1300	4100	-
165	483	2	14100	-	-
165	485	0	800	5400	-
165	485	1	4000	3700	-
165	485	2	1400	2000	-
165	487	0	1300	6100	-
165	487	1	2400	3200	-
165	487	2	1300	2900	-
165	489	0	1300	7200	-
165	489	1	3400	3600	-
165	489	2	2400	-	-
165	491	0	1100	5600	-
165	491	1	1500	2500	-
165	491	2	1600	5700	-
165	493	0	1400	3500	-
165	493	1	3700	3300	-
165	493	2	2200	3200	-
165	495	0	1100	5700	3200
165	495	1	3500	3100	2900

Plot 1B EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
165	495	2	1300	2700	2100
165	497	0	1600	7600	-
165	497	1	3900	4000	-
165	497	2	2000	3100	-
167	483	0	1000	7800	-
167	483	1	4100	4100	-
167	483	2	1500	-	-
167	485	0	1200	6700	4800
167	485	1	4300	4200	3400
167	485	2	4000	3100	2100
167	487	0	1400	7100	-
167	487	1	3900	4700	-
167	487	2	6700	-	-
167	489	0	1300	4800	-
167	489	1	1500	3200	-
167	489	2	2300	2700	-
167	491	0	1200	5300	-
167	491	1	900	3600	-
167	491	2	500	-	-
167	493	0	1000	4000	-
167	493	1	2300	3600	-
167	493	2	2000	2900	-
167	495	0	1200	5300	-
167	495	1	3800	2800	-
167	495	2	1900	2700	-
167	497	0	1500	7600	-
167	497	1	4300	300	-
167	497	2	1200	-	-
169	483	0	1100	6800	-
169	483	1	4300	5300	-
169	483	2	3500	-	-
169	485	0	1400	7400	-
169	485	1	5000	5200	-
169	485	2	4700	5400	-
169	487	0	1800	7000	-
169	487	1	2600	4400	-
169	487	2	1400	33300	-
169	489	0	1500	7900	-
169	489	1	1200	4300	-
169	489	2	1300	2800	-
169	491	0	1200	6000	-
169	491	1	2300	3700	-
169	491	2	1600	-	-
169	493	0	1000	5600	-

Plot 1B EC Data					
Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
169	493	1	2400	3200	-
169	493	2	1600	5700	-
169	495	0	900	3100	-
169	495	1	3900	3600	-
169	495	2	1000	3300	-
169	497	0	1100	8100	-
169	497	1	2400	6100	-
169	497	2	3000	-	-
171	483	0	900	5800	-
171	483	1	4100	6300	-
171	483	2	1900	-	-
171	485	0	1200	7200	-
171	485	1	4500	3700	-
171	485	2	3100	3300	-
171	487	0	1100	8200	-
171	487	1	4900	4300	-
171	487	2	5500	-	-
171	489	0	1600	6900	-
171	489	1	1500	3500	-
171	489	2	1600	2900	-
171	491	0	1400	9400	-
171	491	1	2300	3800	-
171	491	2	1800	3200	-
171	493	0	1100	7400	-
171	493	1	3700	4200	-
171	493	2	2900	-	-
171	495	0	800	6700	-
171	495	1	4000	3700	-
171	495	2	2900	-	-
171	497	0	1000	5700	-
171	497	1	6400	3400	-
171	497	2	5100	2700	-
173	483	0	700	7700	-
173	483	1	3000	4300	-
173	483	2	2100	-	-
173	485	0	1000	8800	-
173	485	1	3600	3800	-
173	485	2	1500	3000	-
173	487	0	1200	8600	-
173	487	1	3400	4400	-
173	487	2	2500	3900	-
173	489	0	1500	7500	-
173	489	1	4100	3800	-
173	489	2	4900	-	-

Plot 1B EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
173	491	0	100	8800	-
173	491	1	700	3700	-
173	491	2	2500	2800	-
173	493	0	900	8000	-
173	493	1	3800	4500	-
173	493	2	2100	3300	-
173	495	0	1100	5900	-
173	495	1	3500	3800	-
173	495	2	1800	-	-
173	497	0	700	5100	-
173	497	1	3500	4300	-
173	497	2	2100	-	-
175	483	0	900	5700	-
175	483	1	3300	4300	-
175	483	2	2200	3400	-
175	485	0	600	7900	-
175	485	1	3600	3600	-
175	485	2	3000	2500	-
175	487	0	1000	5500	-
175	487	1	3500	3100	-
175	487	2	3300	4800	-
175	489	0	700	5500	-
175	489	1	3500	4700	-
175	489	2	2500	3700	-
175	491	0	1100	5000	4000
175	491	1	4800	3400	3500
175	491	2	3300	3300	3900
175	493	0	1200	8500	-
175	493	1	4200	5500	-
175	493	2	4200	3700	-
175	495	0	1000	9100	-
175	495	1	3500	4500	-
175	495	2	1800	-	-
175	497	0	600	5200	-
175	497	1	3800	4400	-
175	497	2	2900	2600	-
177	483	0	3100	5500	-
177	483	1	9100	4400	-
177	483	2	4500	2700	-
177	485	0	1000	8400	-
177	485	1	4500	4600	-
177	485	2	2500	3700	-
177	487	0	1200	5200	-
177	487	1	4100	4800	-

Plot 1B EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
177	487	2	3700	3100	-
177	489	0	1500	7600	-
177	489	1	4400	3900	-
177	489	2	3800	-	-
177	491	0	1000	4600	-
177	491	1	3200	3600	-
177	491	2	2600	2900	-
177	493	0	1200	7500	-
177	493	1	1100	3400	-
177	493	2	3000	3100	-
177	495	0	700	4000	-
177	495	1	2600	2800	-
177	495	2	5500	3300	-
177	497	0	800	3700	-
177	497	1	3400	3600	-
177	497	2	2800	2900	-
179	483	0	1200	6100	-
179	483	1	4300	3700	-
179	483	2	2100	2700	-
179	485	0	800	5800	-
179	485	1	3300	4300	-
179	485	2	3000	3500	-
179	487	0	1000	6100	-
179	487	1	2400	4500	-
179	487	2	4200	3300	-
179	489	0	1200	8200	-
179	489	1	3700	3800	-
179	489	2	2800	3200	-
179	491	0	1500	6000	-
179	491	1	3700	2800	-
179	491	2	3900	2900	-
179	493	0	900	7700	-
179	493	1	4000	3300	-
179	493	2	3500	2900	-
179	495	0	1300	4500	-
179	495	1	3500	3900	-
179	495	2	2400	3000	-
179	497	0	1300	3200	-
179	497	1	3700	3500	-
179	497	2	3000	-	-
181	483	0	900	5700	-
181	483	1	2900	4900	-
181	483	2	4100	2900	-
181	485	0	1200	3100	-

Plot 1B EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
181	485	1	2400	2700	-
181	485	2	4500	2000	-
181	487	0	900	4200	-
181	487	1	2900	2600	-
181	487	2	3900	-	-
181	489	0	1100	3900	-
181	489	1	2900	3200	-
181	489	2	3600	2700	-
181	491	0	1100	4800	-
181	491	1	2900	3800	-
181	491	2	3800	2800	-
181	493	0	900	5900	-
181	493	1	4100	3800	-
181	493	2	3600	3300	-
181	495	0	700	5000	4200
181	495	1	3300	3000	3900
181	495	2	3400	2900	4000
181	497	0	1400	2800	-
181	497	1	4700	2600	-
181	497	2	3900	3100	-
183	483	0	1100	6500	-
183	483	1	3500	5400	-
183	483	2	2500	4000	-
183	485	0	1400	3300	4400
183	485	1	3400	3800	4000
183	485	2	1600	5100	2200
183	487	0	1300	4900	-
183	487	1	1100	2500	-
183	487	2	4300	-	-
183	489	0	1000	5100	-
183	489	1	2900	2600	-
183	489	2	3100	2900	-
183	491	0	1400	3800	-
183	491	1	3700	2600	-
183	491	2	4000	1900	-
183	493	0	1200	4400	-
183	493	1	3900	3300	-
183	493	2	3000	-	-
183	495	0	1200	4500	-
183	495	1	2500	2800	-
183	495	2	1700	2700	-
183	497	0	600	3100	-
183	497	1	2000	2900	-
183	497	2	3100	2000	-

Plot 1B EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
185	483	0	800	6600	-
185	483	1	3600	4400	-
185	483	2	3500	3500	-
185	485	0	800	5300	-
185	485	1	2800	3800	-
185	485	2	2900	2400	-
185	487	0	1600	5300	-
185	487	1	3400	3000	-
185	487	2	4400	2600	-
185	489	0	1000	4700	-
185	489	1	3300	3100	-
185	489	2	3900	2500	-
185	491	0	1200	5000	-
185	491	1	3200	3000	-
185	491	2	4100	-	-
185	493	0	1500	4700	-
185	493	1	3300	2300	-
185	493	2	3700	-	-
185	495	0	1000	4100	-
185	495	1	3100	2900	-
185	495	2	2900	2100	-
185	497	0	800	2400	-
185	497	1	3100	3300	-
185	497	2	4600	3400	-
187	483	0	800	2700	-
187	483	1	3500	4200	-
187	483	2	2700	3100	-
187	485	0	1100	5400	-
187	485	1	3300	3800	-
187	485	2	2600	2700	-
187	487	0	1100	5200	-
187	487	1	2900	3700	-
187	487	2	3400	2900	-
187	489	0	1200	6300	-
187	489	1	4200	3300	-
187	489	2	4100	-	-
187	491	0	1100	5400	4700
187	491	1	3200	5100	4300
187	491	2	3700	3700	3500
187	493	0	900	5400	-
187	493	1	3700	3200	-
187	493	2	3200	-	-
187	495	0	1000	4300	-
187	495	1	4000	3000	-

Plot 1B EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
187	495	2	4100	2500	-
187	497	0	1200	4600	-
187	497	1	3900	2900	-
187	497	2	2600	3400	-
189	483	0	900	4700	-
189	483	1	3200	2600	-
189	483	2	2800	1600	-
189	485	0	1200	4100	-
189	485	1	2900	2500	-
189	485	2	3100	2200	-
189	487	0	1200	5600	-
189	487	1	3500	4300	-
189	487	2	3400	2100	-
189	489	0	1500	5300	-
189	489	1	3100	3600	-
189	489	2	4200	2200	-
189	491	0	1100	5500	-
189	491	1	4000	4300	-
189	491	2	4700	-	-
189	493	0	1600	6600	-
189	493	1	1400	4800	-
189	493	2	2500	3200	-
189	495	0	900	4300	-
189	495	1	3200	2800	-
189	495	2	2500	2100	-
189	497	0	1200	3700	-
189	497	1	2700	3400	-
189	497	2	2100	-	-
191	483	0	1000	3900	-
191	483	1	3200	4400	-
191	483	2	3600	2900	-
191	485	0	1200	4700	-
191	485	1	4200	3300	-
191	485	2	3900	2300	-
191	487	0	900	3900	-
191	487	1	4400	3100	-
191	487	2	5000	-	-
191	489	0	600	4600	-
191	489	1	3200	3500	-
191	489	2	3600	3200	-
191	491	0	1000	5500	-
191	491	1	2700	4900	-
191	491	2	2900	4100	-
191	493	0	1400	4300	-

Plot 1B EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
191	493	1	3200	3600	-
191	493	2	2800	3300	-
191	495	0	1000	4500	-
191	495	1	2600	2900	-
191	495	2	2900	2400	-
191	497	0	900	4300	-
191	497	1	2100	3100	-
191	497	2	2200	2800	-
193	483	0	1200	3900	-
193	483	1	2300	3700	-
193	483	2	2700	3300	-
193	485	0	1200	4200	-
193	485	1	1700	2900	-
193	485	2	2000	2400	-
193	487	0	900	3900	-
193	487	1	2500	3200	-
193	487	2	2100	2800	-
193	489	0	600	5000	-
193	489	1	2000	3000	-
193	489	2	2100	2600	-
193	491	0	900	5600	-
193	491	1	3000	4100	-
193	491	2	3500	3200	-
193	493	0	1200	5400	-
193	493	1	3300	4200	-
193	493	2	3700	3800	-
193	495	0	1500	5600	4000
193	495	1	4100	4400	3700
193	495	2	2500	3100	3500
193	497	0	900	3400	-
193	497	1	3100	3500	-
193	497	2	2600	3800	-
195	483	0	1000	6600	-
195	483	1	2700	5600	-
195	483	2	3200	2800	-
195	485	0	1200	5300	3900
195	485	1	3300	3300	3000
195	485	2	2000	2700	1500
195	487	0	1200	6400	-
195	487	1	2500	4700	-
195	487	2	1900	2800	-
195	489	0	500	5200	-
195	489	1	3400	4100	-
195	489	2	2500	3300	-

Plot 1B EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
195	491	0	1100	4400	-
195	491	1	2200	4200	-
195	491	2	1900	4100	-
195	493	0	1200	5100	-
195	493	1	5000	3600	-
195	493	2	3400	-	-
195	495	0	1300	5800	-
195	495	1	4200	2900	-
195	495	2	2500	2200	-
195	497	0	900	2500	-
195	497	1	3200	3100	-
195	497	2	2300	3700	-
197	483	0	1200	3300	-
197	483	1	3500	2700	-
197	483	2	10500	2500	-
197	485	0	1100	4100	-
197	485	1	3500	3900	-
197	485	2	3200	2900	-
197	487	0	1200	3300	-
197	487	1	2800	4800	-
197	487	2	3200	4600	-
197	489	0	1000	5200	-
197	489	1	900	4900	-
197	489	2	3600	-	-
197	491	0	1100	5200	-
197	491	1	2900	3400	-
197	491	2	3700	3600	-
197	493	0	1300	6000	-
197	493	1	3000	3600	-
197	493	2	3800	2800	-
197	495	0	1200	3300	-
197	495	1	3100	3800	-
197	495	2	3200	3000	-
197	497	0	1000	2800	-
197	497	1	3200	3600	-
197	497	2	3300	3200	-

Plot 2A EC Data					
Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
263	443	0	6100	800	-
263	443	1	2300	1000	-
263	443	2	3600	-	-
263	445	0	7800	3300	-
263	445	1	3900	1600	-
263	445	2	4100	-	-
263	447	0	9600	1800	-
263	447	1	4000	2800	-
263	447	2	4400	-	-
263	449	0	7200	4800	-
263	449	1	4100	3700	-
263	449	2	3800	-	-
263	451	0	8400	3800	-
263	451	1	4300	3200	-
263	451	2	4500	-	-
263	453	0	7900	3900	-
263	453	1	4700	4000	-
263	453	2	4600	-	-
263	455	0	6200	1800	-
263	455	1	5100	3200	-
263	455	2	4000	-	-
263	457	0	8500	4600	-
263	457	1	4200	4100	-
263	457	2	4100	-	-
265	443	0	8200	1800	-
265	443	1	5600	-	-
265	443	2	3500	-	-
265	445	0	5900	2300	1500
265	445	1	3200	2800	1900
265	445	2	3800	-	3700
265	447	0	7600	3200	-
265	447	1	3800	3400	-
265	447	2	4100	-	-
265	449	0	6300	2200	-
265	449	1	4200	4700	-
265	449	2	3900	5100	-
265	451	0	7700	4900	-
265	451	1	4700	3700	-
265	451	2	5200	-	-
265	453	0	6000	4100	-
265	453	1	4600	4000	-
265	453	2	3500	4900	-
265	455	0	9300	4000	3600
265	455	1	4700	3800	5900

Plot 2A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
265	455	2	5000	-	4700
265	457	0	9100	4700	-
265	457	1	6300	4200	-
265	457	2	4800	-	-
267	443	0	8600	1600	-
267	443	1	4300	2200	-
267	443	2	3500	-	-
267	445	0	10100	2900	-
267	445	1	3600	3200	-
267	445	2	3600	-	-
267	447	0	8600	3400	-
267	447	1	4200	4200	-
267	447	2	4300	4900	-
267	449	0	6600	2600	-
267	449	1	5500	4500	-
267	449	2	5000	4800	-
267	451	0	8600	2700	-
267	451	1	3800	4700	-
267	451	2	4100	-	-
267	453	0	6500	2000	-
267	453	1	4700	4200	-
267	453	2	3600	-	-
267	455	0	4800	6700	-
267	455	1	5800	4800	-
267	455	2	4400	-	-
267	457	0	5500	5900	-
267	457	1	5700	5200	-
267	457	2	4700	-	-
269	443	0	7600	1400	-
269	443	1	5000	2200	-
269	443	2	3700	-	-
269	445	0	8400	1200	-
269	445	1	4600	3700	-
269	445	2	4300	-	-
269	447	0	7600	2900	-
269	447	1	6600	-	-
269	447	2	5000	-	-
269	449	0	8000	7200	-
269	449	1	7500	5500	-
269	449	2	4600	-	-
269	451	0	5400	6300	-
269	451	1	6800	4600	-
269	451	2	4800	-	-
269	453	0	6900	7100	-

Plot 2A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
269	453	1	8300	5700	-
269	453	2	7000	-	-
269	455	0	4100	5500	-
269	455	1	6400	4900	-
269	455	2	4600	-	-
269	457	0	5300	6100	-
269	457	1	5700	7400	-
269	457	2	4600	-	-
271	443	0	7700	1300	-
271	443	1	3300	3500	-
271	443	2	3200	-	-
271	445	0	5200	2200	-
271	445	1	3600	-	-
271	445	2	3600	-	-
271	447	0	6800	9400	-
271	447	1	3500	4300	-
271	447	2	3800	-	-
271	449	0	4900	-	-
271	449	1	4000	10100	-
271	449	2	3600	-	-
271	451	0	6900	8600	-
271	451	1	4600	7100	-
271	451	2	4700	-	-
271	453	0	7000	6700	-
271	453	1	5700	5600	-
271	453	2	4500	4200	-
271	455	0	5800	4400	-
271	455	1	5500	4500	-
271	455	2	3400	-	-
271	457	0	7200	5700	-
271	457	1	5500	-	-
271	457	2	3400	-	-
273	443	0	5800	2300	-
273	443	1	4900	3200	-
273	443	2	4300	3500	-
273	445	0	5800	2800	-
273	445	1	4700	3500	-
273	445	2	4400	2900	-
273	447	0	3800	3300	-
273	447	1	5100	3700	-
273	447	2	4500	-	-
273	449	0	7200	3600	5500
273	449	1	4500	3300	4700
273	449	2	3600	-	4000

Plot 2A EC Data					
Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
273	451	0	8100	2200	-
273	451	1	4200	3800	-
273	451	2	4500	-	-
273	453	0	6300	4600	-
273	453	1	3700	4900	-
273	453	2	4500	-	-
273	455	0	5800	1800	-
273	455	1	4700	4500	-
273	455	2	4300	5700	-
273	457	0	6100	3800	-
273	457	1	7300	4100	-
273	457	2	4400	4300	-
275	443	0	5300	2100	-
275	443	1	3800	3200	-
275	443	2	4300	-	-
275	445	0	7900	2400	-
275	445	1	4000	3800	-
275	445	2	3800	4200	-
275	447	0	7300	2900	-
275	447	1	4900	3800	-
275	447	2	4900	-	-
275	449	0	6700	3400	-
275	449	1	3900	4100	-
275	449	2	3300	4900	-
275	451	0	5900	3200	-
275	451	1	4800	4700	-
275	451	2	4000	-	-
275	453	0	7200	2800	-
275	453	1	3900	3900	-
275	453	2	4100	4700	-
275	455	0	7800	2000	-
275	455	1	6400	4200	-
275	455	2	3700	-	-
275	457	0	7300	3700	-
275	457	1	3700	3800	-
275	457	2	3500	-	-
277	443	0	6200	2800	-
277	443	1	3900	3700	-
277	443	2	3600	-	-
277	445	0	7400	2700	-
277	445	1	4700	4200	-
277	445	2	4200	-	-
277	447	0	5900	1900	-
277	447	1	6300	3800	-

Plot 2A EC Data					
Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
277	447	2	5300	-	-
277	449	0	6500	3100	-
277	449	1	5200	3600	-
277	449	2	4700	-	-
277	451	0	6700	4000	-
277	451	1	5400	4400	-
277	451	2	5000	-	-
277	453	0	7800	3500	-
277	453	1	3100	4200	-
277	453	2	3000	-	-
277	455	0	5800	6800	-
277	455	1	4400	5100	-
277	455	2	4100	-	-
277	457	0	8900	4200	-
277	457	1	3800	3800	-
277	457	2	4600	2800	-
279	443	0	7300	3200	-
279	443	1	4400	3900	-
279	443	2	3100	-	-
279	445	0	5800	3200	-
279	445	1	5300	3800	-
279	445	2	2900	2700	-
279	447	0	6600	2300	-
279	447	1	4700	3900	-
279	447	2	4500	-	-
279	449	0	5900	4000	-
279	449	1	5600	4400	-
279	449	2	4400	-	-
279	451	0	7900	2500	-
279	451	1	6500	3900	-
279	451	2	6000	4000	-
279	453	0	9500	2800	-
279	453	1	6200	3600	-
279	453	2	5300	-	-
279	455	0	8700	4100	-
279	455	1	5500	3900	-
279	455	2	5900	-	-
279	457	0	7800	4600	-
279	457	1	5300	4200	-
279	457	2	4500	-	-
281	443	0	6300	2300	-
281	443	1	3600	2900	-
281	443	2	3600	-	-
281	445	0	8100	2800	-

Plot 2A EC Data					
Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
281	445	1	4700	3600	-
281	445	2	4700	3700	-
281	447	0	7000	2800	-
281	447	1	7100	3300	-
281	447	2	4600	-	-
281	449	0	9200	3200	-
281	449	1	5700	4100	-
281	449	2	4500	-	-
281	451	0	7500	3300	-
281	451	1	4600	4300	-
281	451	2	4400	-	-
281	453	0	10300	2500	-
281	453	1	5200	3300	-
281	453	2	5500	-	-
281	455	0	8400	4300	3400
281	455	1	5200	3800	3900
281	455	2	5900	4600	4900
281	457	0	8200	4500	-
281	457	1	6000	3900	-
281	457	2	5000	-	-
283	443	0	8100	2700	-
283	443	1	3500	3900	-
283	443	2	4700	-	-
283	445	0	5600	2800	3400
283	445	1	5100	3700	3100
283	445	2	4900	-	3600
283	447	0	7100	3000	-
283	447	1	5500	4100	-
283	447	2	4600	-	-
283	449	0	6800	3900	-
283	449	1	6500	4400	-
283	449	2	5400	-	-
283	451	0	5400	3900	-
283	451	1	6700	4200	-
283	451	2	5200	5000	-
283	453	0	7100	3500	-
283	453	1	5500	4300	-
283	453	2	4500	-	-
283	455	0	9500	3900	-
283	455	1	6500	4400	-
283	455	2	5500	-	-
283	457	0	7200	5400	-
283	457	1	5500	4700	-
283	457	2	5000	4600	-

Plot 2A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
285	443	0	6800	4200	-
285	443	1	5000	4200	-
285	443	2	5200	4300	-
285	445	0	8800	3800	-
285	445	1	3900	5300	-
285	445	2	5300	-	-
285	447	0	8300	3700	-
285	447	1	4600	3900	-
285	447	2	4300	-	-
285	449	0	6000	8500	-
285	449	1	6300	5400	-
285	449	2	4800	5800	-
285	451	0	6800	6200	-
285	451	1	5700	5300	-
285	451	2	4500	-	-
285	453	0	8200	6200	-
285	453	1	5500	6100	-
285	453	2	3600	-	-
285	455	0	7600	6300	-
285	455	1	5200	4600	-
285	455	2	5700	-	-
285	457	0	7300	6100	-
285	457	1	6100	4500	-
285	457	2	5200	-	-
287	443	0	7500	3600	-
287	443	1	4200	4200	-
287	443	2	6500	-	-
287	445	0	6200	6100	-
287	445	1	5200	4500	-
287	445	2	5000	-	-
287	447	0	8000	4400	-
287	447	1	6100	4200	-
287	447	2	5300	-	-
287	449	0	7200	4700	-
287	449	1	4900	3800	-
287	449	2	5300	-	-
287	451	0	9200	6200	-
287	451	1	7000	7000	-
287	451	2	4700	-	-
287	453	0	8900	6600	-
287	453	1	5700	3300	-
287	453	2	3200	5600	-
287	455	0	10600	5700	-
287	455	1	6000	4900	-

Plot 2A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
287	455	2	5100	-	-
287	457	0	7700	5200	-
287	457	1	6600	4800	-
287	457	2	4600	-	-
289	443	0	6200	3200	-
289	443	1	4700	4000	-
289	443	2	5200	-	-
289	445	0	8500	3100	-
289	445	1	5800	4900	-
289	445	2	4600	5500	-
289	447	0	7100	3900	-
289	447	1	6400	4000	-
289	447	2	3500	-	-
289	449	0	6500	5100	5200
289	449	1	3700	4800	5400
289	449	2	3200	-	5400
289	451	0	7200	10200	-
289	451	1	3200	700	-
289	451	2	3700	-	-
289	453	0	6400	10200	-
289	453	1	5600	7000	-
289	453	2	5900	5100	-
289	455	0	9100	4300	-
289	455	1	3700	4900	-
289	455	2	3900	-	-
289	457	0	7900	4000	-
289	457	1	4100	5400	-
289	457	2	3700	-	-
291	443	0	5700	3000	-
291	443	1	6400	3900	-
291	443	2	4900	-	-
291	445	0	4900	2500	-
291	445	1	5000	2800	-
291	445	2	4600	-	-
291	447	0	4200	5500	-
291	447	1	4000	4500	-
291	447	2	4000	-	-
291	449	0	7000	5400	-
291	449	1	3900	3900	-
291	449	2	4900	-	-
291	451	0	9100	6100	-
291	451	1	6000	5300	-
291	451	2	3600	-	-
291	453	0	7300	5800	-

Plot 2A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
291	453	1	4500	4600	-
291	453	2	4600	-	-
291	455	0	7300	5500	-
291	455	1	5400	5600	-
291	455	2	4900	-	-
291	457	0	8300	5400	-
291	457	1	3300	5700	-
291	457	2	4000	-	-
293	443	0	5100	3700	-
293	443	1	4700	4100	-
293	443	2	4100	-	-
293	445	0	7200	4100	-
293	445	1	5200	3700	-
293	445	2	3800	-	-
293	447	0	7800	6300	-
293	447	1	5800	4400	-
293	447	2	6000	-	-
293	449	0	6000	5600	-
293	449	1	5300	4700	-
293	449	2	4800	3600	-
293	451	0	7200	4700	-
293	451	1	6600	3700	-
293	451	2	5300	-	-
293	453	0	9100	5600	-
293	453	1	6600	4600	-
293	453	2	5300	4400	-
293	455	0	8200	6900	-
293	455	1	5200	5000	-
293	455	2	6300	-	-
293	457	0	6400	5200	-
293	457	1	6700	4700	-
293	457	2	4800	4100	-
295	443	0	5800	4500	-
295	443	1	5100	4000	-
295	443	2	4800	-	-
295	445	0	7400	4400	4500
295	445	1	5400	3800	4500
295	445	2	4800	-	4900
295	447	0	7900	5500	-
295	447	1	3800	4200	-
295	447	2	4500	-	-
295	449	0	5800	7600	-
295	449	1	3300	4500	-
295	449	2	4200	-	-

Plot 2A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
295	451	0	7600	7100	-
295	451	1	6200	5300	-
295	451	2	3900	-	-
295	453	0	8200	8000	-
295	453	1	5200	4800	-
295	453	2	4900	-	-
295	455	0	7300	5900	4400
295	455	1	6200	5400	5100
295	455	2	3700	-	5200
295	457	0	6200	5300	-
295	457	1	5300	3800	-
295	457	2	4500	-	-
297	443	0	7900	4700	-
297	443	1	4300	2200	-
297	443	2	4600	3800	-
297	445	0	6600	4900	-
297	445	1	5700	4300	-
297	445	2	5200	3800	-
297	447	0	8200	6000	-
297	447	1	5400	4400	-
297	447	2	5200	-	-
297	449	0	6500	5700	-
297	449	1	5000	3900	-
297	449	2	3600	-	-
297	451	0	4200	6900	-
297	451	1	5200	5400	-
297	451	2	3900	-	-
297	453	0	5800	5300	-
297	453	1	7100	4600	-
297	453	2	3200	-	-
297	455	0	7600	3700	-
297	455	1	3800	400	-
297	455	2	3900	3600	-
297	457	0	8200	2700	-
297	457	1	3900	2500	-
297	457	2	4100	-	-

Plot 2B EC Data

Grid X	Grid Y	Depth (ft)	µS/cm Fall 2017	µS/cm Spring 2019
263	483	0	7200	3900
263	483	1	4900	4300
263	483	2	3500	4900
263	485	0	6500	-
263	485	1	5600	-
263	485	2	5400	-
263	487	0	6200	-
263	487	1	5800	-
263	487	2	5300	-
263	489	0	6900	-
263	489	1	7600	-
263	489	2	4800	-
263	491	0	5900	-
263	491	1	6200	-
263	491	2	6000	-
263	493	0	7500	-
263	493	1	7200	-
263	493	2	6200	-
263	495	0	8800	-
263	495	1	5200	-
263	495	2	5400	-
263	497	0	6100	-
263	497	1	5000	-
263	497	2	5400	-
265	483	0	7800	-
265	483	1	5400	-
265	483	2	5000	-
265	485	0	7200	-
265	485	1	4500	-
265	485	2	4900	-
265	487	0	7600	-
265	487	1	4600	-
265	487	2	4700	-
265	489	0	8300	-
265	489	1	6000	-
265	489	2	5100	-
265	491	0	7100	-
265	491	1	5400	-
265	491	2	5700	-
265	493	0	6100	-
265	493	1	6100	-
265	493	2	5200	-
265	495	0	6700	-
265	495	1	5200	-
265	495	2	4800	-
265	497	0	7800	-
265	497	1	5700	-
265	497	2	6000	-
267	483	0	7900	-
267	483	1	6200	-

Plot 2B EC Data				
Grid X	**Grid Y**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Spring 2019**
267	483	2	5700	-
267	485	0	8100	-
267	485	1	4700	-
267	485	2	5600	-
267	487	0	6000	-
267	487	1	3500	-
267	487	2	4200	-
267	489	0	6400	-
267	489	1	3900	-
267	489	2	4300	-
267	491	0	8200	-
267	491	1	5900	-
267	491	2	5200	-
267	493	0	6100	-
267	493	1	5700	-
267	493	2	5500	-
267	495	0	5200	6000
267	495	1	5200	7300
267	495	2	5600	6800
267	497	0	5900	-
267	497	1	5600	-
267	497	2	4800	-
269	483	0	8300	-
269	483	1	8700	-
269	483	2	4300	-
269	485	0	6800	-
269	485	1	4400	-
269	485	2	5000	-
269	487	0	6300	-
269	487	1	3000	-
269	487	2	3500	-
269	489	0	7400	-
269	489	1	5100	-
269	489	2	5300	-
269	491	0	6900	-
269	491	1	4200	-
269	491	2	6000	-
269	493	0	5800	-
269	493	1	5500	-
269	493	2	5600	-
269	495	0	6300	-
269	495	1	6100	-
269	495	2	6200	-
269	497	0	7800	-
269	497	1	4000	-
269	497	2	5600	-
271	483	0	5500	-
271	483	1	4500	-
271	483	2	5600	-
271	485	0	7100	-

Plot 2B EC Data				
Grid X	**Grid Y**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Spring 2019**
271	485	1	4200	-
271	485	2	5500	-
271	487	0	6400	-
271	487	1	4900	-
271	487	2	5100	-
271	489	0	7300	-
271	489	1	4800	-
271	489	2	4900	-
271	491	0	8300	-
271	491	1	3700	-
271	491	2	4500	-
271	493	0	7000	-
271	493	1	4500	-
271	493	2	5100	-
271	495	0	6300	-
271	495	1	5500	-
271	495	2	5400	-
271	497	0	7700	-
271	497	1	5700	-
271	497	2	5000	-
273	483	0	6700	-
273	483	1	5700	-
273	483	2	5900	-
273	485	0	5100	-
273	485	1	3700	-
273	485	2	5000	-
273	487	0	6200	-
273	487	1	4300	-
273	487	2	3700	-
273	489	0	6700	6000
273	489	1	5600	4900
273	489	2	4900	3600
273	491	0	7800	-
273	491	1	6000	-
273	491	2	5500	-
273	493	0	5900	-
273	493	1	6900	-
273	493	2	4200	-
273	495	0	4400	-
273	495	1	3100	-
273	495	2	4700	-
273	497	0	7200	-
273	497	1	4500	-
273	497	2	5700	-
275	483	0	7800	-
275	483	1	5000	-
275	483	2	5200	-
275	485	0	7100	-
275	485	1	3800	-
275	485	2	5000	-

Plot 2B EC Data				
Grid X	**Grid Y**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Spring 2019**
275	487	0	7200	-
275	487	1	5600	-
275	487	2	4500	-
275	489	0	8400	-
275	489	1	5100	-
275	489	2	5900	-
275	491	0	6100	-
275	491	1	6300	-
275	491	2	4900	-
275	493	0	5200	-
275	493	1	4800	-
275	493	2	4900	-
275	495	0	6400	-
275	495	1	3700	-
275	495	2	5300	-
275	497	0	7300	-
275	497	1	4500	-
275	497	2	4900	-
277	483	0	6100	-
277	483	1	6500	-
277	483	2	5700	-
277	485	0	4900	-
277	485	1	5200	-
277	485	2	5700	-
277	487	0	4300	-
277	487	1	6100	-
277	487	2	5300	-
277	489	0	6200	-
277	489	1	6100	-
277	489	2	5400	-
277	491	0	7600	-
277	491	1	6400	-
277	491	2	6800	-
277	493	0	8500	-
277	493	1	3600	-
277	493	2	5900	-
277	495	0	7200	-
277	495	1	5000	-
277	495	2	5900	-
277	497	0	7100	-
277	497	1	4300	-
277	497	2	5100	-
279	483	0	6700	-
279	483	1	5200	-
279	483	2	5500	-
279	485	0	5200	-
279	485	1	3800	-
279	485	2	4400	-
279	487	0	5900	-
279	487	1	6600	-

Plot 2B EC Data				
Grid X	**Grid Y**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Spring 2019**
279	487	2	5300	-
279	489	0	6200	-
279	489	1	5800	-
279	489	2	6500	-
279	491	0	7100	-
279	491	1	4300	-
279	491	2	4700	-
279	493	0	6100	-
279	493	1	3800	-
279	493	2	5300	-
279	495	0	6500	-
279	495	1	6900	-
279	495	2	5900	-
279	497	0	6200	-
279	497	1	6800	-
279	497	2	5900	-
281	483	0	5100	-
281	483	1	2900	-
281	483	2	5100	-
281	485	0	6100	-
281	485	1	4800	-
281	485	2	5000	-
281	487	0	6900	-
281	487	1	5200	-
281	487	2	4900	-
281	489	0	6600	-
281	489	1	5200	-
281	489	2	5700	-
281	491	0	7200	-
281	491	1	3000	-
281	491	2	5700	-
281	493	0	7800	-
281	493	1	6400	-
281	493	2	6600	-
281	495	0	6200	-
281	495	1	6200	-
281	495	2	5800	-
281	497	0	7100	-
281	497	1	5200	-
281	497	2	6200	-
283	483	0	6000	3600
283	483	1	5700	3500
283	483	2	4000	3600
283	485	0	6300	-
283	485	1	3900	-
283	485	2	4800	-
283	487	0	5100	-
283	487	1	4600	-
283	487	2	2500	-
283	489	0	6200	-

Plot 2B EC Data				
Grid X	**Grid Y**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Spring 2019**
283	489	1	3700	-
283	489	2	4500	-
283	491	0	7800	-
283	491	1	4100	-
283	491	2	4500	-
283	493	0	6500	-
283	493	1	8100	-
283	493	2	6400	-
283	495	0	6200	6900
283	495	1	5900	5700
283	495	2	5800	5200
283	497	0	6100	-
283	497	1	2900	-
283	497	2	5100	-
285	483	0	5800	-
285	483	1	3200	-
285	483	2	4700	-
285	485	0	6700	-
285	485	1	2400	-
285	485	2	5000	-
285	487	0	6100	-
285	487	1	3500	-
285	487	2	3700	-
285	489	0	6000	-
285	489	1	2900	-
285	489	2	5200	-
285	491	0	6900	-
285	491	1	3600	-
285	491	2	4600	-
285	493	0	7700	-
285	493	1	5900	-
285	493	2	6700	-
285	495	0	6000	-
285	495	1	6700	-
285	495	2	5700	-
285	497	0	7800	-
285	497	1	4100	-
285	497	2	5300	-
287	483	0	7900	-
287	483	1	6700	-
287	483	2	6300	-
287	485	0	7200	-
287	485	1	5600	-
287	485	2	5200	-
287	487	0	6400	-
287	487	1	4500	-
287	487	2	5400	-
287	489	0	5200	-
287	489	1	4700	-
287	489	2	4300	-

Plot 2B EC Data				
Grid X	**Grid Y**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Spring 2019**
287	491	0	5700	-
287	491	1	3900	-
287	491	2	4300	-
287	493	0	7500	-
287	493	1	4800	-
287	493	2	4800	-
287	495	0	7800	-
287	495	1	2800	-
287	495	2	4500	-
287	497	0	6600	-
287	497	1	4000	-
287	497	2	5200	-
289	483	0	6100	-
289	483	1	7700	-
289	483	2	6400	-
289	485	0	6900	-
289	485	1	4100	-
289	485	2	4900	-
289	487	0	6900	-
289	487	1	2700	-
289	487	2	3300	-
289	489	0	6100	-
289	489	1	4100	-
289	489	2	3800	-
289	491	0	6200	5700
289	491	1	6300	6600
289	491	2	4800	3900
289	493	0	6800	-
289	493	1	5800	-
289	493	2	3100	-
289	495	0	7300	-
289	495	1	5000	-
289	495	2	5500	-
289	497	0	6000	-
289	497	1	5200	-
289	497	2	5500	-
291	483	0	5300	-
291	483	1	4600	-
291	483	2	3300	-
291	485	0	6800	-
291	485	1	3600	-
291	485	2	4200	-
291	487	0	6300	-
291	487	1	4000	-
291	487	2	5300	-
291	489	0	5200	-
291	489	1	2300	-
291	489	2	4000	-
291	491	0	5500	-
291	491	1	4300	-

Plot 2B EC Data				
Grid X	**Grid Y**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Spring 2019**
291	491	2	5000	-
291	493	0	6800	-
291	493	1	3900	-
291	493	2	4200	-
291	495	0	4800	-
291	495	1	6800	-
291	495	2	4700	-
291	497	0	7200	-
291	497	1	6900	-
291	497	2	5400	-
293	483	0	6500	-
293	483	1	4000	-
293	483	2	6800	-
293	485	0	8200	-
293	485	1	3400	-
293	485	2	3200	-
293	487	0	7800	-
293	487	1	1900	-
293	487	2	3300	-
293	489	0	6600	-
293	489	1	5200	-
293	489	2	5900	-
293	491	0	7400	-
293	491	1	4600	-
293	491	2	4900	-
293	493	0	7100	-
293	493	1	6300	-
293	493	2	5900	-
293	495	0	6200	-
293	495	1	2300	-
293	495	2	3400	-
293	497	0	6900	-
293	497	1	4600	-
293	497	2	2700	-
295	483	0	6000	-
295	483	1	3700	-
295	483	2	3700	-
295	485	0	6400	2000
295	485	1	4900	3000
295	485	2	5900	3600
295	487	0	6900	-
295	487	1	7100	-
295	487	2	4700	-
295	489	0	5100	-
295	489	1	2200	-
295	489	2	4400	-
295	491	0	6100	-
295	491	1	2900	-
295	491	2	4000	-
295	493	0	7800	-

Plot 2B EC Data				
Grid X	**Grid Y**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Spring 2019**
295	493	1	7000	-
295	493	2	5200	-
295	495	0	6300	5500
295	495	1	6500	5400
295	495	2	5900	4300
295	497	0	5900	-
295	497	1	5100	-
295	497	2	4600	-
297	483	0	6100	-
297	483	1	4300	-
297	483	2	5200	-
297	485	0	7200	-
297	485	1	3500	-
297	485	2	5200	-
297	487	0	7400	-
297	487	1	2500	-
297	487	2	3900	-
297	489	0	6700	-
297	489	1	4400	-
297	489	2	4900	-
297	491	0	6200	-
297	491	1	6500	-
297	491	2	5000	-
297	493	0	7100	-
297	493	1	4200	-
297	493	2	5000	-
297	495	0	6000	-
297	495	1	4300	-
297	495	2	5000	-
297	497	0	6300	-
297	497	1	3600	-
297	497	2	5300	-

Plot 3A EC Data						
Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	Pre-flood µS/cm 2018	µS/cm Fall 2018	µS/cm Spring 2019
203	523	0	15100	9500	2900	-
203	523	1	11600	9200	4800	-
203	523	2	6700	--	3700	-
203	525	0	14900	9800	3900	-
203	525	1	11600	11900	7300	-
203	525	2	8800	--	-	-
203	527	0	14400	16400	1500	-
203	527	1	11600	13700	6300	-
203	527	2	10800	--	7900	-
203	529	0	13400	10900	6200	-
203	529	1	13800	16000	9300	-
203	529	2	11200	14400	-	-
203	531	0	12600	7900	7300	-
203	531	1	15800	15500	8500	-
203	531	2	11400	--	-	-
203	533	0	13900	11400	7400	-
203	533	1	14600	15700	9400	-
203	533	2	9700	13800	-	-
203	535	0	14100	9800	5800	-
203	535	1	12500	8800	8300	-
203	535	2	7500	--	-	-
203	537	0	15700	9300	1900	-
203	537	1	17000	11200	2700	-
203	537	2	12100	10600	-	-
205	523	0	15600	10200	6500	-
205	523	1	15900	13400	4700	-
205	523	2	17100	9600	-	-
205	525	0	13700	16800	1000	-
205	525	1	15600	14200	4200	-
205	525	2	14300	10800	-	-
205	527	0	12900	15100	5700	-
205	527	1	15200	10900	6200	-
205	527	2	11800	12400	6300	-
205	529	0	12200	8900	9200	-
205	529	1	15100	14800	8500	-
205	529	2	8700	10300	-	-
205	531	0	13500	9500	7600	-
205	531	1	15300	13300	7300	-
205	531	2	9900	14200	-	-
205	533	0	14900	9400	6300	-
205	533	1	15700	14200	9500	-
205	533	2	10600	15000	-	-
205	535	0	16200	6700	3900	-
205	535	1	14700	7200	8100	-

Plot 3A EC Data						
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**Pre-flood µS/cm 2018**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
205	535	2	11100	6500	-	-
205	537	0	18900	4600	5200	-
205	537	1	1800	6700	5600	-
205	537	2	12200	8000	-	-
207	523	0	12700	11100	6500	-
207	523	1	13300	7500	6900	-
207	523	2	18500	6500	-	-
207	525	0	14000	13400	8600	-
207	525	1	17600	9700	8000	-
207	525	2	17100	7800	-	-
207	527	0	16400	1300	6200	-
207	527	1	20000	5700	8300	-
207	527	2	13400	8200	-	-
207	529	0	14700	13800	7300	-
207	529	1	19000	9600	10000	-
207	529	2	12100	10000	-	-
207	531	0	12500	12000	10900	-
207	531	1	15500	9000	9700	-
207	531	2	10300	7400	-	-
207	533	0	14300	10600	9200	5500
207	533	1	14900	9400	10200	6700
207	533	2	10100	8200	-	6700
207	535	0	17000	7500	2900	-
207	535	1	14100	8100	8400	-
207	535	2	8700	5800	-	-
207	537	0	15900	4900	6900	-
207	537	1	15600	5400	9200	-
207	537	2	10600	7200	-	-
209	523	0	14400	10200	5900	-
209	523	1	16100	7900	3400	-
209	523	2	11400	6600	6000	-
209	525	0	14700	10600	9800	3300
209	525	1	14400	11800	10100	5100
209	525	2	12000	10400	-	4600
209	527	0	14900	12100	8000	-
209	527	1	15700	7300	7900	-
209	527	2	12700	8500	-	-
209	529	0	14700	12600	7900	-
209	529	1	15600	13200	8000	-
209	529	2	14900	11300	9200	-
209	531	0	14400	10200	9400	-
209	531	1	15500	11100	10200	-
209	531	2	18200	9200	-	-
209	533	0	15600	9300	9300	-

Plot 3A EC Data						
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**Pre-flood µS/cm 2018**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
209	533	1	16000	9200	8200	-
209	533	2	15200	8400	-	-
209	535	0	16800	4700	6300	-
209	535	1	17300	11300	9400	-
209	535	2	14100	8200	-	-
209	537	0	19200	6800	2800	-
209	537	1	18600	7000	6900	-
209	537	2	13700	8900	-	-
211	523	0	15300	10700	6500	-
211	523	1	17500	8100	5800	-
211	523	2	13700	4600	5900	-
211	525	0	16100	9100	7400	-
211	525	1	18400	7700	7600	-
211	525	2	12400	10100	-	-
211	527	0	14400	14200	6300	-
211	527	1	16300	10300	4600	-
211	527	2	11000	10300	5300	-
211	529	0	12600	7400	5200	-
211	529	1	14100	8300	6100	-
211	529	2	9600	10700	8800	-
211	531	0	16100	13200	8500	-
211	531	1	17200	11800	9400	-
211	531	2	10400	9100	-	-
211	533	0	15200	6300	6400	-
211	533	1	19000	8800	8700	-
211	533	2	10400	7500	-	-
211	535	0	14500	7800	6400	-
211	535	1	17800	9000	10300	-
211	535	2	16300	8600	-	-
211	537	0	13100	5300	6600	-
211	537	1	16200	7900	8900	-
211	537	2	19300	11100	-	-
213	523	0	15100	11600	8300	-
213	523	1	16500	17200	7500	-
213	523	2	10900	4700	-	-
213	525	0	14200	11500	9600	-
213	525	1	16900	10400	8900	-
213	525	2	11100	10200	-	-
213	527	0	13300	13100	8200	-
213	527	1	17700	9000	7800	-
213	527	2	9200	9900	-	-
213	529	0	14100	9700	8500	-
213	529	1	16900	9000	6300	-
213	529	2	13100	10300	7500	-

Plot 3A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	μS/cm Fall 2017	Pre-flood μS/cm 2018	μS/cm Fall 2018	μS/cm Spring 2019
213	531	0	15200	11000	8300	4700
213	531	1	16600	9000	-	5000
213	531	2	14700	10100	-	5600
213	533	0	14900	13300	5700	-
213	533	1	16800	12100	8500	-
213	533	2	13400	8500	-	-
213	535	0	14300	7100	6800	-
213	535	1	17100	12800	10200	-
213	535	2	12200	11400	-	-
213	537	0	16200	4000	2600	-
213	537	1	19100	7600	8800	-
213	537	2	13200	8700	-	-
215	523	0	16100	12800	2300	-
215	523	1	13900	8600	2000	-
215	523	2	13000	--	-	-
215	525	0	15100	12400	4300	-
215	525	1	15200	8600	8100	-
215	525	2	13100	10000	-	-
215	527	0	14700	8300	9800	-
215	527	1	17200	5100	5500	-
215	527	2	12400	9500	5200	-
215	529	0	13000	10900	7700	-
215	529	1	20000	6100	4300	-
215	529	2	11400	8900	-	-
215	531	0	13700	9200	3800	-
215	531	1	20000	11100	7900	-
215	531	2	12000	10700	-	-
215	533	0	14300	6200	7900	-
215	533	1	17200	10300	9600	-
215	533	2	13400	9500	-	-
215	535	0	13700	10000	7100	-
215	535	1	16300	11600	10400	-
215	535	2	12900	--	-	-
215	537	0	13400	8200	6600	-
215	537	1	14300	11200	10400	-
215	537	2	12100	10100	-	-
217	523	0	17600	10800	9500	-
217	523	1	20000	10200	7800	-
217	523	2	15700	9600	-	-
217	525	0	16200	11200	6600	-
217	525	1	19700	11000	5700	-
217	525	2	16000	10300	3900	-
217	527	0	15300	14000	8200	-
217	527	1	19500	11400	9300	-

Plot 3A EC Data						
Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	Pre-flood µS/cm 2018	µS/cm Fall 2018	µS/cm Spring 2019
217	527	2	16200	8300	-	-
217	529	0	14900	14400	10600	-
217	529	1	15200	8200	4900	-
217	529	2	15700	9100	-	-
217	531	0	14600	10200	8200	-
217	531	1	11000	9800	9600	-
217	531	2	15200	10600	-	-
217	533	0	14400	7500	5000	-
217	533	1	13200	8200	9300	-
217	533	2	15300	7500	-	-
217	535	0	14200	7400	5000	-
217	535	1	15700	9600	7300	-
217	535	2	15200	6800	-	-
217	537	0	14000	7400	6200	-
217	537	1	16200	11700	10900	-
217	537	2	15400	10200	-	-
219	523	0	17300	11900	8000	-
219	523	1	19100	8000	7900	-
219	523	2	17000	10600	-	-
219	525	0	15600	10600	9400	-
219	525	1	17500	8700	7800	-
219	525	2	16500	9100	8900	-
219	527	0	14400	9100	9600	-
219	527	1	16900	10300	7800	-
219	527	2	14800	9200	8600	-
219	529	0	13700	12500	11400	-
219	529	1	17100	8300	8600	-
219	529	2	13200	8100	-	-
219	531	0	14100	10200	7500	-
219	531	1	17300	12100	8500	-
219	531	2	13800	6700	-	-
219	533	0	14900	2700	10000	-
219	533	1	17700	4800	9400	-
219	533	2	14200	6200	-	-
219	535	0	15200	10800	8700	-
219	535	1	17500	12900	10500	-
219	535	2	15900	6400	-	-
219	537	0	15700	7900	7600	-
219	537	1	17300	11800	9900	-
219	537	2	17500	9300	-	-
221	523	0	20000	16800	4900	-
221	523	1	16100	7300	8900	-
221	523	2	11800	8900	-	-
221	525	0	17200	11200	9700	-

Plot 3A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	Pre-flood µS/cm 2018	µS/cm Fall 2018	µS/cm Spring 2019
221	525	1	17900	9200	11100	-
221	525	2	16200	8500	-	-
221	527	0	15700	15200	12500	-
221	527	1	19300	13600	10200	-
221	527	2	17400	11700	-	-
221	529	0	14800	13400	15700	-
221	529	1	18200	12300	11900	-
221	529	2	15400	10000	-	-
221	531	0	14300	8700	14700	-
221	531	1	17200	8600	14600	-
221	531	2	12300	5900	9500	-
221	533	0	12800	10100	8200	-
221	533	1	18300	12100	9100	-
221	533	2	12800	9700	-	-
221	535	0	11400	9900	9700	-
221	535	1	20000	7300	10300	-
221	535	2	13100	7800	-	-
221	537	0	12400	8100	6700	-
221	537	1	18400	11600	9800	-
221	537	2	13500	7400	-	-
223	523	0	19200	9300	8700	3700
223	523	1	16500	9100	10300	4500
223	523	2	18200	11700	9700	5400
223	525	0	18200	6900	9300	-
223	525	1	15400	12100	11900	-
223	525	2	17500	6800	12600	-
223	527	0	16600	10500	12600	-
223	527	1	17200	15000	9200	-
223	527	2	18800	10900	-	-
223	529	0	14500	12600	11100	-
223	529	1	19100	11900	10000	-
223	529	2	20000	11100	-	-
223	531	0	15200	8500	8700	-
223	531	1	17400	9900	7800	-
223	531	2	15500	10300	-	-
223	533	0	15900	10100	7400	-
223	533	1	9600	12400	15800	-
223	533	2	11200	10400	-	-
223	535	0	16100	12300	9700	5800
223	535	1	14200	11400	17600	7000
223	535	2	13000	12800	-	5400
223	537	0	17100	7800	11400	-
223	537	1	16800	10200	17100	-
223	537	2	15200	9300	9900	-

Plot 3A EC Data						
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**Pre-flood µS/cm 2018**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
225	523	0	17400	5000	8700	-
225	523	1	15700	9300	8200	-
225	523	2	9700	12200	-	-
225	525	0	17200	9900	7900	-
225	525	1	18000	12100	11500	-
225	525	2	11400	8100	-	-
225	527	0	17100	10000	8100	-
225	527	1	20000	12200	10700	-
225	527	2	14200	10000	-	-
225	529	0	17400	15100	11700	-
225	529	1	18000	12900	11700	-
225	529	2	13200	10200	-	-
225	531	0	17000	7800	11800	-
225	531	1	14700	10900	8000	-
225	531	2	11200	8800	-	-
225	533	0	16200	6200	8700	-
225	533	1	14200	9300	10500	-
225	533	2	11000	9800	-	-
225	535	0	15400	10100	13700	-
225	535	1	15100	11900	9700	-
225	535	2	10400	11600	-	-
225	537	0	15900	9300	7700	-
225	537	1	15200	12400	10600	-
225	537	2	11100	11000	-	-
227	523	0	16000	8900	12500	-
227	523	1	15100	11700	17600	-
227	523	2	12000	8300	-	-
227	525	0	19100	7200	9600	-
227	525	1	18100	9900	15700	-
227	525	2	15800	7600	-	-
227	527	0	17100	4800	12000	-
227	527	1	15300	7900	16400	-
227	527	2	14800	8000	19300	-
227	529	0	15700	12100	16900	-
227	529	1	13200	12000	20000	-
227	529	2	14600	9100	-	-
227	531	0	16100	7800	15800	-
227	531	1	14600	7700	17500	-
227	531	2	13900	6300	-	-
227	533	0	17400	5400	14600	-
227	533	1	16500	9300	19300	-
227	533	2	17200	9900	18500	-
227	535	0	14200	11300	18700	-
227	535	1	15000	11100	20000	-

Plot 3A EC Data						
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**Pre-flood µS/cm 2018**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
227	535	2	14500	8700	-	-
227	537	0	13100	6900	15800	-
227	537	1	15200	12800	17300	-
227	537	2	13800	7200	-	-
229	523	0	12100	11500	17200	-
229	523	1	14800	13700	19400	-
229	523	2	16200	10200	-	-
229	525	0	12800	7100	10900	-
229	525	1	12100	10400	13000	-
229	525	2	16500	6700	7600	-
229	527	0	15100	6800	12800	-
229	527	1	13200	9200	13200	-
229	527	2	15800	7100	-	-
229	529	0	15400	11400	9700	3300
229	529	1	13100	10300	16700	5300
229	529	2	15100	7200	15900	5400
229	531	0	15400	8500	12400	-
229	531	1	12100	7300	10400	-
229	531	2	15600	7900	-	-
229	533	0	15200	9700	12200	-
229	533	1	14400	7300	15700	-
229	533	2	15500	8200	-	-
229	535	0	14900	8300	16100	-
229	535	1	16700	11200	19400	-
229	535	2	16200	9600	15500	-
229	537	0	14200	10000	16600	-
229	537	1	15500	11100	11900	-
229	537	2	16700	0	-	-
231	523	0	14900	6300	13800	-
231	523	1	13600	6700	123300	-
231	523	2	15200	4600	-	-
231	525	0	15300	8200	14900	-
231	525	1	17100	11100	17100	-
231	525	2	16100	10800	11200	-
231	527	0	14200	6200	12600	-
231	527	1	15900	10400	13500	-
231	527	2	17400	7800	-	-
231	529	0	14700	9600	12700	-
231	529	1	15900	10000	13100	-
231	529	2	18300	9500	-	-
231	531	0	15600	9500	13800	-
231	531	1	16400	10800	19100	-
231	531	2	17800	10200	15000	-
231	533	0	16500	9200	12600	-

Plot 3A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	Pre-flood µS/cm 2018	µS/cm Fall 2018	µS/cm Spring 2019
231	533	1	17200	12900	17900	-
231	533	2	15500	9600	-	-
231	535	0	13300	9400	13300	-
231	535	1	15600	10800	12700	-
231	535	2	15200	9500	-	-
231	537	0	12900	5000	13500	-
231	537	1	17600	7700	19700	-
231	537	2	15300	11800	-	-
233	523	0	16800	4700	10200	-
233	523	1	16400	9800	17100	-
233	523	2	19200	10200	-	-
233	525	0	15800	7100	10700	-
233	525	1	16500	11400	18400	-
233	525	2	16500	8200	-	-
233	527	0	15200	6900	15300	-
233	527	1	17800	9000	20000	-
233	527	2	15200	7600	16000	-
233	529	0	14400	8800	9600	-
233	529	1	13600	9300	12600	-
233	529	2	14100	6200	10000	-
233	531	0	13700	11300	5200	-
233	531	1	12300	9800	7600	-
233	531	2	13600	6600	13100	-
233	533	0	13200	9000	10700	-
233	533	1	18400	12400	11700	-
233	533	2	12900	8100	-	-
233	535	0	14300	8200	11800	-
233	535	1	17100	11200	18300	-
233	535	2	13100	6300	-	-
233	537	0	13600	11900	12600	-
233	537	1	18700	14100	11900	-
233	537	2	20000	9000	-	-
235	523	0	18400	4600	10100	2500
235	523	1	17900	8200	8600	5900
235	523	2	16000	9800	-	6100
235	525	0	16700	4900	9500	-
235	525	1	18200	11200	15200	-
235	525	2	17200	7600	8300	-
235	527	0	15400	4800	13700	-
235	527	1	15700	9400	8200	-
235	527	2	14500	10700	8000	-
235	529	0	15100	7100	15700	-
235	529	1	13100	9600	18000	-
235	529	2	14600	7100	-	-

Plot 3A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	Pre-flood µS/cm 2018	µS/cm Fall 2018	µS/cm Spring 2019
235	531	0	15000	6900	9600	-
235	531	1	16000	10200	12100	-
235	531	2	12900	12000	9300	-
235	533	0	14900	6100	11700	-
235	533	1	17400	10900	16300	-
235	533	2	13400	5100	-	-
235	535	0	13400	4700	13100	2800
235	535	1	14900	11200	17300	4000
235	535	2	13500	11700	15300	2500
235	537	0	12100	8300	15000	-
235	537	1	13900	9700	12900	-
235	537	2	13500	6800	-	-
237	523	0	17200	6700	9400	-
237	523	1	15500	7500	13600	-
237	523	2	20000	7400	-	-
237	525	0	16200	5900	10500	-
237	525	1	14500	8600	17100	-
237	525	2	18600	9700	15200	-
237	527	0	15500	3800	11200	-
237	527	1	13200	9700	14800	-
237	527	2	12500	9900	-	-
237	529	0	15300	9800	9900	-
237	529	1	14700	8400	13800	-
237	529	2	13200	7800	-	-
237	531	0	17500	6800	8600	-
237	531	1	16400	11000	7200	-
237	531	2	13400	5800	-	-
237	533	0	15500	7900	11000	-
237	533	1	15900	9300	14300	-
237	533	2	12600	5800	-	-
237	535	0	14700	4900	9600	-
237	535	1	15500	7900	17300	-
237	535	2	11500	4100	12300	-
237	537	0	15600	4900	12100	-
237	537	1	14200	10600	9200	-
237	537	2	13200	5900	-	-

Plot 3B EC Data						
Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	Pre-flood µS/cm 2018	µS/cm Fall 2018	µS/cm Spring 2019
323	523	0	5900	5900	2800	-
323	523	1	7400	6400	2900	-
323	523	2	6500	6000	1500	-
323	525	0	11200	3700	1700	-
323	525	1	9600	5900	2800	-
323	525	2	8400	5800	2000	-
323	527	0	13200	6900	1400	-
323	527	1	11400	7600	2800	-
323	527	2	9700	9300	2300	-
323	529	0	12400	6400	1500	-
323	529	1	10600	10500	1400	-
323	529	2	10100	10800	1600	-
323	531	0	10300	3000	2100	-
323	531	1	10700	6300	4100	-
323	531	2	9400	7200	4600	-
323	533	0	8600	300	2800	-
323	533	1	9400	12300	8800	-
323	533	2	8600	7200	4700	-
323	535	0	10000	12400	2700	-
323	535	1	7700	7200	5300	-
323	535	2	8400	4300	5300	-
323	537	0	9500	--	1500	-
323	537	1	8600	--	2400	-
323	537	2	9200	--	-	-
325	523	0	13400	7900	2900	-
325	523	1	10600	8600	3600	-
325	523	2	10400	7700	4200	-
325	525	0	14600	15500	4900	-
325	525	1	11100	8500	4100	-
325	525	2	9700	6700	4200	-
325	527	0	12400	500	2600	-
325	527	1	10900	9500	3600	-
325	527	2	8600	9300	1700	-
325	529	0	11600	4700	2200	-
325	529	1	11200	6600	1700	-
325	529	2	7900	8400	1600	-
325	531	0	10400	3300	1800	-
325	531	1	9900	9200	3200	-
325	531	2	8400	7400	4700	-
325	533	0	1100	1100	2200	-
325	533	1	9200	1000	3400	-
325	533	2	9300	7500	5100	-
325	535	0	10600	9800	2500	-
325	535	1	9200	10800	6300	-

Plot 3B EC Data						
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**Pre-flood µS/cm 2018**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
325	535	2	8800	8100	5400	-
325	537	0	9300	10600	2000	-
325	537	1	9400	6200	6500	-
325	537	2	9600	--	4700	-
327	523	0	9400	1000	2200	-
327	523	1	11200	6300	3700	-
327	523	2	10100	10800	1900	-
327	525	0	9900	9900	2000	3300
327	525	1	10400	9400	4400	4100
327	525	2	9700	11300	1800	4700
327	527	0	10500	1800	2400	-
327	527	1	9200	9700	3700	-
327	527	2	8000	11200	6900	-
327	529	0	10200	3300	1700	-
327	529	1	10500	9000	3100	-
327	529	2	9600	9400	3200	-
327	531	0	10300	3400	2600	-
327	531	1	11600	6000	2800	-
327	531	2	10100	12100	2100	-
327	533	0	9800	5500	2100	2300
327	533	1	10200	6500	4800	2800
327	533	2	8400	9300	4200	3100
327	535	0	9500	8200	2800	-
327	535	1	8100	5300	6100	-
327	535	2	9200	10700	5900	-
327	537	0	8900	11200	1900	-
327	537	1	9200	9200	4800	-
327	537	2	9600	10200	4200	-
329	523	0	10600	10000	2300	-
329	523	1	11100	5900	4800	-
329	523	2	10800	4200	4100	-
329	525	0	13300	12600	2100	-
329	525	1	10600	10500	6700	-
329	525	2	11600	11300	7300	-
329	527	0	12600	12400	1400	-
329	527	1	12000	11100	3200	-
329	527	2	11800	12600	6200	-
329	529	0	10700	12000	1500	-
329	529	1	12000	10800	6800	-
329	529	2	12300	11700	4300	-
329	531	0	10500	4400	2100	-
329	531	1	10800	7800	5900	-
329	531	2	11200	8200	7900	-
329	533	0	10200	9400	2200	-

Plot 3B EC Data						
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**Pre-flood µS/cm 2018**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
329	533	1	9500	5300	4800	-
329	533	2	9100	9800	3600	-
329	535	0	10000	3900	1900	-
329	535	1	10900	5800	2600	-
329	535	2	7400	7400	2400	-
329	537	0	9500	3700	2000	-
329	537	1	11400	6300	3100	-
329	537	2	10800	9100	4400	-
331	523	0	9000	11400	1600	-
331	523	1	13100	10200	3300	-
331	523	2	12100	8100	4200	-
331	525	0	10600	12100	1800	-
331	525	1	11400	8200	5800	-
331	525	2	11100	9800	8800	-
331	527	0	11400	10100	1700	-
331	527	1	10700	11600	4500	-
331	527	2	9700	10000	6600	-
331	529	0	11600	8600	2500	-
331	529	1	9900	11000	4100	-
331	529	2	8700	12300	5800	-
331	531	0	9800	5200	3800	-
331	531	1	13900	5700	6000	-
331	531	2	13100	9400	4800	-
331	533	0	9500	6500	2300	-
331	533	1	12200	11600	6100	-
331	533	2	11500	9600	5100	-
331	535	0	10400	10200	1300	-
331	535	1	11600	8700	4900	-
331	535	2	9800	11000	4800	-
331	537	0	10600	3200	2300	-
331	537	1	10500	10100	3700	-
331	537	2	11000	7300	5700	-
333	523	0	11400	16300	1900	-
333	523	1	13100	15000	5100	-
333	523	2	12400	--	4800	-
333	525	0	11300	10400	1900	-
333	525	1	11400	12100	6100	-
333	525	2	11900	8200	5200	-
333	527	0	10600	11700	2300	-
333	527	1	10500	12200	5600	-
333	527	2	11200	11800	7200	-
333	529	0	10900	9900	2200	-
333	529	1	9800	10200	8100	-
333	529	2	10400	11700	7400	-

Plot 3B EC Data						
Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	Pre-flood µS/cm 2018	µS/cm Fall 2018	µS/cm Spring 2019
333	531	0	11200	8300	2300	-
333	531	1	10000	8100	8100	-
333	531	2	9400	9000	7500	-
333	533	0	9800	3700	1800	-
333	533	1	10100	11100	3600	-
333	533	2	8600	12900	4300	-
333	535	0	12500	2700	2000	-
333	535	1	10600	6800	2700	-
333	535	2	9400	6400	6400	-
333	537	0	13200	2800	1800	-
333	537	1	10100	4000	3700	-
333	537	2	9500	--	3200	-
335	523	0	11900	10200	2600	-
335	523	1	9400	8900	7300	-
335	523	2	11200	--	5300	-
335	525	0	11300	11400	2300	-
335	525	1	10400	10200	6400	-
335	525	2	9400	6100	7800	-
335	527	0	11200	12100	2900	-
335	527	1	11400	13000	6900	-
335	527	2	6500	12500	6400	-
335	529	0	11200	12600	2000	3900
335	529	1	8900	11500	6200	2500
335	529	2	7400	11400	5100	4000
335	531	0	11300	10000	2100	-
335	531	1	7800	7600	5100	-
335	531	2	9200	11400	7000	-
335	533	0	11500	4700	1800	-
335	533	1	9200	8800	4300	-
335	533	2	10100	5700	3100	-
335	535	0	11400	2900	1900	-
335	535	1	10100	8500	5400	-
335	535	2	12000	5700	4700	-
335	537	0	11500	2600	1600	-
335	537	1	10100	6300	2900	-
335	537	2	10800	--	4700	-
337	523	0	11600	12000	3800	-
337	523	1	10800	10700	7500	-
337	523	2	9900	--	6100	-
337	525	0	11600	16200	6600	-
337	525	1	9900	8100	5000	-
337	525	2	12000	10500	6100	-
337	527	0	11200	14200	2200	-
337	527	1	9900	11300	7100	-

Plot 3B EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	Pre-flood µS/cm 2018	µS/cm Fall 2018	µS/cm Spring 2019
337	527	2	10400	13100	6300	-
337	529	0	11600	15100	1900	-
337	529	1	9400	9100	5600	-
337	529	2	9100	8100	2000	-
337	531	0	10900	6900	1400	-
337	531	1	9800	5900	7500	-
337	531	2	9500	9400	8000	-
337	533	0	11000	2700	1800	-
337	533	1	8200	5200	5700	-
337	533	2	10000	7400	5200	-
337	535	0	10200	4600	1800	-
337	535	1	7600	8900	5400	-
337	535	2	8200	8100	3600	-
337	537	0	8300	2400	1000	-
337	537	1	6200	4700	2500	-
337	537	2	3300	--	2800	-
339	523	0	7800	3000	2100	-
339	523	1	10300	7900	7700	-
339	523	2	10600	9800	7900	-
339	525	0	8700	10100	2200	-
339	525	1	10900	9400	6300	-
339	525	2	9800	8200	8100	-
339	527	0	8700	12200	2500	-
339	527	1	12100	5600	7900	-
339	527	2	8200	15600	6800	-
339	529	0	9400	13000	2600	-
339	529	1	10000	8700	7200	-
339	529	2	8700	11900	3300	-
339	531	0	10300	12000	3600	-
339	531	1	9100	7100	7000	-
339	531	2	9500	8600	5000	-
339	533	0	7900	2400	2200	2600
339	533	1	9200	6600	4300	3200
339	533	2	7100	9700	6000	3600
339	535	0	6800	3900	1600	-
339	535	1	8800	7300	2500	-
339	535	2	5900	5900	5100	-
339	537	0	8100	2500	1000	-
339	537	1	10400	2700	1600	-
339	537	2	6500	-	1800	-
341	523	0	10200	11600	1800	-
341	523	1	8600	11400	4800	-
341	523	2	8900	--	2900	-
341	525	0	9100	10100	1900	-

Plot 3B EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	Pre-flood µS/cm 2018	µS/cm Fall 2018	µS/cm Spring 2019
341	525	1	9300	8100	4600	-
341	525	2	9600	9300	7200	-
341	527	0	8500	14300	2300	-
341	527	1	9200	9800	5500	-
341	527	2	6500	13600	4900	-
341	529	0	7500	13100	1900	-
341	529	1	6800	9900	4200	-
341	529	2	7000	8700	7600	-
341	531	0	8100	7800	1700	-
341	531	1	9200	6000	4500	-
341	531	2	10900	9300	6500	-
341	533	0	7900	12200	1900	-
341	533	1	10300	6700	2000	-
341	533	2	12400	7700	7200	-
341	535	0	10400	3000	1200	-
341	535	1	9900	8300	2600	-
341	535	2	10800	6800	4500	-
341	537	0	12400	2900	1200	-
341	537	1	9200	4100	1600	-
341	537	2	10800	--	1000	-
343	523	0	8700	12700	3700	-
343	523	1	9200	10200	7700	-
343	523	2	10000	14000	7600	-
343	525	0	8600	14600	2200	4200
343	525	1	8900	7600	7600	5100
343	525	2	10200	11700	8200	6400
343	527	0	7900	10600	2300	-
343	527	1	7300	11400	6000	-
343	527	2	8500	14600	8200	-
343	529	0	9000	13200	3000	-
343	529	1	10600	9800	6700	-
343	529	2	9100	11400	7200	-
343	531	0	9100	12000	2100	-
343	531	1	10600	11300	2200	-
343	531	2	8300	11800	6800	-
343	533	0	10200	5400	2000	-
343	533	1	9100	10400	3900	-
343	533	2	8400	12700	7100	-
343	535	0	11600	2800	2100	-
343	535	1	8100	7800	4500	-
343	535	2	7600	5400	7000	-
343	537	0	10100	2600	1500	-
343	537	1	9200	2900	2300	-
343	537	2	8600	--	2600	-

Plot 3B EC Data						
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**Pre-flood µS/cm 2018**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
345	523	0	8700	12100	2300	-
345	523	1	8600	10200	7800	-
345	523	2	9000	11800	6600	-
345	525	0	10900	10700	1800	-
345	525	1	7100	9500	6300	-
345	525	2	7900	16200	8800	-
345	527	0	9200	8500	2100	-
345	527	1	7800	9300	5600	-
345	527	2	8600	16200	6900	-
345	529	0	9000	13400	2300	-
345	529	1	8200	10100	7100	-
345	529	2	9900	11500	6700	-
345	531	0	9200	8300	2500	-
345	531	1	8500	9200	4100	-
345	531	2	9500	11700	7600	-
345	533	0	9300	8500	2500	-
345	533	1	6600	9800	4400	-
345	533	2	9400	12600	4900	-
345	535	0	8900	5300	1900	-
345	535	1	11400	6700	4300	-
345	535	2	10200	1400	6100	-
345	537	0	7300	3200	4000	-
345	537	1	12100	3300	2100	-
345	537	2	9500	--	2900	-
347	523	0	2300	10500	2000	-
347	523	1	11200	12200	7100	-
347	523	2	9700	11200	4900	-
347	525	0	8900	11100	4100	-
347	525	1	10400	11000	7600	-
347	525	2	9600	11900	4200	-
347	527	0	9400	10000	2800	-
347	527	1	8700	9400	5600	-
347	527	2	9000	8900	7300	-
347	529	0	8400	8100	1600	-
347	529	1	8100	10800	5800	-
347	529	2	8600	9700	8200	-
347	531	0	8800	9300	1900	2700
347	531	1	7900	7700	5800	3400
347	531	2	8000	4900	7100	5800
347	533	0	9300	7500	2200	-
347	533	1	8600	8000	4600	-
347	533	2	8400	9100	7100	-
347	535	0	9200	5200	2100	-
347	535	1	9500	8700	2900	-

Plot 3B EC Data						
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**Pre-flood µS/cm 2018**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
347	535	2	8400	4900	5300	-
347	537	0	9200	3000	1500	-
347	537	1	10400	4800	2000	-
347	537	2	11000	--	2700	-
349	523	0	7200	11700	2800	-
349	523	1	6900	8000	7700	-
349	523	2	8800	14300	5900	-
349	525	0	6200	12200	5600	-
349	525	1	7100	11900	7800	-
349	525	2	11100	14500	6700	-
349	527	0	7100	9400	3100	-
349	527	1	8600	10100	7400	-
349	527	2	9400	11500	7700	-
349	529	0	7900	4700	3300	-
349	529	1	9300	11400	7400	-
349	529	2	6900	11500	7800	-
349	531	0	8700	7000	2200	-
349	531	1	7900	9500	3500	-
349	531	2	8600	12200	9100	-
349	533	0	8300	5700	1500	-
349	533	1	7300	8700	2200	-
349	533	2	10500	11800	9200	-
349	535	0	9200	3600	1800	-
349	535	1	7800	8600	2400	-
349	535	2	10100	9300	5100	-
349	537	0	8300	2500	1700	-
349	537	1	6600	3600	3400	-
349	537	2	9700	--	4800	-
351	523	0	9500	14200	1900	-
351	523	1	11600	12800	6800	-
351	523	2	9700	13800	11200	-
351	525	0	9900	12000	2900	-
351	525	1	11200	13800	6700	-
351	525	2	9200	13900	8100	-
351	527	0	9500	9900	2100	-
351	527	1	6700	11200	5900	-
351	527	2	7800	1200	10200	-
351	529	0	8900	13200	2500	-
351	529	1	7200	10700	4000	-
351	529	2	9000	15100	7900	-
351	531	0	7600	6700	1700	-
351	531	1	9700	8900	3300	-
351	531	2	9300	13900	8000	-
351	533	0	8200	7000	2200	-

Plot 3B EC Data						
Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	Pre-flood µS/cm 2018	µS/cm Fall 2018	µS/cm Spring 2019
351	533	1	7200	10000	3400	-
351	533	2	8800	13300	7500	-
351	535	0	7900	4900	1700	-
351	535	1	6600	11100	3100	-
351	535	2	7800	8100	7500	-
351	537	0	9100	2200	1500	-
351	537	1	7200	3900	3100	-
351	537	2	8100	--	1200	-
353	523	0	8600	15300	2900	-
353	523	1	8200	9800	4500	-
353	523	2	8900	9200	8700	-
353	525	0	7900	10400	2300	-
353	525	1	8300	12300	7100	-
353	525	2	10900	13900	8300	-
353	527	0	8600	11200	1100	3000
353	527	1	7800	12100	6500	4700
353	527	2	8100	15100	8500	5500
353	529	0	8600	5500	2000	-
353	529	1	7500	13800	4100	-
353	529	2	6700	14900	7500	-
353	531	0	8600	4900	2100	-
353	531	1	8400	8900	5400	-
353	531	2	7100	15700	8700	-
353	533	0	9300	10000	2100	-
353	533	1	8000	13100	4800	-
353	533	2	7300	18900	7600	-
353	535	0	10200	4600	1700	2100
353	535	1	8400	10500	3100	3400
353	535	2	8100	11200	8400	4100
353	537	0	8700	13400	1300	-
353	537	1	7200	5600	2700	-
353	537	2	8700	--	5600	-
355	523	0	10000	16000	300	-
355	523	1	8400	10200	6400	-
355	523	2	5200	--	9900	-
355	525	0	11100	8800	2000	-
355	525	1	7900	11400	6500	-
355	525	2	8700	13900	8000	-
355	527	0	10800	4900	2500	-
355	527	1	8500	9900	3900	-
355	527	2	10300	15900	8200	-
355	529	0	10200	6700	1700	-
355	529	1	8700	13400	6200	-
355	529	2	8600	15200	8300	-

Plot 3B EC Data						
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**Pre-flood µS/cm 2018**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
355	531	0	9100	6800	2300	-
355	531	1	5000	10900	5700	-
355	531	2	5400	18200	9400	-
355	533	0	9900	6100	1500	-
355	533	1	6500	10500	4200	-
355	533	2	7200	18300	9200	-
355	535	0	9100	5500	1800	-
355	535	1	7200	8900	2300	-
355	535	2	9600	9900	3100	-
355	537	0	10200	3500	1900	-
355	537	1	8400	4300	4500	-
355	537	2	8700	--	5400	-
357	523	0	9100	12400	2200	-
357	523	1	8900	10700	9300	-
357	523	2	10200	11800	8800	-
357	525	0	10400	11500	2100	-
357	525	1	9200	13300	6900	-
357	525	2	8700	11500	9700	-
357	527	0	11200	10900	1900	-
357	527	1	8500	11700	6900	-
357	527	2	10200	14100	7100	-
357	529	0	10600	10200	2400	-
357	529	1	7300	14400	7200	-
357	529	2	11200	10100	8700	-
357	531	0	11000	11100	2500	-
357	531	1	8900	12000	7600	-
357	531	2	10400	17300	9100	-
357	533	0	11100	15500	3400	-
357	533	1	9300	10400	3800	-
357	533	2	8700	12200	9200	-
357	535	0	900	11600	1900	-
357	535	1	8600	13700	4200	-
357	535	2	8600	8800	5800	-
357	537	0	9100	4600	1400	-
357	537	1	7400	4800	2000	-
357	537	2	8100	5400	2000	-

Plot 4 EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
343	423	0	1900	7400	-
343	423	1	3600	6800	-
343	423	2	3400	5900	-
343	425	0	2800	2300	-
343	425	1	1620	2100	-
343	425	2	5100	-	-
343	427	0	4200	3300	-
343	427	1	1300	2300	-
343	427	2	4600	-	-
343	429	0	4900	2100	-
343	429	1	1500	1900	-
343	429	2	3700	-	-
343	431	0	5700	2200	-
343	431	1	4100	1500	-
343	431	2	7600	-	-
343	433	0	3800	3600	-
343	433	1	2100	2300	-
343	433	2	6300	-	-
343	435	0	1700	3900	-
343	435	1	1500	2200	-
343	435	2	6300	-	-
343	437	0	2000	2000	-
343	437	1	1800	1700	-
343	437	2	4900	-	-
345	423	0	3500	3700	-
345	423	1	2700	9800	-
345	423	2	4000	-	-
345	425	0	4600	4100	-
345	425	1	2400	2600	-
345	425	2	3000	1300	-
345	427	0	3600	5700	3100
345	427	1	1800	4000	2200
345	427	2	2100	-	2400
345	429	0	2400	5200	-
345	429	1	1200	3200	-
345	429	2	1800	3200	-
345	431	0	3300	4800	-
345	431	1	4100	2900	-
345	431	2	6400	2400	-
345	433	0	4500	4800	-
345	433	1	5600	2100	-
345	433	2	7800	1500	-
345	435	0	3600	5200	-
345	435	1	4200	4800	-

Plot 4 EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
345	435	2	5800	3000	-
345	437	0	1500	3800	-
345	437	1	3200	2700	-
345	437	2	4000	3100	-
347	423	0	8300	4600	-
347	423	1	5700	-	-
347	423	2	6400	-	-
347	425	0	6900	2400	-
347	425	1	5600	3700	-
347	425	2	5200	-	-
347	427	0	4900	8300	-
347	427	1	5500	4300	-
347	427	2	4100	-	-
347	429	0	4100	10200	-
347	429	1	4200	6900	-
347	429	2	6200	-	-
347	431	0	3000	6400	-
347	431	1	3600	6000	-
347	431	2	7100	2900	-
347	433	0	2200	3300	2400
347	433	1	3200	2800	1800
347	433	2	5400	6100	1600
347	435	0	1700	5100	-
347	435	1	3800	6000	-
347	435	2	4100	3700	-
347	437	0	2700	4400	-
347	437	1	4500	3200	-
347	437	2	6200	1800	-
349	423	0	3600	2600	-
349	423	1	3800	-	-
349	423	2	5600	-	-
349	425	0	5200	8800	-
349	425	1	3100	7000	-
349	425	2	4100	-	-
349	427	0	4800	8100	-
349	427	1	3500	5900	-
349	427	2	4800	4200	-
349	429	0	3900	11300	-
349	429	1	4100	7500	-
349	429	2	5300	6500	-
349	431	0	4100	7100	-
349	431	1	5900	3200	-
349	431	2	4300	2200	-
349	433	0	4800	4300	-

Plot 4 EC Data					
Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
349	433	1	6200	2600	-
349	433	2	3800	2100	-
349	435	0	3000	5800	-
349	435	1	4600	4900	-
349	435	2	3900	-	-
349	437	0	1300	5900	-
349	437	1	2200	3200	-
349	437	2	6100	3600	-
351	423	0	8100	7200	-
351	423	1	5400	-	-
351	423	2	7000	-	-
351	425	0	7300	14300	-
351	425	1	5300	11600	-
351	425	2	6800	-	-
351	427	0	6700	11500	-
351	427	1	5200	57000	-
351	427	2	5900	3300	-
351	429	0	5600	3800	-
351	429	1	4200	3600	-
351	429	2	6300	2800	-
351	431	0	3100	4400	-
351	431	1	3400	2800	-
351	431	2	6500	3400	-
351	433	0	2800	2900	-
351	433	1	5100	3300	-
351	433	2	5100	2500	-
351	435	0	2200	2800	-
351	435	1	6300	2100	-
351	435	2	4900	-	-
351	437	0	2600	1900	-
351	437	1	5800	1300	-
351	437	2	6700	-	-
353	423	0	4200	2800	-
353	423	1	3100	2500	-
353	423	2	6000	-	-
353	425	0	3600	13600	-
353	425	1	2800	10400	-
353	425	2	5100	-	-
353	427	0	2800	8400	-
353	427	1	3100	5800	-
353	427	2	4200	1900	-
353	429	0	2100	9300	2600
353	429	1	3800	7100	2400
353	429	2	2500	-	1900

Plot 4 EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
353	431	0	2000	8100	-
353	431	1	5600	5500	-
353	431	2	3300	-	-
353	433	0	1700	5600	-
353	433	1	7100	4700	-
353	433	2	5000	-	-
353	435	0	2500	4900	-
353	435	1	4400	4400	-
353	435	2	5200	3800	-
353	437	0	2100	4100	-
353	437	1	3400	3300	-
353	437	2	5400	-	-
355	423	0	3500	4200	-
355	423	1	5200	3900	-
355	423	2	3600	-	-
355	425	0	4400	10700	-
355	425	1	3600	7700	-
355	425	2	4800	4900	-
355	427	0	7500	12600	-
355	427	1	2800	5900	-
355	427	2	6200	5700	-
355	429	0	5000	9500	-
355	429	1	3900	6400	-
355	429	2	5400	-	-
355	431	0	4300	10200	-
355	431	1	2800	5000	-
355	431	2	4900	-	-
355	433	0	4200	7100	-
355	433	1	3600	4200	-
355	433	2	5100	-	-
355	435	0	4100	4800	-
355	435	1	7400	4200	-
355	435	2	5600	5300	-
355	437	0	4800	3200	-
355	437	1	7800	4800	-
355	437	2	5400	-	-
357	423	0	2900	4900	-
357	423	1	7900	4100	-
357	423	2	3900	-	-
357	425	0	3100	16300	-
357	425	1	8600	13900	-
357	425	2	5000	4500	-
357	427	0	4800	13300	-
357	427	1	5000	5900	-

Plot 4 EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
357	427	2	5800	4400	-
357	429	0	7900	5600	-
357	429	1	3600	6300	-
357	429	2	6200	4000	-
357	431	0	6500	4400	-
357	431	1	7400	3900	-
357	431	2	4100	3000	-
357	433	0	2100	5900	-
357	433	1	8000	3500	-
357	433	2	2400	2900	-
357	435	0	3700	5600	-
357	435	1	8300	4800	-
357	435	2	5600	-	-
357	437	0	5500	8100	-
357	437	1	8600	6800	-
357	437	2	8000	-	-
359	423	0	7100	11300	-
359	423	1	12400	5800	-
359	423	2	8100	-	-
359	425	0	6000	12100	-
359	425	1	7200	5700	-
359	425	2	9800	-	-
359	427	0	5700	15300	-
359	427	1	4100	12500	-
359	427	2	10100	6700	-
359	429	0	4700	12300	-
359	429	1	3200	5900	-
359	429	2	8400	4800	-
359	431	0	3600	6500	-
359	431	1	2200	4700	-
359	431	2	2100	4900	-
359	433	0	2900	3900	-
359	433	1	6400	3800	-
359	433	2	9400	3300	-
359	435	0	1300	4900	-
359	435	1	7600	3400	-
359	435	2	11600	3600	-
359	437	0	4600	4400	-
359	437	1	8200	2300	-
359	437	2	14000	-	-
361	423	0	3700	4300	-
361	423	1	4600	3800	-
361	423	2	4100	-	-
361	425	0	4600	9200	6700

Plot 4 EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
361	425	1	5100	6800	2900
361	425	2	3000	-	2100
361	427	0	4100	8400	-
361	427	1	5300	7200	-
361	427	2	4400	-	-
361	429	0	3600	8600	-
361	429	1	5600	4000	-
361	429	2	3200	3800	-
361	431	0	3000	5100	-
361	431	1	3100	3700	-
361	431	2	4400	3800	-
361	433	0	2800	5800	-
361	433	1	1900	4400	-
361	433	2	5300	3400	-
361	435	0	3600	5900	-
361	435	1	2200	4200	-
361	435	2	5100	3200	-
361	437	0	4200	7700	-
361	437	1	6900	2900	-
361	437	2	2100	-	-
363	423	0	5500	4900	-
363	423	1	8200	3600	-
363	423	2	3400	-	-
363	425	0	5100	8400	-
363	425	1	8400	6700	-
363	425	2	5200	-	-
363	427	0	5700	12600	-
363	427	1	8400	3800	-
363	427	2	13400	27000	-
363	429	0	3300	6800	-
363	429	1	5100	2900	-
363	429	2	8100	3400	-
363	431	0	2100	9200	-
363	431	1	4200	4400	-
363	431	2	6300	3700	-
363	433	0	2900	5100	-
363	433	1	3600	3700	-
363	433	2	2100	3000	-
363	435	0	5500	6200	2900
363	435	1	3200	4600	2400
363	435	2	8400	4000	2000
363	437	0	3600	4600	-
363	437	1	3200	3900	-
363	437	2	7600	-	-

Plot 4 EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
365	423	0	7200	4100	-
365	423	1	8400	3700	-
365	423	2	4100	-	-
365	425	0	5900	8800	-
365	425	1	7200	5000	-
365	425	2	3800	-	-
365	427	0	4800	12000	-
365	427	1	4200	4700	-
365	427	2	8600	5400	-
365	429	0	4400	5800	-
365	429	1	1100	3400	-
365	429	2	14800	-	-
365	431	0	3700	5300	-
365	431	1	3200	3600	-
365	431	2	8200	2400	-
365	433	0	2100	5700	-
365	433	1	6300	3900	-
365	433	2	2300	4400	-
365	435	0	3200	4500	-
365	435	1	6400	3600	-
365	435	2	6900	-	-
365	437	0	4900	3100	-
365	437	1	4700	4100	-
365	437	2	7500	-	-
367	423	0	8100	4200	-
367	423	1	5200	2100	-
367	423	2	3300	-	-
367	425	0	8000	7400	-
367	425	1	4100	5800	-
367	425	2	2900	4300	-
367	427	0	7700	6900	-
367	427	1	2600	5400	-
367	427	2	3400	5200	-
367	429	0	6900	8900	2900
367	429	1	3200	6400	2300
367	429	2	4600	-	2100
367	431	0	6200	7100	-
367	431	1	5700	2700	-
367	431	2	5900	5100	-
367	433	0	4100	9400	-
367	433	1	7800	7600	-
367	433	2	6000	-	-
367	435	0	2700	8000	-
367	435	1	9000	2700	-

Plot 4 EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
367	435	2	6900	-	-
367	437	0	6200	3600	-
367	437	1	8100	2700	-
367	437	2	7100	-	-
369	423	0	5100	10000	-
369	423	1	7800	5300	-
369	423	2	7400	-	-
369	425	0	4300	9200	-
369	425	1	4500	5600	-
369	425	2	8200	-	-
369	427	0	4100	5100	-
369	427	1	3600	4100	-
369	427	2	6900	2200	-
369	429	0	4600	4900	-
369	429	1	2500	3300	-
369	429	2	6400	-	-
369	431	0	5200	4700	-
369	431	1	3800	5300	-
369	431	2	5900	3100	-
369	433	0	8000	5800	-
369	433	1	9800	3600	-
369	433	2	5100	-	-
369	435	0	5200	3300	-
369	435	1	8400	3000	-
369	435	2	6200	1800	-
369	437	0	2700	2600	-
369	437	1	1400	1900	-
369	437	2	7200	-	-
371	423	0	5100	4200	-
371	423	1	8400	3900	-
371	423	2	6200	-	-
371	425	0	4000	3800	-
371	425	1	6800	3600	-
371	425	2	5700	1900	-
371	427	0	3200	4800	-
371	427	1	6100	3400	-
371	427	2	4000	-	-
371	429	0	4100	3100	-
371	429	1	7700	2600	-
371	429	2	5400	-	-
371	431	0	4900	2600	-
371	431	1	6700	3800	-
371	431	2	5700	-	-
371	433	0	4100	3300	-

Plot 4 EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
371	433	1	3800	2900	-
371	433	2	5200	1800	-
371	435	0	1500	3900	-
371	435	1	2500	3400	-
371	435	2	4600	-	-
371	437	0	3400	4000	-
371	437	1	3700	3800	-
371	437	2	4200	-	-
373	423	0	1100	3400	-
373	423	1	3200	2400	-
373	423	2	8400	-	-
373	425	0	1900	4100	-
373	425	1	3600	3700	-
373	425	2	6000	3000	-
373	427	0	2500	3300	-
373	427	1	4100	4300	-
373	427	2	4600	3400	-
373	429	0	3200	5500	-
373	429	1	4900	5400	-
373	429	2	3300	-	-
373	431	0	3900	5500	-
373	431	1	5400	5500	-
373	431	2	3800	2100	-
373	433	0	5700	3600	-
373	433	1	6000	4000	-
373	433	2	5800	3800	-
373	435	0	5000	-	2500
373	435	1	4100	2200	2700
373	435	2	5700	3600	2100
373	437	0	4700	4400	-
373	437	1	3800	3800	-
373	437	2	5600	4000	-
375	423	0	2300	-	-
375	423	1	8500	2600	-
375	423	2	7100	3000	-
375	425	0	2500	-	2400
375	425	1	6100	7800	2000
375	425	2	4000	4000	2100
375	427	0	2600	1900	-
375	427	1	4200	3300	-
375	427	2	3300	4200	-
375	429	0	4600	-	-
375	429	1	3300	3600	-
375	429	2	3400	2600	-

Plot 4 EC Data					
Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
375	431	0	5700	1800	-
375	431	1	2400	3800	-
375	431	2	3600	2300	-
375	433	0	7900	2300	-
375	433	1	2900	4200	-
375	433	2	4100	3700	-
375	435	0	12600	-	-
375	435	1	4200	4400	-
375	435	2	5300	2700	-
375	437	0	8600	2700	-
375	437	1	3100	4900	-
375	437	2	6200	2400	-
377	423	0	6500	-	-
377	423	1	7100	9700	-
377	423	2	3400	3200	-
377	425	0	8500	-	-
377	425	1	7900	7800	-
377	425	2	2900	3500	-
377	427	0	4700	-	-
377	427	1	8600	7900	-
377	427	2	4400	5300	-
377	429	0	3100	3300	-
377	429	1	12100	3400	-
377	429	2	7600	-	-
377	431	0	3900	-	-
377	431	1	7200	3100	-
377	431	2	4400	-	-
377	433	0	4200	-	-
377	433	1	5800	2700	-
377	433	2	3000	1400	-
377	435	0	5900	-	-
377	435	1	4800	1700	-
377	435	2	4600	1500	-
377	437	0	7500	-	-
377	437	1	4600	3300	-
377	437	2	4100	2100	-

Field Cell 5A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
103	563	0	1100	4200	-
103	563	1	1200	3100	-
103	563	2	1600	-	-
103	565	0	1300	3200	-
103	565	1	1000	6500	-
103	565	2	4000	7200	-
103	567	0	900	2000	-
103	567	1	1100	3300	-
103	567	2	5500	3700	-
103	569	0	1100	1600	-
103	569	1	1400	2700	-
103	569	2	1200	3100	-
103	571	0	1300	2100	-
103	571	1	1400	2400	-
103	571	2	900	3800	-
103	573	0	1300	1100	-
103	573	1	1100	1900	-
103	573	2	1800	-	-
103	575	0	1200	600	-
103	575	1	1200	200	-
103	575	2	1100	-	-
103	577	0	1400	900	-
103	577	1	800	1500	-
103	577	2	2100	-	-
105	563	0	1000	2100	-
105	563	1	1300	3300	-
105	563	2	2600	-	-
105	565	0	900	1600	-
105	565	1	1600	4300	-
105	565	2	1400	-	-
105	567	0	1100	2400	-
105	567	1	800	1800	-
105	567	2	1500	-	-
105	569	0	1400	900	2400
105	569	1	1100	2300	1700
105	569	2	1800	1700	1500
105	571	0	1600	1500	-
105	571	1	1200	2400	-
105	571	2	1300	-	-
105	573	0	1300	1300	-
105	573	1	1200	2500	-
105	573	2	1600	-	-
105	575	0	1500	2200	-
105	575	1	1400	1800	-
105	575	2	1800	-	-

Field Cell 5A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
105	577	0	1000	1200	-
105	577	1	800	3600	-
105	577	2	1700	-	-
107	563	0	1100	900	-
107	563	1	1600	1300	-
107	563	2	2300	1000	-
107	565	0	1500	1300	-
107	565	1	1000	-	-
107	565	2	1500		-
107	567	0	900	920	2800
107	567	1	700	1200	2400
107	567	2	1800	1500	1900
107	569	0	1200	1000	-
107	569	1	1200	1100	-
107	569	2	1200	700	-
107	571	0	1400	1000	-
107	571	1	2100	2500	-
107	571	2	1600	3000	-
107	573	0	1800	1400	2900
107	573	1	1400	2800	2400
107	573	2	1600	4800	2200
107	575	0	1300	3600	-
107	575	1	900	4900	-
107	575	2	2600	-	-
107	577	0	1200	3500	-
107	577	1	1100	5500	-
107	577	2	1800	-	-
109	563	0	1200	1600	-
109	563	1	900	900	-
109	563	2	3000	-	-
109	565	0	1300	900	-
109	565	1	1100	1300	-
109	565	2	1100	-	-
109	567	0	1000	5000	-
109	567	1	800	1600	-
109	567	2	2100	-	-
109	569	0	1100	500	-
109	569	1	1100	1100	-
109	569	2	1200	-	-
109	571	0	1300	900	-
109	571	1	1000	1400	-
109	571	2	2100	-	-
109	573	0	1500	900	-
109	573	1	1400	1600	-
109	573	2	1000	1800	-

Field Cell 5A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
109	575	0	1300	700	-
109	575	1	1200	1800	-
109	575	2	2300	-	-
109	577	0	900	3700	-
109	577	1	1100	4800	-
109	577	2	1900	-	-
111	563	0	1100	600	-
111	563	1	1400	800	-
111	563	2	1300	-	-
111	565	0	1300	500	-
111	565	1	1300	900	-
111	565	2	2600	-	-
111	567	0	1100	400	-
111	567	1	3300	800	-
111	567	2	2200	1200	-
111	569	0	1500	500	-
111	569	1	1100	1600	-
111	569	2	2800	900	-
111	571	0	700	600	-
111	571	1	1200	800	-
111	571	2	700	-	-
111	573	0	1300	400	-
111	573	1	1500	600	-
111	573	2	1500	1300	-
111	575	0	1100	1400	-
111	575	1	1100	2400	-
111	575	2	1500	-	-
111	577	0	1000	1700	-
111	577	1	1300	2100	-
111	577	2	1900	-	-
113	563	0	1200	600	-
113	563	1	600	1000	-
113	563	2	900	-	-
113	565	0	1400	600	-
113	565	1	1000	1300	-
113	565	2	700	-	-
113	567	0	1600	1400	-
113	567	1	900	1300	-
113	567	2	700	900	-
113	569	0	1400	1100	-
113	569	1	1200	800	-
113	569	2	3100	700	-
113	571	0	1000	600	-
113	571	1	1100	1600	-
113	571	2	2400	900	-

Field Cell 5A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
113	573	0	1300	600	-
113	573	1	1700	500	-
113	573	2	3900	1000	-
113	575	0	600	700	-
113	575	1	1200	1300	-
113	575	2	1600	-	-
113	577	0	1000	1200	-
113	577	1	1000	1500	-
113	577	2	3500	1800	-
115	563	0	1600	1500	-
115	563	1	1200	1100	-
115	563	2	1500	-	-
115	565	0	1300	800	-
115	565	1	800	1200	-
115	565	2	1100	-	-
115	567	0	900	900	-
115	567	1	1100	1300	-
115	567	2	1000	1600	-
115	569	0	600	1300	-
115	569	1	1100	2100	-
115	569	2	700	2700	-
115	571	0	1400	700	-
115	571	1	1400	800	-
115	571	2	2100	1500	-
115	573	0	1200	1300	-
115	573	1	1500	1600	-
115	573	2	1500	1100	-
115	575	0	1400	1000	-
115	575	1	1100	900	-
115	575	2	1600	1900	-
115	577	0	1600	1600	-
115	577	1	1200	900	-
115	577	2	1400	1600	-
117	563	0	1500	600	-
117	563	1	1600	2100	-
117	563	2	1500	-	-
117	565	0	1200	2100	-
117	565	1	1000	600	-
117	565	2	1000	800	-
117	567	0	1400	800	-
117	567	1	1300	1200	-
117	567	2	1100	2300	-
117	569	0	1100	500	-
117	569	1	1000	1600	-
117	569	2	1900	-	-

Field Cell 5A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
117	571	0	1400	500	-
117	571	1	1600	1100	-
117	571	2	1200	1200	-
117	573	0	900	800	-
117	573	1	1300	700	-
117	573	2	1500	1300	-
117	575	0	900	400	-
117	575	1	1400	1400	-
117	575	2	1100	1800	-
117	577	0	1100	3300	-
117	577	1	1400	2100	-
117	577	2	900	-	-
119	563	0	1200	400	-
119	563	1	1100	900	-
119	563	2	1500	-	-
119	565	0	1400	800	-
119	565	1	1500	500	-
119	565	2	1500	800	-
119	567	0	1000	200	-
119	567	1	900	700	-
119	567	2	1300	-	-
119	569	0	1500	1100	-
119	569	1	1200	800	-
119	569	2	1600	400	-
119	571	0	1500	600	-
119	571	1	1200	500	-
119	571	2	1600	300	-
119	573	0	1100	900	-
119	573	1	1500	500	-
119	573	2	800	800	-
119	575	0	1700	900	-
119	575	1	1300	700	-
119	575	2	1300	1500	-
119	577	0	1200	800	-
119	577	1	1500	900	-
119	577	2	4300	-	-
121	563	0	1100	500	-
121	563	1	1000	700	-
121	563	2	300	-	-
121	565	0	1400	800	-
121	565	1	700	200	-
121	565	2	1900	400	-
121	567	0	1300	600	-
121	567	1	1100	250	-
121	567	2	1800	290	-

Field Cell 5A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
121	569	0	1100	700	-
121	569	1	2500	900	-
121	569	2	1300	1400	-
121	571	0	1200	200	-
121	571	1	1300	800	-
121	571	2	1900	800	-
121	573	0	1400	300	2100
121	573	1	1000	400	1800
121	573	2	1000	800	1200
121	575	0	900	900	-
121	575	1	1000	600	-
121	575	2	1400	900	-
121	577	0	600	700	-
121	577	1	1200	1900	-
121	577	2	1000	-	-
123	563	0	900	1200	-
123	563	1	1100	2500	-
123	563	2	600	-	-
123	565	0	1300	900	2200
123	565	1	1500	500	1200
123	565	2	1100	300	500
123	567	0	1100	2100	-
123	567	1	1000	1600	-
123	567	2	1200	-	-
123	569	0	1500	700	-
123	569	1	700	900	-
123	569	2	900	500	-
123	571	0	1800	1000	-
123	571	1	1300	1400	-
123	571	2	1500	800	-
123	573	0	1600	600	-
123	573	1	900	500	-
123	573	2	1400	600	-
123	575	0	1500	500	-
123	575	1	1200	1100	-
123	575	2	800	4400	-
123	577	0	1500	2800	-
123	577	1	1000	2300	-
123	577	2	1700	2400	-
125	563	0	1200	1300	-
125	563	1	1500	500	-
125	563	2	1000	-	-
125	565	0	1000	600	-
125	565	1	1500	900	-
125	565	2	1800	-	-

Field Cell 5A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
125	567	0	1400	600	-
125	567	1	2300	1000	-
125	567	2	1600	-	-
125	569	0	1000	900	-
125	569	1	1600	800	-
125	569	2	500	400	-
125	571	0	900	400	-
125	571	1	900	600	-
125	571	2	1300	800	-
125	573	0	1200	300	-
125	573	1	1300	500	-
125	573	2	1200	500	-
125	575	0	1900	700	-
125	575	1	1400	800	-
125	575	2	1300	1200	-
125	577	0	1600	1700	-
125	577	1	1400	1700	-
125	577	2	1500	1500	-
127	563	0	1200	600	-
127	563	1	1400	800	-
127	563	2	1600	-	-
127	565	0	1800	1400	-
127	565	1	1200	900	-
127	565	2	900	800	-
127	567	0	1700	800	-
127	567	1	1500	1300	-
127	567	2	1100	-	-
127	569	0	800	700	2000
127	569	1	300	600	1800
127	569	2	1000	500	1700
127	571	0	1400	1100	-
127	571	1	1300	1200	-
127	571	2	800	800	-
127	573	0	1100	1800	-
127	573	1	700	900	-
127	573	2	1300	700	-
127	575	0	1200	2100	-
127	575	1	1500	1400	-
127	575	2	1000	1200	-
127	577	0	1400	3100	-
127	577	1	1600	1800	-
127	577	2	1200	-	-
129	563	0	1200	2100	-
129	563	1	1000	500	-
129	563	2	1800	-	-

Field Cell 5A EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fall 2018	µS/cm Spring 2019
129	565	0	1100	1300	-
129	565	1	1000	600	-
129	565	2	900	400	-
129	567	0	1400	1200	-
129	567	1	1000	600	-
129	567	2	2100	-	-
129	569	0	1200	1500	-
129	569	1	900	1300	-
129	569	2	1600	1100	-
129	571	0	1400	1500	-
129	571	1	1500	1300	-
129	571	2	2100	900	-
129	573	0	1700	2400	-
129	573	1	1300	1700	-
129	573	2	900	600	-
129	575	0	1300	2700	-
129	575	1	1100	2400	-
129	575	2	1100	1000	-
129	577	0	1600	1200	-
129	577	1	1200	700	-
129	577	2	600	-	-
131	563	0	600	400	-
131	563	1	1400	700	-
131	563	2	600	-	-
131	565	0	1300	1900	-
131	565	1	1000	800	-
131	565	2	500	-	-
131	567	0	700	700	-
131	567	1	500	1200	-
131	567	2	1100	800	-
131	569	0	900	1800	-
131	569	1	600	600	-
131	569	2	700	700	-
131	571	0	1600	1400	-
131	571	1	1100	1000	-
131	571	2	1500	-	-
131	573	0	1200	1900	-
131	573	1	1500	900	-
131	573	2	1300	900	-
131	575	0	1700	1300	-
131	575	1	900	3800	-
131	575	2	1200	1506	-
131	577	0	600	1400	-
131	577	1	1400	2400	-
131	577	2	500	-	-

Field Cell 5A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
133	563	0	1000	1000	-
133	563	1	1400	1500	-
133	563	2	1000	-	-
133	565	0	1500	1200	-
133	565	1	1300	600	-
133	565	2	1000	-	-
133	567	0	1500	1400	1900
133	567	1	1400	1400	1600
133	567	2	1500	1600	700
133	569	0	1000	1300	-
133	569	1	1700	1500	-
133	569	2	900	800	-
133	571	0	1900	1000	-
133	571	1	1400	800	-
133	571	2	1100	500	-
133	573	0	1700	1200	2100
133	573	1	1300	700	2100
133	573	2	1300	500	1300
133	575	0	1400	900	-
133	575	1	1700	500	-
133	575	2	1500	1800	-
133	577	0	1600	1100	-
133	577	1	1900	1400	-
133	577	2	1800	1300	-
135	563	0	1000	500	-
135	563	1	1400	400	-
135	563	2	1100	-	-
135	565	0	1700	400	-
135	565	1	1000	600	-
135	565	2	800	1200	-
135	567	0	1100	2200	-
135	567	1	1500	700	-
135	567	2	900	400	-
135	569	0	1300	700	-
135	569	1	1100	700	-
135	569	2	1200	500	-
135	571	0	1400	200	-
135	571	1	1700	400	-
135	571	2	1400	900	-
135	573	0	1300	1100	-
135	573	1	1900	800	-
135	573	2	1200	600	-
135	575	0	1500	700	-
135	575	1	1600	900	-
135	575	2	800	500	-

Field Cell 5A EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fall 2018**	**µS/cm Spring 2019**
135	577	0	1400	800	-
135	577	1	1700	300	-
135	577	2	700	700	-
137	563	0	1200	700	-
137	563	1	1600	900	-
137	563	2	1700	-	-
137	565	0	1500	600	-
137	565	1	900	500	-
137	565	2	800	1800	-
137	567	0	1600	2000	-
137	567	1	600	800	-
137	567	2	800	300	-
137	569	0	1300	700	-
137	569	1	400	500	-
137	569	2	900	300	-
137	571	0	700	1700	-
137	571	1	1200	500	-
137	571	2	500	300	-
137	573	0	1400	1100	-
137	573	1	1700	500	-
137	573	2	900	800	-
137	575	0	1100	600	-
137	575	1	1000	400	-
137	575	2	1600	500	-
137	577	0	1200	1100	-
137	577	1	1000	500	-
137	577	2	700	-	-

Field Cell 5B EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fal l2018	µS/cm Spring 2019
103	523	0	1800	2100	-
103	523	1	1600	2400	-
103	523	2	3200	-	-
103	525	0	1300	2700	-
103	525	1	1600	2200	-
103	525	2	1900	-	-
103	527	0	1200	3100	-
103	527	1	1500	2500	-
103	527	2	900	-	-
103	529	0	1200	1700	-
103	529	1	1200	2300	-
103	529	2	1500	-	-
103	531	0	1300	2400	-
103	531	1	1600	3400	-
103	531	2	2400	-	-
103	533	0	1900	2500	-
103	533	1	1100	2600	-
103	533	2	1400	-	-
103	535	0	1100	2700	-
103	535	1	1700	3700	-
103	535	2	1200	-	-
103	537	0	1000	2900	-
103	537	1	1100	3000	-
103	537	2	1100	-	-
105	523	0	1600	1500	-
105	523	1	1000	1600	-
105	523	2	3700	-	-
105	525	0	1500	1300	-
105	525	1	1500	1900	-
105	525	2	2900	1600	-
105	527	0	1800	1400	-
105	527	1	1600	1700	-
105	527	2	2700	1900	-
105	529	0	1200	1500	-
105	529	1	1500	1400	-
105	529	2	1300	700	-
105	531	0	1200	1100	-
105	531	1	1400	2200	-
105	531	2	2600	2300	-
105	533	0	1600	2100	-
105	533	1	1500	1500	-
105	533	2	2100	2600	-
105	535	0	900	1800	-
105	535	1	1000	3700	-
105	535	2	1200	5700	-

Field Cell 5B EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fal l2018**	**µS/cm Spring 2019**
105	537	0	1300	3600	-
105	537	1	800	1600	-
105	537	2	1000	-	-
107	523	0	1500	1300	-
107	523	1	1200	2400	-
107	523	2	2600	-	-
107	525	0	1800	1300	-
107	525	1	1100	1900	-
107	525	2	2100	2800	-
107	527	0	1500	2300	2200
107	527	1	800	1300	2100
107	527	2	3300	-	2200
107	529	0	1600	1800	-
107	529	1	1200	1500	-
107	529	2	900	1200	-
107	531	0	1300	1900	-
107	531	1	1300	1200	-
107	531	2	1600	1600	-
107	533	0	800	900	2500
107	533	1	1200	1700	1800
107	533	2	1500	2600	2100
107	535	0	1200	1500	-
107	535	1	1100	1300	-
107	535	2	2900	2100	-
107	537	0	900	1700	-
107	537	1	1100	2500	-
107	537	2	1700	-	-
109	523	0	1200	1500	-
109	523	1	1400	2900	-
109	523	2	2500	-	-
109	525	0	1200	2100	-
109	525	1	1200	2600	-
109	525	2	2100	3200	-
109	527	0	1600	1000	-
109	527	1	800	2500	-
109	527	2	1200	3000	-
109	529	0	1100	1800	-
109	529	1	1400	1700	-
109	529	2	1500	2200	-
109	531	0	1600	1300	-
109	531	1	1200	2000	-
109	531	2	2500	-	-
109	533	0	1700	1400	-
109	533	1	1000	2100	-
109	533	2	1100	-	-

Field Cell 5B EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fal l2018	µS/cm Spring 2019
109	535	0	1000	1400	-
109	535	1	1100	700	-
109	535	2	1200	700	-
109	537	0	1600	2000	-
109	537	1	1500	2300	-
109	537	2	1600	3400	-
111	523	0	900	1800	-
111	523	1	1200	3100	-
111	523	2	1200	-	-
111	525	0	1600	900	-
111	525	1	1400	1700	-
111	525	2	2300	3000	-
111	527	0	1100	1400	-
111	527	1	1600	2500	-
111	527	2	1700	2100	-
111	529	0	800	800	-
111	529	1	3100	1900	-
111	529	2	1200	1400	-
111	531	0	1400	1100	-
111	531	1	600	1500	-
111	531	2	1200	1900	-
111	533	0	1800	7000	-
111	533	1	1600	1500	-
111	533	2	1100	-	-
111	535	0	1400	1400	-
111	535	1	1800	900	-
111	535	2	1000	500	-
111	537	0	1300	1400	-
111	537	1	1400	2100	-
111	537	2	2000	3100	-
113	523	0	1600	1500	-
113	523	1	1400	2300	-
113	523	2	1200	-	-
113	525	0	1100	1300	-
113	525	1	700	2700	-
113	525	2	1300	2500	-
113	527	0	1400	1100	-
113	527	1	1400	2300	-
113	527	2	1600	-	-
113	529	0	1100	1600	1900
113	529	1	1700	2000	1500
113	529	2	1800	-	900
113	531	0	1800	1000	-
113	531	1	1100	1400	-
113	531	2	1100	1200	-

Field Cell 5B EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fal l2018	µS/cm Spring 2019
113	533	0	1300	900	-
113	533	1	1600	1600	-
113	533	2	300	-	-
113	535	0	1100	900	-
113	535	1	1000	1400	-
113	535	2	1000	1700	-
113	537	0	1400	1400	-
113	537	1	1200	2400	-
113	537	2	2100	2900	-
115	523	0	600	2200	-
115	523	1	1200	1800	-
115	523	2	1900	-	-
115	525	0	1400	1400	-
115	525	1	1300	2100	-
115	525	2	1200	2800	-
115	527	0	1800	900	-
115	527	1	1600	1600	-
115	527	2	1100	2300	-
115	529	0	1000	1700	-
115	529	1	1400	2700	-
115	529	2	1300	2900	-
115	531	0	1700	1400	-
115	531	1	1300	1600	-
115	531	2	1300	1500	-
115	533	0	1100	1600	-
115	533	1	500	1300	-
115	533	2	1300	900	-
115	535	0	1600	500	-
115	535	1	1200	1000	-
115	535	2	1300	1900	-
115	537	0	1000	1900	-
115	537	1	1200	2400	-
115	537	2	1200	2900	-
117	523	0	600	1500	-
117	523	1	1200	2100	-
117	523	2	1400	-	-
117	525	0	1300	700	-
117	525	1	1400	1200	-
117	525	2	2000	1700	-
117	527	0	1800	600	-
117	527	1	1500	1200	-
117	527	2	1000	1500	-
117	529	0	600	1000	-
117	529	1	1300	600	-
117	529	2	1200	900	-

Field Cell 5B EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**μS/cm Fall 2017**	**μS/cm Fal l2018**	**μS/cm Spring 2019**
117	531	0	1100	1500	-
117	531	1	800	1600	-
117	531	2	2500	2100	-
117	533	0	1600	600	-
117	533	1	1300	700	-
117	533	2	500	900	-
117	535	0	1400	700	-
117	535	1	1300	1300	-
117	535	2	1800	1800	-
117	537	0	1300	1100	-
117	537	1	1100	1700	-
117	537	2	1400	2200	-
119	523	0	1000	1300	-
119	523	1	1500	1400	-
119	523	2	1000	-	-
119	525	0	1300	600	-
119	525	1	1300	800	-
119	525	2	1200	800	-
119	527	0	1100	300	-
119	527	1	1700	300	-
119	527	2	1200	600	-
119	529	0	1500	1100	-
119	529	1	1600	800	-
119	529	2	1500	1600	-
119	531	0	1300	400	-
119	531	1	1500	300	-
119	531	2	1400	600	-
119	533	0	1000	700	-
119	533	1	1800	900	-
119	533	2	1500	-	-
119	535	0	1600	800	-
119	535	1	1800	700	-
119	535	2	1600	400	-
119	537	0	1300	1600	-
119	537	1	1600	1300	-
119	537	2	900	2100	-
121	523	0	1200	900	-
121	523	1	1400	1300	-
121	523	2	1200	-	-
121	525	0	1600	1600	-
121	525	1	1300	1800	-
121	525	2	1700	2100	-
121	527	0	1100	700	-
121	527	1	1700	300	-
121	527	2	1500	100	-

Field Cell 5B EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fal l2018**	**µS/cm Spring 2019**
121	529	0	1500	200	-
121	529	1	1600	400	-
121	529	2	1400	1200	-
121	531	0	1300	1000	-
121	531	1	1200	300	-
121	531	2	1900	800	-
121	533	0	800	1400	2600
121	533	1	1400	600	1700
121	533	2	1300	-	900
121	535	0	1600	1200	-
121	535	1	1300	500	-
121	535	2	1200	300	-
121	537	0	1400	1500	-
121	537	1	1400	900	-
121	537	2	800	1600	-
123	523	0	1200	1700	-
123	523	1	1500	2300	-
123	523	2	2100	-	-
123	525	0	1300	400	1900
123	525	1	1200	900	1200
123	525	2	2300	700	1000
123	527	0	1700	1500	-
123	527	1	1700	600	-
123	527	2	1000	400	-
123	529	0	1200	1200	-
123	529	1	3500	400	-
123	529	2	1700	300	-
123	531	0	1200	1100	-
123	531	1	500	600	-
123	531	2	900	400	-
123	533	0	1300	1000	-
123	533	1	1300	700	-
123	533	2	500	-	-
123	535	0	1600	900	-
123	535	1	900	700	-
123	535	2	1200	400	-
123	537	0	1400	1100	-
123	537	1	1300	1700	-
123	537	2	1200	2100	-
125	523	0	600	1100	-
125	523	1	1100	3000	-
125	523	2	1000	-	-
125	525	0	1300	1000	-
125	525	1	1300	1700	-
125	525	2	1500	2800	-

Field Cell 5B EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fal l2018**	**µS/cm Spring 2019**
125	527	0	1300	1700	-
125	527	1	1500	1600	-
125	527	2	1400	1200	-
125	529	0	1600	1100	-
125	529	1	1200	500	-
125	529	2	1300	600	-
125	531	0	1200	1600	-
125	531	1	1300	500	-
125	531	2	900	400	-
125	533	0	1500	1600	-
125	533	1	1900	1100	-
125	533	2	1300	300	-
125	535	0	1100	1200	-
125	535	1	1000	300	-
125	535	2	2100	100	-
125	537	0	1800	1500	-
125	537	1	1400	900	-
125	537	2	1400	2900	-
127	523	0	600	2600	-
127	523	1	1500	2100	-
127	523	2	2000	-	-
127	525	0	1300	1800	-
127	525	1	1300	1600	-
127	525	2	1300	1200	-
127	527	0	1500	1400	-
127	527	1	1600	900	-
127	527	2	900	700	-
127	529	0	1500	1800	-
127	529	1	1000	1400	-
127	529	2	1500	-	-
127	531	0	1600	1100	-
127	531	1	1500	1400	-
127	531	2	700	800	-
127	533	0	1300	1800	-
127	533	1	1000	1300	-
127	533	2	2500	800	-
127	535	0	1700	1500	-
127	535	1	1600	1600	-
127	535	2	1300	1200	-
127	537	0	1500	1700	-
127	537	1	1000	1600	-
127	537	2	3800	2500	-
129	523	0	1800	1200	-
129	523	1	1400	2500	-
129	523	2	1700	-	-

Field Cell 5B EC Data

Grid X-axis	Grid Y-axis	Depth (ft)	µS/cm Fall 2017	µS/cm Fal l2018	µS/cm Spring 2019
129	525	0	1600	800	-
129	525	1	1300	1200	-
129	525	2	900	1700	-
129	527	0	1500	600	-
129	527	1	1500	900	-
129	527	2	1300	1100	-
129	529	0	600	1000	2000
129	529	1	1000	1700	1400
129	529	2	1500	2000	1400
129	531	0	1700	1900	-
129	531	1	1300	1100	-
129	531	2	1500	800	-
129	533	0	1100	1500	-
129	533	1	1000	800	-
129	533	2	800	700	-
129	535	0	1300	1700	-
129	535	1	1400	1200	-
129	535	2	1900	1000	-
129	537	0	1600	900	-
129	537	1	1500	1900	-
129	537	2	1300	2200	-
131	523	0	1000	1400	-
131	523	1	1500	2400	-
131	523	2	1000	-	-
131	525	0	1500	1100	-
131	525	1	1300	1200	-
131	525	2	1300	800	-
131	527	0	1200	1400	-
131	527	1	1500	1200	-
131	527	2	1300	-	-
131	529	0	1000	1400	-
131	529	1	1300	1300	-
131	529	2	900	-	-
131	531	0	1400	1600	-
131	531	1	1800	1200	-
131	531	2	700	900	-
131	533	0	1200	1300	-
131	533	1	1300	800	-
131	533	2	1100	600	-
131	535	0	600	900	-
131	535	1	1200	1100	-
131	535	2	1000	2700	-
131	537	0	1400	2000	-
131	537	1	1500	2600	-
131	537	2	1800	2800	-

Field Cell 5B EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**μS/cm Fall 2017**	**μS/cm Fal l2018**	**μS/cm Spring 2019**
133	523	0	1200	2800	-
133	523	1	1500	2700	-
133	523	2	800	-	-
133	525	0	1300	2000	-
133	525	1	1600	2200	-
133	525	2	1900	1600	-
133	527	0	1400	1200	-
133	527	1	1100	1000	-
133	527	2	1100	700	-
133	529	0	1400	1100	-
133	529	1	1000	900	-
133	529	2	800	800	-
133	531	0	1600	1500	-
133	531	1	3100	1200	-
133	531	2	1600	-	-
133	533	0	1200	1400	2300
133	533	1	3000	600	1900
133	533	2	1600	700	1300
133	535	0	1600	1400	-
133	535	1	1300	1800	-
133	535	2	700	1900	-
133	537	0	900	1200	-
133	537	1	1000	1500	-
133	537	2	1700	2400	-
135	523	0	1300	800	-
135	523	1	1400	1800	-
135	523	2	1600	-	-
135	525	0	1200	1300	2500
135	525	1	1000	500	2500
135	525	2	1000	400	2100
135	527	0	1500	900	-
135	527	1	1600	700	-
135	527	2	2100	-	-
135	529	0	900	600	-
135	529	1	1200	400	-
135	529	2	1300	500	-
135	531	0	1700	1500	-
135	531	1	1600	800	-
135	531	2	1500	500	-
135	533	0	1300	1600	-
135	533	1	1700	900	-
135	533	2	800	500	-
135	535	0	1400	2100	-
135	535	1	1400	800	-
135	535	2	1000	600	-

Field Cell 5B EC Data					
Grid X-axis	**Grid Y-axis**	**Depth (ft)**	**µS/cm Fall 2017**	**µS/cm Fal l2018**	**µS/cm Spring 2019**
135	537	0	1900	1600	-
135	537	1	1300	800	-
135	537	2	2000	500	-
137	523	0	1300	700	-
137	523	1	1000	1900	-
137	523	2	1100	-	-
137	525	0	1200	1900	-
137	525	1	1200	900	-
137	525	2	1300	500	-
137	527	0	1600	700	-
137	527	1	1100	300	-
137	527	2	1600	500	-
137	529	0	1400	900	-
137	529	1	1200	600	-
137	529	2	1000	1000	-
137	531	0	1600	700	-
137	531	1	1300	700	-
137	531	2	1000	200	-
137	533	0	1200	800	-
137	533	1	1200	400	-
137	533	2	1800	500	-
137	535	0	1500	700	-
137	535	1	1100	400	-
137	535	2	800	400	-
137	537	0	1000	1400	-
137	537	1	900	700	-
137	537	2	600	-	-

APPENDIX C – Cost Comparison Sheet

Table 11 - Cost Comparison Sheet

			1A - Excavate-N-Replace (w/o drainage)		1B - Excavate-N-Replace (w/ drainage)		2A - Excavate-N-Mix (w/o drainage)		2B - Excavate-N-Mix (w/ drainage)		3A - Amended Soil		3B - Amended Soil w/ Water Flooding		4 - Dirty-N-Clean Mixed		5A - Build-It-Up with Gravel Drainage		5B - Build-It-Up with Geosynthetic Drainage	
DESCRIPTION	**UNITS**	**UNIT COST**	**UNITS NEEDED**	**SUBTOTAL**	**UNITS NEEDED**	**SUBTOTAL**	**UNITS NEEDED**	**SUBTOTAL**	**UNITS NEEDED**	**SUBTOTAL**	**UNITS NEEDED**	**SUBTOTAL**	**UNITS NEEDED**	**SUBTOTAL**	**UNITS NEEDED**	**SUBTOTAL**	**UNITS NEEDED**	**SUBTOTAL**	**UNITS NEEDED**	**SUBTOTAL**
Mobilization/Demobilzation	LUMP SUM	$ 5,000.00	1	$ 5,000.00	1	$ 5,000.00	1	$ 5,000.00	1	$ 5,000.00	1	$ 5,000.00	1	$ 5,000.00	1	$ 5,000.00	1	$ 5,000.00	1	$ 5,000.00
Excavation/Labor	PER PLOT	$ 3,140.00	1	$ 3,140.00	1	$ 3,140.00	1	$ 3,140.00	1	$ 3,140.00	1	$ 3,140.00	1	$ 3,140.00	1	$ 3,140.00	0	--	0	--
Above Grade Dirt Work/Labor	PER PLOT	$ 2,000.00	0	--	0	--	0	--	0	--	0	--	0	--	0	--	1	$ 2,000.00	1	$ 2,000.00
Water Trucks	PER TRIP	$ 250.00	0	--	0	--	0	--	0	--	0	--	10	$ 2,500.00	0	--	0	--	0	--
Install of Sump Pit with Drainage	EACH	$ 739.00	0	--	1	$ 739.00	0	--	1	$ 739.00	1	$ 739.00	1	$ 739.00	1	$ 739.00	0	--	0	--
Filter Fabric	SQ YARD	$ 3.13	0	--	85	$ 265.63	85	$ 265.63	85	$ 265.63	85	$ 265.63	85	$ 265.63	85	$ 265.63	2	$ 85.00	0	--
Backfill - General Fill (Topsoil)	TON	$ 33.90	120	$ 4,068.00	100	$ 3,390.00	0	--	0	--	0	--	0	--	0	--	100	$ 3,390.00	100	$ 3,390.00
Backfill - Riprap	TON	$ 60.00	0	--	0	--	0	--	0	--	0	--	0	--	0	--	0	--	0	--
Backfill - Gravel	TON	$ 40.00	0	--	20	$ 800.00	0	--	20	$ 800.00	20	$ 800.00	20	$ 800.00	20	$ 800.00	20	$ 800.00	0	--
Disposal	TON	$25.00	120	$ 3,000.00	120	$ 3,000.00	0	--	0	--	0	--	0	--	0	--	0	--	0	--
Gypsum (for amendment)	TON	$ 325.00	0	--	0	--	0	--	0	--	1	$ 325.00	1	$ 325.00	0	--	0	--	0	--
Straw Bale (for amendment)	EACH	$ 30.00	0	--	0	--	0	--	0	--	1	$ 30.00	1	$ 30.00	0	--	0	--	0	--
Drainage Geocomposite	SQ YARD	$ 2.80	0	--		--	0	--				--		--		--		--	90	$ 252.00
Impervious Liner	SQ FOOT	$ 0.40	0	--	0	--	0	--	0	--	0	--	0	--	0	--	0	--	0	--
Phytoremediation Construction	PER PLOT	$ 3,650.00	0	--	1	$ 3,650.00	0	--	1	$ 3,650.00	1	$ 3,650.00	1	$ 3,650.00	1	$ 3,650.00	1	$ 3,650.00	1	$ 3,650.00
TOTAL COST				**$ 15,208.00**		**$ 19,984.63**		**$ 8,405.63**		**$ 13,594.63**		**$ 13,949.63**		**$ 16,449.63**		**$ 13,594.63**		**$ 14,925.00**		**$ 14,292.00**
Cost Per Ton (56 tons per plot)				$ 271.57		$ 356.87		$ 150.10		$ 242.76		$ 249.10		$ 293.74		$ 242.76		$ 266.52		$ 255.21
Extrapolated Cost Based on NDIC Site 3 at $60/ton				$ 62.50		$ 82.08		$ 34.52		$ 55.84		$ 57.29		$ 67.56		$ 53.41		$ 58.63		$ 56.15
Total Estimated Cost for 1/2-Acre Site				$ 234,437.50		$ 307,880.99		$ 129,496.16		$ 209,437.34		$ 214,906.43		$ 253,421.16		$ 200,331.37		$ 219,935.87		$ 210,607.93
Total Estimated Cost for 1-Acre Site				$ 468,875.00		$ 615,761.98		$ 258,992.32		$ 418,874.67		$ 429,812.86		$ 506,842.32		$ 400,662.73		$ 439,871.73		$ 421,215.87
Total Estimated Cost for 2-Acre Site				$ 937,750.00		$ 1,231,523.97		$ 517,984.63		$ 837,749.34		$ 859,625.71		$ 1,013,684.64		$ 801,325.46		$ 879,743.46		$ 842,431.73
No. of 1/2-Acre Sites Per $3 Million				21		16		39		24		23		20		25		23		24
No. of 1-Acre Sites Per $3 Million				11		8		19		12		12		10		12		11		12
No. of 2-Acre Sites Per $3 Million				5		4		10		6		6		5		6		6		6

APPENDIX D – Laboratory Analytical Reports

Table 1 - Test Cell Soil Samples

Table 2 - Laboratory Water

Table 3 - PRC-3

ESC Laboratory Analytical Reports and Chain of Custodies

Table 1 - Test Cell Analtyical Results

Sample No.	SC, umhos/cm	Chloride, mg/L
Amend 1 5,000	664	92
Amend 1 12,000	1,670	121
Ammend 1 18,000	1,030	193
Ammend 2 5,000	2,380	63
Amend 2 12,000	2,870	220
Amend 2 18,000	3,170	ND
Amend 3 5,000	1,910	48
Amend 3 12,000	4,060	242
Amend 3 18,000	2,790	140
Amend 4 5,000	2,400	42
Amend 4 12,000	2,730	99
Amend 4 18,000	1,330	120
Amend 5 5,000	2,570	55
Amend 5 12,000	1,180	204
Amend 5 18,000	1,780	172
Amend 6 5,000	3,010	47
Amend 6 12,000	641	68
Amend 6 18,000	2,390	68
Amend 7 5,000	1,050	54
Amend 7 12,000	2,180	126
Amend 7 18,000	2,070	176
Amend 8 5,000	246	54
Amend 8 12,000	499	78
Amend 8 18,000	764	535
Amend 9 3500-6500	1,280	1,290
Amend 9 10,000-14,000	12,700	9,850
Amend 9 16,000-20,000	11,400	6,420
Control 5000	242	59
Control 12,000	13,900	10,400
Control 18,000	562	179
3,500-6,500	2,440	1,510

M1177088 - Brine Pond Remediation Study

Table 1 - Test Cell Analtyical Results

Terracon Consultants, Inc.

Sample No.	SC, umhos/cm	Chloride, mg/L
10,000-14,000	919	117
16,000-20,000	20,100	10,500

Notes

Definitions - SC (specific conductance/electrical conductivity)

SC tested using EPA Method 9050A

Chlorides tested using EPA Method 9056

Calcium, magnesium, and sodium (metals) tested using EPA Method 6010B
-- = not applicable
NE = not established

Table 2 - Test Cell Water Analytical Results

Sample No.	SC, umhos/cm	Chloride, mg/L	Sodium, mg/L
Composite 6/4	30,700	8,930	5,480

Notes

Definitions - SC (specific conductance/electrical conductivity)

SC tested using EPA Method 9050A

Chlorides tested using EPA Method 9056

Calcium, magnesium, and sodium (metals) tested using EPA Method 6010B

-- = not applicable

NE = not established

Sample No.	SC, umhos/cm	Chloride, mg/L	Sodium, mg/L
PRC-3	4,510	1,130	665

Notes

Definitions - SC (specific conductance/electrical conductivity)

SC tested using EPA Method 9050A

Chlorides tested using EPA Method 9056

Calcium, magnesium, and sodium (metals) tested using EPA Method 6010B

-- = not applicable

NE = not established

Pace Analytical®
National Center for Testing & Innovation

ANALYTICAL REPORT

August 31, 2018

Terracon - Fargo, ND

Sample Delivery Group:	L1020455
Samples Received:	08/24/2018
Project Number:	
Description:	Brine Pond Study
Site:	MINOT ND
Report To:	Corey Linderman / Jacqueline Finck 860 9TH ST E West Fargo, ND 58078

Entire Report Reviewed By: John V Hawkins

John Hawkins
Project Manager

12065 Lebanon Rd   Mount Juliet, TN 37122   615-758-5858   800-767-5859   www.pacenational.com

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AMEND 1 5000 L1020455-01 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 15:30	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 20:01	MAJ

AMEND 1 12000 L1020455-02 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 15:30	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 20:09	MAJ

AMEND 1 18000 L1020455-03 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 15:30	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 20:18	MAJ

AMEND 2 5000 L1020455-04 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 15:40	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 20:27	MAJ

AMEND 2 12000 L1020455-05 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 15:40	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 20:36	MAJ

AMEND 2 18000 L1020455-06 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 15:45	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 20:44	MAJ

AMEND 3 5000 L1020455-07 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 15:50	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 22:22	MAJ

AMEND 3 12000 L1020455-08 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 15:50	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 22:31	MAJ

AMEND 3 18000 L1020455-09 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 15:50	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 22:40	MAJ

AMEND 4 5000 L1020455-10 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 15:55	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 22:49	MAJ

AMEND 4 12000 L1020455-11 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:00	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 23:06	MAJ

AMEND 4 18000 L1020455-12 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:00	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 23:15	MAJ

AMEND 5 5000 L1020455-13 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:05	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 23:24	MAJ

AMEND 5 12000 L1020455-14 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:10	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 23:33	MAJ

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:10	08/24/18 08:45

AMEND 5 18000 L1020455-15 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/28/18 23:41	MAJ

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:15	08/24/18 08:45

AMEND 6 5000 L1020455-16 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/29/18 00:08	MAJ

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:15	08/24/18 08:45

AMEND 6 12000 L1020455-17 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/29/18 00:16	MAJ

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:20	08/24/18 08:45

AMEND 6 18000 L1020455-18 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/29/18 00:25	MAJ

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:20	08/24/18 08:45

AMEND 7 5000 L1020455-19 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157204	1	08/25/18 13:39	08/25/18 14:27	MJA
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/29/18 00:34	MAJ

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:23	08/24/18 08:45

AMEND 7 12000 L1020455-20 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157063	1	08/24/18 20:56	08/29/18 00:52	MAJ

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:25	08/24/18 08:45

AMEND 7 18000 L1020455-21 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157206	1	08/25/18 12:35	08/27/18 17:47	MAJ

AMEND 8 18000 L1020455-22 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:35	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157206	5	08/25/18 12:35	08/27/18 17:56	MAJ

AMEND 8 12000 L1020455-23 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:30	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157206	1	08/25/18 12:35	08/27/18 18:04	MAJ

AMEND 8 5000 L1020455-24 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:30	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157206	1	08/25/18 12:35	08/27/18 18:13	MAJ

AMEND 9 3500-6500 L1020455-25 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:30	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157206	5	08/25/18 12:35	08/27/18 18:22	MAJ

AMEND 9 10000-14000 L1020455-26 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:30	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157206	20	08/25/18 12:35	08/27/18 18:31	MAJ

AMEND 9 16000-20000 L1020455-27 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:30	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157206	20	08/25/18 12:35	08/27/18 18:57	MAJ

CONTROL 5000 L1020455-28 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:35	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157206	1	08/25/18 12:35	08/27/18 19:06	MAJ

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

CONTROL 12000 L1020455-29 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:39	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157206	50	08/25/18 12:35	08/27/18 19:15	MAJ

CONTROL 18000 L1020455-30 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/21/18 16:40	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157206	1	08/25/18 12:35	08/27/18 19:32	MAJ

3500-6500 L1020455-31 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/22/18 16:35	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157206	5	08/25/18 12:35	08/27/18 19:41	MAJ

10000-14000 L1020455-32 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/22/18 16:35	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157206	1	08/25/18 12:35	08/27/18 19:50	MAJ

16000-20000 L1020455-33 Solid

Collected by	Collected date/time	Received date/time
Sean Gordon	08/22/18 16:35	08/24/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 9050AMod	WG1157205	1	08/27/18 20:49	08/27/18 23:27	MZ
Wet Chemistry by Method 9056A	WG1157206	20	08/25/18 12:35	08/27/18 19:58	MAJ

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

John V Hawkins

John Hawkins
Project Manager

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	664		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	92.1		10.0	1	08/28/2018 20:01	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	1670		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	121		10.0	1	08/28/2018 20:09	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	1030		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	193		10.0	1	08/28/2018 20:18	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	2380		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	62.8		10.0	1	08/28/2018 20:27	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	2870		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	220		10.0	1	08/28/2018 20:36	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	3170		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	ND		10.0	1	08/28/2018 20:44	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	1910		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	48.2		10.0	1	08/28/2018 22:22	WG1157063

Wet Chemistry by Method 9050AMod

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	umhos/cm		umhos/cm		date / time	
Specific Conductance	4060		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	242		10.0	1	08/28/2018 22:31	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	2790		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	140		10.0	1	08/28/2018 22:40	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	2400		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	41.6		10.0	1	08/28/2018 22:49	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	2730		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	98.9		10.0	1	08/28/2018 23:06	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	1330		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	120		10.0	1	08/28/2018 23:15	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	2570		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	54.8		10.0	1	08/28/2018 23:24	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	1180		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	204		10.0	1	08/28/2018 23:33	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	1780		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	172		10.0	1	08/28/2018 23:41	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	3010		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	46.9		10.0	1	08/29/2018 00:08	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	641		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	68.0		10.0	1	08/29/2018 00:16	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	2390		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	68.7		10.0	1	08/29/2018 00:25	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	1050		10.0	1	08/25/2018 14:27	WG1157204

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	54.0		10.0	1	08/29/2018 00:34	WG1157063

Wet Chemistry by Method 9050AMod

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	umhos/cm		umhos/cm		date / time	
Specific Conductance	2180		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	126		10.0	1	08/29/2018 00:52	WG1157063

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	2070		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	176		10.0	1	08/27/2018 17:47	WG1157206

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	764		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	535		50.0	5	08/27/2018 17:56	WG1157206

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	499		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	78.1		10.0	1	08/27/2018 18:04	WG1157206

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	246		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	54.8		10.0	1	08/27/2018 18:13	WG1157206

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	1280		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	1290		50.0	5	08/27/2018 18:22	WG1157206

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	12700		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	9850		200	20	08/27/2018 18:31	WG1157206

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	11400		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	6420		200	20	08/27/2018 18:57	WG1157206

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	242		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	58.8		10.0	1	08/27/2018 19:06	WG1157206

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	13900		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	10400		500	50	08/27/2018 19:15	WG1157206

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	562		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	179		10.0	1	08/27/2018 19:32	WG1157206

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	2440		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	1510		50.0	5	08/27/2018 19:41	WG1157206

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	919		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	117		10.0	1	08/27/2018 19:50	WG1157206

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	20100		10.0	1	08/27/2018 23:27	WG1157205

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	10500		200	20	08/27/2018 19:58	WG1157206

Method Blank (MB)

(MB) R3336664-1 08/25/18 14:27

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	U		10.0	10.0

L1020455-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1020455-01 08/25/18 14:27 • (DUP) R3336664-4 08/25/18 14:27

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	664	670	1	0.900		20

L1020455-11 Original Sample (OS) • Duplicate (DUP)

(OS) L1020455-11 08/25/18 14:27 • (DUP) R3336664-5 08/25/18 14:27

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	2730	2720	1	0.367		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3336664-2 08/25/18 14:27 • (LCSD) R3336664-3 08/25/18 14:27

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	1090	1100	1100	101	101	85.0-115			0.0906	20

Method Blank (MB)

(MB) R3337095-1 08/27/18 23:27

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	U		10.0	10.0

L1020455-20 Original Sample (OS) • Duplicate (DUP)

(OS) L1020455-20 08/27/18 23:27 • (DUP) R3337095-4 08/27/18 23:27

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	2180	2170	1	0.460		20

L1020455-32 Original Sample (OS) • Duplicate (DUP)

(OS) L1020455-32 08/27/18 23:27 • (DUP) R3337095-5 08/27/18 23:27

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	919	909	1	1.09		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3337095-2 08/27/18 23:27 • (LCSD) R3337095-3 08/27/18 23:27

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	1090	1100	1090	101	99.7	85.0-115			1.10	20

Method Blank (MB)

(MB) R3337655-1 08/28/18 18:15

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	U		0.795	10.0

L1020455-10 Original Sample (OS) • Duplicate (DUP)

(OS) L1020455-10 08/28/18 22:49 • (DUP) R3337655-4 08/28/18 22:57

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	41.6	37.7	1	9.77		15

L1020455-19 Original Sample (OS) • Duplicate (DUP)

(OS) L1020455-19 08/29/18 00:34 • (DUP) R3337655-5 08/29/18 00:43

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	54.0	50.9	1	5.84		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3337655-2 08/28/18 18:24 • (LCSD) R3337655-3 08/28/18 18:33

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	205	205	102	103	80.0-120			0.0673	15

L1020455-20 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1020455-20 08/29/18 00:52 • (MS) R3337655-6 08/29/18 01:00 • (MSD) R3337655-7 08/29/18 01:09

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Chloride	500	126	626	633	99.8	101	1	80.0-120			1.21	15

Method Blank (MB)

(MB) R3337099-1 08/27/18 16:19

	MB Result	MB Qualifier	MB MDL	MB RDL
Analyte	mg/kg		mg/kg	mg/kg
Chloride	U		0.795	10.0

L1020455-29 Original Sample (OS) • Duplicate (DUP)

(OS) L1020455-29 08/27/18 19:15 • (DUP) R3337099-4 08/27/18 19:23

	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
Analyte	mg/kg	mg/kg		%		%
Chloride	10400	9910	50	4.86		15

L1020545-02 Original Sample (OS) • Duplicate (DUP)

(OS) L1020545-02 08/27/18 20:16 • (DUP) R3337099-5 08/27/18 20:42

	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
Analyte	mg/kg	mg/kg		%		%
Chloride	30.2	37.1	1	20.2	P1	15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3337099-2 08/27/18 16:28 • (LCSD) R3337099-3 08/27/18 16:37

	Spike Amount	LCS Result	LCSD Result	LCS Rec.	LCSD Rec.	Rec. Limits	LCS Qualifier	LCSD Qualifier	RPD	RPD Limits
Analyte	mg/kg	mg/kg	mg/kg	%	%	%			%	%
Chloride	200	204	205	102	102	80.0-120			0.195	15

L1020545-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1020545-03 08/27/18 20:51 • (MS) R3337099-6 08/27/18 21:00 • (MSD) R3337099-7 08/27/18 21:09

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	mg/kg	mg/kg	mg/kg	mg/kg	%	%		%			%	%
Chloride	500	40.9	559	551	104	102	1	80.0-120			1.45	15

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Abbreviations and Definitions

MDL	Method Detection Limit.
ND	Not detected at the Reporting Limit (or MDL where applicable).
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
P1	RPD value not applicable for sample concentrations less than 5 times the reporting limit.

ACCREDITATIONS & LOCATIONS

Pace National is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our one location design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be YOUR LAB OF CHOICE.
* Not all certifications held by the laboratory are applicable to the results reported in the attached report.
* Accreditation is only applicable to the test methods specified on each scope of accreditation held by Pace National.

State Accreditations

Alabama	40660
Alaska	17-026
Arizona	AZ0612
Arkansas	88-0469
California	2932
Colorado	TN00003
Connecticut	PH-0197
Florida	E87487
Georgia	NELAP
Georgia [1]	923
Idaho	TN00003
Illinois	200008
Indiana	C-TN-01
Iowa	364
Kansas	E-10277
Kentucky [1,6]	90010
Kentucky [2]	16
Louisiana	AI30792
Louisiana [1]	LA180010
Maine	TN0002
Maryland	324
Massachusetts	M-TN003
Michigan	9958
Minnesota	047-999-395
Mississippi	TN00003
Missouri	340
Montana	CERT0086
Nebraska	NE-OS-15-05
Nevada	TN-03-2002-34
New Hampshire	2975
New Jersey–NELAP	TN002
New Mexico [1]	n/a
New York	11742
North Carolina	Env375
North Carolina [1]	DW21704
North Carolina [3]	41
North Dakota	R-140
Ohio–VAP	CL0069
Oklahoma	9915
Oregon	TN200002
Pennsylvania	68-02979
Rhode Island	LAO00356
South Carolina	84004
South Dakota	n/a
Tennessee [1,4]	2006
Texas	T 104704245-17-14
Texas [5]	LAB0152
Utah	TN00003
Vermont	VT2006
Virginia	460132
Washington	C847
West Virginia	233
Wisconsin	9980939910
Wyoming	A2LA

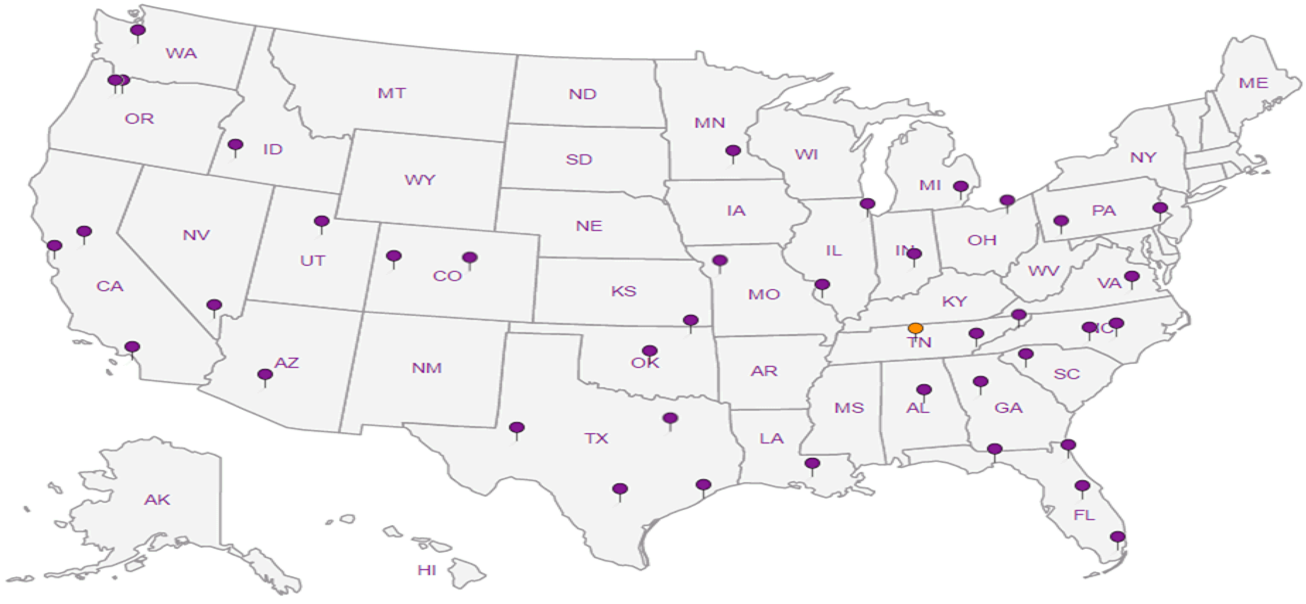
Third Party Federal Accreditations

A2LA – ISO 17025	1461.01
A2LA – ISO 17025 [5]	1461.02
Canada	1461.01
EPA–Crypto	TN00003
AIHA-LAP,LLC EMLAP	100789
DOD	1461.01
USDA	P330-15-00234

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

Our Locations

Pace National has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. Pace National performs all testing at our central laboratory.



Chain of Custody Page 1 of 4

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12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L# L1020455

F123

Acctnum: **TERRAFND**
Template:
Prelogin:
TSR: **3:1 - John Hawkins**
PB:
Shipped Via:

Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:
Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Report to: Corey Lindeman

Email To: corey.lindeman@terracon.com

Project Description: Brine Pond Study

City/State Collected: West Fargo, ND

Phone: **701-356-7621**
Fax:

Client Project # M1177088

Lab Project # TERRAFND-M1177088

Collected by (print): Sean Gordon

Site/Facility ID #

P.O. #

Collected by (signature):

Immediately Packed on Ice N ___ Y X

Rush? (Lab MUST Be Notified)
___ Same Day
___ Next Day
___ Two Day
___ Three Day
X Five Day
___ 5 Day (Rad Only)
___ 10 Day (Rad Only)

Quote #

Date Results Needed

Analysis / Container / Preservative: Chlorides/EC 4oz

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	Chlorides/EC 4oz	Remarks	Sample # (lab only)
Amend 1 5000	Comp	SS	N/A	8/21/18	3:30	1	X		-01
Amend 1 12000	Comp	SS	AA	8/21/18	3:30	1	X		-02
Amend 1 18000	Comp	SS	NA	8/21/18	3:30	1	X		-03
Amend 2 5000	Comp	SS	NA	8/21/18	3:40	1	X		-04
Amend 2 12000	Comp	SS	NA	8/21/18	3:40	1	X		-05
Amend 2 18000	Comp	SS	NA	8/21/18	3:45	1	X		-06
Amend 3 5000	Comp	SS	NA	8/21/18	3:50	1	X		-07
Amend 3 12000	Comp	SS	NA	8/21/18	3:50	1	X		-08
Amend 3 18000	Comp	SS	NA	8/21/18	3:50	1	X		-09
Amend 4 5000	Comp	SS	NA	8/21/18	3:55	1	X		-10

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other ________

Remarks:

pH ______ Temp ______
Flow ______ Other ______

RAD SCREEN: <0.5 mR/hr

Samples returned via:
__ UPS ✓ FedEx __ Courier __ ____

Tracking # 7466 1469 2078

Sample Receipt Checklist
COC Seal Present/Intact: _NP [✓ Y] _N
COC Signed/Accurate: [✓ Y] _N
Bottles arrive intact: [✓ Y] _N
Correct bottles used: [✓ Y] _N
Sufficient volume sent: [✓ Y] _N
If Applicable
VOA Zero Headspace: _Y _N
Preservation Correct/Checked: _Y _N

Relinquished by : (Signature)
Date: 8/23/18
Time: 4:30
Received by: (Signature)

Trip Blank Received: Yes / [✓ No]
HCL / MeoH
TBR

Relinquished by : (Signature)
Date:
Time:
Received by: (Signature)

Temp: 1.2 °C
Bottles Received: 33

If preservation required by Login: Date/Time

Relinquished by : (Signature)
Date:
Time:
Received for lab by: (Signature) asm

Date: 8/24/18
Time: 849

Hold:

Condition: NCF / [✓ OK]

Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:

Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page 3 of 4

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12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

Report to: Corey Lindeman

Email To: corey.lindeman@terracon.com

Project Description: Brine Pond Study

City/State Collected: West Fargo, ND

Phone: **701-356-7621**
Fax:

Client Project #: M1177088

Lab Project #: TERRAFND-M1177088

L# 1020455

Table #

Collected by (print): Sean Gordon

Site/Facility ID #

P.O. #

Acctnum: **TERRAFND**

Template:

Prelogin:

TSR: **341 - John Hawkins**

PB:

Shipped Via:

Collected by (signature):

Immediately Packed on Ice N ___ Y X

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	Chlorides/EC 4oz	Remarks	Sample # (lab only)
Amend 4 12000	Comp	SS	NA	8/21/18	4:00	1	X		-11
Amend 4 18000	Comp	SS	NA	8/21/18	4:00	1	X		-12
Amend 5 5000	Comp	SS	NA	8/21/18	4:05	1	X		-13
Amend 5 12000	Comp	SS	NA	8/21/18	4:10	1	X		-14
Amend 5 18000	Comp	SS	NA	8/21/18	4:10	1	X		-15
Amend 6 5000	Comp	SS	NA	8/21/18	4:15	1	X		-16
Amend 6 12000	Comp	SS	NA	8/21/18	4:15	1	X		-17
Amend 6 18000	Comp	SS	NA	8/21/18	4:20	1	X		-18
Amend 7 5000	Comp	SS	NA	8/21/18	4:20	1	X		-19
Amend 7 12000	Comp	SS	NA	8/21/18	4:23	1	X		-20

* Matrix:
SS - Soil **AIR** - Air **F** - Filter
GW - Groundwater **B** - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other ________

Remarks:

pH ______ Temp ______

Flow ______ Other ______

RAD SCREEN: <0.5 mR/hr

Samples returned via:
__ UPS __ FedEx __ Courier __ ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature)	Date: 8/23/18	Time: 4:30	Received by: (Signature)	Trip Blank Received: Yes / [✓ No] HCL / MeoH TBR	
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: 1.2 °C	Bottles Received: 33
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 8/24/18	Time: 845

If preservation required by Login: Date/Time

Hold:

Condition: NCF / [✓ OK]

Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:

Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page 3 of 4

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12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

Report to: Corey Lindeman

Email To: corey.lindeman@terracon.com

Project Description: Brine Pond Study

City/State Collected: West Fargo, ND

Phone: 701-356-7621

Fax:

Client Project # M1177088

Lab Project # TERRAFND-M1177088

L# 1020455

Table #

Collected by (print): Sean Gordon

Site/Facility ID #

P.O. #

Acctnum: **TERRAFND**

Template:

Prelogin:

TSR: **341 - John Hawkins**

PB:

Shipped Via:

Collected by (signature):

Immediately Packed on Ice N ___ Y X

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	Chlorides/EC 4oz	Remarks	Sample # (lab only)
Amend 7 18000	Comp	SS	NA	8/21/18	4:25	1	X		-21
Amend 8 18000	Comp	SS	NA	8/21/18	4:35	1	X		-22
Amend 8 12000	Comp	SS	NA	8/21/18	4:30	1	X		-23
Amend 8 5000	Comp	SS	NA	8/21/18	4:30	1	X		-24
Amend 9 3500-6500	Comp	SS	NA	8/22/18	4:30	1	X		-25
Amend 9 10,000-14000	Comp	SS	NA	8/22/18	4:30	1	X		-26
Amend 9 16,000-20,000	Comp	SS	NA	8/22/18	4:30	1	X		-27
Control 5000	Comp	SS	NA	8/21/18	4:35	1	X		-28
Control 12000	Comp	SS	NA	8/21/18	4:39	1	X		-29
Control 18000	Comp	SS	NA	8/21/18	4:40	1	X		-30

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

RAD SCREEN: <0.5 mR/hr

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier __ ____

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature)	Date: 8/23/18	Time: 4:30	Received by: (Signature)	Trip Blank Received: Yes / [✓ No] HCL / MeoH TBR	
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: 1.2 °C Bottles Received: 33	If preservation required by Login: Date/Time
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 8/24/18 Time: 845	Hold: Condition: NCF / [✓ OK]

Chain of Custody Page 4 of 4

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12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:

Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Report to: Corey Lindeman

Email To: corey.lindeman@terracon.com

Project Description: Bike Pond Study

City/State Collected: West Fargo, ND

Phone: **701-356-7621**
Fax:

Client Project # M1177088

Lab Project # TERRAFND-M1177088

Collected by (print): Sean Gordon

Site/Facility ID #

P.O. #

Collected by (signature):

Immediately Packed on Ice N____ Y X

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

L# 1020455

Table #

Acctnum: **TERRAFND**

Template:

Prelogin:

TSR: **341 - John Hawkins**

PB:

Shipped Via:

Analysis / Container / Preservative

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	Chlorides/EC 4oz										Remarks	Sample # (lab only)
3500-6500	Comp	SS	NA	8/23/18	4:35	1	X											-31
10,000-14000	Comp	SS	NA	8/23/18	4:35	1	X											-32
16,000-20000	Comp	SS	NA	8/23/18	4:35	1	X											-33

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

RAD SCREEN: <0.5 mR/hr

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier __ ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature) Sean Gordon
Date: 8/23/18
Time: 4:30
Received by: (Signature)
Trip Blank Received: Yes / [✓ No]
HCL / MeoH
TBR

Relinquished by : (Signature)
Date:
Time:
Received by: (Signature)
Temp: 1.2 °C
Bottles Received: 33
If preservation required by Login: Date/Time

Relinquished by : (Signature)
Date:
Time:
Received for lab by: (Signature)
Date: 8/24/18
Time: 849
Hold:
Condition: NCF / [✓ OK]

ANALYTICAL REPORT

June 11, 2018

Terracon - Fargo, ND

Sample Delivery Group:	L998986
Samples Received:	06/05/2018
Project Number:	M1177088
Description:	Brine Pond Study
Report To:	Correy Linderman 860 9TH ST E West Fargo, ND 58078

Entire Report Reviewed By: John V Hawkins

John Hawkins
Technical Service Representative

12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.esclabsciences.com

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	Collected by	Collected date/time	Received date/time
COMPOSITE 6/4 L998986-01 WW	Corey Lindeman	06/04/18 08:00	06/05/18 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 120.1	WG1120174	1	06/05/18 23:21	06/05/18 23:21	MZ
Wet Chemistry by Method 300.0	WG1120066	100	06/05/18 17:57	06/05/18 17:57	DR
Metals (ICP) by Method 200.7	WG1120545	10	06/06/18 15:07	06/07/18 16:28	TRB

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All radiochemical sample results for solids are reported on a dry weight basis with the exception of tritium, carbon-14 and radon, unless wet weight was requested by the client. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

John V Hawkins

John Hawkins
Technical Service Representative

COMPOSITE 6/4

Collected date/time: 06/04/18 08:00

SAMPLE RESULTS - 01

L998986

Wet Chemistry by Method 120.1

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	umhos/cm		umhos/cm		date / time	
Specific Conductance	30700		10.0	1	06/05/2018 23:21	WG1120174

Wet Chemistry by Method 300.0

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/l		mg/l		date / time	
Chloride	8930		100	100	06/05/2018 17:57	WG1120066

Metals (ICP) by Method 200.7

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/l		mg/l		date / time	
Sodium	5480		10.0	10	06/07/2018 16:28	WG1120545

Method Blank (MB)

(MB) R3315623-1 06/05/18 23:21

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	U		10.0	10.0

L998862-01 Original Sample (OS) • Duplicate (DUP)

(OS) L998862-01 06/05/18 23:21 • (DUP) R3315623-4 06/05/18 23:21

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	3510	3510	1	0.000		20

L999136-04 Original Sample (OS) • Duplicate (DUP)

(OS) L999136-04 06/05/18 23:21 • (DUP) R3315623-5 06/05/18 23:21

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	1080	1070	1	0.930		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3315623-2 06/05/18 23:21 • (LCSD) R3315623-3 06/05/18 23:21

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	877	872	873	99.4	99.5	85.0-115			0.115	20

Method Blank (MB)

(MB) R3315496-1 06/05/18 07:16

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Chloride	U		0.0519	1.00

L998576-19 Original Sample (OS) • Duplicate (DUP)

(OS) L998576-19 06/05/18 15:23 • (DUP) R3315496-4 06/05/18 15:39

Analyte	Original Result mg/l	DUP Result mg/l	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	2.65	2.61	1	1.73		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3315496-2 06/05/18 07:31 • (LCSD) R3315496-3 06/05/18 07:47

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	40.0	39.4	39.3	98.5	98.4	90.0-110			0.116	20

L998576-19 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L998576-19 06/05/18 15:23 • (MS) R3315496-5 06/05/18 15:54 • (MSD) R3315496-6 06/05/18 16:09

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Chloride	50.0	2.65	53.6	54.0	102	103	1	80.0-120			0.782	20

Method Blank (MB)

(MB) R3316147-1 06/07/18 09:24

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Sodium	U		0.0939	1.00

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3316147-2 06/07/18 09:26 • (LCSD) R3316147-3 06/07/18 09:29

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Sodium	10.0	9.67	9.81	96.7	98.1	85.0-115			1.39	20

L999091-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L999091-01 06/07/18 09:31 • (MS) R3316147-5 06/07/18 09:36 • (MSD) R3316147-6 06/07/18 09:39

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Sodium	10.0	68.4	78.0	75.8	96.3	73.8	1	70.0-130			2.93	20

L999099-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L999099-01 06/07/18 09:41 • (MS) R3316147-7 06/07/18 09:44 • (MSD) R3316147-8 06/07/18 09:46

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Sodium	10.0	196	209	204	126	81.2	1	70.0-130			2.19	20

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Abbreviations and Definitions

MDL	Method Detection Limit.
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, the sample preparation volume or weight values differ from the standard, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
	The remainder of this page intentionally left blank, there are no qualifiers applied to this SDG.

ACCREDITATIONS & LOCATIONS

ESC Lab Sciences is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our one location design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be YOUR LAB OF CHOICE.

* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

* Accreditation is only applicable to the test methods specified on each scope of accreditation held by ESC Lab Sciences.

State Accreditations

Alabama	40660	Nebraska	NE-OS-15-05
Alaska	17-026	Nevada	TN-03-2002-34
Arizona	AZ0612	New Hampshire	2975
Arkansas	88-0469	New Jersey–NELAP	TN002
California	2932	New Mexico [1]	n/a
Colorado	TN00003	New York	11742
Connecticut	PH-0197	North Carolina	Env375
Florida	E87487	North Carolina [1]	DW21704
Georgia	NELAP	North Carolina [3]	41
Georgia [1]	923	North Dakota	R-140
Idaho	TN00003	Ohio–VAP	CL0069
Illinois	200008	Oklahoma	9915
Indiana	C-TN-01	Oregon	TN200002
Iowa	364	Pennsylvania	68-02979
Kansas	E-10277	Rhode Island	LAO00356
Kentucky [1,6]	90010	South Carolina	84004
Kentucky [2]	16	South Dakota	n/a
Louisiana	AI30792	Tennessee [1,4]	2006
Louisiana [1]	LA180010	Texas	T 104704245-17-14
Maine	TN0002	Texas [5]	LAB0152
Maryland	324	Utah	TN00003
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	460132
Minnesota	047-999-395	Washington	C847
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	9980939910
Montana	CERT0086	Wyoming	A2LA

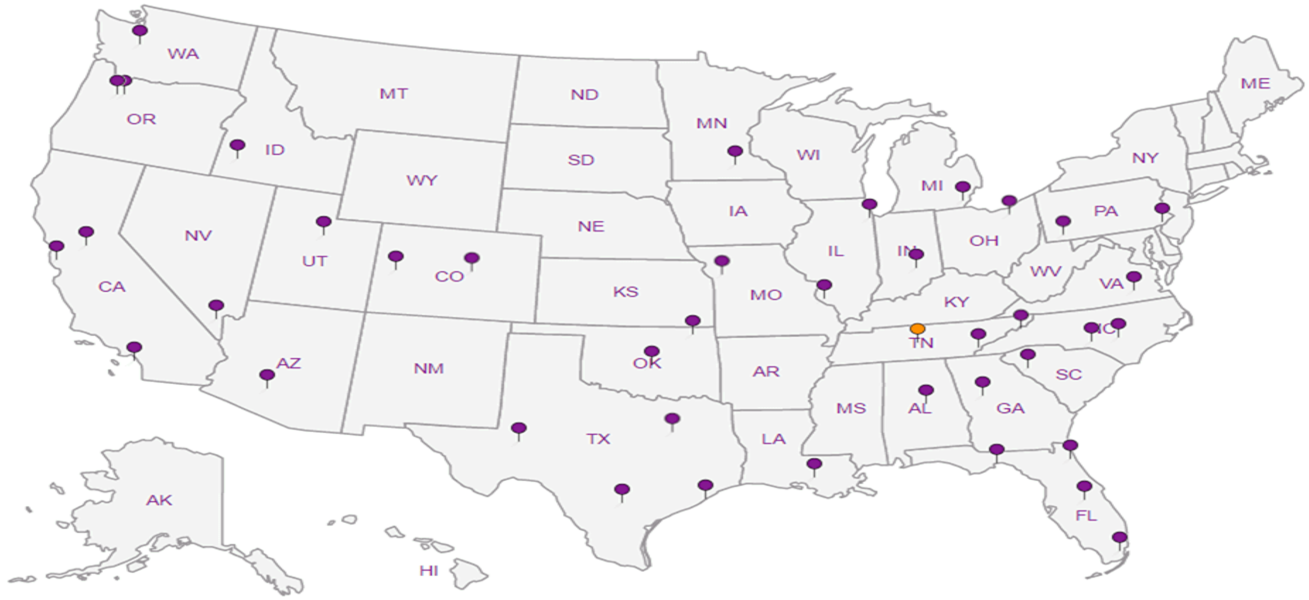
Third Party Federal Accreditations

A2LA – ISO 17025	1461.01	AIHA-LAP,LLC EMLAP	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	P330-15-00234
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

Our Locations

ESC Lab Sciences has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. ESC Lab Sciences performs all testing at our central laboratory.



Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:
~~Levi Goff~~ Corey Lindeman
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

ESC
L·A·B S·C·I·E·N·C·E·S
a subsidiary of Pace Analytical

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L# 998986

F135

Report to: Corey Lindeman

Email To: Corey.lindeman@terracon.com

Project Description: Brine Pond Study

City/State Collected: West Fargo, ND

Phone: ~~701-356-7621~~ 701-639-4486
Fax:

Client Project # M1177088

Lab Project # TERRFND-M1177088

Collected by (print): Corey Lindeman

Site/Facility ID #

P.O. #

Collected by (signature):

Rush? (Lab MUST Be Notified)
___ Same Day
[✓ Five Day]
___ Next Day
___ 5 Day (Rad Only)
___ Two Day
___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Immediately Packed on Ice N ___ [✓ Y]

Acctnum: TERRAFND
Template:
Prelogin:
TSR: 341 - John Hawkins
FB:
Shipped Via:

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	Chlorides 125mL No Pres	SpCON 250mL No Pres	Sodium 250mL No Pres	Remarks	Sample # (lab only)
Composite 6/4	Comp	OT	-0-	6/4/18	8:00AM	3					01

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other Drainage

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS [✓ FedEx] __ Courier ______

Tracking # 7466 1467 4962

Sample Receipt Checklist
COC Seal Present/Intact: [✓ NP] __Y __N
COC Signed/Accurate: [✓ Y] __N
Bottles arrive intact: [✓ Y] __N
Correct bottles used: [✓ Y] __N
Sufficient volume sent: [✓ Y] __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Trip Blank Received: Yes / No HCL / MeoH TBR	
	6/4/18	8:30AM			
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: 2.3 °C	Bottles Received: 3
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 6/5/18	Time: 845

If preservation required by Login: Date/Time

Hold:

Condition: [✓ NCF] / OK

Matt Shacklock

ESC
LAB SCIENCES
YOUR LAB OF CHOICE

Login #:998986	**Client:** TERRAFND	**Date:6/5**	**Evaluated by:Matt S**

Non-Conformance (check applicable items)

	Sample Integrity		**Chain of Custody Clarification**		
	Parameter(s) past holding time	x	Login Clarification Needed		**If Broken Container:**
	Improper temperature		Chain of custody is incomplete		Insufficient packing material around container
	Improper container type		Please specify Metals requested.		Insufficient packing material inside cooler
	Improper preservation		Please specify TCLP requested.		Improper handling by carrier (FedEx / UPS / Courie
	Insufficient sample volume.		Received additional samples not listed on coc.		Sample was frozen
	Sample is biphasic.		Sample ids on containers do not match ids on coc		Container lid not intact
	Vials received with headspace.		Trip Blank not received.		**If no Chain of Custody:**
	Broken container		Client did not "X" analysis.		Received by:
	Broken container:		Chain of Custody is missing		Date/Time:
	Sufficient sample remains				Temp./Cont. Rec./pH:
					Carrier:
					Tracking#

Login Comments:

1. **Analysis not marked**
2. **Sodium bottle unpreserved**

Client informed by:		Call		Email		Voice Mail		Date: 6/5/18	Time: 1412
TSR Initials: JCR	Client Contact:								

Login Instructions:

1) Analyze for all analyses on COC.
2) Preserve and log for NAICP

ANALYTICAL REPORT

July 17, 2018

Terracon - Fargo, ND

Sample Delivery Group:	L1009635
Samples Received:	07/16/2018
Project Number:	M1177088
Description:	Brine Pond Study
Site:	MINOT ND
Report To:	Corey Linderman 860 9TH ST E West Fargo, ND 58078

Entire Report Reviewed By: John V Hawkins

John Hawkins
Project Manager

12065 Lebanon Rd   Mount Juliet, TN 37122   615-758-5858   800-767-5859   www.pacenational.com

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Cn: Case Narrative 4

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  Metals (ICP) by Method 200.7 8

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Sc: Sample Chain of Custody 11

	Collected by	Collected date/time	Received date/time
PRC-3 L1009635-01 WW	Jacqueline Finck	07/13/18 17:00	07/16/18 09:50

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Wet Chemistry by Method 120.1	WG1138673	1	07/17/18 10:37	07/17/18 10:37	MJA
Wet Chemistry by Method 300.0	WG1138318	20	07/17/18 01:26	07/17/18 01:26	MCG
Metals (ICP) by Method 200.7	WG1138631	1	07/16/18 13:42	07/17/18 09:32	CCE

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times, unless qualified or notated within the report. Where applicable, all MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All radiochemical sample results for solids are reported on a dry weight basis with the exception of tritium, carbon-14 and radon, unless wet weight was requested by the client. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

John V Hawkins

John Hawkins
Project Manager

Wet Chemistry by Method 120.1

Analyte	Result umhos/cm	Qualifier	RDL umhos/cm	Dilution	Analysis date / time	Batch
Specific Conductance	4510		10.0	1	07/17/2018 10:37	WG1138673

Wet Chemistry by Method 300.0

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
Chloride	1130		20.0	20	07/17/2018 01:26	WG1138318

Metals (ICP) by Method 200.7

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
Sodium,Dissolved	665	V	1.00	1	07/17/2018 09:32	WG1138631

Method Blank (MB)

(MB) R3326096-2 07/17/18 10:37

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	U		10.0	10.0

L1009353-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1009353-01 07/17/18 10:37 • (DUP) R3326096-6 07/17/18 10:37

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	2510	2500	1	0.399		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3326096-3 07/17/18 10:37 • (LCSD) R3326096-5 07/17/18 10:37

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	877	889	887	101	101	85.0-115			0.225	20

Method Blank (MB)

(MB) R3326090-1 07/16/18 16:52

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Chloride	U		0.0519	1.00

L1009642-01 Original Sample (OS) • Duplicate (DUP)

(OS) L1009642-01 07/17/18 02:03 • (DUP) R3326090-11 07/17/18 02:21

Analyte	Original Result mg/l	DUP Result mg/l	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	13.2	13.4	1	1.69		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3326090-2 07/16/18 17:10 • (LCSD) R3326090-3 07/16/18 17:28

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	40.0	38.5	38.4	96.2	96.1	90.0-110			0.0801	20

L1009642-01 Original Sample (OS) • Matrix Spike (MS)

(OS) L1009642-01 07/17/18 02:03 • (MS) R3326090-12 07/17/18 02:39

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MS Rec. %	Dilution	Rec. Limits %	MS Qualifier
Chloride	50.0	13.2	63.1	99.8	1	80.0-120	

Method Blank (MB)

(MB) R3326086-1 07/17/18 09:24

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Sodium,Dissolved	0.273	J	0.0939	1.00

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3326086-2 07/17/18 09:26 • (LCSD) R3326086-3 07/17/18 09:29

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Sodium,Dissolved	10.0	10.1	10.1	101	101	85.0-115			0.109	20

L1009635-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L1009635-01 07/17/18 09:32 • (MS) R3326086-5 07/17/18 09:37 • (MSD) R3326086-6 07/17/18 09:40

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Sodium,Dissolved	10.0	665	665	672	0.000	68.8	1	70.0-130	V	V	1.07	20

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Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
J	The identification of the analyte is acceptable; the reported value is an estimate.
V	The sample concentration is too high to evaluate accurate spike recoveries.

ACCREDITATIONS & LOCATIONS

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State Accreditations

Alabama	40660
Alaska	17-026
Arizona	AZ0612
Arkansas	88-0469
California	2932
Colorado	TN00003
Connecticut	PH-0197
Florida	E87487
Georgia	NELAP
Georgia [1]	923
Idaho	TN00003
Illinois	200008
Indiana	C-TN-01
Iowa	364
Kansas	E-10277
Kentucky [1,6]	90010
Kentucky [2]	16
Louisiana	AI30792
Louisiana [1]	LA180010
Maine	TN0002
Maryland	324
Massachusetts	M-TN003
Michigan	9958
Minnesota	047-999-395
Mississippi	TN00003
Missouri	340
Montana	CERT0086

Nebraska	NE-OS-15-05
Nevada	TN-03-2002-34
New Hampshire	2975
New Jersey–NELAP	TN002
New Mexico [1]	n/a
New York	11742
North Carolina	Env375
North Carolina [1]	DW21704
North Carolina [3]	41
North Dakota	R-140
Ohio–VAP	CL0069
Oklahoma	9915
Oregon	TN200002
Pennsylvania	68-02979
Rhode Island	LAO00356
South Carolina	84004
South Dakota	n/a
Tennessee [1,4]	2006
Texas	T 104704245-17-14
Texas [5]	LAB0152
Utah	TN00003
Vermont	VT2006
Virginia	460132
Washington	C847
West Virginia	233
Wisconsin	9980939910
Wyoming	A2LA

Third Party Federal Accreditations

A2LA – ISO 17025	1461.01
A2LA – ISO 17025 [5]	1461.02
Canada	1461.01
EPA–Crypto	TN00003

AIHA-LAP,LLC EMLAP	100789
DOD	1461.01
USDA	P330-15-00234

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [6] Wastewater n/a Accreditation not applicable

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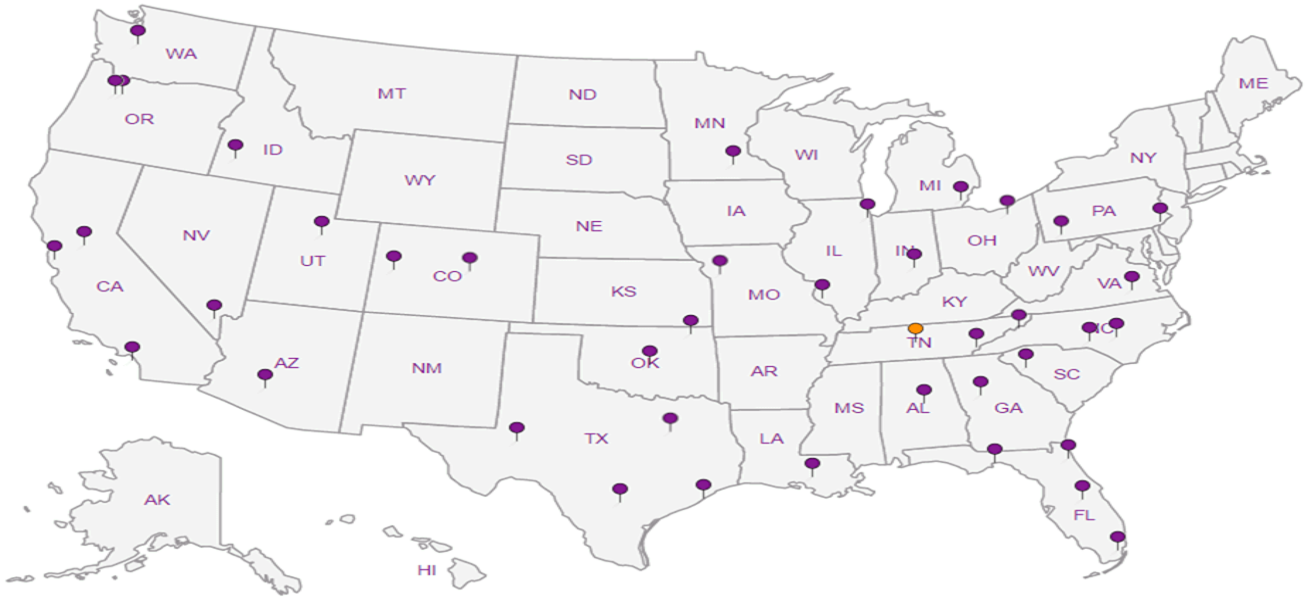

Chain of Custody Page 1 of 1

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L·A·B S·C·I·E·N·C·E·S
a subsidiary of Pace Analytical

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L# L1009635

Table #

Acctnum: **TERRAFND**

Template:

Prelogin:

TSR: **341 - John Hawkins**

PB:

Shipped Via:

Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:
~~Lori Sell~~ Corey Lindeman
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Report to: Corey Lindeman

Email To: corey.lindeman@terracon.com

Project Description: Brine Pond Study

City/State Collected: Maxbass, ND

Phone: **701-356-7621**

Fax:

Client Project # M1177088

Lab Project # TERRAFND-M1177088

Site/Facility ID #

P.O. #

Collected by (print): Jacqueline Fromm

Collected by (signature): Jacqueline Fromm

Immediately Packed on Ice N ____ Y X

Rush? (Lab MUST Be Notified)
X Same Day ___ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed 7/14/18

Analysis / Container / Preservative

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	Chlorides 125mL HDPE	SPCON 250 mL HDPE	Sodium	Remarks	Sample # (lab only)
PRC-3	~~Comp~~ Grab	OT	0	7/13/18	5:10 pm	3	X	X	X		-01

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other Drainage

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
___ UPS ___ FedEx ___ Courier ___ ______

Tracking # 746014692332

Sample Receipt Checklist
COC Seal Present/Intact: [✓ NP] ___Y ___N
COC Signed/Accurate: [✓ Y] ___N
Bottles arrive intact: [✓ Y] ___N
Correct bottles used: [✓ Y] ___N
Sufficient volume sent: [✓ Y] ___N
If Applicable
VOA Zero Headspace: ___Y ___N
Preservation Correct/Checked: ___Y ___N

Relinquished by : (Signature) Jacqueline Fromm Date: 7/13/18 Time: 6:30pm

Received by: (Signature)

Trip Blank Received: Yes / No
HCL / MeoH
TBR

Relinquished by : (Signature) Date: Time:

Received by: (Signature)

Temp: 19.1°C °C Bottles Received: 3

If preservation required by Login: Date/Time

Relinquished by : (Signature) Date: Time:

Received for lab by: (Signature)

Date: 7/16/18 Time: 0950

Hold:

Condition: [✓ NCF] / OK

Pace Analytical®
National Center for Testing & Innovation

Login #: L1009635	**Client: TERRAFND**	**Date: 7/16/18**	**Evaluated by: Jeremy**

Non-Conformance (check applicable items)

	Sample Integrity		Chain of Custody Clarification		
	Parameter(s) past holding time		Login Clarification Needed		**If Broken Container:**
x	Improper temperature		Chain of custody is incomplete		Insufficient packing material around container
	Improper container type		Please specify Metals requested.		Insufficient packing material inside cooler
x	Improper preservation		Please specify TCLP requested.		Improper handling by carrier (FedEx / UPS / Courie
	Insufficient sample volume.		Received additional samples not listed on coc.		Sample was frozen
	Sample is biphasic.		Sample ids on containers do not match ids on coc		Container lid not intact
	Vials received with headspace.		Trip Blank not received.		**If no Chain of Custody:**
	Broken container		Client did not "X" analysis.		Received by:
	Broken container:		Chain of Custody is missing		Date/Time:
	Sufficient sample remains				Temp./Cont. Rec./pH:
					Carrier:
					Tracking#

Login Comments:

1. Received at 19.1 Deg C.
2. Sodium received unpreserved. Total or Dissolved?

Client informed by:		Call		Email		Voice Mail	Date: 7-16-18	Time: 12:29
TSR Initials: JVH	Client Contact: Jackie							

Login Instructions:

1. Received at 19.1 Deg C. **Proceed per client**
2. Sodium received unpreserved. Total or Dissolved? **They desire dissolved sodium**

APPENDIX E – Previous Reports

LSI Preliminary Findings
Baseline Site Assessment
2nd Quarterly Report
3rd Quarterly Report
4th Quarterly Report
5th Quarterly Report
Preliminary Final Report

September 6, 2017

Mr. Cody VanderBusch
Reclamation Specialist
North Dakota Department of Mineral Resources – Oil & Gas Division
600 East Boulevard Avenue Dept. 405
Bismarck, ND 58505-0840

Office: 701-328-8018
Email: cwvanderbusch@nd.gov

Re: Limited Site Investigation – Preliminary Findings
Andersen Parcel
NE ¼ S26-T161N-82W (48.746589, -101.256850)
Bottineau County, North Dakota
Terracon Project No. M1177088

Dear Mr. VanderBusch:

Terracon Consultants, Inc. (Terracon) is pleased to submit this letter of Preliminary Findings summarizing observations and field screening services performed at the above referenced site on August 28-30, 2017.

1.0 SITE DESCRIPTION

Terracon selected one location (latitude 48.746589, longitude -101.256850) approximately 2.25 miles east-southeast of Renville Corner on 25th Avenue NW in Bottineau County, North Dakota identified by the North Dakota Department of Mineral Resources – Oil & Gas Division (NDIC) as a brine pond location as verified by 1961 aerial imagery. Terracon understands the suspect brine pond is located on a parcel of land owned by Daryl and Muriel Andersen (Parcel Number 29000010813000). The location of the brine pond is depicted on Exhibits 1 and 2.

2.0 SCOPE OF SERVICES

The objective of the Limited Site Investigation (LSI) is to evaluate the presence of electrical conductivity (EC), chlorides, sodium, sodium adsorption ratio (SAR), and exchangeable sodium percentage (ESP) above laboratory reporting limits in on-site historic drilling pad locations and immediately adjacent site soils as a result of brine released at the site. The assessment will investigate the horizontal and vertical extent of the brine pond as well as assessing concentration contained as a result of potential releases associated with the site.

2.1 Standard of Care

Terracon's services were performed in a manner consistent with generally accepted practices of the profession undertaken in similar studies in the same geographical area during the same time. Terracon makes no warranties, either express or implied, regarding the findings, conclusions, or recommendations. Please note that Terracon does not warrant the work of laboratories, regulatory agencies, or other third parties supplying information used in the preparation of the report. These LSI services were performed in accordance with the scope of services agreed with you, our client, as reflected in our proposal and were not restricted by American Society of Testing and Materials (ASTM) E1903-11.

2.2 Additional Scope Limitations

Findings, conclusions, and recommendations resulting from these services are based upon information derived from the on-site activities and other services performed under this scope of work; such information is subject to change over time. Certain indicators of the presence of hazardous substances, petroleum products, or other constituents may have been latent, inaccessible, unobservable, nondetectable, or not present during these services. We cannot represent that the site contains no hazardous substances, toxic materials, petroleum products, or other latent conditions beyond those identified during this LSI. Subsurface conditions may vary from those encountered at specific borings or wells or during other surveys, tests, assessments, investigations, or exploratory services. The data, interpretations, findings, and our recommendations are based solely upon data obtained at the time and within the scope of these services.

2.3 Reliance

This report has been prepared for the exclusive use of NDIC and any authorization for use or reliance by any other party (except a governmental entity having jurisdiction over the site) is prohibited without the express written authorization of NDIC and Terracon. Any unauthorized distribution or reuse is at NDIC's sole risk. Notwithstanding the foregoing, reliance by authorized parties will be subject to the terms, conditions, and limitations stated in the proposal, LSI report, and Task Order. The limitation of liability defined in the terms and conditions is the aggregate limit of Terracon's liability to NDIC and all relying parties unless otherwise agreed in writing.

3.0 FIELD INVESTIGATION

Terracon conducted the fieldwork under a general health and safety plan developed for this project. Work was performed using Occupational Safety and Health Agency (OSHA) Level D work attire consisting of hard hats, safety glasses, reflective vests, hearing protection, protective work gloves, and steel-toed work boots. Non-expendable sampling supplies were cleaned at the beginning of the field activity, and between each soil boring by hand scrubbing in an Alconox™ and potable water solution followed by rinsing in potable water. Terracon contacted the North Dakota One Call system and requested location and markings for all utilities that the service was responsible for before commencing intrusive activities at the site. Field investigations occurred on August 28-30, 2017

3.1 Soil Borings

Terracon advanced 12 soil borings with a truck-mounted hollow-stem auger (HSA) drill rig to maximum depths of 25 feet below grade surface (bgs) in the vicinity of the suspect brine pond. Terracon advanced an additional 31 borings to maximum depths of 25 feet bgs for obtaining additional information for later modeling the extent of brine contamination at the site. One additional boring was advanced to a depth of 20 feet bgs approximately 300 feet north of the suspect brine pond to establish a control sample. Exhibit 3 indicates the approximate locations of the soil borings.

Terracon field screened soil samples from for organic vapors using a photoionization detector (PID), electrical conductivity using an EC meter to measure salinity, and chlorides with QuanTab® titration test strips to assess chloride content. The PID provides a direct reading in parts per million (ppm) isobutylene equivalents. The EC meter provides a direct reading in microsiemens per centimeter (µS/cm) and is referred to in this report as micromhos per centimeter (µmhos/cm), a corresponding unit of measure, as field estimates, for EC evaluations. Chloride concentrations were obtained from aqueous extracts of soil samples or water samples using QuanTab® titration tests which provide field salt concentrations in milligrams per liter (mg/L).

Upon removal of the sampler from the soil boring, Terracon put a portion of each sample in a sealable plastic bag. After a stabilization period, Terracon screened the headspace above the soil using the PID equipped with a 10.6 electron-volt (eV) ultraviolet lamp source by piercing the bag with the probe. Soils were then screened using the EC meter equipped with a stainless steel probe inserted directly into the soil. Terracon calibrated the PID and EC meter in accordance with the manufacturer's recommendations before the field activities.

Soil samples were selected to screen aqueous extracts for chloride concentrations using QuanTab® titration test low range (30-600 mg/L) strips and high range (300-6,000 mg/L) strips providing a minimum field detection limit of 27 mg/L and maximum field detection limit of 6,637 mg/L. Boring logs will include field screening results for each soil boring for organic vapors, EC, and chlorides in the final LSI report. Based on the field screening results, Terracon selected soil samples from each soil boring for laboratory analysis.

Terracon's soil boring sampling program consisted of the collection and analysis of two to three soil samples from the zones exhibiting the highest EC and/or PID field reading or the interval of most-likely environmental impact as determined in the field by the sampling professional. After collecting each soil sample in laboratory-provided containers, Terracon recorded the sample time on each container label in permanent ink and placed the filled containers in an ice-filled cooler for transport. The samples and completed chain-of-custody forms were shipped via overnight courier to Environmental Science Corporation Laboratory Services (ESC) in Mt. Juliet, Tennessee, a National Environmental Laboratory Accreditation Program (NELAP)-accredited laboratory provided the analytical services.

At the completion of field activities, Terracon abandoned the borings on August 30, 2017 with commercial bentonite sealant. The borings were completed to surface level.

3.2 Groundwater

Two soil borings exhibiting groundwater (B-2 and B-44) were converted into temporary groundwater sampling points using five feet of 2-inch nominal diameter, 0.01-inch slotted schedule 40 poly vinyl chloride (PVC) screen and enough solid 2-inch nominal diameter schedule 40 PVC riser to leave two to three feet of pipe above grade. The temporary groundwater sampling points were developed by surging and removing groundwater until fluids visually appeared relatively free of fine-grained sediment. Following development of the temporary groundwater sampling points, one set of groundwater samples were collected from boring B-44 using a new polypropylene bailer; however, due to slow infiltration rate and lack of groundwater volume after purging boring B-2, a groundwater sample was not able to be collected.

After collecting the groundwater sample in laboratory-provided containers, Terracon recorded the sample time on each container label in permanent ink and placed the filled containers in an ice-filled cooler for transport. The samples and completed chain-of-custody forms were shipped via overnight courier to ESC.

At the completion of field activities, Terracon retrieved the temporary well screen and abandoned the borings with commercial bentonite sealant. The borings were completed to surface level.

3.3 Electrical Conductivity (EC)

EC surface soil mapping was conducted by using a FieldScout Direct Soil EC meter with an 8-inch stainless steel probe inserted directly into soil to detect the presence of salts in the soil. Surface EC readings were collected in a grid spacing at approximate 20 foot and was limited to the surface, one foot bgs, and two feet bgs readings. The area of mapping was increased until readings were below 2,000 µmhos/cm in the upper two feet to assess the lateral extent of the pit. EC readings were also collected from soil samples from the soil borings. Background EC readings from the control boring (B-45) were obtained for background purposes.

3.4 Chlorides

Terracon field tested soils with QuanTab® titration test strips to measure chloride content in brine impacted soils identified using the EC meter. Samples were collected for performing chloride field screening in soils from the borings and select surficial samples in the general vicinity of the suspect brine pond. Chloride concentrations were also obtained from the control boring (B-45) for site specific background data.

4.0 RESULTS OF THE FIELD INVESTIGATION

4.1 Geology/Hydrogeology

Boring logs will be included in the final LSI report and will summarize the observed soil stratigraphy. A summary descriptive narrative is provided below.

Terracon's borings generally encountered approximately 6-18 inches of organic clay, black to very dark grayish brown in coloration, underlain by native clayey sands and lean clays containing various amounts of sand and gravel to the termination depth of our borings. In several borings, uncontrolled fill was encountered to approximate depths of 1-6 feet bgs in areas of the suspected brine pond location with deeper fill encountered in boring B-1 near the center of the suspected brine pond. Obvious signs of contaminant impacts (i.e., odors, staining, etc.) were observed during soil boring advancements of several borings within the suspected brine pond area as well as surrounding borings. Groundwater was encountered between approximately six and 12 feet bgs in borings B-2 and B-44, respectively. Groundwater was not observed in the remaining borings during advancement, or for the short duration the boreholes remained open.

4.2 PID Field Screening

The organic vapor field screening results utilizing the PID will be summarized on boring logs to be included in the final LSI report. Readings greater than 100 ppm were observed in the borings within the suspected brine pond area as well as surrounding borings with readings exceeding 5,000 ppm in soil boring B-6 (located within the area of the suspected brine pond) at two to three feet bgs.

4.3 EC Field Screening

The EC screening results utilizing the EC meter will be summarized on boring logs to be included in final LSI report. An EC field screening map with the grid sample locations will be illustrated in the final LSI report. EC readings greater than 2,000 µS/cm were recorded in the upper two feet of soil on the site with the highest recorded readings (>20,000 µS/cm) in the vicinity of the suspect brine pond and surrounding area without vegetation.

4.4 Chloride Field Screening

Field results using QuanTab® titration test strips to determine chloride will be included in the final LSI report. The highest chloride concentrations (>6,000 mg/L) from aqueous extracts of soil samples collected were in the vicinity of the suspect brine pond and surrounding area.

5.0 CONCLUSIONS

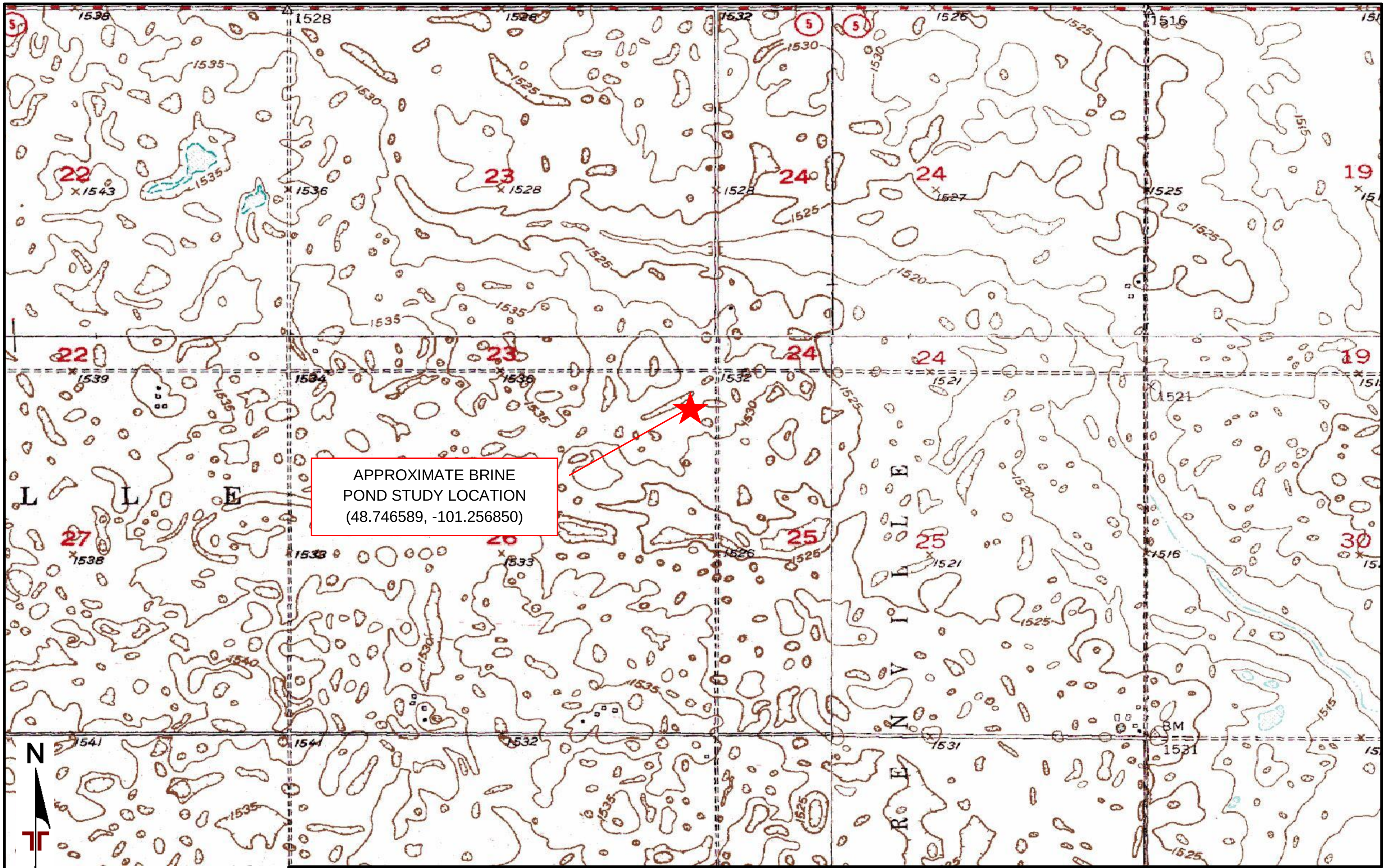
Based on the scope of services described in this report and subject to the limitations described herein, Terracon concludes the following:

- Terracon generally encountered approximately 6-18 inches of organic clay, which was black to very dark grayish brown in coloration, underlain by native clayey sands and lean clays containing various amounts of sand and gravel to the termination depth of our borings. In several borings, uncontrolled fill was encountered to approximate depths of 1-6 feet bgs in areas of the suspected brine pond location with deeper fill encountered in boring B-1 near the center of the suspected brine pond.
- Based on interpretation of 1961 aerial imagery, visual observations, and limited review of field screening data, and preliminary findings of approximate depths of uncontrolled fill encountered in our soil borings, the horizontal extent of the brine pond appears to be approximately 100 feet by 100 feet with a vertical extent of approximately six feet bgs.

Sincerely,
Terracon Consultants, Inc.

Leif H. Schonteich, CSP, CHMM
Environmental Department Manager

Jonathan B. Ellingson (for)
Daniel Schneider, P.E., CHMM
Sr. Environmental Program Manager



APPROXIMATE BRINE
POND STUDY LOCATION
(48.746589, -101.256850)

TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY QUADRANGLES INCLUDE: .

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

Project Manager: LHS	**Project No.** M1177088
Drawn by: LHS	**Scale:** 1"=2,000'
Checked by: JBE	**File Name:** M1177088.pdf
Approved by: DFS	**Date:** 08/25/2017

Terracon

860 9th St. NE Unit K
West Fargo, ND 58078

TOPOGRAPHIC MAP

NDIC Brine Remedial Technology Study
Andersen Parcel
Bottineau County, North Dakota

Exhibit
1

AERIAL PHOTOGRAPHY PROVIDED BY
MICROSOFT BING MAPS

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

Project Manager: LHS	**Project No.** M1177088
Drawn by: LHS	**Scale:** AS SHOWN
Checked by: JBE	**File Name:** M1177088.pdf
Approved by: DFS	**Date:** 08/25/2017

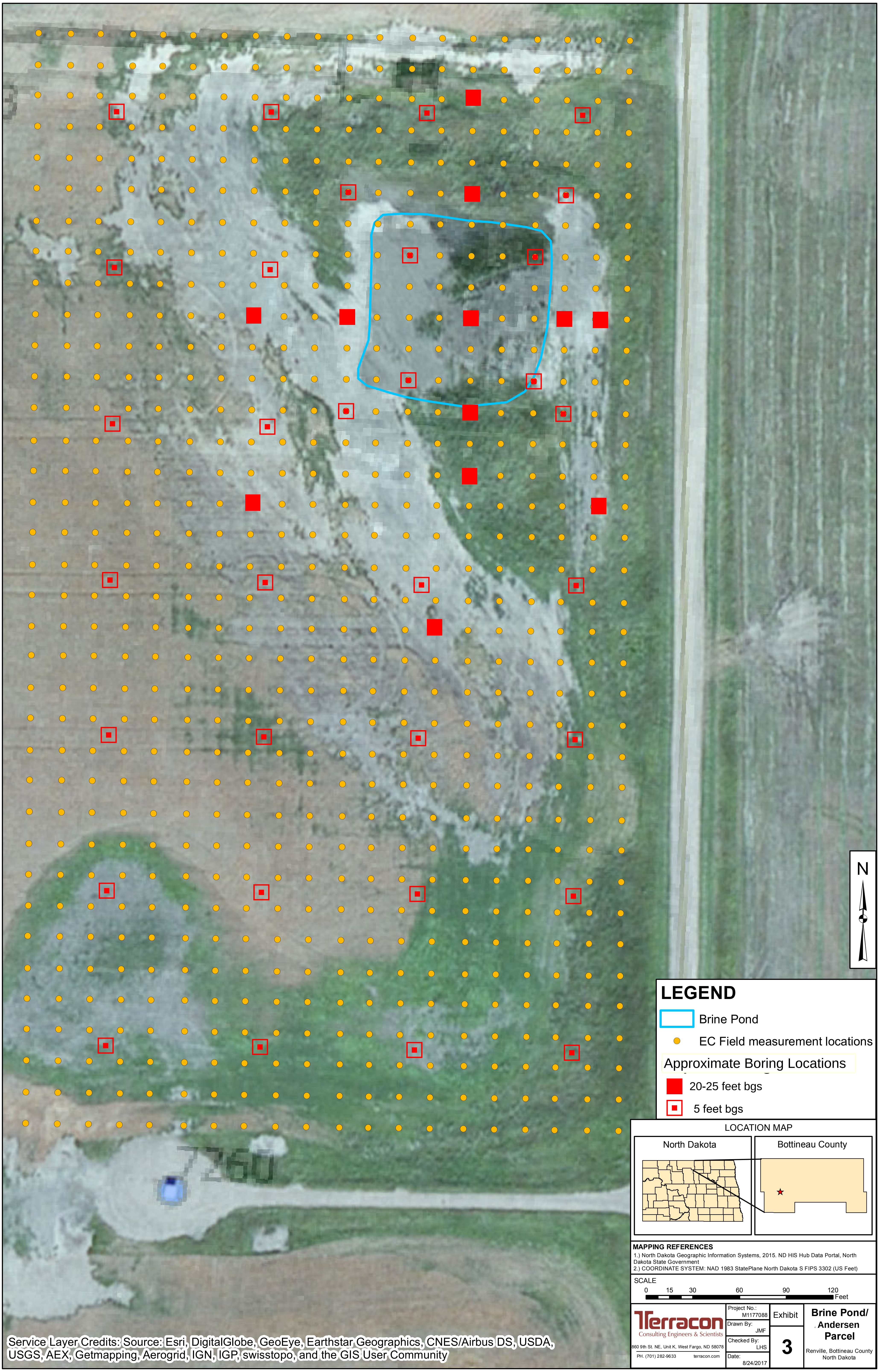
Terracon
860 9th St. NE Unit K
West Fargo, ND 58078

SITE DIAGRAM

NDIC Brine Remedial Technology Study
Andersen Parcel

Bottineau County, North Dakota

Exhibit
2



LEGEND

▭	Brine Pond
●	EC Field measurement locations

Approximate Boring Locations

🟥	20-25 feet bgs
▣	5 feet bgs

MAPPING REFERENCES

1.) North Dakota Geographic Information Systems, 2015. ND HIS Hub Data Portal, North Dakota State Government

2.) COORDINATE SYSTEM: NAD 1983 StatePlane North Dakota S FIPS 3302 (US Feet)

SCALE

0 15 30 60 90 120 Feet

Terracon
Consulting Engineers & Scientists
860 9th St. NE, Unit K, West Fargo, ND 58078
PH. (701) 282-9633 terracon.com

Project No.: M1177088
Drawn By: JMF
Checked By: LHS
Date: 8/24/2017

Exhibit
3

Brine Pond/ Andersen Parcel

Renville, Bottineau County
North Dakota

Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Baseline Site Assessment

NDIC Brine Remediation Study

NE ¼ S26-T161N-82W

Bottineau County, North Dakota

December 21, 2017

Terracon Project No. M1177088

Prepared for:

North Dakota Department of Mineral Resources
Oil & Gas Division
Bismarck, North Dakota

Prepared by:

Terracon Consultants, Inc.
West Fargo, North Dakota

December 21, 2017

North Dakota Department of Mineral Resources – Oil & Gas Division
600 East Boulevard Avenue Dept. 405
Bismarck, ND 58505-0840

Attn: Mr. Cody VanderBusch – Reclamation Specialist
P: [701] 328-8018
E: cwvanderbusch@nd.gov

Re: Baseline Site Assessment
NDIC Brine Remediation Study
NE ¼ S26-T161N-82W (48.746589, -101.256850)
Bottineau County, North Dakota
Terracon Project No. M1177088

Dear Mr. VanderBusch:

Terracon Consultants, Inc. (Terracon) is pleased to submit our report of Baseline Site Assessment completed at the site referenced above. The report presents data from recent field activities including the completion of soil borings and the collection of soil/water samples for chemical analysis. Terracon conducted this assessment in general accordance with our Agreement for Services (reference number PM1177088) dated August 25, 2017, as well as, our Work Plan (reference number M1177088) dated August 29, 2017.

Terracon appreciates this opportunity to provide environmental consulting services for this project. Should you have any questions or require additional information, please do not hesitate to contact our office.

Sincerely,
Terracon Consultants, Inc.

Corey D. Lindeman, EI	Daniel F. Schneider, CHMM
Staff Engineer	National Director,
	Site Investigation and Remediation
	Principal

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BASELINE SITE ASSESSMENT
NDIC BRINE REMEDIATION STUDY
BOTTINEAU COUNTY, NORTH DAKOTA
Terracon Project No. M1177088
December 21, 2017

1.0 BACKGROUND

Terracon has selected one location (latitude 48.7466, longitude -101.2569) approximately 2.25 miles east-southeast of Renville Corner on 25th Avenue NW in Bottineau County, North Dakota (Exhibit 1) identified by the North Dakota Department of Mineral Resources – Oil & Gas Division (NDIC) as an abandoned brine pond location as evidenced on 1961 aerial imagery. Terracon further understands the brine pond location is located on a parcel of land owned by Daryl and Muriel Andersen (Parcel Number 29000010813000). The approximate location of the brine pond is depicted on Exhibit 2. The existing topography of the site is illustrated on Exhibit 3.

2.0 SCOPE OF SERVICES

The objective of this report is to evaluate baseline electrical conductivity (EC), chlorides, sodium, sodium adsorption ratio (SAR), cation exchange capacity (CEC), and exchangeable sodium percentage (ESP) above laboratory reporting limits in on-site historic brine pond locations and immediately adjacent site soils as a result of brine released at the site. The assessment investigated the horizontal and vertical extent of the brine pond due to historic oil and gas operations associated with the site.

2.1 Standard of Care

Terracon's services were performed in a manner consistent with generally accepted practices of the profession undertaken in similar studies in the same geographical area during the same time. Terracon makes no warranties, either express or implied, regarding the findings, conclusions, or recommendations. Please note that Terracon does not warrant the work of laboratories, regulatory agencies, or other third parties supplying information used in the preparation of the report. These reporting services were performed in accordance with the scope of services agreed with you, our client, as reflected in our proposal (Terracon Proposal No. PM1177088 dated August 25, 2017) and were not restricted by American Society of Testing and Materials (ASTM) E1903-11.

2.2 Additional Scope Limitations

Findings, conclusions, and recommendations resulting from these services are based upon information derived from the on-site activities and other services performed under this scope of services; such information is subject to change over time. Certain indicators of the presence of hazardous substances, petroleum products, or other constituents may have been latent, inaccessible, unobservable, non-detectable, or not present during these services. We cannot represent that the site contains no hazardous substances, toxic materials, petroleum products, or other latent conditions beyond those identified during this assessment. Subsurface conditions may vary from those encountered at specific borings or wells or during other surveys, tests, assessments, investigations, or exploratory services. The data, interpretations, findings, and our recommendations are based solely upon data obtained at the time and within the scope of these services.

2.3 Reliance

This report has been prepared for the exclusive use of NDIC Oil and Gas Division and any authorization for use or reliance by any other party (except a governmental entity having jurisdiction over the site) is prohibited without the express written authorization of NDIC Oil and Gas Division and Terracon. Any unauthorized distribution or reuse is at NDIC Oil and Gas Division's sole risk. Notwithstanding the foregoing, reliance by authorized parties will be subject to the terms, conditions, and limitations stated in the proposal, Baseline Site Assessment report, and Agreement for Services. The limitation of liability defined in the terms and conditions is the aggregate limit of Terracon's liability to NDIC Oil and Gas Division and all relying parties unless otherwise agreed in writing.

3.0 FIELD INVESTIGATION

Terracon conducted the fieldwork under a site-specific health and safety plan (HASP) developed for this project. Work was performed using Occupational Safety and Health Agency (OSHA) Level D work attire consisting of hard hats, safety glasses, reflective vests, hearing protection, protective gloves, and protective boots. Non-expendable sampling supplies were cleaned at the beginning of the field activity, and between each soil boring by hand scrubbing in an Alconoxä and potable water solution followed by rinsing in potable water.

3.1 Soil Borings

Prior to mobilization to the site, Terracon contacted the North Dakota One Call system and requested location and markings for all on-site utilities. On August 29-30, 2017, Terracon advanced 45 soil borings (B-1 through B-45) using a track-mounted drill rig equipped with 3-¼-inch hollow-stem auger to advance the borings to maximum depths of approximately 25 feet below ground surface (bgs) on the site to assess soil and groundwater (if encountered) for possible subsurface brine impacts. Soil samples were collected in five-foot intervals using a decontaminated split-spoon sampler during borehole advancement. Upon sample recovery, the field professional observed the samples for visual indications of impact. The remainder of the soil core was then visually described using the Unified Soil Classification System (USCS).

Terracon field screened soil samples from the borings for organic vapors using a photoionization detector (PID), electrical conductivity using an EC meter to measure salinity, and chlorides with QuanTab® titration test strips to determine chloride content. The PID provides a direct reading in parts per million (ppm) isobutylene equivalents. The EC meter provides a direct reading in microsiemens per centimeter (µS/cm) and is referred to in this report as micromhos per centimeter (µmhos/cm), a corresponding unit of measure, although not precise, for EC evaluations. Based on our experience, the measurements within a one square foot area of similar soil type typically vary by 500 µS/cm from the average tested values. Chloride concentrations were obtained from aqueous extracts of soil samples or water samples using QuanTab® titration tests, which provide salt concentrations in milligrams per liter (mg/L).

Upon removal of the sampler from the soil boring, Terracon put a portion of each sample in a sealable plastic bag. After a stabilization period, Terracon screened the headspace above the soil using the PID equipped with a 10.6 electron-volt (eV) ultraviolet lamp source. Soils were then screened using the EC meter equipped with a stainless steel probe inserted directly into the soil. Terracon calibrated the PID and EC meter in accordance with the manufacturer's recommendations before the field activities.

Soil samples were selected to screen aqueous extracts for chloride concentrations using QuanTab® titration test low range (30-600 mg/L) strips and high range (300-6,000 mg/L) strips providing a minimum field detection limit of 27 mg/L and maximum field detection limit of 6,637 mg/L. The boring logs include field screening results for each soil boring for organic vapors, EC, and chlorides. Based on the field screening results, Terracon selected soil samples from each soil boring for laboratory analysis.

Terracon's soil boring sampling program consisted of the collection and analysis of one to three soil samples from the zones exhibiting the highest EC and/or PID field reading or the interval of most-likely environmental impact as determined in the field by the sampling professional.

After collecting each soil sample in laboratory-provided containers, Terracon recorded the sample time on each container label in permanent ink and place the filled containers in an ice-filled cooler for transport. The samples and completed chain-of-custody forms were shipped via overnight courier to Environmental Science Corporation Laboratory Services (ESC) in Mt. Juliet, Tennessee, a National Environmental Laboratory Accreditation Program (NELAP)-accredited laboratory provided the analytical services.

Residual drill cuttings were thin spread onsite at each boring location. The temporary wells were removed within 24 hours of completion and boreholes greater than five feet deep were grouted using a high solids bentonite grout. The five-foot deep boreholes were backfilled with excess soil cuttings shortly after completion.

3.2 Groundwater

Measureable groundwater was encountered in boring B-44 at approximately 12-13 feet below ground surface (bgs) during advancement; however, groundwater was not encountered in the remaining borings during drilling and/or sampling operations. Soil borings B-2 and B-44 were completed as temporary wells for determining a static groundwater level and collecting water samples for laboratory analyses (see Appendix B – Soil Boring Logs). The temporary wells were completed using 10 feet of 2-inch nominal diameter, 0.010-inch slotted schedule 40 poly vinyl chloride (PVC) screen and enough solid 2-inch nominal diameter schedule 40 PVC riser to leave approximately three feet of pipe above grade.

A static groundwater level was allowed to develop in the temporary wells prior to sampling. The wells were then purged using bailers and allowed to recharge with undisturbed groundwater. The groundwater samples were collected using a new, clean bailer and placed in laboratory provided containers. Produced groundwater was disposed of at the site by pouring on the surface.

3.3 Electrical Conductivity (EC)

EC surface soil mapping was conducted using an EC meter (Spectrum Technologies, Inc. Model No. 2265FSTP) with stainless steel probe inserted directly into soil to assess the presence of salts in the soil. Surface EC readings were collected in a grid spacing at approximate 20-foot on center and were limited to the surface, one-foot bgs, and/or two feet bgs (see Exhibit 4). The area of mapping was increased until readings were below 2,000 µmhos/cm in the upper two feet to evaluate the lateral extent of the brine impact. EC readings were also collected from soil samples from the soil borings. Background EC readings from control soil boring B-45 outside of the presumed brine impact area were obtained for determining background purposes.

3.4 Chlorides

Terracon field-tested selected soil samples with QuanTab® titration test strips to measure chloride content in salt impacted soils screened and identified using the EC meter.

Chlorides were field screened in soils from borings B-1 through B-44. Chloride concentrations were also obtained from control soil boring B-45 for determining background data.

4.0 RESULTS OF THE FIELD INVESTIGATION

4.1 Geology/Hydrogeology

The soil boring logs in Appendix B summarize the observed soil stratigraphy. In general, topsoil was encountered underlain by glacially deposited soils. However, borings near the original brine pit encountered lean clay fill, which occasionally showed signs of petroleum hydrocarbon contamination. In these borings, the very dark grayish brown to black clay fill extended to depths between 4-7 feet bgs. The fill was typically underlain by native lean clays, which contained various amounts of silt lenses and were brownish gray to brown in coloration. Borings in which native soils were encountered at the surface, very dark gray to very dark grayish brown topsoil was encountered at depths up to 2.5 feet bgs. The topsoil was underlain by similar sandy clays and silts, which extended to the termination depths of the borings.

Laboratory testing was performed on two Shelby tube samples collected in the upper four feet to measure the plasticity characteristics, in-place density, and permeability (see Appendix B for test results). Classification and hydraulic conductivity results were used to understand the infiltration rates for the flooded test plots and expected permeabilities for future testing. The sample depths were chosen to represent the soils that would be removed during the test plot study discussed later in this report.

Groundwater or moisture changes in the subsurface material was not apparent during the majority of the soil boring advancement; however, boring B-44 encountered water-bearing sand and gravel at approximately 12 feet. Borings B-2 and B-44 were completed as temporary wells. After completion, the temporary wells were allowed to recharge to measure a static groundwater level and collect samples for analyses. Static groundwater levels were measured at depths ranging from approximately 12-13 feet bgs in B-44.

4.2 Organic Vapor Field Screening

The organic vapor field screening results using the PID are presented on the boring logs in Appendix B. Organic vapor readings were typically less than 10 ppm in many of the borings; however, borings B-1, B-23, B-35, B-37, B-38, B-39, B-41, and B-42 encountered moderate readings between 10.1 and 28.0 ppm, and borings B-6, B-8, and B-16 encountered readings ranging from 200 to greater than 5,000 ppm. However, the two location in which we encountered high PID values appeared to be anomalous and not representative of the entire site.

4.3 EC Field Screening

The EC field-screening map with the grid locations is illustrated as Exhibit 4 in Appendix A with laboratory results by location of selected EC samples summarized in Tables 1 and 2 in Appendix C.

5.0 ANALYTICAL RESULTS

Collected soil and water sample(s) were analyzed for the following constituents and characteristics:

- Specific conductance (USEPA method 9050A Mod)
- Chlorides (USEPA method 9056A)
- Sodium (and selected metals) (USEPA method 6010C)
- Cation exchange capacity (CEC) (USEPA method 9081)

The data summary tables (Tables 1 [soil] and Table 2 [groundwater]), are attached in Appendix C; and laboratory analytical/test reports and chain-of custodies recorded are attached in Appendix D. The following sections describe the results of the laboratory testing.

5.1 Soil Sample Results

Soil samples from selected borings were analyzed by ESC for concentrations of EC, chlorides, and sodium. Sodium adsorption ratio (SAR) and exchangeable sodium percentage (ESP) were calculated from these results. Composite samples were analyzed by AgVise for CEC. Laboratory results indicate the following:

5.1.1 Electrical Conductivity

Control samples for EC were collected from boring B-45 (1-foot, 3-foot, and 15-foot intervals) with readings of 12,000 µmhos/cm, 3,660 µmhos/cm, and 1,100 µmhos/cm, respectively. EC was detected in samples collected from borings at values ranging from 121 µmhos/cm in boring B-1 (24-25 feet) to 28,500 µmhos/cm in boring B-12 (0-1 foot).

5.1.2 Chloride

Control samples for chlorides were collected from boring B-45 (1-foot, 3-foot, and 15-foot intervals) with readings of 19 mg/kg, 89 mg/kg, and 61 mg/kg, respectively. Concentrations of chloride in samples collected from borings and selected grid locations were reported above laboratory method detection limits (MDLs) in each sample. Chloride concentrations were detected in samples collected from borings at concentrations ranging from 51 mg/kg in boring B-1 (24-25 feet) to 13,700 mg/kg in boring B-12 (0-1 foot).

5.1.3 Sodium Adsorption Ratio (SAR)

Soil samples were submitted for SAR at the same depth intervals as laboratory EC and chlorides. The results ranged from -0.42 percent at a depth of 25 feet in boring B-1 to 48.90 percent at three feet in boring B-12. The average ratio within the borings was approximately 21.5 percent.

5.1.4 Exchangeable Sodium Percentage (ESP)

Soil samples were submitted for ESP at the same depth intervals as laboratory EC, chlorides, and SAR. The results ranged from 0.57 at a depth of 25 feet in boring B-1 to 65.70 at three feet in boring B-12. The average ratio within the borings was approximately 22.7.

5.1.5 Cation Exchange Capacity (CEC)

Composite soil samples at a depth of 1-3 feet were submitted for CEC from borings B-1, B-3, B-6, B-7, B-12, B-13, B-18, B-39, and B-45. These sample locations were chosen due to their close proximity to the test plots. The results ranged from 24.9 mEq/100 grams of soil in boring B-39 to 55.0 mEq/100 grams of soil in both borings B-1 and B-12. The average CEC value for samples from the borings was approximately 41.4 mEq/100 grams of soil.

5.2 Groundwater Sample Results

The groundwater samples collected from temporary wells (B-2 and B-44) were analyzed by ESC for EC, chlorides, calcium, magnesium, and sodium. The laboratory groundwater analytical data is summarized on Table 2 in Appendix C. Laboratory analysis indicated the following:

5.2.1 Electrical Conductivity

Electrical conductivity levels exhibited in the groundwater samples collected from the temporary sampling points ranged from 98,000 µmhos/cm to 43,100 µmhos/cm.

5.2.2 Chlorides

Concentrations of chlorides exhibited in the groundwater samples were detected above both laboratory MDLs and the NDDoH guidance/USEPA maximum contaminant level (MCL) of 250 mg/L with concentrations ranging from 26,700 to 43,100 mg/L.

5.2.3 Calcium, Magnesium and Sodium

Concentrations of calcium, magnesium, and sodium exhibited in the groundwater samples were detected above laboratory MDLs ranging from 2,500 to 8,500 mg/L, 749 to 2,700 mg/L, and 22,100 to 26,500 mg/L for calcium, magnesium, and sodium, respectively. Clays and organic soils have a large number of negatively-charged sites that can hold cations such as sodium. In the event of a brine release, the calcium, potassium, and magnesium can be replaced by sodium, which changes the structure of the clays (API Publication 4758, *Strategies for Addressing Salt Impacts of Produced Water Releases to Plants, Soils, and Groundwater*, September 2006).

6.0 INVESTIGATION DERIVED WASTES

Soil cuttings accumulated from this project were thin-spread on site at the completion of each soil boring. Based on the laboratory analytical results, purge water was not considered hazardous and has been disposed of on-site.

7.0 CONCLUSIONS

Based on the scope of services described in this report and subject to the limitations described herein, Terracon concludes the following:

7.1 Field Results

- Terracon generally encountered an approximate 1-7 feet of either very dark grayish brown topsoil or lean clay fill underlain by native, lean clays, silts, and sands which typically varied in color from brown to gray. These glacially deposited soils extended to the termination depths or our borings.
- Organic vapor readings Organic vapor readings were typically less than 10 ppm in many of the borings; however, borings B-1, B-23, B-35, B-37, B-38, B-39, B-41, and B-42 encountered moderate readings between 10.1 and 28.0 ppm, and borings B-6, B-8, and B-16 encountered readings ranging from 200 to greater than 5,000 ppm; however, the extremely high readings appeared to be anomalous.
- EC readings above 2,000 µmhos/cm were recorded in the upper two feet of soil at various site grid locations and the majority of our soil borings. The highest site grid reading of greater than 20,000 µmhos/cm was also recorded in several locations, typically exhibiting poor or non-existent vegetation growth.
- Chloride concentrations from aqueous extracts of soil (using QuanTab® titration test strips to determine chloride content) samples collected from our boring locations ranged from 28 to 6,939 mg/kg with an average concentration approximately 1,600 mg/kg. An average concentration of approximately 87 mg/kg was observed in our control boring (B-45) with values ranging from 28 to 166 mg/kg.

7.2 Lab Results

- Electrical conductivity levels from soil samples ranged from 121 to 28,500 µmhos/cm.
- Chloride concentrations in groundwater samples collected ranged from 51 to 13,700 mg/L.
- Electrical conductivity levels from groundwater samples ranged from 98,000 to 111,000 µmhos/cm.

- Chloride concentrations in groundwater samples collected ranged from 26,700 to 43,100 mg/L.

8.0 PROJECT STUDY

Based on the results previously discussed in this report, a second phase of the project includes Terracon conducting the following study techniques for remediating salt from soil surrounding the historical brine pond. The study is outlined in the following sections.

8.1 Study Test Plots

Terracon constructed nine test plots at the site to test different remediation methods. In addition to the test plots, three drainage features were constructed as phytoremediation cells (PRCs), to hold surface run-off and/or high groundwater, which may contact the soils near several of the plots. PRCs consisted of constructed areas excavated to depths ranging from 1.5-6 feet bgs. Native halophytic vegetation will be selected based on tolerance to salt to encourage brine reduction through the vegetative bioaccumulation process.

Terracon has a 100% commitment to the safety of all its employees. As such, and in accordance with our Incident and Injury Free® safety culture, Terracon developed a safety plan, which was used by our personnel during field services, and was requested the same from any subcontractors who perform work at the site. Prior to commencement of on-site activities, Terracon held a meeting to review health and safety needs for this specific project based on any additional hazards encountered during original drilling operations. The fieldwork was performed under a USEPA Level D work uniform consisting of hard hats, safety glasses, protective gloves, and steel-toed boots.

No later than 48 hours prior to intrusive activities, Terracon and the subcontractor contacted North Dakota One Call to arrange for identification of underground utility locations at the subject site. Terracon also coordinated directly with utility companies with underground or overhead lines within or near the planned excavation to minimize disturbance to the lines if present.

Refer to Drawings 01 and 02 for the test plot locations and planned cross-sections. The following paragraphs describe the test plots and PRCs as constructed, as well as, photographs of each cell during various stages in construction:

- Plot 1A
    - Approximately 30 inches of soil was excavated (excavation slopes were approximately 2:1 (H:V)); and approximately 30 inches of imported (clean) backfill was placed up to grade.

- Plot 1B
    - Approximately 36 inches of existing soil was excavated (excavation slopes were approximately 2:1 (H:V)), a layer of geotextile was placed in the bottom of the excavation; approximately six inches of gravel was placed at the base and up the sides of the excavation to serve as a capillary break; a layer of geotextile was placed over the gravel layer; approximately 30 inches of imported (clean) backfill was placed up to grade. Design will include a sump pit/drainage system using 4-inch corrugated pipe, which will drain into Phytoremediation Cell 3 (PRC-3).

- Plot 2A
  - Approximately 30 inches of soil was excavated (excavation slopes were approximately 2:1 (H:V)); and approximately 30 inches of homogenized soil was placed up to grade. Homogenized soil will consist of mixing test plot excavated soils with less brine-impacted soils obtained from just north of this plot area (plot 2B area).

- Plot 2B
  - Approximately 36 inches of soil was excavated (excavation slopes were approximately 2:1 (H:V)); a layer of geotextile was placed in the bottom of

the excavation; approximately six inches of gravel was placed at the base and up the sides of the excavation to serve as a capillary break; a layer of geotextile was placed over the gravel layer; approximately 30 inches of homogenized soil was placed up to grade. Homogenized soil will consist of mixing test plot excavated soils with less brine-impacted soils obtained from just south of this plot area (plot 2A area). Design will include a sump pit/drainage system using 4-inch corrugated pipe, which will drain into PRC-3.

- Plot 3A
  - Approximately 36 inches of soil was excavated (excavation slopes were approximately 2:1 (H:V)); a layer of geotextile was placed at the bottom of the excavation; approximately six inches of gravel was placed at the base and up the sides of the excavation to serve as a capillary break; a layer of geotextile was placed over the gravel layer; approximately 30 inches of amended soil (excavated soil mixed with gypsum) was placed up to grade. An approximately 12-inch above-grade berm was constructed around the edge of the plot (to maintain irrigation water within the plot area). Design will include a sump pit/drainage system using 4-inch corrugated pipe, which will drain into PRC-3.

- Plot 3B
  - Approximately 36 inches of soil was excavated (excavation slopes were approximately 2:1 (H:V)); a layer of geotextile was placed at the bottom of the excavation; approximately six inches of gravel was placed at the base and up the sides of the excavation to serve as a capillary break; a layer of geotextile was placed over the gravel layer; approximately 30 inches of amended soil (excavated soil mixed with gypsum) was placed up to grade. An approximately 12-inch above-grade berm was constructed around the edge of the plot (to maintain irrigation water within the plot area). Design will include a sump pit/drainage system using 4-inch corrugated pipe, which will drain into PRC-3. Once completed, this test plot was irrigated with an approximately 4-inch depth of water.

- Plot 4
  - Approximately 36 inches of soil was excavated from the center portion (approximately middle third of plot); remaining soil within the plot area was excavated and mixed with imported (clean) soils (excavation slopes were approximately 2:1 (H:V)); a layer of geotextile was placed at the bottom of the excavation; approximately six inches of gravel was placed at the base and up the sides of the excavation to serve as a capillary break; a layer of geotextile was placed over the gravel layer; approximately 30 inches of the mixed soil was placed up to grade. Design will include a sump pit/drainage system using 4-inch corrugated pipe, which will drain into PRC-3.

- Plot 5A
  - The ground level was graded to approximately 2 ½ percent sloping downward towards PRC-2; a layer of geotextile was placed at grade; approximately six inches of gravel was placed over the geotextile and will extend laterally to PRC-2; a layer of geotextile was placed over the gravel layer; approximately 30 inches of imported (clean) soil was placed on top of the geofabric/gravel section with side slopes of approximately 2:1 (H:V). The gravel layer and geotextile will extend approximately 24 inches further than the imported (clean) soil on the sides not in contact with PRC-2. The remaining side will continue into PRC-2 for drainage.

- Plot 5B
  - The ground level was graded to approximately 2 ½ percent sloping downward towards PRC-2; a layer of composite geotextile (i.e. American Wickdrain SheetDrain-186) was placed at grade and will extend laterally to PRC-2 (used as the drainage system and filter fabric); approximately 30 inches of imported (clean) soil was placed on top of the geofabric/gravel section with side slopes of approximately 2:1 (H:V). The composite geotextile extended approximately 24 inches further than the imported

(clean) soil on the sides not in contact with PRC-2. The remaining side will extend into PRC-2 approximately 6-12 inches.

- PRC-1
  - Approximately 30 inches of soil was excavated (excavation slopes were approximately 2:1 (H:V)) and approximately 6 inches of imported (clean) organic clay was placed at the bottom and up the sides of the excavation leaving a 24-inch deep low-lying area. The original plan was to place 12 inches of organic fill in the bottom and up the sides; however, after excavation, primarily organic soils were present at the base and slopes of the excavation, so a reduced depth of fill was placed as needed. No test plots drain into PRC-1.

  - Typha (cattails) was planted in three sections (thirds) in this plot: one-third will have bunches of transplanted cattails spaced every 2-4 feet; one-third will have similar planting, however, cattail bunches was split up and spread out evenly across the area; one-third was planted from seed (see illustration and photo below).

- PRC-2
  - Approximately 30 inches of soil was excavated (excavation slopes were approximately 2:1 (H:V)); a layer of impermeable geotextile was placed; and 12 inches of imported (clean) organic clay was placed at the bottom and up the sides of the excavation leaving an 18-inch deep low-lying area. Test plots 5A and 5B will drain into PRC-2 (riprap was placed near the exit of the 5B drainage system).

- PRC-3
  - Approximately 72 inches of soil was excavated (excavation slopes were approximately 1:1 (H:V)), a layer of impermeable geotextile was placed;

and 12 inches of imported (clean) organic clay was placed at the bottom and up the sides of the excavation leaving an approximately 60-inch deep low-lying area. Test plots 1B, 2, 3A, 3B, and 4 will drain into PRC-3 (riprap was placed near the exit of these drainage systems).

8.2 On-site Soil Management

Soil excavated for the test plots were either stockpiled on-site or was amended and placed back into the excavation. No excavated soils left the site during excavation operations. Excess soil excavated from the plots was placed and lightly compacted directly south of plot 2A. This area is designated for the phytoremediation study in-which we will be planting several varieties of salt-tolerant plants to see what and if each plant type will grow in brine-impacted soils. At this time, the types and number of plants have not been determined. This study will be conducted in the spring and summer of 2018.

8.3 Field Testing

Each test plot was field screened for EC upon completion of installation and after 6-12 months to assess the remediation techniques used in each plot. Testing includes using the EC probe to measure surfaces, 1-foot, and 2-foot intervals spaced using a 2-foot grid system within the center of each plot. The areas within three feet of the perimeter of each plot were avoided due to near-surface gravel underlying many of the fill areas. At least four samples from each test plot will be collected for laboratory testing for EC and chlorides during the spring 2018. Approximately one-half of the samples will be collected and tested at as soon as samples can be obtained during spring thaw, and the remaining samples will be collected and tested approximately 10-12 months after the installation.

8.4 Analytical Laboratory Testing

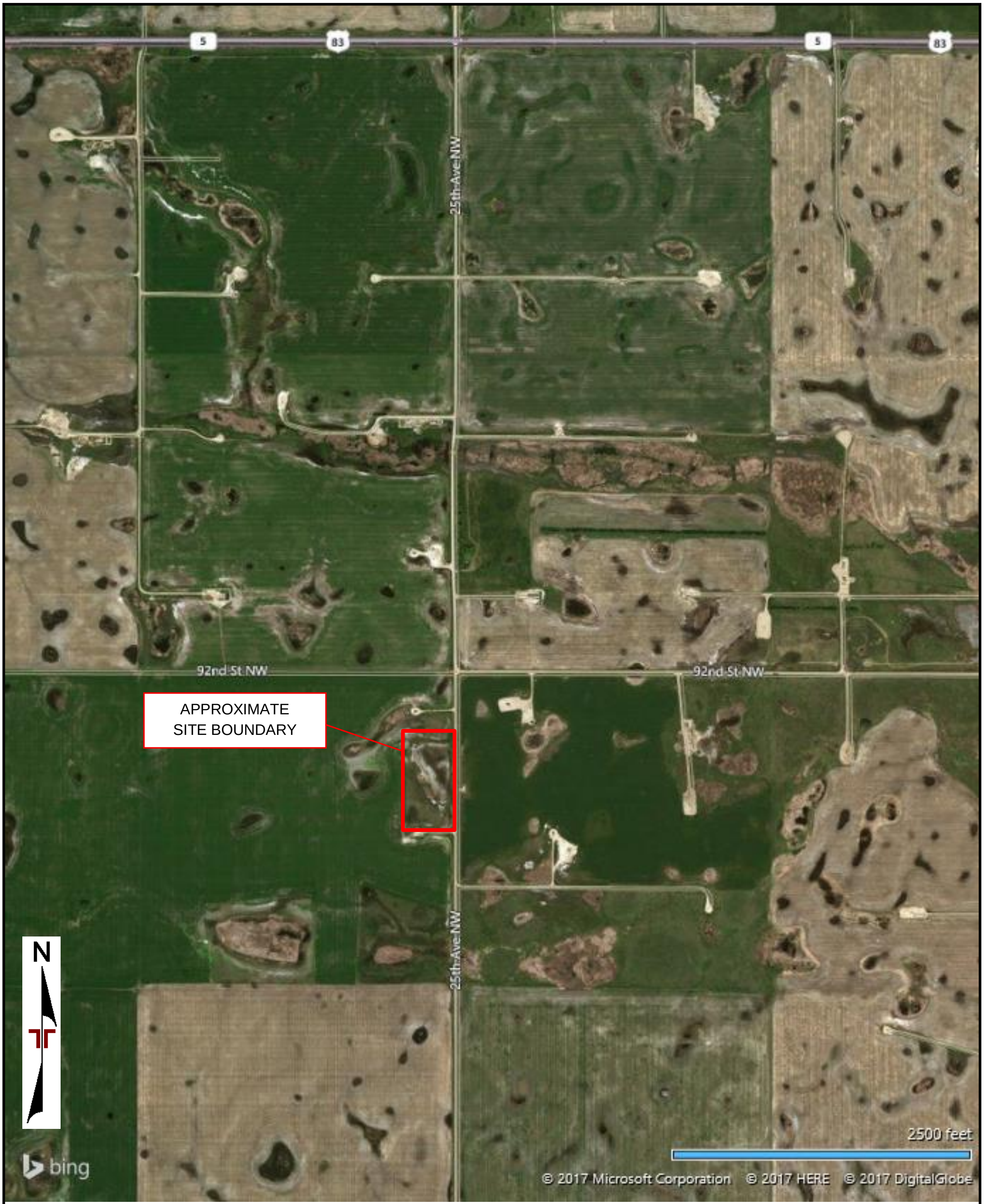
At least four samples from each test plot will be collected for laboratory testing for EC and chlorides during the spring 2018. Approximately one-half of the samples will be collected and tested at as soon as samples can be obtained during spring thaw, and the remaining samples will be collected and tested approximately 10-12 months after the time of installation, similar to the field-testing methodology.

8.5 Reporting

This document is going to be used as an on-going deliverable, in-which the report will be expanded as the project progresses through the various future stages.

APPENDIX A – EXHIBITS

Exhibit 1 – Site Location Map
Exhibit 2 – Soil Boring Location Map
Exhibit 3 – Surface EC Map



TOPOGRAPHIC MAP IMAGE COURTESY OF THE U.S. GEOLOGICAL SURVEY
QUADRANGLES INCLUDE: .

Project Manager: LHS	Project No. M1177088
Drawn by: CDL	Scale: AS SHOWN
Checked by: LHS	File Name:
Approved by: LHS	Date: 10/19/2017

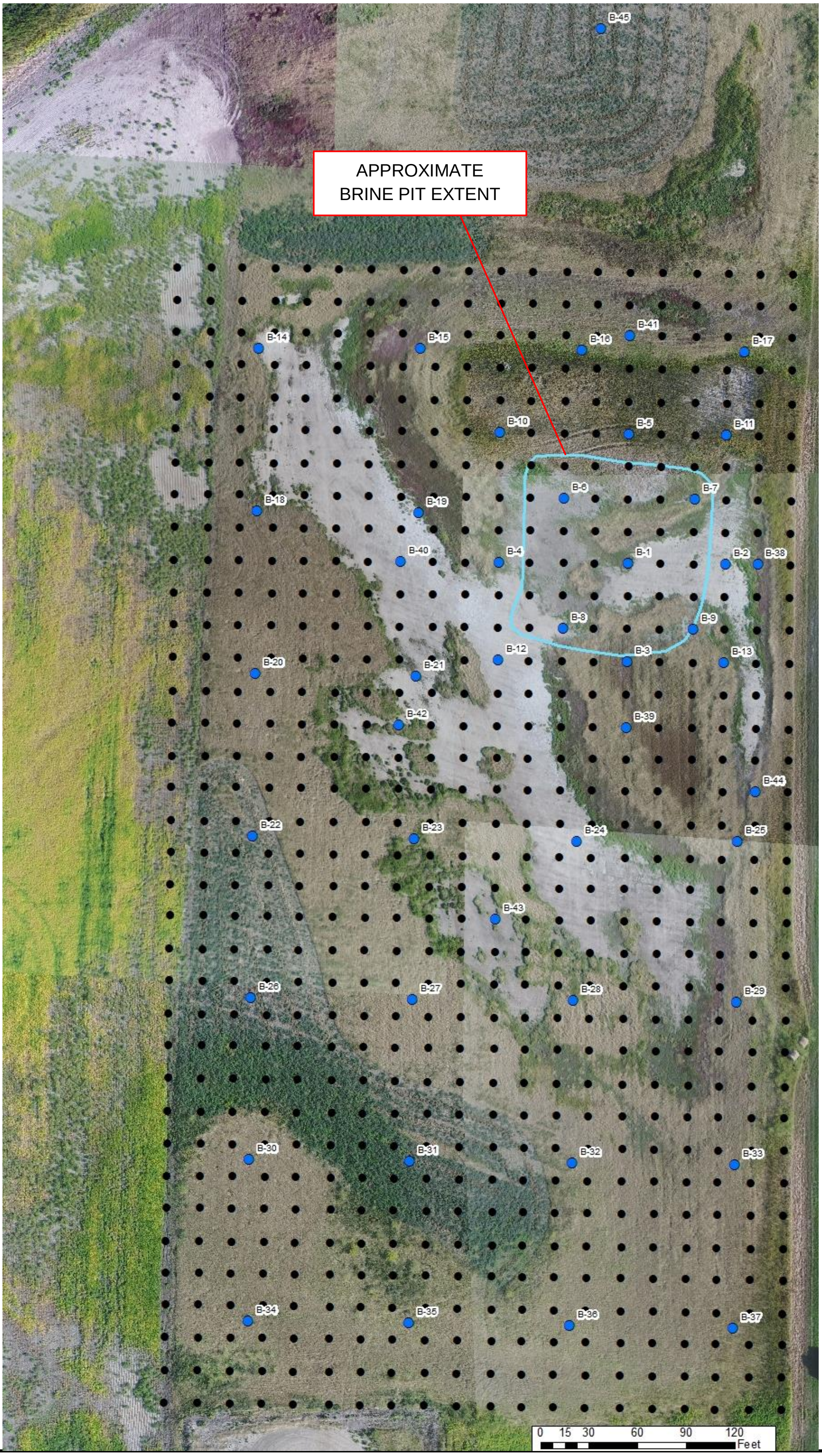
Terracon
860 9th St. NE, Unit K
West Fargo, ND 58078

SITE LOCATION MAP

NDIC Brine Remediation Study

NE ¼ S26-T161N-82W
Bottineau County, North Dakota

Exhibit
1



N

AERIAL PHOTOGRAPHY PROVIDED BY ESRI

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

Project Manager: LHS
Drawn by: CDL
Checked by: LHS
Approved by: LHS

Project No. M1177088
Scale: AS SHOWN
File Name:
Date: 10/19/2017

Terracon

860 9th St. NE, Unit K
West Fargo, ND 58078

SOIL BORING LOCATION MAP

NDIC Brine Remediation Study

NE ¼ S26-T161N-82W
Bottineau County, North Dakota

Exhibit

2

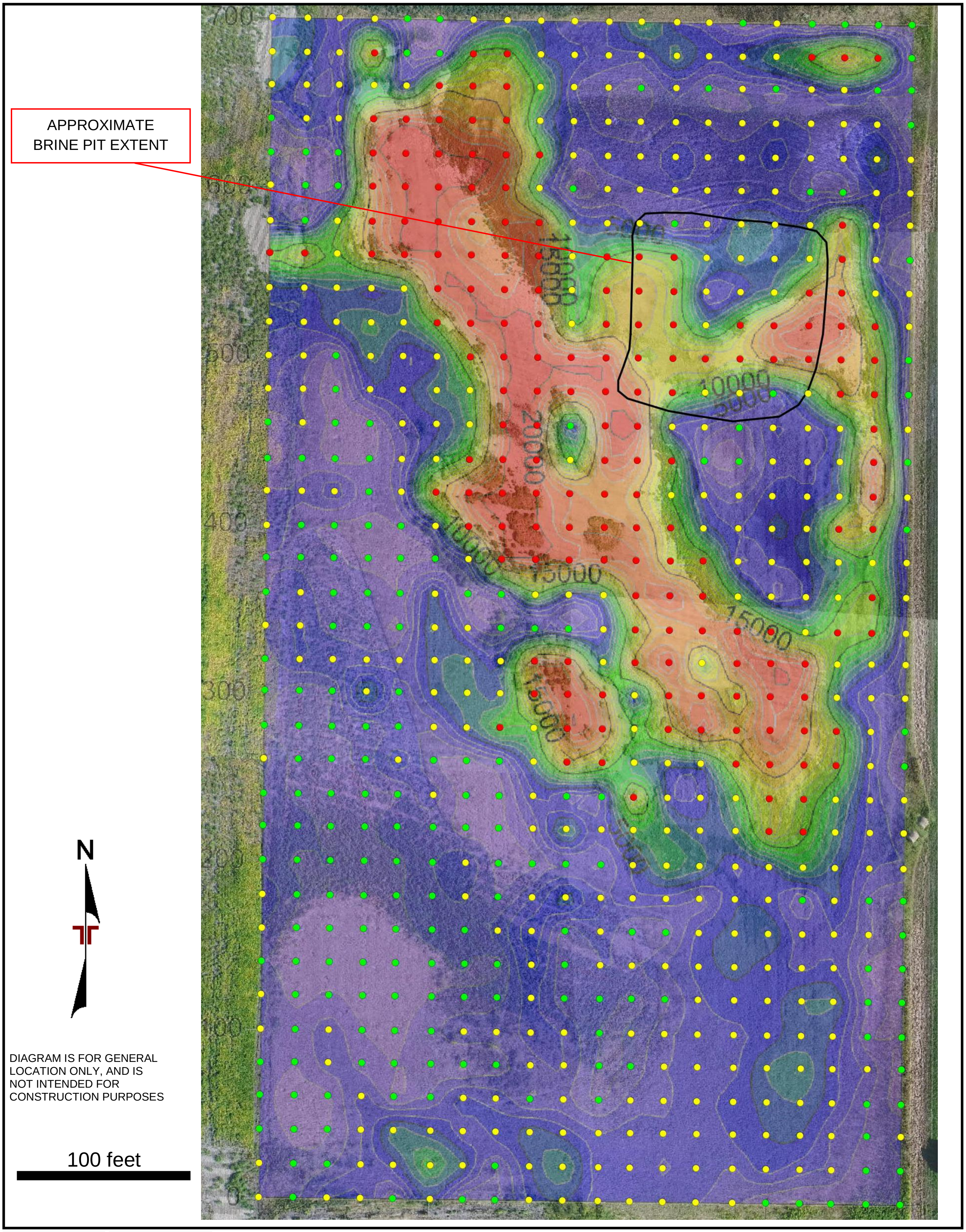


DIAGRAM IS FOR GENERAL
LOCATION ONLY, AND IS
NOT INTENDED FOR
CONSTRUCTION PURPOSES

Project Manager: LHS	Project No. M1177088	**Terracon** 860 9th St. NE, Unit K West Fargo, ND 58078	SURFACE EC MAP	Exhibit
Drawn by: CDL	Scale: AS SHOWN		NDIC Brine Remediation Study **NE ¼ S26-T161N-82W** **Bottineau County, North Dakota**	3
Checked by: LHS	File Name:			
Approved by: LHS	Date: 10/19/2017			

APPENDIX B – SOIL LOGS

General Notes
Unified Soil Classification System
Soil Logs for B-1 through B-45
Atterberg Limits/Soil Density Testing Results
Flexible-wall Permeability Testing Results

GENERAL NOTES

DESCRIPTION OF SYMBOLS AND ABBREVIATIONS

SAMPLING

▯ **Auger**	☒ **Split Spoon**
■ **Shelby Tube**	▮ **Macro Core**
☒ **Ring Sampler**	▮ **Rock Core**
✋ **Grab Sample**	⧄ **No Recovery**

WATER LEVEL

▽	**Water Initially Encountered**
▽	**Water Level After a Specified Period of Time**
▼	**Water Level After a Specified Period of Time**

Water levels indicated on the soil boring logs are the levels measured in the borehole at the times indicated. Groundwater level variations will occur over time. In low permeability soils, accurate determination of groundwater levels is not possible with short term water level observations.

FIELD TESTS

(HP)	**Hand Penetrometer**
(T)	**Torvane**
(b/f)	**Standard Penetration Test (blows per foot)**
(PID)	**Photo-Ionization Detector**
(OVA)	**Organic Vapor Analyzer**

DESCRIPTIVE SOIL CLASSIFICATION

Soil classification is based on the Unified Soil Classification System. Coarse Grained Soils have more than 50% of their dry weight retained on a #200 sieve; their principal descriptors are: boulders, cobbles, gravel or sand. Fine Grained Soils have less than 50% of their dry weight retained on a #200 sieve; they are principally described as clays if they are plastic, and silts if they are slightly plastic or non-plastic. Major constituents may be added as modifiers and minor constituents may be added according to the relative proportions based on grain size. In addition to gradation, coarse-grained soils are defined on the basis of their in-place relative density and fine-grained soils on the basis of their consistency.

LOCATION AND ELEVATION NOTES

Unless otherwise noted, Latitude and Longitude are approximately determined using a hand-held GPS device. The accuracy of such devices is variable. Surface elevation data annotated with +/- indicates that no actual topographical survey was conducted to confirm the surface elevation. Instead, the surface elevation was approximately determined from topographic maps of the area.

STRENGTH TERMS

RELATIVE DENSITY OF COARSE-GRAINED SOILS (More than 50% retained on No. 200 sieve.) Density determined by Standard Penetration Resistance Includes gravels, sands and silts.			**CONSISTENCY OF FINE-GRAINED SOILS** (50% or more passing the No. 200 sieve.) Consistency determined by laboratory shear strength testing, field visual-manual procedures or standard penetration resistance			
Descriptive Term (Density)	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**	**Descriptive Term (Consistency)**	**Unconfined Compressive Strength, Qu, psf**	**Standard Penetration or N-Value Blows/Ft.**	**Ring Sampler Blows/Ft.**
Very Loose	0 - 3	0 - 6	Very Soft	less than 500	0 - 1	< 3
Loose	4 - 9	7 - 18	Soft	500 to 1,000	2 - 4	3 - 4
Medium Dense	10 - 29	19 - 58	Medium-Stiff	1,000 to 2,000	5 - 7	5 - 9
Dense	30 - 50	59 - 98	Stiff	2,000 to 4,000	8 - 14	10 - 18
Very Dense	> 50	≥ 99	Very Stiff	4,000 to 8,000	15 - 30	19 - 42
			Hard	> 8,000	> 30	> 42

RELATIVE PROPORTIONS OF SAND AND GRAVEL

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 15
With	15 - 29
Modifier	> 30

GRAIN SIZE TERMINOLOGY

Major Component of Sample	Particle Size
Boulders	Over 12 in. (300 mm)
Cobbles	12 in. to 3 in. (300mm to 75mm)
Gravel	3 in. to #4 sieve (75mm to 4.75 mm)
Sand	#4 to #200 sieve (4.75mm to 0.075mm
Silt or Clay	Passing #200 sieve (0.075mm)

RELATIVE PROPORTIONS OF FINES

Descriptive Term(s) of other constituents	Percent of Dry Weight
Trace	< 5
With	5 - 12
Modifier	> 12

PLASTICITY DESCRIPTION

Term	Plasticity Index
Non-plastic	0
Low	1 - 10
Medium	11 - 30
High	> 30

UNIFIED SOIL CLASSIFICATION SYSTEM

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

[A] Based on the material passing the 3-inch (75-mm) sieve

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

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

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

[E] $Cu = D_{60}/D_{10} \qquad Cc = \dfrac{(D_{30})^2}{D_{10} \times D_{60}}$

[F] If soil contains ≥ 15% sand, add "with sand" to group name.

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

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

[I] If soil contains ≥ 15% gravel, add "with gravel" to group name.

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

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

[L] If soil contains ≥ 30% plus No. 200 predominantly sand, add "sandy" to group name.

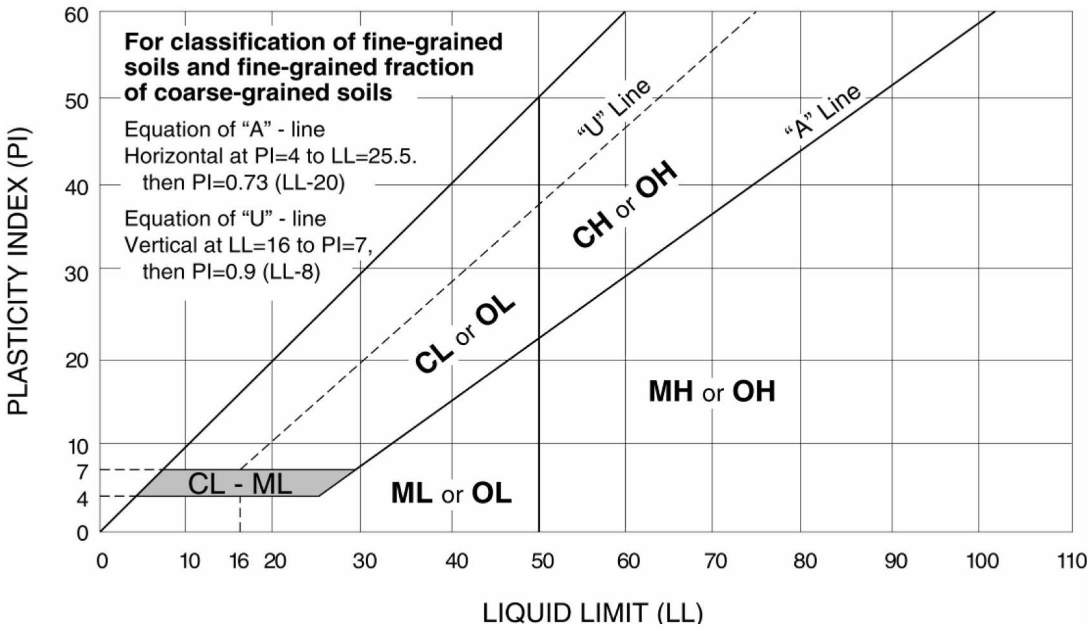
[M] If soil contains ≥ 30% plus No. 200, predominantly gravel, add "gravelly" to group name.

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

[O] PI < 4 or plots below "A" line.

[P] PI plots on or above "A" line.

[Q] PI plots below "A" line.



BORING LOG NO. B-1

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 520 Easting: 280

Approximate Surface Elev: 1524.38 (Ft.) +/-

DEPTH		ELEVATION (Ft.)
	FILL - ORGANIC LEAN CLAY, black to gray, moist	
6.0		1518.5+/-
	LEAN CLAY WITH SAND (CL), with occasional sand lenses and trace gravel, light grayish brown to grayish brown, moist to very moist	
16.0		1508.5+/-
	LEAN CLAY WITH SAND (CL), with trace gravel, dark gray, moist	
25.0		1499.5+/-
	Boring Terminated at 25 Feet	

SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
☒	10,900	4,181	1.0
☒	6,910	3,777	<1
☒	9,000	3,118	<1
☒	10,500	2,015	3.4
☒	9,000	2,603	14.1
☒	11,700	4,649	17.4
☒	9,150	1,709	7.3
☒	11,900	2,845	5.7
☒	12,160	1,855	3.2
☒	12,840	2,015	5.1
☒	10,500	3,118	3.2
☒	11,900	2,386	1.1
☒	11,400	2,845	5.8
☒	12,200	2,386	3.2
☒	10,500	2,015	2.2
☒	6,580	1,051	<1
☒	5,590	1,709	<1
☒	4,450	688	1.4
☒	2,930	403	1.0
☒	2,540	193	1.4
☒	1,290	33	<1
☒	1,000	51	1.7
☒	823	<28	2.1
☒	700	<28	2.1
☒	700	<28	1.0

DEPTH (Ft.): 5, 10, 15, 20, 25

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with bentonite grout

Notes:
PID readings are in isobutylene equivalents
Moderate petroleum odor from 5' to 6'

WATER LEVEL OBSERVATIONS

No free water observed

▨ *Cave in 24 hrs after completion*

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-4

BORING LOG NO. B-2

Page 1 of 1

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 520 Easting: 340

Approximate Surface Elev: 1525.00 (Ft.) +/-

DEPTH	DESCRIPTION	ELEVATION (Ft.)
	TOPSOIL (ORGANIC LEAN CLAY) (OH), black, moist	
2.5		1522.5+/-
	LEAN CLAY WITH SAND (CL), with occasional silt lenses, grayish brown, moist to very moist	
12.0		1513+/-
	LEAN CLAY WITH SAND (CL), with occasional silt lenses and iron staining, grayish brown to brownish gray mottled, moist	
16.0		1509+/-
	LEAN CLAY WITH SAND (CL), with trace gravel, gray to dark gray, moist	
20.0		1505+/-
	Boring Terminated at 20 Feet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	9,450	5,118	<1
		☒	6,740	1,753	1.9
		☒	7,440	N.S.	1.2
		☒	6,150	N.S.	1.0
		☒	6,990	911	1.1
5	▽	☒	7,280	988	1.3
		☒	6,600	772	1.4
		☒	7,550	1,261	1.8
		☒	8,980	1,908	1.1
		☒	11,710	1,753	2.7
10		☒	16,360	4,552	4.0
	▨	☒	12,910	4,072	5.5
		☒	15,900	3,661	3.6
		☒	14,660	5,118	3.9
		☒	10,580	4,552	<1
15		☒	7,230	2,485	1.9
		☒	6,560	1,261	2.8
		☒	5,160	911	1.7
		☒	4,660	546	2.5
		☒	3,450	324	2.4
20					

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with bentonite grout

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

▽ *After 24 hrs*

▨ *Cave in 24 hrs after completion*

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-5

BORING LOG NO. B-3

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE:
NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 460 Easting: 280

Approximate Surface Elev: 1525.07 (Ft.) +/-

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)
1.3	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, black, moist	1524+/-
12.0	**LEAN CLAY WITH SAND (CL)**, with trace gravel, grayish brown, moist	1513+/-
16.0	**LEAN CLAY WITH SAND (CL)**, with occasional sand lenses, trace gravel, and iron staining, grayish brown, moist	1509+/-
20.0	**SANDY LEAN CLAY (CL)**, with trace gravel and iron staining, gray, moist	1505+/-

Boring Terminated at 20 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
0-1		☒	3,970	911	<1
1-2		☒	2,840	596	<1
2-3		☒	3,740	N.S.	<1
3-4		☒	3,220	368	<1
4-5		☒	2,210	153	<1
5-6		☒	2,200	N.S.	2.4
6-7		☒	3,090	N.S.	<1
7-8		☒	3,440	N.S.	<1
8-9		☒	4,450	N.S.	<1
9-10		☒	10,510	911	<1
10-11		☒	8,340	1,908	1.7
11-12		☒	11,040	2,725	3.4
12-13		☒	10,740	2,725	2.2
13-14		☒	11,340	2,997	<1
14-15		☒	10,840	2,425	1.0
15-16		☒	6,610	1,485	1.2
16-17		☒	7,760	988	1.3
17-18		☒	5,130	709	2.0
18-19		☒	4,110	709	2.1
19-20		☒	3,460	409	1.5

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with bentonite grout

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS
No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-6

BORING LOG NO. B-4

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 520 Easting: 200

Approximate Surface Elev: 1524.99 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)
	TOPSOIL (ORGANIC LEAN CLAY) (OH), black, moist	
2.0		1523+/-
	LEAN CLAY WITH SAND (CL), with occasional silt lenses and trace gravel, dark grayish brown, moist	
12.0		1513+/-
	LEAN CLAY WITH SAND (CL), with occasional sand lenses, trace gravel, and iron staining, grayish brown to light gray mottled, moist	
16.0		1509+/-
	SANDY LEAN CLAY (CL), with trace gravel and iron staining, dark gray to brown, moist	
20.0		1505+/-

Boring Terminated at 20 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	7,020	1,763	<1
		☒	7,100	1,840	<1
		☒	8,080	2,607	<1
		☒	6,030	1,172	<1
5		☒	5,660	845	<1
		☒	5,820	1,623	<1
		☒	5,340	1,763	<1
		☒	8,940	1,763	<1
		☒	9,960	1,917	<1
10		☒	11,600	2,488	<1
		☒	7,130	2,860	2.0
		☒	9,270	2,488	2.6
		☒	10,980	1,840	<1
		☒	8,860	1,840	1.9
15		☒	7,890	1,271	<1
		☒	4,290	1,172	<1
		☒	5,450	545	<1
		☒	3,270	325	<1
		☒	2,780	59	1.1
20		☒	2,040	34	<1

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with bentonite grout

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-7

BORING LOG NO. B-5

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 300 Easting: 280

Approximate Surface Elev: 1524.79 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)
2.0	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, black, moist	1523+/-
5.0	**LEAN CLAY WITH SAND (CL)**, with trace gravel and iron staining, dark grayish brown, moist	1520+/-
15.0	**LEAN CLAY WITH SAND (CL)**, with trace gravel and iron staining, grayish brown to light gray mottled, moist	1510+/-
20.0	**SANDY LEAN CLAY (CL)**, with occasional sand lenses and trace gravel, dark gray to brown, moist	1505+/-

Boring Terminated at 20 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	1,590	2,994	2.2
		☒	1,950	2,725	1.9
		☒	2,480	244	1.2
		☒	2,500	325	<1
5		☒	2,960	289	<1
		☒	2,180	405	<1
		☒	2,560	284	1.5
		☒	2,920	405	<1
		☒	3,060	545	1.0
10		☒	3,370	996	2.6
		☒	1,970	1,917	1.9
		☒	1,970	2,383	<1
		☒	4,000	2,088	2.3
		☒	4,400	1,495	1.6
15		☒	8,600	1,379	2.4
		☒	5,850	996	2.0
		☒	5,250	653	1.5
		☒	5,500	545	2.1
		☒	5,450	545	1.7
20		☒	3,400	364	1.3

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with bentonite grout

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-8

BORING LOG NO. B-6

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 560 Easting: 240

Approximate Surface Elev: 1525.79 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
▨	1.0	**FILL - ORGANIC LEAN CLAY** , very dark gray to very dark brown, moist	1525+/-			☒	7,600	845	1.1
▨		**FILL - LEAN CLAY WITH SAND** , very dark gray to light gray mixed, moist				☒	4,500	2,994	4.0
▨						☒	5,700	3,299	>5,000
▨						☒	8,400	2,994	>5,000
▨				5		☒	9,100	3,147	243.6
▨						☒	13,700	4,057	74.7
▨	7.0		1519+/-			☒	12,600	2,003	24.8
▨		**LEAN CLAY WITH SAND (CL)**, with trace gravel, grayish brown, moist				☒	9,200	996	40.8
▨						☒	5,900	2,725	29.8
▨	10.0		1516+/-	10		☒	5,100	2,860	18.8

Boring Terminated at 10 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:

PID readings are in isobutylene equivalents
Faint petroleum odor from 2.5' to 3.5'
Approximatley 0.25" thick decaying plant matter layer at 4.5'

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-9

BORING LOG NO. B-7

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE:
NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 560 Easting: 320

Approximate Surface Elev: 1527.09 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
▨	1.0	**FILL - ORGANIC LEAN CLAY**, very dark gray, dry	1526+/-			☒	3,400	2,725	1.2
▨		**FILL - LEAN CLAY WITH SAND**, dark gray to light brownish gray mixed, dry to 3' then moist				☒	5,000	1,271	1.4
						☒	3,500	1,271	<1
	4.0		1523+/-			☒	4,900	1,127	1.4
▨	5.0	**LEAN CLAY WITH SAND (CL)**, with trace gravel, brownish gray, moist	1522+/-	5		☒	7,800	1,172	2.2
		Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS
No free water observed

860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-10

BORING LOG NO. B-8

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 480 Easting: 240

Approximate Surface Elev: 1527.43 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
▨	1.0	**FILL - ORGANIC LEAN CLAY**, dark grayish brown, dry	1526.5+/-			☒	10,800	6,620	2.8
▨		**FILL - LEAN CLAY WITH SAND**, brown to dark gray mixed, moist				☒	9,500	2,277	5.3
						☒	6,300	2,725	6.2
	4.5		1523+/-			☒	10,600	5,100	3.0
▨	5.0	**LEAN CLAY WITH SAND (CL)**, grayish brown, moist	1522.5+/-	5		☒	9,900	6,620	200.6

Boring Terminated at 5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:

PID readings are in isobutylene equivalents
An approximately 0.5" thick layer of black grease/thick oil encountered at 4.5'

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-11

BORING LOG NO. B-9

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 480 Easting: 320

Approximate Surface Elev: 1527.04 (Ft.) +/-

DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
0.3	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, dark grayish brown, dry	1526.5+/-			☒	10,500	3,475	<1
	LEAN CLAY WITH SAND (CL), with trace gravel, iron staining, and petroleum staining (very dark gray from 3.5' to 3.7'), grayish brown, dry to 2' then moist				☒	5,700	1,325	<1
					☒	6,400	1,559	1.2
					☒	5,600	918	<1
5.0		1522+/-	5		☒	6,400	1,271	1.1

Boring Terminated at 5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:

PID readings are in isobutylene equivalents
Faint petroleum odor from 3.5' to 4'

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-12

BORING LOG NO. B-10

Page 1 of 1

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 600 Easting: 200

Approximate Surface Elev: 1524.43 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)
▨	1.5	**FILL - ORGANIC LEAN CLAY** , with trace gravel, very dark grayish brown, dry to 1' then moist	1523+/-
▥	3.0	**SANDY SILT (ML)**, brownish gray, moist	1521.5+/-
▧	5.0	**LEAN CLAY WITH SAND (CL)**, with occasional sand lenses, trace gravel, and iron staining, brownish gray to brown mottled, moist	1519.5+/-
		Boring Terminated at 5 Feet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	2,800	325	1.4
		☒	3,100	202	1.6
		☒	2,600	405	2.4
		☒	3,100	496	2.0
5		☒	3,700	345	1.6

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS
No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-13

BORING LOG NO. B-11

Page 1 of 1

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 600 Easting: 340

Approximate Surface Elev: 1524.63 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)
▨		**FILL - LEAN CLAY WITH SAND** , with trace gravel, grayish brown, dry	
	1.5		1523+/-
		BURIED TOPSOIL (ORGANIC LEAN CLAY) (OH), very dark grayish brown, dry to 2' then moist	
	3.5		1521+/-
🟩		**LEAN CLAY WITH SAND (CL)**, with trace gravel and iron staining, brownish gray to grayish brown, moist	
	5.0		1519.5+/-
		Boring Terminated at 5 Feet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	1,100	263	1.5
		☒	2,100	405	<1
		☒	2,400	318	1.2
		☒	2,900	194	1.8
5		☒	2,500	119	<1

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-14

BORING LOG NO. B-12

Page 1 of 1

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 460 Easting: 200

Approximate Surface Elev: 1524.76 (Ft.) +/-

GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
	0.2	**TOPSOIL (ORGANIC LEAN CLAY) (OL)**, very dark gray, dry	1524.5+/-			☒	19,800	N.S.	<1
		LEAN CLAY WITH SAND (CL), grayish brown, moist				☒	10,800	N.S.	<1
						☒	14,100	5,100	1.4
						☒	14,000	5,782	1.7
	5.0		1520+/-	5		☒	5,100	3,650	1.3

Boring Terminated at 5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-15

BORING LOG NO. B-13

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 460 Easting: 340

Approximate Surface Elev: 1524.96 (Ft.) +/-

GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)
	0.8	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, black to very dark gray, dry	1524+/-
	1.5	**LEAN CLAY WITH SAND (CL)**, gray, moist	1523.5+/-
	5.0	**LEAN CLAY WITH SAND (CL)**, with trace gravel, grayish brown, moist	1520+/-

Boring Terminated at 5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	8,700	1222	<1
		☒	7,400	1623	<1
		☒	5,000	1271	<1
		☒	5,100	1081	<1
5		☒	5,500	1039	1.6

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-16

BORING LOG NO. B-14

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 650 Easting: 50

Approximate Surface Elev: 1526.01 (Ft.) +/-

DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
1.0	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, black to very dark gray, dry	1525+/-			☒	10,700	4,057	<1
	LEAN CLAY WITH SAND (CL), with trace gravel, grayish brown, moist				☒	10,960	4,533	1.8
					☒	8,350	3,475	1.2
					☒	9,750	4,295	<1
5.0		1521+/-	5		☒	8,880	3,650	<1

Boring Terminated at 5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-17

BORING LOG NO. B-15

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 650 Easting: 150

Approximate Surface Elev: 1525.37 (Ft.) +/-

GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
	0.7	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, very dark gray to gray, moist	1524.5+/-			☒	3,750	545	1.8
		LEAN CLAY WITH SAND (CL), with occasional sand lenses and trace gravel, light brown to grayish brown, moist				☒	3,100	653	<1
						☒	2,850	521	1.5
						☒	2,530	345	<1
	5.0		1520.5+/-	5		☒	2,650	202	<1

Boring Terminated at 5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-18

BORING LOG NO. B-16

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 650 Easting: 250

Approximate Surface Elev: 1525.11 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
▨	0.7	**FILL - ORGANIC LEAN CLAY** , very dark grayish brown, moist	1524.5+/-			☒	6,400	571	2.0
▨		**FILL - LEAN CLAY WITH SAND (CL)**, light brownish gray, moist, strong petroleum odor starting at 2'				☒	3,450	405	11.1
	3.0		1522+/-			☒	2,100	325	>5,000
▨	4.0	**LEAN CLAY WITH SAND (CL)**, with petroleum staining and trace gravel, very dark gray to black, moist, strong petroleum odor	1521+/-			☒	1,890	449	>5,000
▨	5.0	**LEAN CLAY WITH SAND (CL)**, with trace gravel, light brownish gray, moist, strong petroleum odor	1520+/-	5		☒	2,350	263	>5,000
		Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-19

BORING LOG NO. B-17

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 650 Easting: 350

Approximate Surface Elev: 1525.4 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
	0.3	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, dark grayish brown to very dark gray, moist	1525+/-			☒	3,870	521	<1
	2.0	**LEAN CLAY WITH SAND (CL)**, light brownish gray, moist	1523.5+/-			☒	2,000	449	<1
		LEAN CLAY WITH SAND (CL), with trace gravel, grayish brown, moist				☒	1,700	405	<1
						☒	1,750	194	<1
	5.0		1520.5+/-	5		☒	2,200	354	1.7
		Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-20

THIS BORING LOG IS NOT VALID IF SEPARATED FROM ORIGINAL REPORT. GEO SMART LOG-NO WELL M1177088.GPJ TERRACON_DATATEMPLATE.GDT 10/19/17

BORING LOG NO. B-18

Page 1 of 1

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 550 Easting: 50

Approximate Surface Elev: 1527.32 (Ft.) +/-

GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
▨	0.5	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, very dark gray, moist	1527+/-			☒	4,800	1,495	<1
▨		**LEAN CLAY WITH SAND (CL)**, with occasional sand lenses, light gray to grayish brown, moist to 4.8' then wet				☒	5,700	2,488	<1
▨						☒	5,440	2,277	<1
▨						☒	6,470	1,840	<1
▨	5.0		1522.5+/-	5		☒	5,670	1,840	<1

Boring Terminated at 5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-21

BORING LOG NO. B-19

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 550 Easting: 150

Approximate Surface Elev: 1525.66 (Ft.) +/-

DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
1.0	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, black to gray, moist	1524.5+/-			☒	9,400	2,607	<1
	LEAN CLAY WITH SAND (CL), with trace gravel, light brown to grayish brown, moist				☒	6,750	996	<1
					☒	4,050	405	<1
					☒	4,230	545	<1
5.0		1520.5+/-	5		☒	3,300	N.S.	<1

Boring Terminated at 5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-22

BORING LOG NO. B-20

Page 1 of 1

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 450 Easting: 50

Approximate Surface Elev: 1526.57 (Ft.) +/-

DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
	TOPSOIL (ORGANIC LEAN CLAY) (OH), dark grayish brown to very dark gray, moist				☒	900	597	3.2
1.5		1525+/-			☒	2,000	713	1.7
	LEAN CLAY WITH SAND (CL), with occasional sand lenses, grayish brown, moist				☒	4,560	1,917	3.1
					☒	6,100	2,183	1.7
5.0		1521.5+/-	5		☒	9,540	3,147	<1
	Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-29-2017	Boring Completed: 08-29-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-23

BORING LOG NO. B-21

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 450 Easting: 150

Approximate Surface Elev: 1526.42 (Ft.) +/-

DEPTH		ELEVATION (Ft.)
0.7	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, very dark grayish brown, moist	1525.5+/-
5.0	**LEAN CLAY WITH SAND (CL)**, with occasional sand lenses and trace gravel, grayish brown, moist	1521.5+/-

Boring Terminated at 5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	14,700	5,782	<1
		☒	15,500	5,441	<1
		☒	12,800	5,441	<1
		☒	12,200	3,650	<1
5		☒	9,650	2,607	1.1

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS
No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-24

BORING LOG NO. B-22

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 350 Easting: 50

Approximate Surface Elev: 1526.09 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		TOPSOIL (ORGANIC LEAN CLAY) (OH), very dark grayish brown, moist				☒	710	427	4.7
	1.5		1524.5+/-			☒	130	597	6.1
		LEAN CLAY WITH SAND (CL), with occasional silt lenses and trace gravel, grayish brown, moist				☒	3,350	996	4.3
						☒	4,600	996	7.7
	5.0		1521+/-	5		☒	3,710	918	4.8
		Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-25

BORING LOG NO. B-23

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 350 Easting: 150

Approximate Surface Elev: 1525.96 (Ft.) +/-

DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
	<u>TOPSOIL (ORGANIC LEAN CLAY) (OH)</u>, very dark grayish brown, moist				☒	2,140	1,172	5.7
1.5		1524.5+/-						
	<u>LEAN CLAY WITH SAND (CL)</u>, with occasional silt and sand lenses and trace gravel, light brownish gray to grayish brown, moist				☒	6,150	1,917	10.3
					☒	5,770	2,607	5.7
					☒	3,770	2,488	9.7
					☒	4,480	1,325	9.7
5.0		1521+/-	5					
	Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-26

BORING LOG NO. B-24

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 350 Easting: 250

Approximate Surface Elev: 1524.94 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
	0.8	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, very dark grayish brown, moist	1524+/-			☒	14,500	3,854	6.7
▨		**SANDY LEAN CLAY (CL)**, with occasional sand lenses and trace gravel, light brownish gray to grayish brown, moist				☒	10,000	2,994	4.2
						☒	6,500	1,917	5.8
						☒	6,400	1,623	4.1
	5.0		1520+/-	5		☒	6,700	2,277	4.0
		Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-27

BORING LOG NO. B-25

Page 1 of 1

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 350 Easting: 350

Approximate Surface Elev: 1525.91 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
	0.5	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, black, moist	1525.5+/-			☒	10,400	2,488	1.3
		LEAN CLAY WITH SAND (CL), light brownish gray, moist				☒	9,200	1,495	1.4
	2.5		1523.5+/-			☒	3,800	1,039	1.0
		LEAN CLAY WITH SAND (CL), with occasional sand lenses and trace gravel, light brown to brownish gray, moist				☒	3,300	996	1.6
	5.0		1521+/-	5		☒	5,500	1,379	2.2
		Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS
No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-28

BORING LOG NO. B-26

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 250 Easting: 50

Approximate Surface Elev: 1525.52 (Ft.) +/-

DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
1.0	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, black, moist	1524.5+/-			☒	1,830	52	4.4
	LEAN CLAY WITH SAND (CL), with occasional silt lenses, grayish brown, moist				☒	3,170	46	3.2
					☒	3,860	56	8.6
					☒	4,110	52	9.1
5.0		1520.5+/-	5		☒	4,200	46	6.4

Boring Terminated at 5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-29

BORING LOG NO. B-27

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PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 250 Easting: 150

Approximate Surface Elev: 1525.49 (Ft.) +/-

DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
0.5	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, very dark grayish brown, moist	1525+/-			☒	5,700	1,379	1.8
	LEAN CLAY WITH SAND (CL), with occasional silt and sand lenses, grayish brown, moist				☒	5,200	1,222	5.2
					☒	8,700	1,763	5.6
					☒	9,800	2,860	2.9
5.0		1520.5+/-	5		☒	5,400	2,088	5.6
	Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS
No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-30

BORING LOG NO. B-28

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 250 Easting: 250

Approximate Surface Elev: 1524.72 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
	0.7	**TOPSOIL (ORGANIC LEAN CLAY) (OL)**, very dark brownish gray, dry	1524+/-			☒	1,300	3,299	7.5
		LEAN CLAY WITH SAND (CL), with trace gravel, dark grayish brown to grayish brown, moist				☒	7,600	2,488	2.5
						☒	5,700	1,917	4.6
						☒	6,100	1,917	2.6
	5.0		1519.5+/-	5		☒	6,200	1,623	2.7

Boring Terminated at 5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-31

BORING LOG NO. B-29

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 250 Easting: 350

Approximate Surface Elev: 1525.07 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
	0.5	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, very dark gray, moist	1524.5+/-			☒	4,500	811	3.4
		LEAN CLAY WITH SAND (CL), with occasional sand lenses and trace gravel, light brownish gray to grayish brown, moist				☒	2,500	306	1.1
						☒	2,750	354	1.9
						☒	1,700	180	5.5
	5.0		1520+/-	5		☒	2,150	90	3.5
		Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-32

BORING LOG NO. B-30

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PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 150 Easting: 50

Approximate Surface Elev: 1524.45 (Ft.) +/-

DEPTH	MATERIAL DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
0.5	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, black, moist	1524+/-			☒	210	<28	3.9
	LEAN CLAY WITH SAND (CL), with trace gravel, grayish brown, moist				☒	370	<28	4.9
					☒	1,230	<28	6.2
					☒	1,130	40	5.1
5.0		1519.5+/-	5		☒	960	52	5.5

Boring Terminated at 5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-33

BORING LOG NO. B-31

Page 1 of 1

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 150 Easting: 150

Approximate Surface Elev: 1525.1 (Ft.) +/-

GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
	0.5	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, very dark grayish brown to dark gray, moist	1524.5+/-			☒	1,940	244	2.2
		LEAN CLAY (CL), with occasional sand lenses and trace gravel, grayish brown, moist				☒	1,870	130	7.1
						☒	1,480	166	4.2
						☒	2,110	136	4.0
	5.0		1520+/-	5		☒	1,020	74	6.0

Boring Terminated at 5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-34

BORING LOG NO. B-32

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 150 Easting: 250

Approximate Surface Elev: 1526 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
▨		**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, very dark grayish brown to dark gray, moist				☒	4,800	515	9.0
	1.2		1525+/-						
▨		**LEAN CLAY WITH SAND (CL)**, with trace gravel, light grayish brown, moist				☒	4,600	318	5.9
						☒	4,200	329	7.0
						☒	4,600	244	4.9
	5.0		1521+/-	5		☒	3,300	136	6.5
		Boring Terminated at 5 Feet							

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-35

BORING LOG NO. B-33

Page 1 of 1

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

GRAPHIC LOG	LOCATION See Exhibit A-2 Northing: 150 Easting: 350 Approximate Surface Elev: 1525.41 (Ft.) +/- DEPTH ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
	TOPSOIL (ORGANIC LEAN CLAY) (OH), black to dark gray, moist			☒	3,700	515	1.1
	1.5 1524+/- **LEAN CLAY WITH SAND (CL)**, with trace gravel, brownish gray, moist			☒	2,400	244	4.7
				☒	1,500	109	<1
				☒	1,300	95	2.6
	5.0 1520.5+/-	5		☒	1,300	66	4.6
	Boring Terminated at 5 Feet						

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS
No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-36

BORING LOG NO. B-34

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PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 50 Easting: 50

Approximate Surface Elev: 1524.43 (Ft.) +/-

GRAPHIC LOG	DEPTH		ELEVATION (Ft.)
	0.5	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, black, moist	1524+/-
	5.0	**LEAN CLAY WITH SAND (CL)**, with occasional silt lenses and trace gravel, light brownish gray to grayish brown, moist	1519.5+/-

Boring Terminated at 5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	1,740	329	<1
		☒	1,350	180	<1
		☒	1,810	166	2.7
		☒	1,280	194	5.2
5		☒	1,320	74	5.4

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-37

BORING LOG NO. B-35

Page 1 of 1

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 50 Easting: 150

Approximate Surface Elev: 1524.88 (Ft.) +/-

DEPTH	DESCRIPTION	ELEVATION (Ft.)
1.8	**TOPSOIL (ORGANIC LEAN CLAY) (OL)**, black to dark gray, moist	1523+/-
5.0	**LEAN CLAY WITH SAND (CL)**, with occasional sand lenses and trace gravel, light brownish gray to grayish brown, moist	1520+/-

Boring Terminated at 5 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	3,200	411	3.6
		☒	2,540	354	4.6
		☒	2,120	263	6.4
		☒	2,220	194	10.7
5		☒	1,810	130	11.4

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS
No free water observed

860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-38

BORING LOG NO. B-36

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 50 Easting: 250

Approximate Surface Elev: 1524.54 (Ft.) +/-

DEPTH		ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
1.0	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, very dark grayish brown, moist	1523.5+/-			☒	2,100	284	9.1
	LEAN CLAY WITH SAND (CL), with occasional sand lenses and trace gravel, light brownish gray to grayish brown, moist				☒	2,300	244	5.9
					☒	2,300	194	7.8
					☒	2,400	284	2.6
5.0		1519.5+/-	5		☒	1,900	329	4.9

Boring Terminated at 5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-39

BORING LOG NO. B-37

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 50 Easting: 350

Approximate Surface Elev: 1525.25 (Ft.) +/-

GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
▨	1.0	**TOPSOIL (ORGANIC LEAN CLAY) (OH)**, very dark grayish brown, moist	1524.5+/-			☒	2,800	219	15.9
▨		**LEAN CLAY WITH SAND (CL)**, with occasional sand lenses and trace gravel, light brownish gray to grayish brown, moist				☒	2,200	354	4.2
▨						☒	2,000	244	6.4
▨						☒	2,000	130	5.6
▨	5.0		1520.5+/-	5		☒	1,600	82	2.6

Boring Terminated at 5 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with soil cuttings upon completion

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-40

BORING LOG NO. B-38

Page 1 of 1

PROJECT: **NDIC Brine Remediation Study**

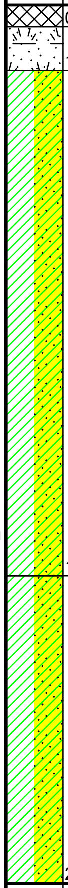
CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 520 Easting: 360

Approximate Surface Elev: 1525.12 (Ft.) +/-



DEPTH		ELEVATION (Ft.)
0.5	**FILL - SILT**, light brownish gray, dry	1524.5+/-
1.5	**BURIED TOPSOIL (ORGANIC LEAN CLAY) (OL)**, very dark grayish brown, moist	1523.5+/-
13.0	**LEAN CLAY WITH SAND (CL)**, with occasional sand lenses, trace gravel, and iron staining, grayish brown, moist	1512+/-
20.0	**LEAN CLAY WITH SAND (CL)**, with trace gravel, dark gray, moist	1505+/-
	Boring Terminated at 20 Feet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	10,620	2,003	10.5
		☒	5,750	651	9.6
		☒	4,760	253	6.5
		☒	3,550	443	10.8
5		☒	4,820	227	6.8
		☒	4,170	244	2.5
		☒	5,690	1,379	4.2
		☒	9,560	1,379	<1
		☒	7,820	1,559	8.7
10		☒	9,350	2,088	28.0
		☒	8,540	2,488	9.1
		☒	9,560	2,277	6.2
		☒	6,950	3,299	12.2
		☒	9,310	2,607	3.3
15		☒	8,110	2,003	7.4
		☒	5,170	996	9.7
		☒	4,190	496	11.9
		☒	2,990	411	15.5
		☒	2,250	194	14.8
20		☒	1,850	136	12.8

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with bentonite grout

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-41

BORING LOG NO. B-39

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 420 Easting: 280

Approximate Surface Elev: 1525.07 (Ft.) +/-

GRAPHIC LOG	DEPTH	DESCRIPTION	ELEVATION (Ft.)
☒	0.7	**FILL - LEAN CLAY WITH SAND**, light grayish brown, dry	1524.5+/-
⁘	2.0	**BURIED TOPSOIL (ORGANIC LEAN CLAY) (OL)**, very dark grayish brown, moist	1523+/-
▨	4.0	**LEAN CLAY WITH SAND (CL)**, with trace gravel and iron staining, light brownish gray, moist	1521+/-
▨	16.5	**SANDY LEAN CLAY (CL)**, with occasional silt layers, trace gravel, and iron staining, grayish brown, moist	1508.5+/-
▨	20.0	**SANDY LEAN CLAY (CL)**, with trace gravel, dark gray, moist	1505+/-
		Boring Terminated at 20 Feet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	5,350	1,172	5.1
		☒	2,810	845	5.6
		☒	3,220	449	7.7
		☒	2,690	405	7.6
5		☒	2,820	90	11.2
		☒	2,710	52	7.7
		☒	2,940	52	<1
		☒	3,070	74	5.4
		☒	3,840	153	11.2
10		☒	5,610	306	1.4
		☒	6,860	4,057	2.3
		☒	8,170	4,295	6.6
		☒	12,800	N.S.	9.7
		☒	18,320	4,533	10.1
15		☒	14,650	5,782	3.2
		☒	10,530	4,057	1.6
		☒	9,120	2,607	<1
		☒	8,420	2,488	<1
		☒	7,520	1,763	3.6
20		☒	5,630	1,623	2.2

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with bentonite grout

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-42

BORING LOG NO. B-40

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PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 520 Easting: 140

Approximate Surface Elev: 1524.87 (Ft.) +/-

DEPTH	ELEVATION (Ft.)	DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
TOPSOIL (ORGANIC LEAN CLAY) (OL), black, moist 1.0	1524+/-			☒	12,500	5,100	1.9
LEAN CLAY (CL), with trace gravel and iron staining, light grayish brown, moist				☒	12,430	3,854	1.8
				☒	11,200	4,533	2.3
				☒	10,350	4,057	2.1
				☒	8,600	3,299	<1
6.0	1519+/-	5		☒	5,860	2,725	7.4
LEAN CLAY WITH SAND (CL), with occasional sand lenses, trace gravel, and iron staining, grayish brown, moist				☒	10,270	2,994	4.4
				☒	14,280	4,057	6.7
				☒	11,120	3,854	4.1
				☒	12,800	3,299	3.6
		10		☒	9,500	3,650	7.0
				☒	12,850	5,100	2.3
				☒	11,700	4,057	2.5
				☒	10,250	3,650	3.1
				☒	10,500	2,383	<1
		15		☒	8,300	3,299	2.2
				☒	8,400	4,057	2.5
				☒	7,750	1,763	7.2
				☒	5,650	1,495	7.2
20.0	1505+/-	20		☒	4,600	918	<1

Boring Terminated at 20 Feet

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with bentonite grout

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-43

BORING LOG NO. B-41

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 660 Easting: 280

Approximate Surface Elev: 1524.61 (Ft.) +/-

DEPTH	DESCRIPTION	ELEVATION (Ft.)
1.2	**TOPSOIL (ORGANIC LEAN CLAY) (OL)**, black to gray, dry to 0.5' then moist	1523.5+/-
3.0	**LEAN CLAY WITH SAND (CL)**, light grayish brown, moist	1521.5+/-
20.0	**LEAN CLAY WITH SAND (CL)**, with trace gravel and iron staining, grayish brown, moist	1504.5+/-

Boring Terminated at 20 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	2,180	900	15.2
		☒	4,420	900	6.7
		☒	4,150	602	8.9
		☒	2,540	477	7.4
5		☒	2,230	130	8.1
		☒	2,350	166	7.4
		☒	2,250	289	6.7
		☒	2,300	28	3.0
		☒	2,600	46	2.7
10		☒	2,550	82	1.4
		☒	2,450	109	<1
		☒	3,150	109	9.2
		☒	3,950	602	7.7
		☒	4,500	706	9.0
15		☒	5,830	900	11.1
		☒	4,650	706	7.3
		☒	3,000	602	4.8
		☒	2,950	443	8.0
		☒	3,530	263	7.7
20		☒	2,660	166	14.9

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with bentonite grout

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-44

BORING LOG NO. B-42

Page 1 of 1

PROJECT: NDIC Brine Remediation Study

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 420 Easting: 140

Approximate Surface Elev: 1524.63 (Ft.) +/-

DEPTH		ELEVATION (Ft.)
0.8	**TOPSOIL (ORGANIC LEAN CLAY) (OL)**, very dark grayish brown to gray, dry to 0.5' then moist	1524+/-
	LEAN CLAY WITH SAND (CL), with occasional sand lenses, trace gravel, and iron staining, grayish brown, moist	
25.0		1499.5+/-

Boring Terminated at 25 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	13,500	4533	4.2
		☒	14,340	3299	5.5
		☒	14,590	3650	7.7
		☒	14,990	4057	2.9
5		☒	13,850	3,650	3.9
		☒	10,250	3,650	3.8
		☒	17,100	3,299	1.2
		☒	14,800	2,725	4.7
		☒	12,860	2,277	2.0
10		☒	11,900	1,763	2.3
		☒	9,480	3,299	4.6
		☒	12,520	3,650	10.1
		☒	12,220	3,650	7.8
		☒	11,610	3,650	3.9
15		☒	14,120	1,763	5.2
		☒	7,940	2,488	9.4
		☒	12,440	2,488	4.5
		☒	11,210	900	8.9
		☒	12,740	900	6.5
20		☒	7,350	978	4.8
		☒	13,050	706	5.7
		☒	7,750	706	5.8
		☒	4,540	602	5.9
		☒	3,420	411	4.1
25		☒	2,630	153	4.6

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with bentonite grout

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-45

BORING LOG NO. B-43

PROJECT: NDIC Brine Remediation Study

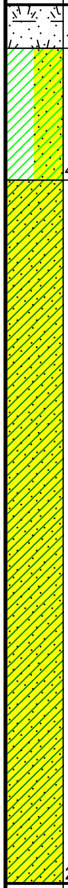
CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 300 Easting: 200

Approximate Surface Elev: 1524.99 (Ft.) +/-



GRAPHIC LOG	DEPTH	ELEVATION (Ft.)
	TOPSOIL (ORGANIC LEAN CLAY) (OL), very dark grayish brown, dry	
	1.0	1524+/-
	LEAN CLAY WITH SAND (CL), light grayish brown, moist	
	4.0	1521+/-
	SANDY LEAN CLAY (CL), with occassional sand and gravel lenses, trace gravel, and iron staining, grayish brown to dark grayish brown, moist	
	20.0	1505+/-
	Boring Terminated at 20 Feet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	16,680	>6,939	<1
		☒	13,500	3,099	1.6
		☒	12,420	2,577	1.4
		☒	10,750	4,458	1.2
5		☒	10,230	2,822	3.3
		☒	830	2,359	1.7
		☒	7,490	1,759	2.8
		☒	5,100	1,989	1.0
		☒	4,900	890	1.4
10		☒	3,860	756	1.6
		☒	1,730	535	1.8
		☒	1,690	362	2.3
		☒	3,050	325	1.9
		☒	2,510	638	1.7
15		☒	2,520	856	2.0
		☒	2,260	1,088	1.3
		☒	2,770	1,326	2.2
		☒	3,310	325	1.8
		☒	3,550	362	2.6
20		☒	3,600	401	1.5

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with bentonite grout

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-46

BORING LOG NO. B-44

Page 1 of 1

PROJECT: **NDIC Brine Remediation Study**

CLIENT: **ND Dept. of Mineral Resources - O&G Division**
Bismarck, North Dakota

SITE: **NE ¼ S26-T161N-82W**
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 380 Easting: 360

Approximate Surface Elev: 1525.01 (Ft.) +/-

DEPTH	Description	ELEVATION (Ft.)
0.5	**TOPSOIL (ORGANIC LEAN CLAY) (OL)**, very dark grayish brown, dry	1524.5+/-
5.0	**LEAN CLAY WITH SAND (CL)**, with occassional sand lenses and trace gravel, grayish brown, moist	1520+/-
17.0	**CLAYEY SAND (SC)**, interbedded sandy lean clay lenses with trace gravel and cobbles, fine to coarse grained, grayish brown, moist to 6' then wet	1508+/-

Auger Refusal at 17 Feet

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	11,410	4,207	<1
		☒	5,480	2,577	1.6
		☒	9,850	1,989	1.4
		☒	11,160	2,250	1.2
		☒	11,240	2,822	3.3
5		☒	12,880	3,782	1.7
		☒	12,640	2,822	2.8
		☒	17,210	3,416	1.0
		☒	19,110	4,207	1.4
		☒	18,520	7,207	1.6
10		☒	11,500	4,708	1.8
		☒	19,670	4,708	2.3
	▽	☒	14,690	7,207	1.9
		☒	16,400	3,782	1.7
		☒	15,500	>6,939	2.0
15		☒	20,000	6,035	1.3
	▨	☒	18,900	>6,939	2.2

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with bentonite grout

Notes:
PID readings are in isobutylene equivalents

WATER LEVEL OBSERVATIONS

▽ *15 mins after completion*

▨ *15 mins after completion*

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-47

BORING LOG NO. B-45

PROJECT: NDIC Brine Remediation Study

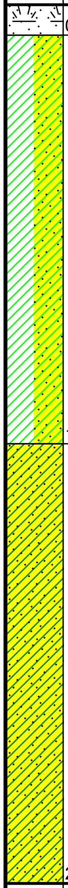
CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

LOCATION See Exhibit A-2

Northing: 850 Easting: 260

Approximate Surface Elev: 1531.39 (Ft.) +/-



DEPTH		ELEVATION (Ft.)
0.7	**TOPSOIL (ORGANIC LEAN CLAY) (OL)**, very dark grayish brown, dry	1530.5+/-
10.0	**LEAN CLAY WITH SAND (CL)**, with occassional sand lenses, trace gravel, and iron staining, grayish brown, dry to 2.5' then moist	1521.5+/-
20.0	**SANDY LEAN CLAY (CL)**, with occassional sand lenses, trace gravel, and iron staining, grayish brown, moist	1511.5+/-
	Boring Terminated at 20 Feet	

DEPTH (Ft.)	WATER LEVEL OBSERVATIONS	SAMPLE TYPE	FIELD EC (uS/cm)	FIELD CHLORIDE (mg/L)	PID
		☒	190	<28	<1
		☒	1350	52	<1
		☒	2840	52	<1
		☒	3020	66	1.4
		☒	2800	99	<1
5		☒	2370	166	1.3
		☒	2670	141	<1
		☒	2500	141	<1
		☒	3000	166	<1
		☒	2860	119	<1
10		☒	2260	166	3.6
		☒	2650	141	6.3
		☒	2290	141	6.6
		☒	2010	90	6.5
		☒	2260	37	4.3
15		☒	2340	34	5.3
		☒	1980	<28	8.2
		☒	1730	<28	8.0
		☒	1910	<28	9.2
		☒	1550	<28	7.1
20					

Stratification lines are approximate. In-situ, the transition may be gradual.

Advancement Method:
3 1/4" Hollow-stem Auger w/ 5' Continuous Sampler

Abandonment Method:
Backfilled with bentonite grout

Notes:
PID readings are in isobutylene equivalents

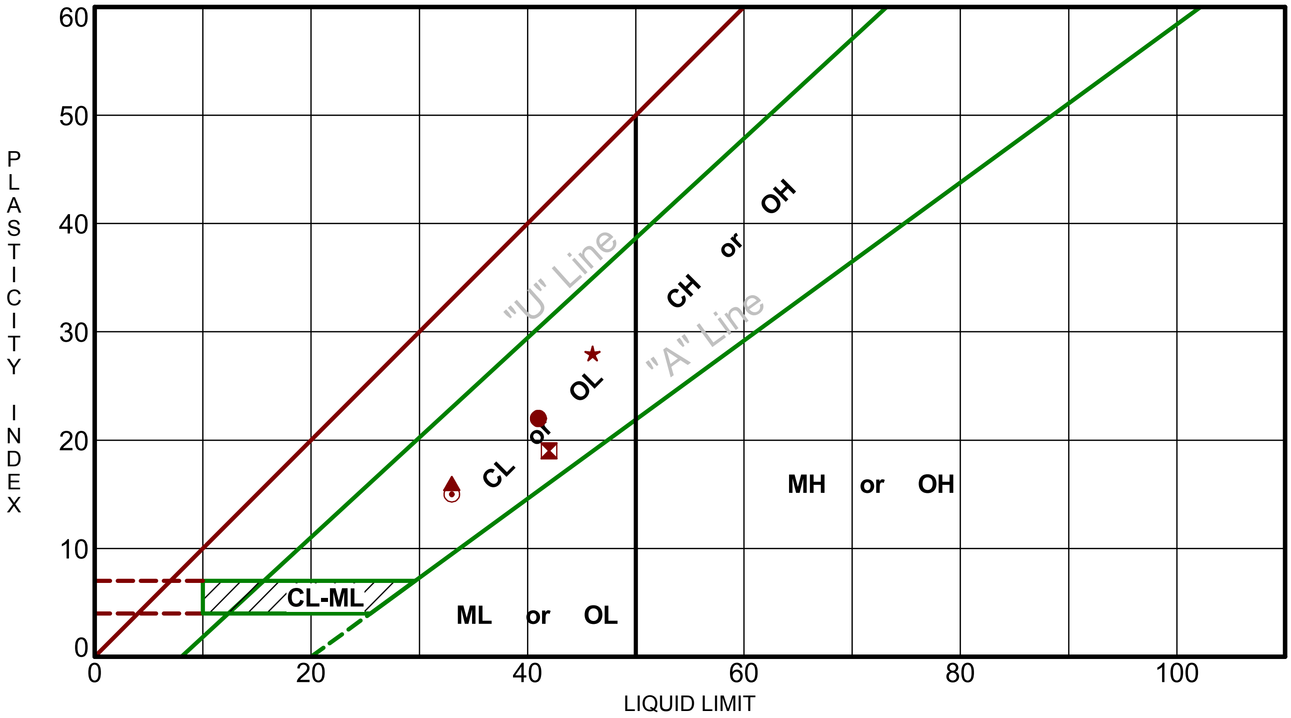
WATER LEVEL OBSERVATIONS
No free water observed

Terracon
860 9th St. NE Unit K
West Fargo, ND

Boring Started: 08-30-2017	Boring Completed: 08-30-2017
Drill Rig: D-90 Truck	Driller: MR
Project No.: M1177088	Exhibit: A-48

ATTERBERG LIMITS RESULTS

ASTM D4318



Boring ID		Depth	LL	PL	PI	Fines	USCS	Description
●	**B-3**	**2 - 3**	**41**	**19**	**22**	**80**	**CL**	**LEAN CLAY with SAND**
⊠	**B-5**	**2 - 3**	**42**	**23**	**19**	**83**	**CL**	**LEAN CLAY with SAND**
▲	**B-24**	**2 - 3**	**33**	**17**	**16**	**66**	**CL**	**SANDY LEAN CLAY**
★	**B-31**	**2 - 3**	**46**	**18**	**28**	**91**	**CL**	**LEAN CLAY**
⊙	**B-40**	**2 - 3**	**33**	**18**	**15**	**89**	**CL**	**LEAN CLAY**

PROJECT: NDIC Brine Remediation Study

SITE: NE ¼ S26-T161N-82W
Bottineau County, North Dakota

Terracon
860 9th St. NE Unit K
West Fargo, ND

PROJECT NUMBER: M1177088

CLIENT: ND Dept. of Mineral Resources - O&G Division
Bismarck, North Dakota

EXHIBIT: B-1

Terracon

Hydraulic Conductivity using a Flexible Wall Permeameter ASTM D-5084-97 "C"

Project:	NDIC Brine Remediation Study	Boring No.:	T-2
Project No.:	M1177088	Sample Depth:	3 feet
Date Sampled :	8/30/2017	Location :	Bottineau County, North Dakota

Soil Type : LEAN CLAY (CL) - black, trace sand

Proctor Results :	n/a	pcf	Molded @ :	n/a	% compact
	n/a	%		30.1	% M.C.

Initial Sample Parameters

						Moisture	Content
Wet Wt Soil (g)	126.09	Soil Diameter(in)	1.371	Soil Height (in)	2.737	Pan No.:	17
Dry Wt Soil (g)	96.92		1.369		2.738	Wet Soil & pan	59.28
Sample Area(cm^2)	9.487		1.365		2.741	Dry Soil & pan	48.39
Sample Area (in^2)	1.470529	Average (in)	1.368	Average(in)	2.739	Pan Wt.	12.20
Density (pcf)	91.6					M.C.	30.1
Assumed Sp.G.	2.65		Void Ratio	0.804			
Vol Wet (cc)	66.00	Vol. Solids Vs(cc)	36.58	Porosity n (%)	45		

Final Sample Parameters

						Moisture	Content
Wet Wt. (g)	51.67	Diameter (in)	1.393	Height (in)	0.994	Pan No.:	112
Dry Wt. (g)	43.22		1.401		1.002	Wet Soil & pan	99.93
Area (cm^2)	9.903		1.400		0.998	Dry Soil & pan	91.50
Area (in^2)	1.535	Average (in)	1.398	Average(in)	0.998	Pan Wt.	48.36
Density (pcf)	107.4					M.C. (%)	19.5

Ave Temp (C°) 20.1

Panel No.:	2	Chamber No.:	7	Hydraulic Gradient	20.3		
Cell Press.(psi)	57.0	Back Press.(psi)	52.0	Tail Press. (psi)	50.0	B Coefficient	0.95

Date	Time(min.)	Elapsed Time	Head (h1)	Tail (h2)	Total Head	k (cm / s)	dt / dh	Accetable
14-Sep	1316		1.16	8.33	177.47			
	1359	43	1.25	8.24	176.55	1.4E-07	1.00	PASS
	1359		1.25	8.24	176.55			
	1507	68	1.39	8.10	175.12	1.4E-07	1.00	PASS
	1537		1.45	8.05	174.56			
	1614	37	1.53	7.97	173.74	1.5E-07	1.00	PASS
	1614		1.53	7.97	173.74			
	1654	40	1.61	7.89	172.93	1.4E-07	1.00	PASS

Average: 1.45E-07 cm/s

1.1E-07 1.8E-07

APPENDIX C – DATA TABLES

Table 1 –Laboratory Results – Soil
Table 2 –Laboratory Results – Groundwater

Table 1
Analytical Laboratory Results - Soil

Boring No.	Sample Depth, ft	SAR	ESP, %	SC, umhos/cm	Chloride, mg/kg	Sodium, mg/kg	CEC, mEq/100g
B-1	1-3**	--	--	--	--	--	55.0
B-1	1	19.00	21.10	16,300	7,320	3,350	--
B-1	3	13.50	15.70	15,200	6,970	2,930	--
B-1	10	55.40	44.60	9,210	5,300	5,100	--
B-1	25	0.57	-0.42	121	51	289	--
B-2	1	48.50	41.30	13,600	6,840	3,160	--
B-2	3	58.20	45.80	4,660	2,880	3,730	--
B-2	11	60.50	46.80	10,100	6,810	5,120	--
B-3	1	15.40	17.70	4,420	1,910	1,500	--
B-3	3	6.38	7.53	2,210	871	1,670	--
B-3	14	44.30	39.00	16,200	7,440	4,610	--
B-4	1-3**	--	--	--	--	--	39.0
B-4	1	29.80	29.90	10,500	4,750	3,330	--
B-4	3	38.40	35.70	9,600	3,700	2,920	--
B-4	10	59.10	46.20	10,500	7,580	4,610	--
B-5	1	14.20	16.40	2,580	1,290	1,370	--
B-5	3	5.57	6.51	1,750	605	1,310	--
B-5	14	26.30	27.30	7,380	3,160	3,060	--
B-6	1-3**	--	--	--	--	--	41.6
B-6	1	33.80	32.70	11,000	4,620	3,980	--
B-6	3	51.00	42.50	7,710	3,640	3,520	--
B-7	1-3**	--	--	--	--	--	37.0
B-7	1	31.20	30.90	10,300	4,440	3,460	--
B-7	3	19.90	21.90	5,530	2,790	2,120	--
B-8	1	43.20	38.40	15,500	8,070	4,980	--
B-8	3	34.60	33.20	10,400	4,530	3,600	--
B-9	1	40.10	36.60	7,500	2,890	3,210	--
B-9	3	48.10	41.10	5,740	2,200	2,740	--
B-10	1	21.30	23.20	2,370	674	1,640	--
B-10	3	29.50	29.70	1,760	528	1,450	--
B-11	1	9.93	11.80	1,090	313	620	--
B-11	3	5.27	6.11	1,460	536	1,360	--
B-12	1-3**	--	--	--	--	--	55.0
B-12	1	65.10	48.70	28,500	13,700	9,920	--
B-12	3	65.70	48.90	18,800	7,680	4,440	--
B-13	1-3**	--	--	--	--	--	38.4
B-13	1	32.60	31.90	7,680	4,450	3,980	--
B-13	3	34.90	33.40	4,930	2,000	2,150	--
B-14	1	41.30	37.30	15,100	7,460	4,830	--
B-14	3	43.30	38.50	8,710	5,280	4,620	--
B-15	1	11.80	14.00	3,000	1,040	1,340	--
B-15	3	13.20	15.40	2,180	837	937	--
B-16	1	12.50	14.70	3,680	1,970	1,530	--
B-16	3	13.00	15.20	1,670	610	944	--
B-17	1	10.80	12.80	2,980	1,170	2,980	--

Boring No.	Sample Depth, ft	SAR	ESP, %	SC, umhos/cm	Chloride, mg/kg	Sodium, mg/kg	CEC, mEq/100g
B-17	3	10.90	13.00	1,640	592	953	--
B-18	1-3**	--	--	--	--	--	45.1
B-18	1	9.61	11.40	7,880	2,460	1,430	--
B-18	3	8.61	10.30	6,900	2,260	1,910	--
B-19	1	41.70	37.60	7,210	3,790	3,770	--
B-19	3	40.60	37.00	2,860	921	1,150	--
B-20	1	4.69	5.35	6,330	558	980	--
B-20	3	8.22	9.80	3,610	1,830	1,290	--
B-21	1	36.30	34.30	17,500	7,790	5,640	--
B-21	3	40.20	36.70	15,700	6,390	5,020	--
B-22	1	4.38	4.95	7,790	494	1,020	--
B-22	3	4.50	5.11	6,050	937	743	--
B-23	1	8.29	9.89	6,390	1,890	1,150	--
B-23	3	10.70	12.60	3,600	1,290	1,600	--
B-24	1	59.00	46.20	9,340	4,290	3,710	--
B-24	3	32.20	31.60	6,820	2,730	2,350	--
B-25	1	26.50	27.50	11,900	577	3,270	--
B-25	3	24.20	25.60	4,590	1,790	2,000	--
B-26	1	4.77	5.46	7,450	126	1,100	--
B-26	3	4.77	5.46	6,480	120	962	--
B-27	1	6.79	8.05	8,960	2,210	1,510	--
B-27	3	7.11	8.44	11,100	3,610	1,820	--
B-28	1	11.30	13.40	12,400	4,550	2,200	--
B-28	3	7.84	9.35	7,980	2,990	1,360	--
B-29	1	12.70	14.90	4,420	1,690	1,330	--
B-29	3	7.58	9.03	1,630	416	713	--
B-30	1	3.34	3.53	6,490	66	209	--
B-30	3	3.56	3.84	481	119	388	--
B-31	1	3.56	3.83	1,550	415	874	--
B-31	3	3.03	3.10	5,210	334	691	--
B-32	1	7.93	9.45	6,810	1,210	1,470	--
B-32	3	6.47	7.65	4,540	631	1,030	--
B-33	1	6.19	7.30	2,920	873	809	--
B-33	3	3.28	3.45	1,520	336	290	--
B-34	1	3.63	3.93	1,480	459	469	--
B-34	3	2.90	2.93	1,120	343	391	--
B-35	1	4.79	5.49	6,150	824	1,020	--
B-35	3	2.56	2.45	2,500	235	570	--
B-36	1	6.15	7.24	1,820	569	718	--
B-36	3	3.99	4.42	1,460	491	429	--
B-37	1	4.15	4.64	2,070	691	679	--
B-37	3	4.33	4.88	1,380	398	472	--
B-38	1	55.00	44.40	5,690	3,400	3,840	--
B-38	3	14.30	16.50	1,330	1,000	2,080	--
B-38	12	39.90	36.50	7,020	4,110	3,770	--

Table 1
Analytical Laboratory Results - Soil

Boring No.	Sample Depth, ft	SAR	ESP, %	SC, umhos/cm	Chloride, mg/kg	Sodium, mg/kg	CEC, mEq/100g
B-39	1-3**	--	--	--	--	--	24.9
B-39	1	16.30	18.50	3,610	2,000	1,540	--
B-39	3	19.40	21.40	1,190	861	1,060	--
B-39	14	53.00	43.50	8,520	3,920	5,340	--
B-40	1	56.40	45.00	18,600	2,990	4,550	--
B-40	3	47.70	40.80	12,200	5,860	3,960	--
B-40	8	43.90	38.80	12,200	4,880	4,420	--
B-41	1	12.20	14.40	4,570	1,170	1,430	--
B-41	3	14.50	16.80	3,130	962	1,190	--
B-41	15	18.10	20.30	2,090	2,040	1,870	--
B-42	1	24.90	26.20	14,500	7,160	3,820	--
B-42	3	29.60	29.80	12,200	6,300	3,580	--
B-42	7	37.50	35.10	10,100	2,730	4,840	--
B-43	1	18.60	20.80	20,300	7,470	4,220	--
B-43	3	21.30	23.10	6,230	5,200	2,610	--
B-43	7	21.40	23.20	1,480	3,890	2,860	--
B-44	1	25.10	26.30	6,920	4,680	3,720	--
B-44	3	29.00	29.30	3,240	3,190	2,530	--
B-44	16	44.00	38.90	1,610	7,090	5,310	--
B-45	1-3**	--	--	--	--	--	36.2
B-45	1	2.81	2.80	12,000	19	460	--
B-45	3	6.69	7.93	3,660	89	1,200	--
B-45	15	3.75	4.09	1,100	61	718	--

Notes

Definitions - SAR (sodium adsorption ratio), ESP (exchangeable sodium percentage), SC (specific conductance/electrical conductivity), CEC (cation exchange capacity)

SC tested using EPA Method 9050A

Chlorides tested using EPA Method 9056

Calcium, magnesium, and sodium (metals) tested using EPA Method 6010B

Cation exchange capacity (CEC) tested using EPA Method 9081

-- = not applicable

NE = not established

Bold = Result exceeds NDIC, NDDoH, and/or EPA guidance level, action level, and/or screening level

[1] Information from North Dakota Department of Health: *UST Information-Cleanup Action Levels for Gasoline and Other Petroleum Hydrocarbons; and Guidelines for the Assessment and Cleanup of Saltwater Releases (Draft; December, 2014)*

[2] EPA Region 9 Regional Screening Levels (RSLs) June, 2015 - Residential and Industrial Soil Screening Levels in mg/kg

[3] Information from North Dakota Industrial Commission: A Guide for Remediation of Salt/Hydrocarbon Impacted Soil

Regulatory Information

North Dakota Regulatory Guidance[1] - SC 2,000 umhos/cm, Chlorides 250 mg/kg

High Electrical Conductivity[2] - SC 4,000 umhos/cm, Chlorides NE

North Dakota Industrial Commission - SC 35,000 umhos/cm, Chlorides NE

Table 2
Analytical Laboratory Results - Groundwater

Boring No.	SAR	ESP, %	SC, umhos/cm	Chloride, mg/L	Calcium, mg/L	Magnesium, mg/L	Sodium, mg/L
B-2	99.6	59.3	98,000	**26,700**	2,500	749	22,100
B-44	64.0	48.2	111,000	**43,100**	8,500	2,700	26,500

Notes

Definitions - SAR (sodium adsorption ratio), ESP (exchangeable sodium percentage), SC (specific conductance/electrical conductivity), CEC (cation exchange capacity)

SC tested using EPA Method 9050A

Chlorides tested using EPA Method 9056

Calcium, magnesium, and sodium (metals) tested using EPA Method 6010B

-- = not applicable

NE = not established

Bold = Result exceeds NDIC, NDDoH, and/or EPA guidance level, action level, and/or screening level

[1] Information from North Dakota Department of Health: *UST Information-Cleanup Action Levels for Gasoline and Other Petroleum Hydrocarbons; and Guidelines for the Assessment and Cleanup*

[2] EPA Region 9 Regional Screening Levels (RSLs) June, 2015 - Tapwater Screening Level in mg/L

Regulatory Information

North Dakota Regulatory Guidance[1] - SC NE, Chlorides 250 mg/L

EPA Region 9 Residential RSLs[2] - SC NE, Chlorides NE

APPENDIX D –LABORATORY REPORTS

ESC Analytical Reports and Chain of Custodies

AgVise Analytical Test Reports – Soil

ANALYTICAL REPORT

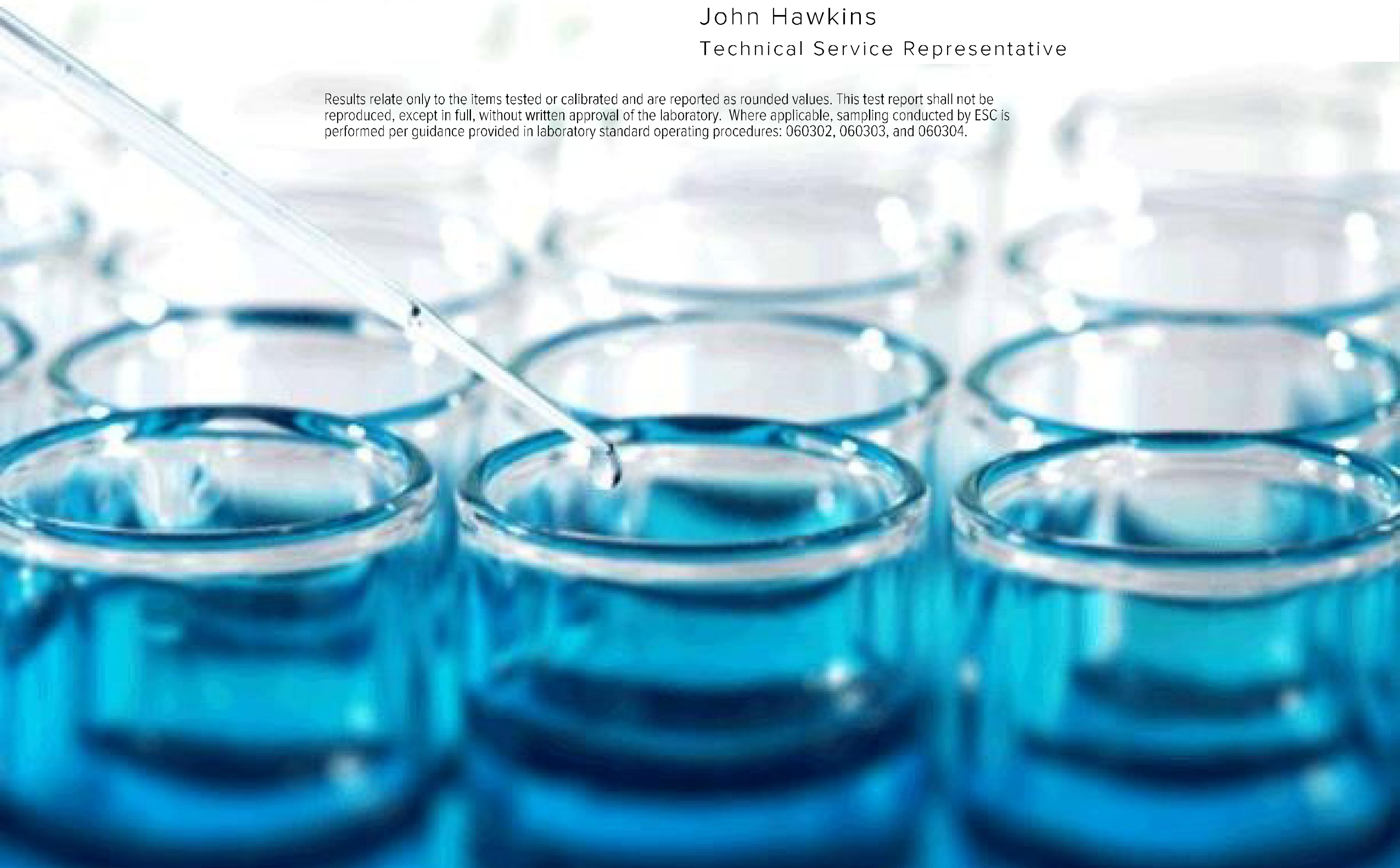
September 08, 2017

Terracon - Fargo, ND

Sample Delivery Group:	L933132
Samples Received:	08/31/2017
Project Number:	
Description:	Brine Pond Study
Site:	MINOT ND
Report To:	Jacqueline Finck 860 9TH ST E West Fargo, ND 58078

Entire Report Reviewed By: John V Hawkins

John Hawkins
Technical Service Representative



12065 Lebanon Rd   Mount Juliet, TN 37122   615-758-5858   800-767-5859   www.esclabsciences.com

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B1 1' L933132-01 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 10:15	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 09:51	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 09:51	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	10	09/01/17 08:59	09/02/17 13:23	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 22:45	CCE

B2 1' L933132-02 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 11:25	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 09:54	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 09:54	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	10	09/01/17 08:59	09/02/17 13:32	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 22:48	CCE

B3 1' L933132-03 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 12:15	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 09:56	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 09:56	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	5	09/01/17 08:59	09/02/17 13:41	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 22:50	CCE

B4 1' L933132-04 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 13:35	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 09:59	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 09:59	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	10	09/01/17 08:59	09/02/17 13:50	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 22:53	CCE

B5 1' L933132-05 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 14:30	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:02	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:02	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1018164	5	09/08/17 11:23	09/08/17 14:12	MAJ
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 22:55	CCE

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

B20 1' L933132-06 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 15:45	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:04	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:04	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	1	09/01/17 08:59	09/02/17 14:34	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 22:58	CCE

B22 1' L933132-07 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 16:00	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:07	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:07	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	1	09/01/17 08:59	09/02/17 14:42	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 23:00	CCE

B26 1' L933132-08 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 16:10	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:10	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:10	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	1	09/01/17 08:59	09/02/17 14:51	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 23:03	CCE

B1 10' L933132-09 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 10:30	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:12	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:12	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	10	09/01/17 08:59	09/02/17 15:00	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 23:06	CCE

B2 11' L933132-10 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 11:40	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 12:29	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 12:29	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	10	09/01/17 08:59	09/02/17 15:09	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 23:13	CCE

B3 14' L933132-11 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 12:30	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 12:32	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 12:32	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	10	09/01/17 08:59	09/02/17 15:17	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 23:16	CCE

B4 10' L933132-12 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 13:50	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:26	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:26	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	10	09/01/17 08:59	09/02/17 16:10	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 23:19	CCE

B5 14' L933132-13 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 14:45	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:29	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:29	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	5	09/01/17 08:59	09/02/17 16:19	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 23:21	CCE

B20 L933132-14 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 15:50	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:32	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:32	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	5	09/01/17 08:59	09/02/17 16:28	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 23:24	CCE

B22 L933132-15 Solid

Collected by	Collected date/time	Received date/time
Jaequeline Finck	08/29/17 16:05	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:34	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:34	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	5	09/01/17 08:59	09/02/17 16:36	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 23:27	CCE

	Collected by	Collected date/time	Received date/time
B26 3' L933132-16 Solid	Jaequeline Finck	08/29/17 16:15	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:37	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:37	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	1	09/01/17 08:59	09/02/17 16:45	NJM
Metals (ICP) by Method 6010C	WG1017660	1	09/07/17 09:27	09/07/17 23:29	CCE

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. All MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All radiochemical sample results for solids are reported on a dry weight basis with the exception of tritium, carbon-14 and radon, unless wet weight was requested by the client. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

John V Hawkins

John Hawkins
Technical Service Representative

B1 1'

Collected date/time: 08/29/17 10:15

SAMPLE RESULTS - 01

L933132

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	19.0		1	09/08/2017 09:51	WG1016359

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	21.1		1	09/08/2017 09:51	WG1016359

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	16300		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	7320		100	10	09/02/2017 13:23	WG1015928

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	3350		100	1	09/07/2017 22:45	WG1017660

B2 1'

Collected date/time: 08/29/17 11:25

SAMPLE RESULTS - 02

L933132

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	48.5		1	09/08/2017 09:54	WG1016359

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	41.3		1	09/08/2017 09:54	WG1016359

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	13600		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	6840		100	10	09/02/2017 13:32	WG1015928

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	3160		100	1	09/07/2017 22:48	WG1017660

B3 1'

Collected date/time: 08/29/17 12:15

SAMPLE RESULTS - 03

L933132

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	15.4		1	09/08/2017 09:56	WG1016359

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	17.7		1	09/08/2017 09:56	WG1016359

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	4420		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	1910		50.0	5	09/02/2017 13:41	WG1015928

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1500		100	1	09/07/2017 22:50	WG1017660

B4 1'
Collected date/time: 08/29/17 13:35

SAMPLE RESULTS - 04

L933132

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	29.8		1	09/08/2017 09:59	WG1016359

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	29.9		1	09/08/2017 09:59	WG1016359

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	10500		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	4750	J3	100	10	09/02/2017 13:50	WG1015928

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	3330		100	1	09/07/2017 22:53	WG1017660

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	14.2		1	09/08/2017 10:02	WG1016359

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	16.4		1	09/08/2017 10:02	WG1016359

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	2580		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	1290		50.0	5	09/08/2017 14:12	WG1018164

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1370		100	1	09/07/2017 22:55	WG1017660

B20 1'

Collected date/time: 08/29/17 15:45

SAMPLE RESULTS - 06

L933132

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	4.69		1	09/08/2017 10:04	WG1016359

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	5.35		1	09/08/2017 10:04	WG1016359

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	6330		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	558		10.0	1	09/02/2017 14:34	WG1015928

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	980		100	1	09/07/2017 22:58	WG1017660

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	4.38		1	09/08/2017 10:07	WG1016359

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	4.95		1	09/08/2017 10:07	WG1016359

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	7790		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	494		10.0	1	09/02/2017 14:42	WG1015928

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1020		100	1	09/07/2017 23:00	WG1017660

B26 1'

Collected date/time: 08/29/17 16:10

SAMPLE RESULTS - 08

L933132

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	4.77		1	09/08/2017 10:10	WG1016359

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	5.46		1	09/08/2017 10:10	WG1016359

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	7450		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	126		10.0	1	09/02/2017 14:51	WG1015928

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	1100		100	1	09/07/2017 23:03	WG1017660

B1 10'
Collected date/time: 08/29/17 10:30

SAMPLE RESULTS - 09

L933132

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	55.4		1	09/08/2017 10:12	WG1016359

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	44.6		1	09/08/2017 10:12	WG1016359

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	9210		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	5300		100	10	09/02/2017 15:00	WG1015928

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	5100		100	1	09/07/2017 23:06	WG1017660

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	60.5		1	09/08/2017 12:29	WG1016359

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	46.8		1	09/08/2017 12:29	WG1016359

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	10100		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	6810		100	10	09/02/2017 15:09	WG1015928

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	5120		100	1	09/07/2017 23:13	WG1017660

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	44.3		1	09/08/2017 12:32	WG1016359

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	39.0		1	09/08/2017 12:32	WG1016359

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	16200		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	7440		100	10	09/02/2017 15:17	WG1015928

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	4610		100	1	09/07/2017 23:16	WG1017660

B4 10'

Collected date/time: 08/29/17 13:50

SAMPLE RESULTS - 12

L933132

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	59.1		1	09/08/2017 10:26	WG1016359

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	46.2		1	09/08/2017 10:26	WG1016359

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	10500		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	7580		100	10	09/02/2017 16:10	WG1015928

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	4610		100	1	09/07/2017 23:19	WG1017660

B5 14'

Collected date/time: 08/29/17 14:45

SAMPLE RESULTS - 13

L933132

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	26.3		1	09/08/2017 10:29	WG1016359

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	27.3		1	09/08/2017 10:29	WG1016359

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	7380		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	3160		50.0	5	09/02/2017 16:19	WG1015928

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	3060		100	1	09/07/2017 23:21	WG1017660

B20

Collected date/time: 08/29/17 15:50

SAMPLE RESULTS - 14

L933132

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	8.22		1	09/08/2017 10:32	WG1016359

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	9.80		1	09/08/2017 10:32	WG1016359

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	3610		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	1830		50.0	5	09/02/2017 16:28	WG1015928

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	1290		100	1	09/07/2017 23:24	WG1017660

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	4.50		1	09/08/2017 10:34	WG1016359

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	5.11		1	09/08/2017 10:34	WG1016359

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	6050		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	937		50.0	5	09/02/2017 16:36	WG1015928

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	743		100	1	09/07/2017 23:27	WG1017660

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	4.77		1	09/08/2017 10:37	WG1016359

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	5.46		1	09/08/2017 10:37	WG1016359

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	6480		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	120		10.0	1	09/02/2017 16:45	WG1015928

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	962		100	1	09/07/2017 23:29	WG1017660

Method Blank (MB)

(MB) WG1015895-1 09/01/17 10:53

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	3.03			

L933132-01 Original Sample (OS) • Duplicate (DUP)

(OS) L933132-01 09/01/17 10:53 • (DUP) WG1015895-4 09/01/17 10:53

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	16300	16300	1	0.184		20

L933132-11 Original Sample (OS) • Duplicate (DUP)

(OS) L933132-11 09/01/17 10:53 • (DUP) WG1015895-5 09/01/17 10:53

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	16200	16200	1	0.185		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) WG1015895-2 09/01/17 10:53 • (LCSD) WG1015895-3 09/01/17 10:53

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	559	563	564	101	101	90.0-110			0.177	20

Method Blank (MB)

(MB) R3246808-1 09/02/17 12:40

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	3.75	J	0.795	10.0

L933132-04 Original Sample (OS) • Duplicate (DUP)

(OS) L933132-04 09/02/17 13:50 • (DUP) R3246808-4 09/02/17 14:16

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	4750	5700	10	18	J3	15

L933165-01 Original Sample (OS) • Duplicate (DUP)

(OS) L933165-01 09/02/17 16:54 • (DUP) R3246808-7 09/02/17 17:03

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	5280	5730	10	8		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3246808-2 09/02/17 12:48 • (LCSD) R3246808-3 09/02/17 12:57

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	221	221	110	111	80-120			0	15

Method Blank (MB)

(MB) R3247988-1 09/08/17 13:28

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	4.24	J	0.795	10.0

L933446-02 Original Sample (OS) • Duplicate (DUP)

(OS) L933446-02 09/08/17 16:24 • (DUP) R3247988-4 09/08/17 16:33

Analyte	Original Result (dry) mg/kg	DUP Result (dry) mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	3390	3410	5	1		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3247988-2 09/08/17 13:37 • (LCSD) R3247988-3 09/08/17 13:46

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	223	225	111	113	80-120			1	15

Method Blank (MB)

(MB) R3247700-1 09/07/17 22:11

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Sodium	U		9.85	100

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3247700-2 09/07/17 22:14 • (LCSD) R3247700-3 09/07/17 22:16

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Sodium	1000	1080	1060	108	106	80-120			1	20

L933040-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933040-01 09/07/17 22:19 • (MS) R3247700-6 09/07/17 22:27 • (MSD) R3247700-7 09/07/17 22:29

Analyte	Spike Amount (dry) mg/kg	Original Result (dry) mg/kg	MS Result (dry) mg/kg	MSD Result (dry) mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Sodium	1130	65.4	1340	1290	113	108	1	75-125			4	20

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Abbreviations and Definitions

(dry)	Results are reported based on the dry weight of the sample. [this will only be present on a dry report basis for soils].
MDL	Method Detection Limit.
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
J	The identification of the analyte is acceptable; the reported value is an estimate.
J3	The associated batch QC was outside the established quality control range for precision.

ACCREDITATIONS & LOCATIONS

ESC Lab Sciences is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our "one location" design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be **YOUR LAB OF CHOICE.**
* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

State Accreditations

Alabama	40660	Nevada	TN-03-2002-34
Alaska	UST-080	New Hampshire	2975
Arizona	AZ0612	New Jersey–NELAP	TN002
Arkansas	88-0469	New Mexico	TN00003
California	01157CA	New York	11742
Colorado	TN00003	North Carolina	Env375
Conneticut	PH-0197	North Carolina [1]	DW21704
Florida	E87487	North Carolina [2]	41
Georgia	NELAP	North Dakota	R-140
Georgia [1]	923	Ohio–VAP	CL0069
Idaho	TN00003	Oklahoma	9915
Illinois	200008	Oregon	TN200002
Indiana	C-TN-01	Pennsylvania	68-02979
Iowa	364	Rhode Island	221
Kansas	E-10277	South Carolina	84004
Kentucky [1]	90010	South Dakota	n/a
Kentucky [2]	16	Tennessee [1 4]	2006
Louisiana	AI30792	Texas	T 104704245-07-TX
Maine	TN0002	Texas [5]	LAB0152
Maryland	324	Utah	6157585858
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	109
Minnesota	047-999-395	Washington	C1915
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	9980939910
Montana	CERT0086	Wyoming	A2LA
Nebraska	NE-OS-15-05		

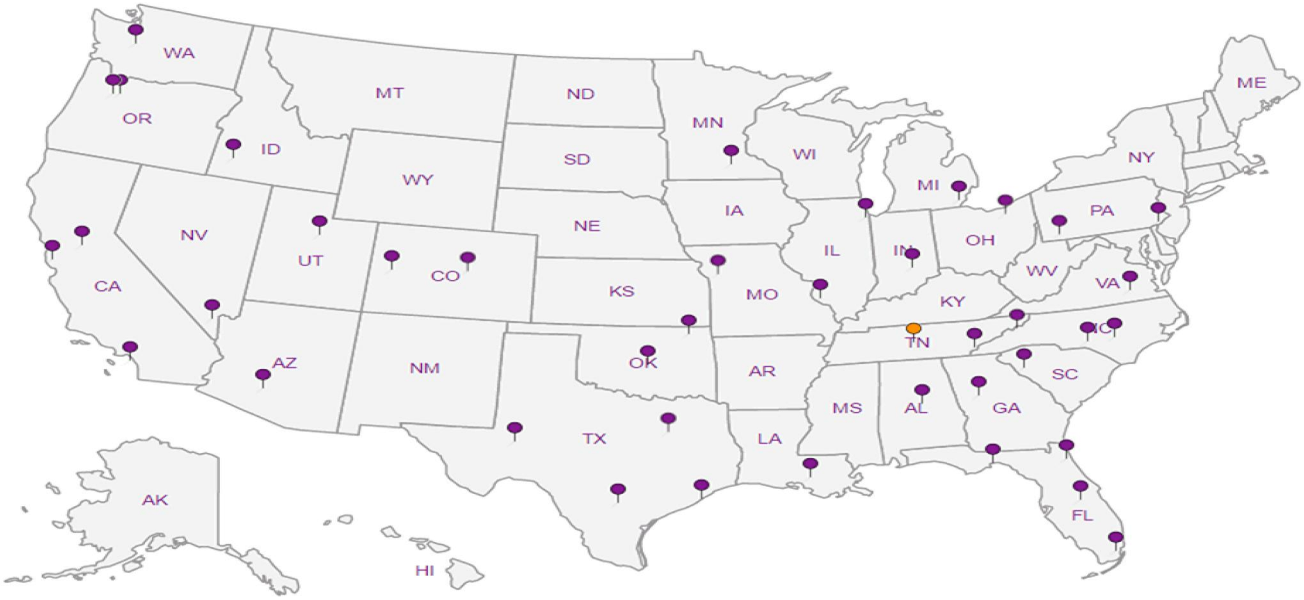
Third Party & Federal Accreditations

A2LA – ISO 17025	1461.01	AIHA-LAP,LLC	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	S-67674
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [n/a] Accreditation not applicable

Our Locations

ESC Lab Sciences has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. **ESC Lab Sciences performs all testing at our central laboratory.**



Chain of Custody Page 1 of 1

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Terracon - Fargo, ND

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West Fargo, ND 58078

Billing Information:
Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Email To: **Jacqueline.Finck@terracon.com**

Report to:
Jacqueline Finck

Project Description: **Brine Pond Study**

City/State Collected: Renville, ND

Phone: **701-356-7621**
Fax:

Client Project #

Lab Project #
TERRAFND-M1177088

Collected by (print): Jacqueline Finck

Site/Facility ID #
MINOT ND

P.O. #

Collected by (signature): Jacqueline Finck

Quote #

Immediately Packed on Ice N X Y ___

Rush? (Lab MUST Be Notified)
___ Same Day X Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Date Results Needed

L# 2933132

E040

Acctnum: **TERRAFND**
Template: **T127227**
Prelogin: **P615134**
TSR: **341 - John Hawkins**
PB: CM 8.15.17
Shipped Via: **FedEX Priority**

Analysis / Container / Preservative

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CHLORIDE 125mlHDPE-NoPres	CL ESP SAR 4ozClr-NoPres	ESP NAICP SAR 250mlHDPE-HNO3	NAICP 2ozClr-NoPres	SPCON (ec) 4ozClr-NoPres	SPCON 250mlHDPE-NoPres	Remarks	Sample # (lab only)
B1	Grab	SS	1'	8/29/17	10:15am	3		X		X	X			-01
B2		SS	1'		11:25 am	3		X		X	X			02
B3		SS	1'		12:15 pm	3		X		X	X			03
B4		SS	1'		1:35 pm	3		X		X	X			04
B5		SS	1'		2:30 pm	3		X		X	X			05
B20		SS	1'		3:45 pm	3		X		X	X			06
B22		SS	1'		4:10 pm	3		X		X	X			07
B26	Grab	SS	1'	8/29/17	4:10 pm	3		X		X	X			08
		SS				3		X		X	X			
		SS				3		X		X	X			

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
___ UPS X FedEx ___ Courier ___ ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature) Jacqueline Finck	Date: 8/30/17	Time: 7:00Am	Received by: (Signature)
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)

Trip Blank Received: Yes / [✓ No]
HCL / MeoH
TBR

Temp: 1.2 °C Bottles Received: 98

Date: 8-31-17 Time: 845

If preservation required by Login: Date/Time

Hold:

Condition: NCF / [✓ OK]

Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:
Levi Seff
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West Fargo, ND 58078

Pres Chk

Email To: Jacqueline.Finck@terracon.com

Report to:
Jacqueline Finck

Project Description: Brine Pond Study

City/State Collected: Renville, ND

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Client Project #

Lab Project #
TERRAFND-M1177088

Collected by (print): Jacqueline

Site/Facility ID #
MINOT ND

P.O. #

Collected by (signature): Jacqueline Finck

Immediately Packed on Ice N X Y ___

Rush? (Lab MUST Be Notified)
___ Same Day
___ Next Day
___ Two Day
___ Three Day
X Five Day
___ 5 Day (Rad Only)
___ 10 Day (Rad Only)

Quote #

Date Results Needed

Analysis / Container / Preservative

Chain of Custody Page 2 of 2

ESC
L·A·B S·C·I·E·N·C·E·S
a subsidiary of Pace Analytical

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L# L933132

Table #

Acctnum: TERRAFND
Template: T127227
Prelogin: P615134
TSR: 341 - John Hawkins
PB: CM 8.15.17
Shipped Via: FedEX Priority

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CHLORIDE 125mlHDPE-NoPres	CL ESP SAR 4ozClr-NoPres	ESP NAICP SAR 250mlHDPE-HNO3	NAICP 2ozClr-NoPres	SPCON (ec) 4ozClr-NoPres	SPCON 250mlHDPE-NoPres					Remarks	Sample # (lab only)
B1	Grab	SS	10'	8/29/17	10:30am	3		X		X	X							-09
B2		SS	11'		11:40am	3		X		X	X							10
B3		SS	14'		1230pm	3		X		X	X							11
B4		SS	10'		1:50pm	3		X		X	X							12
B5		SS	14'		2:45pm	3		X		X	X							13
B20		SS	3'		3:50pm	3		X		X	X							14
B22		SS	3'		4:05pm	3		X		X	X							15
B26	Grab	SS	3'	8/29/17	4:15pm	3		X		X	X							16
		SS				3		X		X	X							
		SS				3		X		X	X							

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
__ UPS X FedEx __ Courier __ ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓ Y __N
COC Signed/Accurate: ✓ Y __N
Bottles arrive intact: ✓ Y __N
Correct bottles used: ✓ Y __N
Sufficient volume sent: ✓ Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature) Jacqueline Finck
Date: 8/30/17
Time: 7:00pm
Received by: (Signature)

Trip Blank Received: Yes / [✓ No]
HCL / MeoH
TBR

Relinquished by : (Signature)
Date:
Time:
Received by: (Signature)

Temp: 1.4 °C
Bottles Received: 48

If preservation required by Login: Date/Time

Relinquished by : (Signature)
Date:
Time:
Received for lab by: (Signature)
Date: 8/31/17
Time: 845

Hold:

Condition: NCF / [✓ OK]

ANALYTICAL REPORT

September 11, 2017

Terracon - Fargo, ND

Sample Delivery Group:	L933165
Samples Received:	08/31/2017
Project Number:	
Description:	Brine Pond Study
Site:	MINOT ND
Report To:	Jacqueline Finck 860 9TH ST E West Fargo, ND 58078

Entire Report Reviewed By: John V Hawkins

John Hawkins
Technical Service Representative

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SAMPLE SUMMARY

B14 3' L933165-01 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 15:25	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:39	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:39	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	10	09/01/17 08:59	09/02/17 16:54	NJM
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 11:18	CCE

B18 3' L933165-02 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 15:45	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:42	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:42	CCE
Wet Chemistry by Method 9050AMod	WG1015895	1	09/01/17 10:53	09/01/17 10:53	MA
Wet Chemistry by Method 9056A	WG1015928	5	09/01/17 08:59	09/02/17 17:29	NJM
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 11:31	CCE

B23 3' L933165-03 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 17:40	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:45	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:45	CCE
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1015928	5	09/01/17 08:59	09/02/17 17:38	NJM
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 11:33	CCE

B27 3' L933165-04 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 17:25	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:53	CCE
Calculated Results	WG1016359	1	09/06/17 13:57	09/08/17 10:53	CCE
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1016346	10	09/05/17 21:40	09/05/17 23:03	NJM
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 11:41	CCE

B30 3' L933165-05 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 16:35	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:40	ST
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:40	ST
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1015932	1	09/01/17 14:33	09/02/17 12:10	DR
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 11:43	CCE

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

B31 3' L933165-06 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 17:20	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:43	ST
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:43	ST
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1015932	1	09/01/17 14:33	09/02/17 12:27	DR
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 11:47	CCE

B34 3' L933165-07 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 16:50	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:45	ST
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:45	ST
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1015932	1	09/01/17 14:33	09/02/17 12:36	DR
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 11:50	CCE

B35 3' L933165-08 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 17:05	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:48	ST
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:48	ST
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1015932	1	09/01/17 14:33	09/02/17 13:02	DR
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 11:52	CCE

B14 1' L933165-09 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 15:20	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 02:15	ST
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 02:15	ST
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1015932	10	09/01/17 14:33	09/02/17 13:11	DR
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 11:55	CCE

B18 1' L933165-10 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 15:40	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:53	ST
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:53	ST
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1015932	5	09/01/17 14:33	09/02/17 13:29	DR
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 11:58	CCE

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 17:35	08/31/17 08:45

B23 1' L933165-11 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:56	ST
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:56	ST
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1015932	5	09/01/17 14:33	09/02/17 13:37	DR
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 12:00	CCE

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 17:20	08/31/17 08:45

B27 1' L933165-12 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:59	ST
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 00:59	ST
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1015932	5	09/01/17 14:33	09/02/17 13:46	DR
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 12:03	CCE

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 16:30	08/31/17 08:45

B30 1' L933165-13 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 01:02	ST
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 01:02	ST
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1015932	1	09/01/17 14:33	09/02/17 13:55	DR
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 12:05	CCE

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 17:15	08/31/17 08:45

B31 1' L933165-14 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 01:09	ST
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 01:09	ST
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1016346	1	09/05/17 21:40	09/05/17 23:12	NJM
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 12:16	CCE

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 16:45	08/31/17 08:45

B34 1' L933165-15 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 01:12	ST
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 01:12	ST
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1016346	1	09/05/17 21:40	09/05/17 23:21	NJM
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 12:18	CCE

	Collected by	Collected date/time	Received date/time
B35 1' L933165-16 Solid	Jacqueline Finck	08/29/17 17:00	08/31/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 01:15	ST
Calculated Results	WG1016361	1	09/08/17 07:11	09/11/17 01:15	ST
Wet Chemistry by Method 9050AMod	WG1015937	1	09/01/17 12:21	09/01/17 12:21	MA
Wet Chemistry by Method 9056A	WG1016346	1	09/05/17 21:40	09/05/17 23:38	NJM
Metals (ICP) by Method 6010C	WG1017338	1	09/07/17 14:50	09/08/17 12:21	CCE

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. All MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All radiochemical sample results for solids are reported on a dry weight basis with the exception of tritium, carbon-14 and radon, unless wet weight was requested by the client. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

John V Hawkins

John Hawkins
Technical Service Representative

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	43.3		1	09/08/2017 10:39	WG1016359

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	38.5		1	09/08/2017 10:39	WG1016359

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	8710		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	5280		100	10	09/02/2017 16:54	WG1015928

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	4620	V	100	1	09/08/2017 11:18	WG1017338

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	8.61		1	09/08/2017 10:42	WG1016359

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	10.3		1	09/08/2017 10:42	WG1016359

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	6900		1	09/01/2017 10:53	WG1015895

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	2260		50.0	5	09/02/2017 17:29	WG1015928

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1910		100	1	09/08/2017 11:31	WG1017338

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	10.7		1	09/08/2017 10:45	WG1016359

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	12.6		1	09/08/2017 10:45	WG1016359

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	3600		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	1290		50.0	5	09/02/2017 17:38	WG1015928

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1600		100	1	09/08/2017 11:33	WG1017338

B27 3'

Collected date/time: 08/29/17 17:25

SAMPLE RESULTS - 04

L933165

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	7.11		1	09/08/2017 10:53	WG1016359

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	8.44		1	09/08/2017 10:53	WG1016359

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	11100		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	3610		100	10	09/05/2017 23:03	WG1016346

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	1820		100	1	09/08/2017 11:41	WG1017338

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	3.56		1	09/11/2017 00:40	WG1016361

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	3.84		1	09/11/2017 00:40	WG1016361

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	481		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	119		10.0	1	09/02/2017 12:10	WG1015932

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	388		100	1	09/08/2017 11:43	WG1017338

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	3.03		1	09/11/2017 00:43	WG1016361

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	3.10		1	09/11/2017 00:43	WG1016361

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	5210		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	334		10.0	1	09/02/2017 12:27	WG1015932

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	691		100	1	09/08/2017 11:47	WG1017338

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	2.90		1	09/11/2017 00:45	WG1016361

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	2.93		1	09/11/2017 00:45	WG1016361

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	1120		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	343		10.0	1	09/02/2017 12:36	WG1015932

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	391		100	1	09/08/2017 11:50	WG1017338

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	2.56		1	09/11/2017 00:48	WG1016361

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	2.45		1	09/11/2017 00:48	WG1016361

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	2500		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	235		10.0	1	09/02/2017 13:02	WG1015932

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	570		100	1	09/08/2017 11:52	WG1017338

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	41.3		1	09/11/2017 02:15	WG1016361

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	37.3		1	09/11/2017 02:15	WG1016361

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	15100		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	7460		100	10	09/02/2017 13:11	WG1015932

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	4830		100	1	09/08/2017 11:55	WG1017338

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	9.61		1	09/11/2017 00:53	WG1016361

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	11.4		1	09/11/2017 00:53	WG1016361

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	7880		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	2460		50.0	5	09/02/2017 13:29	WG1015932

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1430		100	1	09/08/2017 11:58	WG1017338

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	8.29		1	09/11/2017 00:56	WG1016361

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	9.89		1	09/11/2017 00:56	WG1016361

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	6390		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	1890		50.0	5	09/02/2017 13:37	WG1015932

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1150		100	1	09/08/2017 12:00	WG1017338

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	6.79		1	09/11/2017 00:59	WG1016361

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	8.05		1	09/11/2017 00:59	WG1016361

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	8960		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	2210		50.0	5	09/02/2017 13:46	WG1015932

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1510		100	1	09/08/2017 12:03	WG1017338

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	3.34		1	09/11/2017 01:02	WG1016361

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	3.53		1	09/11/2017 01:02	WG1016361

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	6490		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	65.7		10.0	1	09/02/2017 13:55	WG1015932

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	209		100	1	09/08/2017 12:05	WG1017338

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	3.56		1	09/11/2017 01:09	WG1016361

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	3.83		1	09/11/2017 01:09	WG1016361

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	1550		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	415		10.0	1	09/05/2017 23:12	WG1016346

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	874		100	1	09/08/2017 12:16	WG1017338

B34 1'

Collected date/time: 08/29/17 16:45

SAMPLE RESULTS - 15

L933165

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	3.63		1	09/11/2017 01:12	WG1016361

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	3.93		1	09/11/2017 01:12	WG1016361

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	1480		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	459		10.0	1	09/05/2017 23:21	WG1016346

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	469		100	1	09/08/2017 12:18	WG1017338

B35 1'

Collected date/time: 08/29/17 17:00

SAMPLE RESULTS - 16

L933165

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	4.79		1	09/11/2017 01:15	WG1016361

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	5.49		1	09/11/2017 01:15	WG1016361

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	6150		1	09/01/2017 12:21	WG1015937

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	824		10.0	1	09/05/2017 23:38	WG1016346

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1020		100	1	09/08/2017 12:21	WG1017338

Method Blank (MB)

(MB) WG1015895-1 09/01/17 10:53

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	3.03			

L933132-01 Original Sample (OS) • Duplicate (DUP)

(OS) L933132-01 09/01/17 10:53 • (DUP) WG1015895-4 09/01/17 10:53

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	16300	16300	1	0.184		20

L933132-11 Original Sample (OS) • Duplicate (DUP)

(OS) L933132-11 09/01/17 10:53 • (DUP) WG1015895-5 09/01/17 10:53

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	16200	16200	1	0.185		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) WG1015895-2 09/01/17 10:53 • (LCSD) WG1015895-3 09/01/17 10:53

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	559	563	564	101	101	90.0-110			0.177	20

Method Blank (MB)

(MB) WG1015937-1 09/01/17 12:21

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	3.04			

L932991-01 Original Sample (OS) • Duplicate (DUP)

(OS) L932991-01 09/01/17 12:21 • (DUP) WG1015937-4 09/01/17 12:21

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	1440	1440	1	0.278		20

L933165-12 Original Sample (OS) • Duplicate (DUP)

(OS) L933165-12 09/01/17 12:21 • (DUP) WG1015937-5 09/01/17 12:21

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	8960	8930	1	0.335		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) WG1015937-2 09/01/17 12:21 • (LCSD) WG1015937-3 09/01/17 12:21

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	559	563	563	101	101	90.0-110			0.000	20

Method Blank (MB)

(MB) R3246808-1 09/02/17 12:40

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	3.75	J	0.795	10.0

L933132-04 Original Sample (OS) • Duplicate (DUP)

(OS) L933132-04 09/02/17 13:50 • (DUP) R3246808-4 09/02/17 14:16

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	4750	5700	10	18	J3	15

L933165-01 Original Sample (OS) • Duplicate (DUP)

(OS) L933165-01 09/02/17 16:54 • (DUP) R3246808-7 09/02/17 17:03

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	5280	5730	10	8		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3246808-2 09/02/17 12:48 • (LCSD) R3246808-3 09/02/17 12:57

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	221	221	110	111	80-120			0	15

WG1015932

Wet Chemistry by Method 9056A

QUALITY CONTROL SUMMARY

L933165-05,06,07,08,09,10,11,12,13

Method Blank (MB)

(MB) R3246960-1 09/02/17 11:26

	MB Result	MB Qualifier	MB MDL	MB RDL
Analyte	mg/kg		mg/kg	mg/kg
Chloride	1.85	J	0.795	10.0

L933165-09 Original Sample (OS) • Duplicate (DUP)

(OS) L933165-09 09/02/17 13:11 • (DUP) R3246960-4 09/02/17 13:20

	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
Analyte	mg/kg	mg/kg		%		%
Chloride	7460	6770	10	10		15

L933450-04 Original Sample (OS) • Duplicate (DUP)

(OS) L933450-04 09/02/17 15:05 • (DUP) R3246960-7 09/02/17 15:14

	Original Result (dry)	DUP Result (dry)	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
Analyte	mg/kg	mg/kg		%		%
Chloride	4000	3980	5	0		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3246960-2 09/02/17 11:35 • (LCSD) R3246960-3 09/02/17 11:43

	Spike Amount	LCS Result	LCSD Result	LCS Rec.	LCSD Rec.	Rec. Limits	LCS Qualifier	LCSD Qualifier	RPD	RPD Limits
Analyte	mg/kg	mg/kg	mg/kg	%	%	%			%	%
Chloride	200	222	221	111	111	80-120			0	15

L933165-13 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933165-13 09/02/17 13:55 • (MS) R3246960-5 09/02/17 14:04 • (MSD) R3246960-6 09/02/17 14:13

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	mg/kg	mg/kg	mg/kg	mg/kg	%	%		%			%	%
Chloride	500	65.7	622	582	111	103	1	80-120			7	15

Method Blank (MB)

(MB) R3247101-1 09/05/17 22:19

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	2.25	J	0.795	10.0

L933165-15 Original Sample (OS) • Duplicate (DUP)

(OS) L933165-15 09/05/17 23:21 • (DUP) R3247101-4 09/05/17 23:30

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	459	469	1	2		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3247101-2 09/05/17 22:28 • (LCSD) R3247101-3 09/05/17 22:37

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	226	223	113	111	80-120			2	15

L933283-02 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933283-02 09/06/17 00:14 • (MS) R3247101-5 09/06/17 00:22 • (MSD) R3247101-6 09/06/17 00:31

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Chloride	500	49.4	574	567	105	104	1	80-120			1	15

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3247843-7 09/08/17 12:13

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Sodium	U		9.85	100

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3247843-1 09/08/17 11:14 • (LCSD) R3247843-2 09/08/17 11:16

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Sodium	1000	1080	1070	108	107	80-120			1	20

L933165-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933165-01 09/08/17 11:18 • (MS) R3247843-5 09/08/17 11:26 • (MSD) R3247843-6 09/08/17 11:28

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Sodium	1000	4620	6080	5840	146	122	1	75-125	V		4	20

GLOSSARY OF TERMS

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Abbreviations and Definitions

(dry)	Results are reported based on the dry weight of the sample. [this will only be present on a dry report basis for soils].
MDL	Method Detection Limit.
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state “ND” (Not Detected) or “BDL” (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
J	The identification of the analyte is acceptable; the reported value is an estimate.
J3	The associated batch QC was outside the established quality control range for precision.
V	The sample concentration is too high to evaluate accurate spike recoveries.

ACCREDITATIONS & LOCATIONS

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

ESC Lab Sciences is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our “one location” design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be **YOUR LAB OF CHOICE.**
* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

State Accreditations

Alabama	40660
Alaska	UST-080
Arizona	AZ0612
Arkansas	88-0469
California	01157CA
Colorado	TN00003
Conneticut	PH-0197
Florida	E87487
Georgia	NELAP
Georgia [1]	923
Idaho	TN00003
Illinois	200008
Indiana	C-TN-01
Iowa	364
Kansas	E-10277
Kentucky [1]	90010
Kentucky [2]	16
Louisiana	AI30792
Maine	TN0002
Maryland	324
Massachusetts	M-TN003
Michigan	9958
Minnesota	047-999-395
Mississippi	TN00003
Missouri	340
Montana	CERT0086
Nebraska	NE-OS-15-05
Nevada	TN-03-2002-34
New Hampshire	2975
New Jersey–NELAP	TN002
New Mexico	TN00003
New York	11742
North Carolina	Env375
North Carolina [1]	DW21704
North Carolina [2]	41
North Dakota	R-140
Ohio–VAP	CL0069
Oklahoma	9915
Oregon	TN200002
Pennsylvania	68-02979
Rhode Island	221
South Carolina	84004
South Dakota	n/a
Tennessee [1,4]	2006
Texas	T 104704245-07-TX
Texas [5]	LAB0152
Utah	6157585858
Vermont	VT2006
Virginia	109
Washington	C1915
West Virginia	233
Wisconsin	9980939910
Wyoming	A2LA

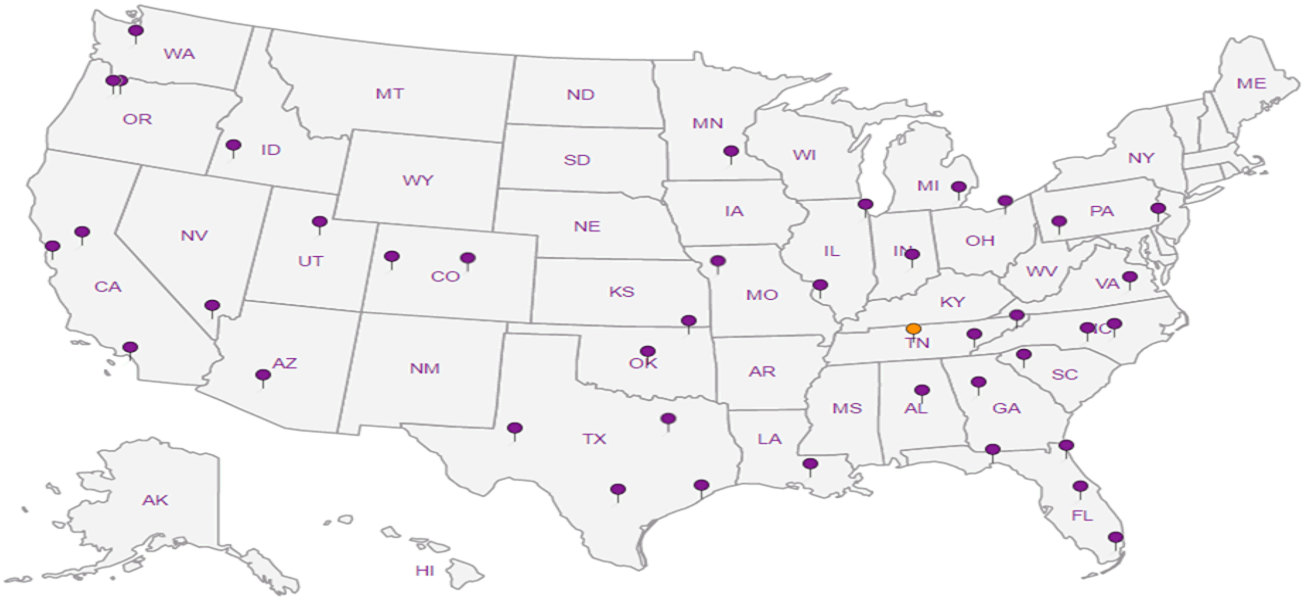
Third Party & Federal Accreditations

A2LA – ISO 17025	1461.01
A2LA – ISO 17025 [5]	1461.02
Canada	1461.01
EPA–Crypto	TN00003
AIHA-LAP,LLC	100789
DOD	1461.01
USDA	S-67674

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [n/a] Accreditation not applicable

Our Locations

ESC Lab Sciences has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. **ESC Lab Sciences performs all testing at our central laboratory.**



Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:

Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Report to:
Jacqueline Finck

Email To: **Jacqueline.Finck@terracon.com**

Project Description: **Brine Pond Study**

City/State Collected: Renville, ND

Phone: **701-356-7621**
Fax:

Client Project #

Lab Project # **TERRAFND-M1177088**

Collected by (print): Jacqueline Finck

Site/Facility ID # **MINOT ND**

P.O. #

Collected by (signature): Jacquelin Finck

Immediately Packed on Ice N ✓ Y ___

Rush? (Lab MUST Be Notified)
___ Same Day
___ Next Day
___ Two Day
___ Three Day
✓ Five Day
___ 5 Day (Rad Only)
___ 10 Day (Rad Only)

Quote #

Date Results Needed

Analysis / Container / Preservative

Chain of Custody Page 1 of 2

ESC
LAB SCIENCES
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12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L# L933165

E041

Acctnum: **TERRAFND**
Template: **T127227**
Prelogin: **P615134**
TSR: 341 - John Hawkins
PB: Cm 6.26.17
Shipped Via: **FedEX Priority**

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CHLORIDE 125mlHDPE-NoPres	CL ESP SAR 4ozClr-NoPres	ESP NAICP SAR 250mlHDPE-HNO3	NAICP 2ozClr-NoPres	SPCON (ec) 4ozClr-NoPres	SPCON 250mlHDPE-NoPres					Remarks	Sample # (lab only)
B14	Grab	SS	3'	8/29/17	3:25pm	3		X		X	X							-01
B18		SS			3:45pm	3		X		X	X							02
B23		SS			5:40pm	3		X		X	X							03
B27		SS			5:25pm	3		X		X	X							04
B30		SS			4:35pm	3		X		X	X							05
B31		SS			5:20pm	3		X		X	X							06
B34		SS			4:50pm	3		X		X	X							07
B35		SS	3'		5:05pm	3		X		X	X							08
		~~SS~~				~~3~~		~~X~~		~~X~~	~~X~~							
	~~Grab~~	~~SS~~		~~8/29/17~~		~~3~~		~~X~~		~~X~~	~~X~~							

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other_________

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS ☒ FedEx __ Courier __ ______

Tracking #

Sample Receipt Checklist ✓
COC Seal Present/Intact: _NP _Y _N
COC Signed/Accurate: ✓Y _N
Bottles arrive intact: ✓Y _N
Correct bottles used: ✓Y _N
Sufficient volume sent: ✓Y _N
If Applicable
VOA Zero Headspace: _Y _N
Preservation Correct/Checked: _Y _N

Relinquished by : (Signature) Jacquelin Finch
Date: 8/30/17
Time: 7:00pm
Received by: (Signature)

Trip Blank Received: Yes [✓ No]
HCL / MeoH
TBR

Relinquished by : (Signature)
Date:
Time:
Received by: (Signature)

Temp: 1.0 °C
Bottles Received: 48

If preservation required by Login: Date/Time

Relinquished by : (Signature)
Date:
Time:
Received for lab by: (Signature)

Date: 8-31-17
Time: 845

Hold:

Condition: NCF / [✓ OK]

Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:
Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Email To: Jacqueline.Finck@terracon.com

Report to:
Jacqueline Finck

Project Description: **Brine Pond Study**

City/State Collected: Renville, ND

Phone: **701-356-7621**
Fax:

Client Project #

Lab Project # **TERRAFND-M1177088**

Collected by (print): Jacqueline Finck

Site/Facility ID # **MINOT ND**

P.O. #

Collected by (signature): Jacqueline Finck

Immediately Packed on Ice N X Y ___

Rush? (Lab MUST Be Notified)
___ Same Day
___ Next Day
___ Two Day
___ Three Day
X Five Day
___ 5 Day (Rad Only)
___ 10 Day (Rad Only)

Quote #

Date Results Needed

Chain of Custody Page 2 of 2

ESC
L·A·B S·C·I·E·N·C·E·S
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12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L# L933165

Table #

Acctnum: **TERRAFND**
Template: **T127227**
Prelogin: **P615134**
TSR: **341 - John Hawkins**
PB: CM 8.25.17
Shipped Via: **FedEX Priority**

Analysis / Container / Preservative

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CHLORIDE 125mlHDPE-NoPres	CL ESP SAR 4ozClr-NoPres	ESP NAICP SAR 250mlHDPE-HNO3	NAICP 2ozClr-NoPres	SPCON (ec) 4ozClr-NoPres	SPCON 250mlHDPE-NoPres					Remarks	Sample # (lab only)
B14	Grab	SS	1'	8/29/17	3:20 pm	3		X		X	X							-09
B18		SS			3:40pm	3		X		X	X							10
B23		SS			5:35pm	3		X		X	X							11
B27		SS			5:20pm	3		X		X	X							12
B30		SS			4:30pm	3		X		X	X							13
B31		SS			5:15pm	3		X		X	X							14
B34		SS			4:45pm	3		X		X	X							15
B35		SS	1'		5:00Am	3		X		X	X							16
		~~SS~~				~~3~~		~~X~~		~~X~~	~~X~~							
	~~Grab~~	~~SS~~		~~8/29/17~~		~~3~~		~~X~~		~~X~~	~~X~~							

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other ________

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS ✓ FedEx __ Courier __ ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature) Jacqueline Finck
Date: 8/30/17
Time: 7:00AM
Received by: (Signature)

Trip Blank Received: Yes / [✓ No]
HCL / MeoH
TBR

Relinquished by : (Signature)
Date:
Time:
Received by: (Signature)

Temp: 1.0 °C
Bottles Received: 48

If preservation required by Login: Date/Time

Relinquished by : (Signature)
Date:
Time:
Received for lab by: (Signature)

Date: 8-31-17
Time: 898

Hold:

Condition: NCF / [✓ OK]

ANALYTICAL REPORT

September 11, 2017

Terracon - Fargo, ND

Sample Delivery Group:	L933519
Samples Received:	09/01/2017
Project Number:	M1177088
Description:	Brine Pond Study
Site:	MINOT ND
Report To:	Jacqueline Finck 860 9TH ST E West Fargo, ND 58078

Entire Report Reviewed By: John V Hawkins

John Hawkins
Technical Service Representative

12065 Lebanon Rd   Mount Juliet, TN 37122   615-758-5858   800-767-5859   www.esclabsciences.com

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B16 1' L933519-01 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 07:50	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:25	ST
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:25	ST
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	5	09/07/17 21:12	09/08/17 01:09	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 12:25	CCE

B16 3' L933519-02 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 07:55	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:28	ST
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:28	ST
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	1	09/07/17 21:12	09/08/17 01:17	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 12:28	CCE

B17 1' L933519-03 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 08:05	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:30	ST
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:30	ST
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	5	09/07/17 21:12	09/08/17 01:26	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 12:31	CCE

B17 3' L933519-04 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 08:10	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:33	ST
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:33	ST
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	1	09/07/17 21:12	09/08/17 01:35	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 12:33	CCE

B19 1' L933519-05 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 07:30	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:36	ST
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:36	ST
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	10	09/07/17 21:12	09/08/17 01:44	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 12:36	CCE

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

B19 3' L933519-06 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 07:35	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:38	ST
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:38	ST
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	1	09/07/17 21:12	09/08/17 01:53	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 12:39	CCE

B21 1' L933519-07 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 07:15	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 02:18	ST
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 02:18	ST
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	10	09/07/17 21:12	09/08/17 02:10	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 12:41	CCE

B21 3' L933519-08 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 07:20	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:44	ST
Calculated Results	WG1018483	1	09/09/17 16:32	09/11/17 01:44	ST
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	10	09/07/17 21:12	09/08/17 02:36	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 12:44	CCE

B11 1' L933519-09 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 12:00	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 11:52	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 11:52	CCE
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	1	09/07/17 21:12	09/08/17 02:45	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 12:47	CCE

B11 3' L933519-10 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 12:05	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 11:56	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 11:56	CCE
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	1	09/07/17 21:12	09/08/17 02:54	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 12:49	CCE

B12 1' L933519-11 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 11:20	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 13:44	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 13:44	CCE
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	20	09/07/17 21:12	09/08/17 03:03	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 12:57	CCE

B12 3' L933519-12 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 11:25	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 13:47	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 13:47	CCE
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	20	09/07/17 21:12	09/08/17 03:12	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 12:59	CCE

B13 1' L933519-13 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 11:10	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:06	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:06	CCE
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	10	09/07/17 21:12	09/08/17 03:20	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 13:02	CCE

B13 3' L933519-14 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 11:15	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:10	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:10	CCE
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	5	09/07/17 21:12	09/08/17 03:29	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 13:05	CCE

B15 1' L933519-15 Solid

Collected by	Collected date/time	Received date/time
Jackie Firck	08/30/17 07:40	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:13	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:13	CCE
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016997	5	09/07/17 21:12	09/08/17 03:38	MAJ
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 13:07	CCE

			Collected by	Collected date/time	Received date/time
B15 3' L933519-16 Solid			Jackie Firck	08/30/17 07:45	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:16	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:16	CCE
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016998	1	09/07/17 01:33	09/07/17 16:16	DR
Metals (ICP) by Method 6010C	WG1017520	1	09/11/17 07:58	09/11/17 13:10	CCE

CASE NARRATIVE

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. All MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All radiochemical sample results for solids are reported on a dry weight basis with the exception of tritium, carbon-14 and radon, unless wet weight was requested by the client. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

John V Hawkins

John Hawkins
Technical Service Representative

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	12.5		1	09/11/2017 01:25	WG1018483

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	14.7		1	09/11/2017 01:25	WG1018483

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	3680		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	1970		50.0	5	09/08/2017 01:09	WG1016997

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1530		100	1	09/11/2017 12:25	WG1017520

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	13.0		1	09/11/2017 01:28	WG1018483

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	15.2		1	09/11/2017 01:28	WG1018483

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	1670		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	610		10.0	1	09/08/2017 01:17	WG1016997

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	944		100	1	09/11/2017 12:28	WG1017520

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	10.8		1	09/11/2017 01:30	WG1018483

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	12.8		1	09/11/2017 01:30	WG1018483

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	2980		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	1170		50.0	5	09/08/2017 01:26	WG1016997

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1130		100	1	09/11/2017 12:31	WG1017520

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	10.9		1	09/11/2017 01:33	WG1018483

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	13.0		1	09/11/2017 01:33	WG1018483

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	1640		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	592		10.0	1	09/08/2017 01:35	WG1016997

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	953		100	1	09/11/2017 12:33	WG1017520

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	41.7		1	09/11/2017 01:36	WG1018483

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	37.6		1	09/11/2017 01:36	WG1018483

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	7210		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	3790		100	10	09/08/2017 01:44	WG1016997

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	3770		100	1	09/11/2017 12:36	WG1017520

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	40.6		1	09/11/2017 01:38	WG1018483

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	37.0		1	09/11/2017 01:38	WG1018483

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	2860		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	921		10.0	1	09/08/2017 01:53	WG1016997

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1150		100	1	09/11/2017 12:39	WG1017520

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	36.3		1	09/11/2017 02:18	WG1018483

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	34.3		1	09/11/2017 02:18	WG1018483

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	17500		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	7790		100	10	09/08/2017 02:10	WG1016997

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	5640		100	1	09/11/2017 12:41	WG1017520

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	40.2		1	09/11/2017 01:44	WG1018483

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	36.7		1	09/11/2017 01:44	WG1018483

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	15700		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	6390		100	10	09/08/2017 02:36	WG1016997

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	5020		100	1	09/11/2017 12:44	WG1017520

B11 1'

Collected date/time: 08/30/17 12:00

SAMPLE RESULTS - 09

L933519

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	9.93		1	09/11/2017 11:52	WG1016363

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	11.8		1	09/11/2017 11:52	WG1016363

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	1090		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	313		10.0	1	09/08/2017 02:45	WG1016997

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	620		100	1	09/11/2017 12:47	WG1017520

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	5.27		1	09/11/2017 11:56	WG1016363

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	6.11		1	09/11/2017 11:56	WG1016363

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	1460		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	536		10.0	1	09/08/2017 02:54	WG1016997

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1360		100	1	09/11/2017 12:49	WG1017520

B12 1'

Collected date/time: 08/30/17 11:20

SAMPLE RESULTS - 11

L933519

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	65.1		1	09/11/2017 13:44	WG1016363

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	48.7		1	09/11/2017 13:44	WG1016363

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	28500		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	13700		200	20	09/08/2017 03:03	WG1016997

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	9920		100	1	09/11/2017 12:57	WG1017520

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	65.7		1	09/11/2017 13:47	WG1016363

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	48.9		1	09/11/2017 13:47	WG1016363

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	18800		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	7680		200	20	09/08/2017 03:12	WG1016997

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	4440		100	1	09/11/2017 12:59	WG1017520

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	32.6		1	09/11/2017 12:06	WG1016363

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	31.9		1	09/11/2017 12:06	WG1016363

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	7680		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	4450		100	10	09/08/2017 03:20	WG1016997

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	3980		100	1	09/11/2017 13:02	WG1017520

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	34.9		1	09/11/2017 12:10	WG1016363

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	33.4		1	09/11/2017 12:10	WG1016363

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	4930		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	2000		50.0	5	09/08/2017 03:29	WG1016997

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	2150		100	1	09/11/2017 13:05	WG1017520

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	11.8		1	09/11/2017 12:13	WG1016363

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	14.0		1	09/11/2017 12:13	WG1016363

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	3000		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	1040		50.0	5	09/08/2017 03:38	WG1016997

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1340		100	1	09/11/2017 13:07	WG1017520

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	13.2		1	09/11/2017 12:16	WG1016363

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	15.4		1	09/11/2017 12:16	WG1016363

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	2180		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	837		10.0	1	09/07/2017 16:16	WG1016998

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	937		100	1	09/11/2017 13:10	WG1017520

Method Blank (MB)

(MB) WG1017005-1 09/06/17 11:04

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	3.08			

L933519-01 Original Sample (OS) • Duplicate (DUP)

(OS) L933519-01 09/06/17 11:04 • (DUP) WG1017005-4 09/06/17 11:04

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	3680	3690	1	0.271		20

L933519-11 Original Sample (OS) • Duplicate (DUP)

(OS) L933519-11 09/06/17 11:04 • (DUP) WG1017005-5 09/06/17 11:04

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	28500	28500	1	0.176		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) WG1017005-2 09/06/17 11:04 • (LCSD) WG1017005-3 09/06/17 11:04

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	559	560	559	100	100	90.0-110			0.179	20

Method Blank (MB)

(MB) R3247958-1 09/07/17 22:57

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	2.03	J	0.795	10.0

L933492-01 Original Sample (OS) • Duplicate (DUP)

(OS) L933492-01 09/07/17 23:41 • (DUP) R3247958-4 09/07/17 23:50

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	114	106	1	7		15

L933519-06 Original Sample (OS) • Duplicate (DUP)

(OS) L933519-06 09/08/17 01:53 • (DUP) R3247958-7 09/08/17 02:01

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	921	927	1	1		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3247958-2 09/07/17 23:06 • (LCSD) R3247958-3 09/07/17 23:15

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	211	217	105	108	80-120			3	15

L933492-03 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933492-03 09/07/17 23:59 • (MS) R3247958-5 09/08/17 00:07 • (MSD) R3247958-6 09/08/17 00:16

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Chloride	500	273	784	827	102	111	1	80-120			5	15

Method Blank (MB)

(MB) R3247676-1 09/07/17 15:14

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	1.83	J	0.795	10.0

L933535-15 Original Sample (OS) • Duplicate (DUP)

(OS) L933535-15 09/07/17 19:02 • (DUP) R3247676-5 09/07/17 19:11

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	674	726	1	7		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3247676-2 09/07/17 15:23 • (LCSD) R3247676-3 09/07/17 15:32

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	218	211	109	106	80-120			3	15

L933535-16 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933535-16 09/07/17 19:20 • (MS) R3247676-6 09/07/17 19:29 • (MSD) R3247676-7 09/07/17 19:37

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Chloride	500	528	1560	1590	207	212	1	80-120	E J5	E J5	2	15

Method Blank (MB)

(MB) R3248321-1 09/11/17 11:56

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Sodium	40.2	J	9.85	100

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3248321-2 09/11/17 11:58 • (LCSD) R3248321-3 09/11/17 12:01

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Sodium	1000	1080	1080	108	108	80-120			0	20

L933514-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933514-01 09/11/17 12:03 • (MS) R3248321-6 09/11/17 12:10 • (MSD) R3248321-7 09/11/17 12:13

Analyte	Spike Amount (dry) mg/kg	Original Result (dry) mg/kg	MS Result (dry) mg/kg	MSD Result (dry) mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Sodium	1250	130	1490	1530	109	112	1	75-125			2	20

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Abbreviations and Definitions

(dry)	Results are reported based on the dry weight of the sample. [this will only be present on a dry report basis for soils].
MDL	Method Detection Limit.
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state “ND” (Not Detected) or “BDL” (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
E	The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL).
J	The identification of the analyte is acceptable; the reported value is an estimate.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high.

ACCREDITATIONS & LOCATIONS

ESC Lab Sciences is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our "one location" design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be **YOUR LAB OF CHOICE.**
* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

State Accreditations

Alabama	40660
Alaska	UST-080
Arizona	AZ0612
Arkansas	88-0469
California	01157CA
Colorado	TN00003
Conneticut	PH-0197
Florida	E87487
Georgia	NELAP
Georgia [1]	923
Idaho	TN00003
Illinois	200008
Indiana	C-TN-01
Iowa	364
Kansas	E-10277
Kentucky [1]	90010
Kentucky [2]	16
Louisiana	AI30792
Maine	TN0002
Maryland	324
Massachusetts	M-TN003
Michigan	9958
Minnesota	047-999-395
Mississippi	TN00003
Missouri	340
Montana	CERT0086
Nebraska	NE-OS-15-05
Nevada	TN-03-2002-34
New Hampshire	2975
New Jersey–NELAP	TN002
New Mexico	TN00003
New York	11742
North Carolina	Env375
North Carolina [1]	DW21704
North Carolina [2]	41
North Dakota	R-140
Ohio–VAP	CL0069
Oklahoma	9915
Oregon	TN200002
Pennsylvania	68-02979
Rhode Island	221
South Carolina	84004
South Dakota	n/a
Tennessee [1,4]	2006
Texas	T 104704245-07-TX
Texas [5]	LAB0152
Utah	6157585858
Vermont	VT2006
Virginia	109
Washington	C1915
West Virginia	233
Wisconsin	9980939910
Wyoming	A2LA

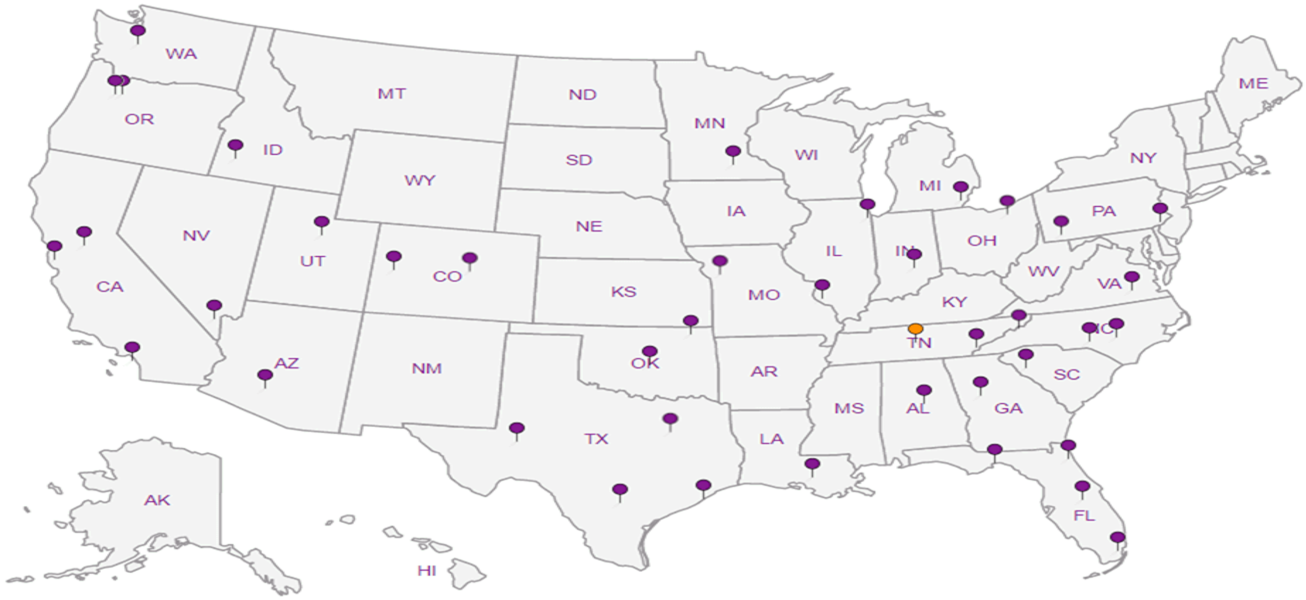
Third Party & Federal Accreditations

A2LA – ISO 17025	1461.01
A2LA – ISO 17025 [5]	1461.02
Canada	1461.01
EPA–Crypto	TN00003
AIHA-LAP,LLC	100789
DOD	1461.01
USDA	S-67674

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [n/a] Accreditation not applicable

Our Locations

ESC Lab Sciences has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. **ESC Lab Sciences performs all testing at our central laboratory.**



Chain of Custody Page 1 of 2

ESC
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a subsidiary of Pace Analytical

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L# L933519

E081

Acctnum: **TERRAFND**
Template: **T127398**
Prelogin: **P615920**
TSR: 341 - John Hawkins
PB: 8-19-17 CM
Shipped Via: **FedEX Standard**

Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:
Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Report to: **Jacqueline Finck**

Email To: Jacqueline.Finck@terracon.com

Project Description: **Brine Pond Study**

City/State Collected: Renville, ND

Phone: **701-356-7621**
Fax:

Client Project # M1177088

Lab Project # **TERRAFND-M1177088**

Collected by (print): Jackie Finck

Site/Facility ID # **MINOT ND**

P.O. #

Collected by (signature): Jacqueline Finck

Rush? (Lab MUST Be Notified)
___ Same Day
___ Next Day
___ Two Day
___ Three Day
X Five Day
___ 5 Day (Rad Only)
___ 10 Day (Rad Only)

Quote #

Date Results Needed

Immediately Packed on Ice N X Y ___

Analysis / Container / Preservative

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CL ESP SAR 4ozClr-NoPres	NAICP 2ozClr-NoPres	SPCON (ec) 4ozClr-NoPres	Remarks	Sample # (lab only)
B16	Grab	SS	1'	8/30/17	750 AM	3	X	X	X		-01
B16		SS	3'		755 AM	3	X	X	X		02
B17		SS	1'		805 AM	3	X	X	X		03
B17		SS	3		810 AM	3	X	X	X		04
B19		SS	1'		730 AM	3	X	X	X		05
B19		SS	3'		735 AM	3	X	X	X		06
B20		SS	1'		715 AM	3	X	X	X		07
B20	Grab	SS	3'	8/30/17	720 AM	3	X	X	X		08
		SS				3	X	X	X		
		SS				3	X	X	X		

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH ______ Temp ________
Flow ______ Other ________

Samples returned via:
__ UPS X FedEx __ Courier ___ ______

Tracking #

Sample Receipt Checklist ✓
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature) Jacqueline Finck
Date: 8/31/17
Time: 630 pm
Received by: (Signature)

Trip Blank Received: Yes / [✓ No]
HCL / MeoH
TBR

Relinquished by : (Signature)
Date:
Time:
Received by: (Signature)

Temp: 1.1 °C
Bottles Received: 48

If preservation required by Login: Date/Time

Relinquished by : (Signature)
Date:
Time:
Received for lab by: (Signature)

Date: 9-1-17
Time: 845

Hold:

Condition: NCF / [✓ OK]

Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:
Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page 2 of 2

ESC
LAB SCIENCES
a subsidiary of

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

Report to: Jacqueline Finck

Email To: Jacqueline.Finck@terracon.com

Project Description: Brine Pond Study

City/State Collected: Renville,

Phone: 701-356-7621
Fax:

Client Project # M1177088

Lab Project # TERRAFND-M1177088

L# L933519

Table #

Collected by (print): Jacqueline Finck

Site/Facility ID # MINOT ND

P.O. #

Acctnum: TERRAFND
Template: T127398
Prelogin: P615920
TSR: 341 - John Hawkins
PB: 8-29-17 CM

Collected by (signature): Jacqueline Finck

Rush? (Lab MUST Be Notified)
___ Same Day ☒ Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Immediately Packed on Ice N X Y ___

Shipped Via: FedEX Standard

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CL ESP SAR 4ozClr-NoPres	NAICP 2ozClr-NoPres	SPCON (ec) 4ozClr-NoPres	Remarks	Sample # (lab only)
B11	Grab	SS	1'	8/30/17	12 00pm	3	X	X	X		-09
B11		SS	3'		12 05pm	3	X	X	X		10
B12		SS	1'		11:20 AM	3	X	X	X		11
B12		SS	3'		11:25 AM	3	X	X	X		12
B13		SS	1'		11 10 AM	3	X	X	X		13
B13		SS	3'		11 15 AM	3	X	X	X		14
B15		SS	1'		740 AM	3	X	X	X		15
B15	Grab	SS	3'	8/30/17	745 AM	3	X	X	X		16
		SS				3	X	X	X		
		SS				3	X	X	X		

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH _______ Temp _______

Flow _______ Other _______

Samples returned via:
__ UPS ☒ FedEx __ Courier __ ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature) Jacqueline Finck	Date: 8/31/17	Time: 6³⁰ pm	Received by: (Signature)	Trip Blank Received: Yes / [✓ No] HCL / MeoH TBR	
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: 1.1 °C	Bottles Received: 48
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: 9-1-17	Time: 845

If preservation required by Login: Date/Time

Hold:

Condition: NCF / [✓ OK]

ANALYTICAL REPORT

September 12, 2017

Terracon - Fargo, ND

Sample Delivery Group:	L933535
Samples Received:	09/01/2017
Project Number:	M1177088
Description:	Brine Pond Study
Site:	MINOT ND
Report To:	Jacqueline Finck 860 9TH ST E West Fargo, ND 58078

Entire Report Reviewed By: John V Hawkins

John Hawkins

Technical Service Representative

12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.esclabsciences.com

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Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 10:20	09/01/17 08:45

B1 3' L933535-01 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:20	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:20	CCE
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016998	10	09/07/17 01:33	09/07/17 16:24	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 18:20	ST

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 10:45	09/01/17 08:45

B1 25' L933535-02 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:30	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:30	CCE
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016998	1	09/07/17 01:33	09/07/17 16:33	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 18:23	ST

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 11:30	09/01/17 08:45

B2 3' L933535-03 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:33	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:33	CCE
Wet Chemistry by Method 9050AMod	WG1017005	1	09/06/17 11:04	09/06/17 11:04	MA
Wet Chemistry by Method 9056A	WG1016998	5	09/07/17 01:33	09/07/17 16:59	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 18:31	ST

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 12:20	09/01/17 08:45

B3 3' L933535-04 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:36	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:36	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	1	09/07/17 01:33	09/07/17 17:08	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 18:33	ST

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 13:40	09/01/17 08:45

B4 3' L933535-05 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:40	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:40	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	5	09/07/17 01:33	09/07/17 17:17	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 18:36	ST

SAMPLE SUMMARY

B5 3' L933535-06 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/29/17 14:35	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:43	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:43	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	1	09/07/17 01:33	09/07/17 17:26	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 18:38	ST

B6 1' L933535-07 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 10:30	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:47	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:47	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	10	09/07/17 01:33	09/07/17 17:35	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 18:41	ST

B6 3' L933535-08 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 10:35	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:50	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:50	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	5	09/07/17 01:33	09/07/17 17:43	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 18:43	ST

B7 1' L933535-09 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 10:45	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:53	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:53	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	10	09/07/17 01:33	09/07/17 17:52	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 18:46	ST

B7 3' L933535-10 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 10:50	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:57	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 12:57	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	5	09/07/17 01:33	09/07/17 18:01	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 18:48	ST

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 10:15	09/01/17 08:45

B8 1' L933535-11 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 13:50	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 13:50	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	10	09/07/17 01:33	09/07/17 18:10	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 18:51	ST

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 10:20	09/01/17 08:45

B8 3' L933535-12 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 13:10	CCE
Calculated Results	WG1016363	1	09/09/17 08:20	09/11/17 13:10	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	10	09/07/17 01:33	09/07/17 18:36	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 18:53	ST

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 10:55	09/01/17 08:45

B9 1' L933535-13 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 13:55	CCE
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 13:55	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	5	09/07/17 01:33	09/07/17 18:45	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 19:01	ST

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 11:00	09/01/17 08:45

B9 3' L933535-14 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 13:58	CCE
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 13:58	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	5	09/07/17 01:33	09/07/17 18:54	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 19:04	ST

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 11:35	09/01/17 08:45

B10 1' L933535-15 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:00	CCE
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:00	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	1	09/07/17 01:33	09/07/17 19:02	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 19:06	ST

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 11:40	09/01/17 08:45

B10 3' L933535-16 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:03	CCE
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:03	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	1	09/07/17 01:33	09/07/17 19:20	DR
Metals (ICP) by Method 6010C	WG1017954	1	09/11/17 14:32	09/11/17 19:09	ST

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. All MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All radiochemical sample results for solids are reported on a dry weight basis with the exception of tritium, carbon-14 and radon, unless wet weight was requested by the client. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

John V Hawkins

John Hawkins
Technical Service Representative

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	13.5		1	09/11/2017 12:20	WG1016363

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	15.7		1	09/11/2017 12:20	WG1016363

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	15200		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	6970		100	10	09/07/2017 16:24	WG1016998

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	2930		100	1	09/11/2017 18:20	WG1017954

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	0.570		1	09/11/2017 12:30	WG1016363

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	-0.421		1	09/11/2017 12:30	WG1016363

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	121		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	51.3		10.0	1	09/07/2017 16:33	WG1016998

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	289	B	100	1	09/11/2017 18:23	WG1017954

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	58.2		1	09/11/2017 12:33	WG1016363

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	45.8		1	09/11/2017 12:33	WG1016363

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	4660		1	09/06/2017 11:04	WG1017005

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	2880		50.0	5	09/07/2017 16:59	WG1016998

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	3730		100	1	09/11/2017 18:31	WG1017954

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	6.38		1	09/11/2017 12:36	WG1016363

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	7.53		1	09/11/2017 12:36	WG1016363

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	2210		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	871		10.0	1	09/07/2017 17:08	WG1016998

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	1670		100	1	09/11/2017 18:33	WG1017954

B4 3'
Collected date/time: 08/29/17 13:40

SAMPLE RESULTS - 05

L933535

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	38.4		1	09/11/2017 12:40	WG1016363

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	35.7		1	09/11/2017 12:40	WG1016363

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	9600		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	3700		50.0	5	09/07/2017 17:17	WG1016998

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	2920		100	1	09/11/2017 18:36	WG1017954

B5 3'

Collected date/time: 08/29/17 14:35

SAMPLE RESULTS - 06

L933535

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	5.57		1	09/11/2017 12:43	WG1016363

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	6.51		1	09/11/2017 12:43	WG1016363

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	1750		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	605		10.0	1	09/07/2017 17:26	WG1016998

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1310		100	1	09/11/2017 18:38	WG1017954

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	33.8		1	09/11/2017 12:47	WG1016363

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	32.7		1	09/11/2017 12:47	WG1016363

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	11000		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	4620		100	10	09/07/2017 17:35	WG1016998

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	3980		100	1	09/11/2017 18:41	WG1017954

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	51.0		1	09/11/2017 12:50	WG1016363

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	42.5		1	09/11/2017 12:50	WG1016363

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	7710		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	3640		50.0	5	09/07/2017 17:43	WG1016998

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	3520		100	1	09/11/2017 18:43	WG1017954

B7 1'

Collected date/time: 08/30/17 10:45

SAMPLE RESULTS - 09

L933535

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	31.2		1	09/11/2017 12:53	WG1016363

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	30.9		1	09/11/2017 12:53	WG1016363

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	10300		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	4440		100	10	09/07/2017 17:52	WG1016998

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	3460		100	1	09/11/2017 18:46	WG1017954

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	19.9		1	09/11/2017 12:57	WG1016363

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	21.9		1	09/11/2017 12:57	WG1016363

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	5530		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	2790		50.0	5	09/07/2017 18:01	WG1016998

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	2120		100	1	09/11/2017 18:48	WG1017954

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	43.2		1	09/11/2017 13:50	WG1016363

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	38.4		1	09/11/2017 13:50	WG1016363

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	15500		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	8070		100	10	09/07/2017 18:10	WG1016998

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	4980		100	1	09/11/2017 18:51	WG1017954

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	34.6		1	09/11/2017 13:10	WG1016363

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	33.2		1	09/11/2017 13:10	WG1016363

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	10400		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	4530		100	10	09/07/2017 18:36	WG1016998

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	3600		100	1	09/11/2017 18:53	WG1017954

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	40.1		1	09/12/2017 13:55	WG1016364

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	36.6		1	09/12/2017 13:55	WG1016364

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	7500		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	2890		50.0	5	09/07/2017 18:45	WG1016998

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	3210		100	1	09/11/2017 19:01	WG1017954

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	48.1		1	09/12/2017 13:58	WG1016364

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	41.1		1	09/12/2017 13:58	WG1016364

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	5740		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	2200		50.0	5	09/07/2017 18:54	WG1016998

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	2740		100	1	09/11/2017 19:04	WG1017954

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	21.3		1	09/12/2017 14:00	WG1016364

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	23.2		1	09/12/2017 14:00	WG1016364

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	2370		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	674		10.0	1	09/07/2017 19:02	WG1016998

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	1640		100	1	09/11/2017 19:06	WG1017954

B10 3'

Collected date/time: 08/30/17 11:40

SAMPLE RESULTS - 16

L933535

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	29.5		1	09/12/2017 14:03	WG1016364

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	29.7		1	09/12/2017 14:03	WG1016364

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	1760		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	528	J5	10.0	1	09/07/2017 19:20	WG1016998

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	1450		100	1	09/11/2017 19:09	WG1017954

QUALITY CONTROL SUMMARY

L933535-01,02,03

Method Blank (MB)

(MB) WG1017005-1 09/06/17 11:04

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	3.08			

L933519-01 Original Sample (OS) • Duplicate (DUP)

(OS) L933519-01 09/06/17 11:04 • (DUP) WG1017005-4 09/06/17 11:04

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	3680	3690	1	0.271		20

L933519-11 Original Sample (OS) • Duplicate (DUP)

(OS) L933519-11 09/06/17 11:04 • (DUP) WG1017005-5 09/06/17 11:04

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	28500	28500	1	0.176		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) WG1017005-2 09/06/17 11:04 • (LCSD) WG1017005-3 09/06/17 11:04

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	559	560	559	100	100	90.0-110			0.179	20

Method Blank (MB)

(MB) WG1017006-1 09/07/17 16:13

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	3.05			

L933535-04 Original Sample (OS) • Duplicate (DUP)

(OS) L933535-04 09/07/17 16:13 • (DUP) WG1017006-4 09/07/17 16:13

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	2210	2210	1	0.136		20

L933535-14 Original Sample (OS) • Duplicate (DUP)

(OS) L933535-14 09/07/17 16:13 • (DUP) WG1017006-5 09/07/17 16:13

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	5740	5750	1	0.174		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) WG1017006-2 09/07/17 16:13 • (LCSD) WG1017006-3 09/07/17 16:13

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	559	561	560	100	100	90.0-110			0.178	20

Method Blank (MB)

(MB) R3247676-1 09/07/17 15:14

	MB Result	MB Qualifier	MB MDL	MB RDL
Analyte	mg/kg		mg/kg	mg/kg
Chloride	1.83	J	0.795	10.0

L933535-15 Original Sample (OS) • Duplicate (DUP)

(OS) L933535-15 09/07/17 19:02 • (DUP) R3247676-5 09/07/17 19:11

	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
Analyte	mg/kg	mg/kg		%		%
Chloride	674	726	1	7		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3247676-2 09/07/17 15:23 • (LCSD) R3247676-3 09/07/17 15:32

	Spike Amount	LCS Result	LCSD Result	LCS Rec.	LCSD Rec.	Rec. Limits	LCS Qualifier	LCSD Qualifier	RPD	RPD Limits
Analyte	mg/kg	mg/kg	mg/kg	%	%	%			%	%
Chloride	200	218	211	109	106	80-120			3	15

L933535-16 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933535-16 09/07/17 19:20 • (MS) R3247676-6 09/07/17 19:29 • (MSD) R3247676-7 09/07/17 19:37

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	mg/kg	mg/kg	mg/kg	mg/kg	%	%		%			%	%
Chloride	500	528	1560	1590	207	212	1	80-120	E J5	E J5	2	15

Method Blank (MB)

(MB) R3248442-1 09/11/17 18:01

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Sodium	54.1	J	9.85	100

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3248442-2 09/11/17 18:03 • (LCSD) R3248442-3 09/11/17 18:06

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Sodium	1000	1090	1130	109	113	80-120			4	20

L933517-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933517-01 09/11/17 18:08 • (MS) R3248442-6 09/11/17 18:16 • (MSD) R3248442-7 09/11/17 18:18

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Sodium	1000	165	1230	1210	106	105	1	75-125			1	20

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Abbreviations and Definitions

MDL	Method Detection Limit.
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state "ND" (Not Detected) or "BDL" (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
B	The same analyte is found in the associated blank.
E	The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL).
J	The identification of the analyte is acceptable; the reported value is an estimate.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high.

ACCREDITATIONS & LOCATIONS

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

ESC Lab Sciences is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our "one location" design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be **YOUR LAB OF CHOICE.**
* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

State Accreditations

Alabama	40660	Nevada	TN-03-2002-34
Alaska	UST-080	New Hampshire	2975
Arizona	AZ0612	New Jersey–NELAP	TN002
Arkansas	88-0469	New Mexico	TN00003
California	01157CA	New York	11742
Colorado	TN00003	North Carolina	Env375
Conneticut	PH-0197	North Carolina [1]	DW21704
Florida	E87487	North Carolina [2]	41
Georgia	NELAP	North Dakota	R-140
Georgia [1]	923	Ohio–VAP	CL0069
Idaho	TN00003	Oklahoma	9915
Illinois	200008	Oregon	TN200002
Indiana	C-TN-01	Pennsylvania	68-02979
Iowa	364	Rhode Island	221
Kansas	E-10277	South Carolina	84004
Kentucky [1]	90010	South Dakota	n/a
Kentucky [2]	16	Tennessee [1,4]	2006
Louisiana	AI30792	Texas	T 104704245-07-TX
Maine	TN0002	Texas [5]	LAB0152
Maryland	324	Utah	6157585858
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	109
Minnesota	047-999-395	Washington	C1915
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	9980939910
Montana	CERT0086	Wyoming	A2LA
Nebraska	NE-OS-15-05		

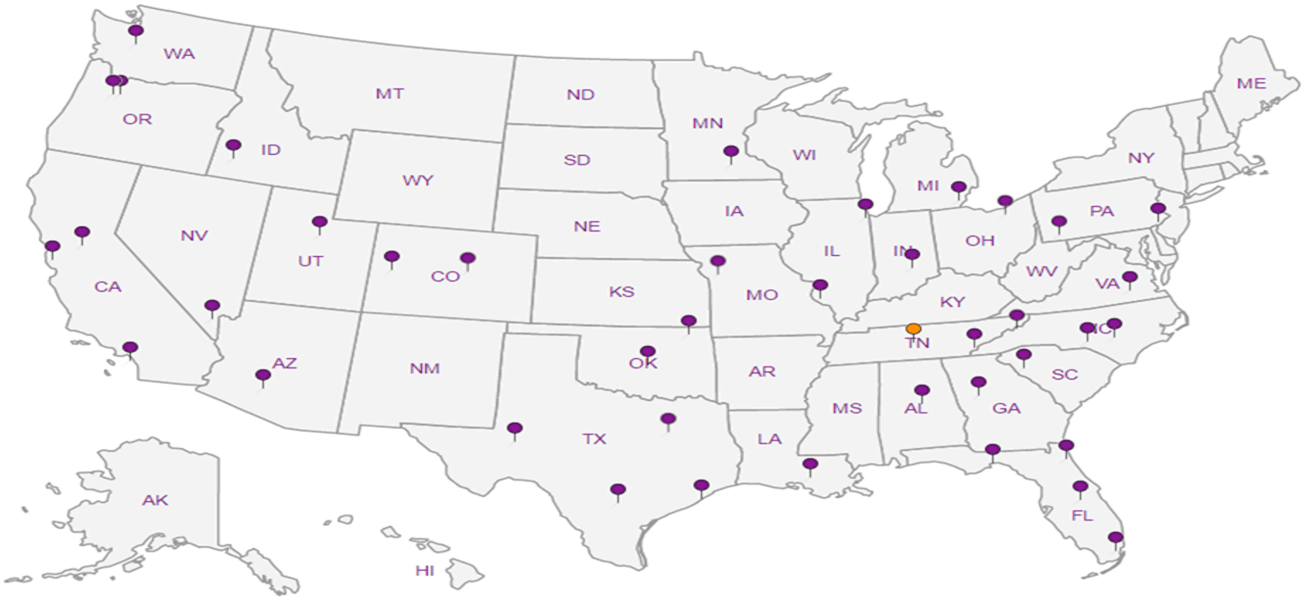
Third Party & Federal Accreditations

A2LA – ISO 17025	1461.01	AIHA-LAP,LLC	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	S-67674
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold n/a Accreditation not applicable

Our Locations

ESC Lab Sciences has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. **ESC Lab Sciences performs all testing at our central laboratory.**



Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:
Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Report to:
Jacqueline Finck

Email To: **Jacqueline.Finck@terracon.com**

Project Description: **Brine Pond Study**

City/State Collected: Renville, ND

Phone: **701-356-7621**
Fax:

Client Project # M1177088

Lab Project # **TERRAFND-M1177088**

Collected by (print): Jacqueline Finck

Site/Facility ID # **MINOT ND**

P.O. #

Collected by (signature): Jacqueline Finck

Rush? (Lab MUST Be Notified)
___ Same Day ___ Five Day
___ Next Day [✓ 5 Day (Rad Only)]
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Immediately Packed on Ice N X Y ___

Chain of Custody Page 1 of 2

ESC LAB SCIENCES a subsidiary of Pace Analytical

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L# L933535

F099

Acctnum: **TERRAFND**
Template: **T127227**
Prelogin: **P615134**
TSR: **341 - John Hawkins**
PB Cm 8.16.17
Shipped Via: **FedEX Priority**

Analysis / Container / Preservative

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CHLORIDE 125mlHDPE-NoPres	CL ESP SAR 4ozClr-NoPres	ESP NAICP SAR 250mlHDPE-HNO3	NAICP 2ozClr-NoPres	SPCON (ec) 4ozClr-NoPres	SPCON 250mlHDPE-NoPres	Remarks	Sample # (lab only)
B1	Grab	SS	3'	8/~~30~~29/17	10:20AM	3		X		X	X			-01
B1		SS	25'	8/29/17	10:45AM	3		X		X	X			02
B2		SS	3'	8/29/17	11:30 AM	3		X		X	X			03
B3		SS	3'	8/29/17	12:20 pm	3		X		X	X			04
B4		SS	3'	8/29/17	1:40 pm	3		X		X	X			05
B5		SS	3'	8/29/17	2:35pm	3		X		X	X			06
B6		SS	1'	8/30/17	10:30AM	3		X		X	X			07
B6	Grab	SS	3'	8/30/17	10:35 AM	3		X		X	X			08
		SS				3		X		X	X			
		SS				3		X		X	X			

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier __ ______

Tracking # 7474 0926 4881

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature) Jacqueline Finck
Date: 8/31/17
Time: 630 pm
Received by: (Signature)

Trip Blank Received: Yes / [✓ No]
HCL / MeoH
TBR

Relinquished by : (Signature)
Date:
Time:
Received by: (Signature)

Temp: 4.9 °C
Bottles Received: 48

If preservation required by Login: Date/Time

Relinquished by : (Signature)
Date:
Time:
Received for lab by: (Signature)

Date: 9-1-17
Time: 0845

Hold:

Condition: NCF / [✓ OK]

Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:
Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page 2 of 2

ESC
L·A·B S·C·I·E·N·C·E·S
a subsidiary of Pace Analytical

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

Report to:
Jacqueline Finck

Email To: Jacqueline.Finck@terracon.com

Project Description: Brine Pond Study

City/State Collected:

Phone: 701-356-7621
Fax:

Client Project # M1177088

Lab Project # TERRAFND-M1177088

L# L933535

Table #

Collected by (print): Jacqueline Finck

Site/Facility ID # MINOT ND

P.O. #

Acctnum: TERRAFND

Collected by (signature): Jacqueline Finck

Quote #

Template: T127398

Prelogin: P615920

Rush? (Lab MUST Be Notified)
___ Same Day
___ Next Day
___ Two Day
___ Three Day
___ Five Day
X 5 Day (Rad Only)
___ 10 Day (Rad Only)

Date Results Needed

TSR: 341 - John Hawkins

PB: CM 8/29-17

Immediately Packed on Ice N ✓ Y ___

Shipped Via: FedEX Standard

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CL ESP SAR 4ozClr-NoPres	NAICP 2ozClr-NoPres	SPCON (ec) 4ozClr-NoPres								Remarks	Sample # (lab only)
B7	Grab	SS	1'	8/30/17	1045Am	3	X	X	X									09
B7		SS	3'		10:50Am	3	X	X	X									10
B8		SS	1'		10:15Am	3	X	X	X									11
B8		SS	3'		10:20Am	3	X	X	X									12
B9		SS	1'		10:55Am	3	X	X	X									13
B9		SS	3'		11:00Am	3	X	X	X									14
B10		SS	1'		1135Am	3	X	X	X									15
B10	Grab	SS	3'	8/30/17	1140Am	3	X	X	X									16
		SS				3	X	X	X									
		SS				3	X	X	X									

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__UPS __FedEx __Courier ______

Tracking # 7474 0926 4981

Sample Receipt Checklist
COC Seal Present/Intact: __NP ✓Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature) Jacqueline Finck

Date: 8/31/17

Time: 6:30pm

Received by: (Signature)

Trip Blank Received: Yes / [✓ No]
HCL / MeoH
TBR

Relinquished by : (Signature)

Date:

Time:

Received by: (Signature)

Temp: 4.9 °C

Bottles Received: 48

If preservation required by Login: Date/Time

Relinquished by : (Signature)

Date:

Time:

Received for lab by: (Signature)

Date: 9-1-17

Time: 0845

Hold:

Condition: NCF / [✓ OK]

ANALYTICAL REPORT

September 12, 2017

Terracon - Fargo, ND

Sample Delivery Group:	L933633
Samples Received:	09/01/2017
Project Number:	M1177088
Description:	Brine Pond Study
Site:	MINOT ND
Report To:	Jacqueline Finck 860 9TH ST E West Fargo, ND 58078

Entire Report Reviewed By: John V Hawkins

John Hawkins
Technical Service Representative

12065 Lebanon Rd Mount Juliet, TN 37122 615-758-5858 800-767-5859 www.esclabsciences.com

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B24 1FT L933633-01 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 10:00	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 16:48	JDG
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 16:48	JDG
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	10	09/07/17 01:33	09/07/17 19:46	DR
Metals (ICP) by Method 6010C	WG1017865	1	09/08/17 11:16	09/11/17 01:11	ST

B24 3FT L933633-02 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 10:05	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:26	CCE
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:26	CCE
Wet Chemistry by Method 9050AMod	WG1017006	1	09/07/17 16:13	09/07/17 16:13	MA
Wet Chemistry by Method 9056A	WG1016998	5	09/07/17 01:33	09/07/17 20:13	DR
Metals (ICP) by Method 6010C	WG1017865	1	09/08/17 11:16	09/11/17 01:13	ST

B25 1FT L933633-03 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 08:20	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:29	CCE
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:29	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	1	09/06/17 16:45	09/08/17 17:26	MAJ
Metals (ICP) by Method 6010C	WG1017865	1	09/08/17 11:16	09/11/17 01:16	ST

B25 3FT L933633-04 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 08:25	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:32	CCE
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:32	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	5	09/06/17 16:45	09/08/17 17:34	MAJ
Metals (ICP) by Method 6010C	WG1017865	1	09/08/17 11:16	09/11/17 01:18	ST

B28 1FT L933633-05 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 09:45	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:35	CCE
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:35	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	10	09/06/17 16:45	09/08/17 18:35	MAJ
Metals (ICP) by Method 6010C	WG1017865	1	09/08/17 11:16	09/11/17 01:21	ST

B28 3FT L933633-06 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 09:50	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:37	CCE
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:37	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	10	09/06/17 16:45	09/08/17 18:44	MAJ
Metals (ICP) by Method 6010C	WG1017865	1	09/08/17 11:16	09/11/17 01:23	ST

B29 1FT L933633-07 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 08:35	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:40	CCE
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:40	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	5	09/06/17 16:45	09/08/17 18:53	MAJ
Metals (ICP) by Method 6010C	WG1017865	1	09/08/17 11:16	09/11/17 01:26	ST

B29 3FT L933633-08 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 08:40	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:43	CCE
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:43	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	1	09/06/17 16:45	09/08/17 19:02	MAJ
Metals (ICP) by Method 6010C	WG1017865	1	09/08/17 11:16	09/11/17 01:28	ST

B32 1FT L933633-09 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 09:30	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:45	CCE
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:45	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	5	09/06/17 16:45	09/08/17 19:11	MAJ
Metals (ICP) by Method 6010C	WG1017865	1	09/08/17 11:16	09/11/17 01:31	ST

B32 3FT L933633-10 Solid

Collected by	Collected date/time	Received date/time
Jacqueline Finck	08/30/17 09:35	09/01/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:48	CCE
Calculated Results	WG1016364	1	09/11/17 06:35	09/12/17 14:48	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	1	09/06/17 16:45	09/08/17 19:19	MAJ
Metals (ICP) by Method 6010C	WG1017865	1	09/08/17 11:16	09/11/17 01:38	ST

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. All MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All radiochemical sample results for solids are reported on a dry weight basis with the exception of tritium, carbon-14 and radon, unless wet weight was requested by the client. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

John V Hawkins

John Hawkins
Technical Service Representative

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	59.0		1	09/12/2017 16:48	WG1016364

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	46.2		1	09/12/2017 16:48	WG1016364

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	9340		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	4290		100	10	09/07/2017 19:46	WG1016998

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	3710		100	1	09/11/2017 01:11	WG1017865

B24 3FT

Collected date/time: 08/30/17 10:05

SAMPLE RESULTS - 02

L933633

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	32.2		1	09/12/2017 14:26	WG1016364

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	31.6		1	09/12/2017 14:26	WG1016364

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	6820		1	09/07/2017 16:13	WG1017006

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	2730		50.0	5	09/07/2017 20:13	WG1016998

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	2350		100	1	09/11/2017 01:13	WG1017865

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	26.5		1	09/12/2017 14:29	WG1016364

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	27.5		1	09/12/2017 14:29	WG1016364

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	11900		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	577		10.0	1	09/08/2017 17:26	WG1017002

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	3270		100	1	09/11/2017 01:16	WG1017865

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	24.2		1	09/12/2017 14:32	WG1016364

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	25.6		1	09/12/2017 14:32	WG1016364

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	4590		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	1790		50.0	5	09/08/2017 17:34	WG1017002

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	2000		100	1	09/11/2017 01:18	WG1017865

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	11.3		1	09/12/2017 14:35	WG1016364

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	13.4		1	09/12/2017 14:35	WG1016364

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	12400		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	4550		100	10	09/08/2017 18:35	WG1017002

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	2200		100	1	09/11/2017 01:21	WG1017865

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	7.84		1	09/12/2017 14:37	WG1016364

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	9.35		1	09/12/2017 14:37	WG1016364

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	7980		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	2990		100	10	09/08/2017 18:44	WG1017002

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1360		100	1	09/11/2017 01:23	WG1017865

B29 1FT

Collected date/time: 08/30/17 08:35

SAMPLE RESULTS - 07

L933633

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	12.7		1	09/12/2017 14:40	WG1016364

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	14.9		1	09/12/2017 14:40	WG1016364

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	4420		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	1690		50.0	5	09/08/2017 18:53	WG1017002

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1330		100	1	09/11/2017 01:26	WG1017865

B29 3FT

Collected date/time: 08/30/17 08:40

SAMPLE RESULTS - 08

L933633

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	7.58		1	09/12/2017 14:43	WG1016364

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	9.03		1	09/12/2017 14:43	WG1016364

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	1630		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	416		10.0	1	09/08/2017 19:02	WG1017002

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	713		100	1	09/11/2017 01:28	WG1017865

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	7.93		1	09/12/2017 14:45	WG1016364

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	9.45		1	09/12/2017 14:45	WG1016364

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	6810		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	1210		50.0	5	09/08/2017 19:11	WG1017002

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1470		100	1	09/11/2017 01:31	WG1017865

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	6.47		1	09/12/2017 14:48	WG1016364

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	7.65		1	09/12/2017 14:48	WG1016364

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	4540		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	631		10.0	1	09/08/2017 19:19	WG1017002

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1030		100	1	09/11/2017 01:38	WG1017865

Method Blank (MB)

(MB) WG1017006-1 09/07/17 16:13

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	3.05			

L933535-04 Original Sample (OS) • Duplicate (DUP)

(OS) L933535-04 09/07/17 16:13 • (DUP) WG1017006-4 09/07/17 16:13

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	2210	2210	1	0.136		20

L933535-14 Original Sample (OS) • Duplicate (DUP)

(OS) L933535-14 09/07/17 16:13 • (DUP) WG1017006-5 09/07/17 16:13

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	5740	5750	1	0.174		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) WG1017006-2 09/07/17 16:13 • (LCSD) WG1017006-3 09/07/17 16:13

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	559	561	560	100	100	90.0-110			0.178	20

Method Blank (MB)

(MB) WG1017007-1 09/07/17 14:05

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	3.06			

L933633-03 Original Sample (OS) • Duplicate (DUP)

(OS) L933633-03 09/07/17 14:05 • (DUP) WG1017007-4 09/07/17 14:05

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	11900	11900	1	0.0841		20

L933766-03 Original Sample (OS) • Duplicate (DUP)

(OS) L933766-03 09/07/17 14:05 • (DUP) WG1017007-5 09/07/17 14:05

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	1820	1820	1	0.165		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) WG1017007-2 09/07/17 14:05 • (LCSD) WG1017007-3 09/07/17 14:05

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	559	559	558	100	99.8	90.0-110			0.179	20

Method Blank (MB)

(MB) R3247676-1 09/07/17 15:14

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	1.83	J	0.795	10.0

L933535-15 Original Sample (OS) • Duplicate (DUP)

(OS) L933535-15 09/07/17 19:02 • (DUP) R3247676-5 09/07/17 19:11

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	674	726	1	7		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3247676-2 09/07/17 15:23 • (LCSD) R3247676-3 09/07/17 15:32

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	218	211	109	106	80-120			3	15

L933535-16 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933535-16 09/07/17 19:20 • (MS) R3247676-6 09/07/17 19:29 • (MSD) R3247676-7 09/07/17 19:37

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Chloride	500	528	1560	1590	207	212	1	80-120	E J5	E J5	2	15

Method Blank (MB)

(MB) R3248066-1 09/08/17 16:13

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	1.9	J	0.795	10.0

L933633-04 Original Sample (OS) • Duplicate (DUP)

(OS) L933633-04 09/08/17 17:34 • (DUP) R3248066-4 09/08/17 17:43

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	1790	1930	5	8		15

L933766-07 Original Sample (OS) • Duplicate (DUP)

(OS) L933766-07 09/08/17 20:38 • (DUP) R3248066-7 09/08/17 20:47

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	3400	4400	5	26	J3	15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3248066-2 09/08/17 16:22 • (LCSD) R3248066-3 09/08/17 16:31

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	216	223	108	111	80-120			3	15

Method Blank (MB)

(MB) R3248159-1 09/11/17 00:38

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Sodium	45.6	J	9.85	100

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3248159-2 09/11/17 00:41 • (LCSD) R3248159-3 09/11/17 00:43

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Sodium	1000	1040	1030	104	103	80-120			1	20

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Abbreviations and Definitions

MDL	Method Detection Limit.
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state “ND” (Not Detected) or “BDL” (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
E	The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL).
J	The identification of the analyte is acceptable; the reported value is an estimate.
J3	The associated batch QC was outside the established quality control range for precision.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high.

ACCREDITATIONS & LOCATIONS

ESC Lab Sciences is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our "one location" design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be **YOUR LAB OF CHOICE.**
* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

State Accreditations

Alabama	40660	Nevada	TN-03-2002-34
Alaska	UST-080	New Hampshire	2975
Arizona	AZ0612	New Jersey–NELAP	TN002
Arkansas	88-0469	New Mexico	TN00003
California	01157CA	New York	11742
Colorado	TN00003	North Carolina	Env375
Conneticut	PH-0197	North Carolina[1]	DW21704
Florida	E87487	North Carolina[2]	41
Georgia	NELAP	North Dakota	R-140
Georgia[1]	923	Ohio–VAP	CL0069
Idaho	TN00003	Oklahoma	9915
Illinois	200008	Oregon	TN200002
Indiana	C-TN-01	Pennsylvania	68-02979
Iowa	364	Rhode Island	221
Kansas	E-10277	South Carolina	84004
Kentucky[1]	90010	South Dakota	n/a
Kentucky[2]	16	Tennessee[1,4]	2006
Louisiana	AI30792	Texas	T 104704245-07-TX
Maine	TN0002	Texas[5]	LAB0152
Maryland	324	Utah	6157585858
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	109
Minnesota	047-999-395	Washington	C1915
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	9980939910
Montana	CERT0086	Wyoming	A2LA
Nebraska	NE-OS-15-05		

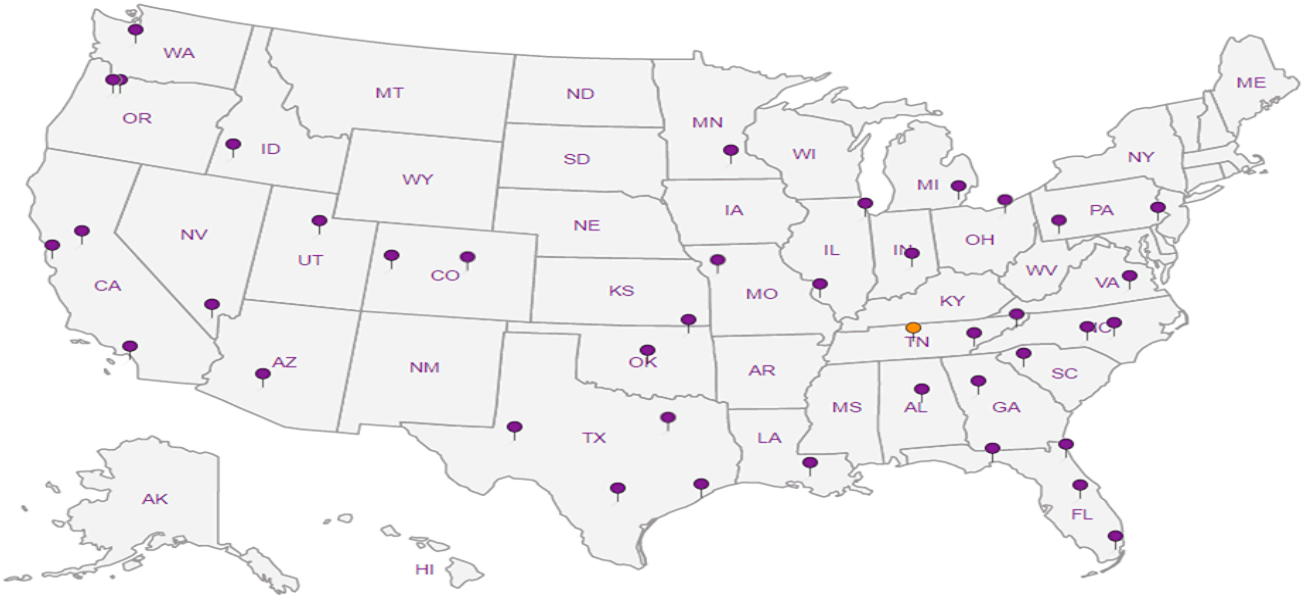
Third Party & Federal Accreditations

A2LA – ISO 17025	1461.01	AIHA-LAP,LLC	100789
A2LA – ISO 17025[5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	S-67674
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [n/a] Accreditation not applicable

Our Locations

ESC Lab Sciences has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. **ESC Lab Sciences performs all testing at our central laboratory.**



Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:
Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Report to: Jacqueline Finck

Email To: Jacqueline.Finck@terracon.com

Project Description: Brine Pond Study

City/State Collected: Renville, ND

Phone: 701-356-7621
Fax:

Client Project # M1177088

Lab Project # TERRAFND-M1177088

Collected by (print): Jacqueline Finck

Site/Facility ID # MINOT ND

P.O. #

Collected by (signature): Jacqueline Finck

Rush? (Lab MUST Be Notified)
___ Same Day [✓ Five Day]
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Immediately Packed on Ice N X Y ___

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

ESC LAB SCIENCES
a subsidiary of Pace Analytical

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L # L933633

D026

Acctnum: TERRAFND
Template: T127398
Prelogin: P615920
TSR: 341 - John Hawkins
PB: 8/19-17 CW
Shipped Via: FedEX Standard

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	Cl ESP SAR 4ozClr-NoPres	NAICP 2ozClr-NoPres	SPCON (ec) 4ozClr-NoPres	Remarks	Sample # (lab only)
B24	Grab	SS	1'	8/30/17	1000 AM	3	X	X	X		-01
B24		SS	3'		1005 AM	3	X	X	X		.02
B25		SS	1'		820 AM	3	X	X	X		.03
B25		SS	3'		825 AM	3	X	X	X		-04
B28		SS	1'		945 AM	3	X	X	X		-05
B28		SS	3'		950 AM	3	X	X	X		-06
B29		SS	1'		835 AM	3	X	X	X		-07
B29		SS	3'		840 AM	3	X	X	X		-08
B32		SS	1'		930 AM	3	X	X	X		-09
B32	Grab	SS	3'	8/30/17	935 AM	3	X	X	X		-10

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other ________

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS [✓ FedEx] __ Courier ______

Tracking # 7474 09 26 487 (can't tell last)

Sample Receipt Checklist
COC Seal Present/Intact: __NP [✓ Y] __N
COC Signed/Accurate: [✓ Y] __N
Bottles arrive intact: [✓ Y] __N
Correct bottles used: [✓ Y] __N
Sufficient volume sent: [✓ Y] __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature) Jacqueline Finck Date: 8/31/17 Time: 630 pm
Received by: (Signature)

Trip Blank Received: Yes / No
HCL / MeoH
TBR

Relinquished by : (Signature) Date: Time:
Received by: (Signature)

Temp: 1.6 MW °C "
Bottles Received: 30

If preservation required by Login: Date/Time

Relinquished by : (Signature) Date: Time:
Received for lab by: (Signature)

Date: 9/1/17 Time: 0845

Hold:

Condition: NCF / [✓ OK]

ANALYTICAL REPORT

September 13, 2017

Terracon - Fargo, ND

Sample Delivery Group:	L933766
Samples Received:	09/02/2017
Project Number:	M1177088
Description:	Brine Pond Study
Site:	MINOT ND
Report To:	Jacqueline Finck 860 9TH ST E West Fargo, ND 58078

Entire Report Reviewed By: John V Hawkins

John Hawkins
Technical Service Representative

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  B38 12FT L933766-09 16
  B39 1FT L933766-10 17
  B39 3FT L933766-11 18
  B39 14FT L933766-12 19
  B40 1FT L933766-13 20
  B40 3FT L933766-14 21
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Collected by	Collected date/time	Received date/time
Jaqueline Finek	08/30/17 08:50	09/02/17 08:45

B33 1FT L933766-01 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:38	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:38	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	5	09/06/17 16:45	09/08/17 19:28	MAJ
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 15:03	CCE

Collected by	Collected date/time	Received date/time
Jaqueline Finek	08/30/17 08:55	09/02/17 08:45

B33 3FT L933766-02 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:41	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:41	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	1	09/06/17 16:45	09/08/17 19:54	MAJ
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 15:16	CCE

Collected by	Collected date/time	Received date/time
Jaqueline Finek	08/30/17 09:15	09/02/17 08:45

B36 1FT L933766-03 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:45	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:45	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	1	09/06/17 16:45	09/08/17 20:03	MAJ
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 15:18	CCE

Collected by	Collected date/time	Received date/time
Jaqueline Finek	08/30/17 09:20	09/02/17 08:45

B36 3FT L933766-04 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:48	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:48	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	1	09/06/17 16:45	09/08/17 20:12	MAJ
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 15:29	CCE

Collected by	Collected date/time	Received date/time
Jaqueline Finek	08/30/17 09:00	09/02/17 08:45

B37 1FT L933766-05 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:51	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:51	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	1	09/06/17 16:45	09/08/17 20:21	MAJ
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 15:31	CCE

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Collected by	Collected date/time	Received date/time
Jaqueline Finek	08/30/17 09:05	09/02/17 08:45

B37 3FT L933766-06 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:55	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:55	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	1	09/06/17 16:45	09/08/17 20:30	MAJ
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 15:34	CCE

Collected by	Collected date/time	Received date/time
Jaqueline Finek	08/30/17 12:50	09/02/17 08:45

B38 1FT L933766-07 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:58	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 08:58	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	5	09/06/17 16:45	09/08/17 20:38	MAJ
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 15:36	CCE

Collected by	Collected date/time	Received date/time
Jaqueline Finek	08/30/17 12:55	09/02/17 08:45

B38 3FT L933766-08 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 09:01	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 09:01	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1018354	2	09/11/17 09:38	09/12/17 02:00	DR
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 15:39	CCE

Collected by	Collected date/time	Received date/time
Jaqueline Finek	08/30/17 13:05	09/02/17 08:45

B38 12FT L933766-09 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 09:05	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 09:05	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	5	09/06/17 16:45	09/08/17 21:05	MAJ
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 15:42	CCE

Collected by	Collected date/time	Received date/time
Jaqueline Finek	08/30/17 13:40	09/02/17 08:45

B39 1FT L933766-10 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 09:15	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 09:15	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	5	09/06/17 16:45	09/08/17 21:31	MAJ
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 15:44	CCE

Collected by Jaqueline Finek | Collected date/time 08/30/17 13:45 | Received date/time 09/02/17 08:45

B39 3FT L933766-11 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 09:18	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 09:18	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	1	09/06/17 16:45	09/08/17 21:40	MAJ
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 15:47	CCE

Collected by Jaqueline Finek | Collected date/time 08/30/17 14:00 | Received date/time 09/02/17 08:45

B39 14FT L933766-12 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 14:02	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 14:02	CCE
Wet Chemistry by Method 9050AMod	WG1017007	1	09/07/17 14:05	09/07/17 14:05	MA
Wet Chemistry by Method 9056A	WG1017002	5	09/06/17 16:45	09/08/17 21:48	MAJ
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 15:50	CCE

Collected by Jaqueline Finek | Collected date/time 08/30/17 14:30 | Received date/time 09/02/17 08:45

B40 1FT L933766-13 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 13:06	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 13:06	CCE
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1019185	10	09/12/17 13:15	09/12/17 14:59	MAJ
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 15:52	CCE

Collected by Jaqueline Finek | Collected date/time 08/30/17 14:35 | Received date/time 09/02/17 08:45

B40 3FT L933766-14 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 13:09	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 13:09	CCE
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	10	09/07/17 18:46	09/07/17 21:27	DR
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 16:00	CCE

Collected by Jaqueline Finek | Collected date/time 08/30/17 14:45 | Received date/time 09/02/17 08:45

B40 8FT L933766-15 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 13:13	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 13:13	CCE
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	10	09/07/17 18:46	09/07/17 21:36	DR
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 16:02	CCE

	Collected by	Collected date/time	Received date/time
B41 1FT L933766-16 Solid	Jaqueline Finek	08/30/17 15:10	09/02/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 09:36	CCE
Calculated Results	WG1017863	1	09/12/17 17:14	09/13/17 09:36	CCE
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	5	09/07/17 18:46	09/07/17 21:44	DR
Metals (ICP) by Method 6010C	WG1019100	1	09/12/17 10:01	09/12/17 16:05	CCE

CASE NARRATIVE

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. All MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All radiochemical sample results for solids are reported on a dry weight basis with the exception of tritium, carbon-14 and radon, unless wet weight was requested by the client. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

John V Hawkins

John Hawkins
Technical Service Representative

B33 1FT

Collected date/time: 08/30/17 08:50

SAMPLE RESULTS - 01

L933766

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	6.19		1	09/13/2017 08:38	WG1017863

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	7.30		1	09/13/2017 08:38	WG1017863

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	2920		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	873		50.0	5	09/08/2017 19:28	WG1017002

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	809	O1	100	1	09/12/2017 15:03	WG1019100

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	3.28		1	09/13/2017 08:41	WG1017863

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	3.45		1	09/13/2017 08:41	WG1017863

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	1520		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	336		10.0	1	09/08/2017 19:54	WG1017002

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	290	B	100	1	09/12/2017 15:16	WG1019100

B36 1FT
Collected date/time: 08/30/17 09:15

SAMPLE RESULTS - 03

L933766

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	6.15		1	09/13/2017 08:45	WG1017863

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	7.24		1	09/13/2017 08:45	WG1017863

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	1820		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	569		10.0	1	09/08/2017 20:03	WG1017002

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	718		100	1	09/12/2017 15:18	WG1019100

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	3.99		1	09/13/2017 08:48	WG1017863

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	4.42		1	09/13/2017 08:48	WG1017863

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	1460		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	491		10.0	1	09/08/2017 20:12	WG1017002

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	429		100	1	09/12/2017 15:29	WG1019100

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	4.15		1	09/13/2017 08:51	WG1017863

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	4.64		1	09/13/2017 08:51	WG1017863

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	2070		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	691		10.0	1	09/08/2017 20:21	WG1017002

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	679		100	1	09/12/2017 15:31	WG1019100

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	4.33		1	09/13/2017 08:55	WG1017863

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	4.88		1	09/13/2017 08:55	WG1017863

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	1380		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	398		10.0	1	09/08/2017 20:30	WG1017002

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	472		100	1	09/12/2017 15:34	WG1019100

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	55.0		1	09/13/2017 08:58	WG1017863

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	44.4		1	09/13/2017 08:58	WG1017863

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	5690		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	3400	J3	50.0	5	09/08/2017 20:38	WG1017002

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	3840		100	1	09/12/2017 15:36	WG1019100

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	14.3		1	09/13/2017 09:01	WG1017863

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	16.5		1	09/13/2017 09:01	WG1017863

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	1330		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	1000		20.0	2	09/12/2017 02:00	WG1018354

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	2080		100	1	09/12/2017 15:39	WG1019100

B38 12FT

Collected date/time: 08/30/17 13:05

SAMPLE RESULTS - 09

L933766

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	39.9		1	09/13/2017 09:05	WG1017863

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	36.5		1	09/13/2017 09:05	WG1017863

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	7020		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	4110		50.0	5	09/08/2017 21:05	WG1017002

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	3770		100	1	09/12/2017 15:42	WG1019100

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	16.3		1	09/13/2017 09:15	WG1017863

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	18.5		1	09/13/2017 09:15	WG1017863

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	3610		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	2000		50.0	5	09/08/2017 21:31	WG1017002

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	1540		100	1	09/12/2017 15:44	WG1019100

B39 3FT

Collected date/time: 08/30/17 13:45

SAMPLE RESULTS - 11

L933766

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	19.4		1	09/13/2017 09:18	WG1017863

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	21.4		1	09/13/2017 09:18	WG1017863

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	1190		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	861		10.0	1	09/08/2017 21:40	WG1017002

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	1060		100	1	09/12/2017 15:47	WG1019100

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	53.0		1	09/13/2017 14:02	WG1017863

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	43.5		1	09/13/2017 14:02	WG1017863

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	8520		1	09/07/2017 14:05	WG1017007

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	3920		50.0	5	09/08/2017 21:48	WG1017002

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	5340		100	1	09/12/2017 15:50	WG1019100

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	56.4		1	09/13/2017 13:06	WG1017863

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	45.0		1	09/13/2017 13:06	WG1017863

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	18600		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	2990		100	10	09/12/2017 14:59	WG1019185

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	4550		100	1	09/12/2017 15:52	WG1019100

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	47.7		1	09/13/2017 13:09	WG1017863

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	40.8		1	09/13/2017 13:09	WG1017863

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	12200		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	5860		100	10	09/07/2017 21:27	WG1017004

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	3960		100	1	09/12/2017 16:00	WG1019100

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	43.9		1	09/13/2017 13:13	WG1017863

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	38.8		1	09/13/2017 13:13	WG1017863

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	12200		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	4880		100	10	09/07/2017 21:36	WG1017004

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	4420		100	1	09/12/2017 16:02	WG1019100

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	12.2		1	09/13/2017 09:36	WG1017863

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	14.4		1	09/13/2017 09:36	WG1017863

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	4570		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	1170		50.0	5	09/07/2017 21:44	WG1017004

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1430		100	1	09/12/2017 16:05	WG1019100

Method Blank (MB)

(MB) WG1017007-1 09/07/17 14:05

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	3.06			

L933633-03 Original Sample (OS) • Duplicate (DUP)

(OS) L933633-03 09/07/17 14:05 • (DUP) WG1017007-4 09/07/17 14:05

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	11900	11900	1	0.0841		20

L933766-03 Original Sample (OS) • Duplicate (DUP)

(OS) L933766-03 09/07/17 14:05 • (DUP) WG1017007-5 09/07/17 14:05

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	1820	1820	1	0.165		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) WG1017007-2 09/07/17 14:05 • (LCSD) WG1017007-3 09/07/17 14:05

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	559	559	558	100	99.8	90.0-110			0.179	20

Method Blank (MB)

(MB) WG1017008-1 09/07/17 15:05

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	3.07			

L933766-13 Original Sample (OS) • Duplicate (DUP)

(OS) L933766-13 09/07/17 15:05 • (DUP) WG1017008-4 09/07/17 15:05

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	18600	18600	1	0.0538		20

L933786-07 Original Sample (OS) • Duplicate (DUP)

(OS) L933786-07 09/07/17 15:05 • (DUP) WG1017008-5 09/07/17 15:05

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	6230	6220	1	0.161		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) WG1017008-2 09/07/17 15:05 • (LCSD) WG1017008-3 09/07/17 15:05

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	559	558	559	99.8	100	90.0-110			0.179	20

Method Blank (MB)

(MB) R3248066-1 09/08/17 16:13

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	1.9	J	0.795	10.0

L933633-04 Original Sample (OS) • Duplicate (DUP)

(OS) L933633-04 09/08/17 17:34 • (DUP) R3248066-4 09/08/17 17:43

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	1790	1930	5	8		15

L933766-07 Original Sample (OS) • Duplicate (DUP)

(OS) L933766-07 09/08/17 20:38 • (DUP) R3248066-7 09/08/17 20:47

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	3400	4400	5	26	J3	15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3248066-2 09/08/17 16:22 • (LCSD) R3248066-3 09/08/17 16:31

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	216	223	108	111	80-120			3	15

Method Blank (MB)

(MB) R3247705-1 09/07/17 20:25

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	4.66	J	0.795	10.0

L933786-14 Original Sample (OS) • Duplicate (DUP)

(OS) L933786-14 09/08/17 00:40 • (DUP) R3247705-7 09/08/17 00:49

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	60.6	52.9	1	14		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3247705-2 09/07/17 20:34 • (LCSD) R3247705-3 09/07/17 20:43

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	208	208	104	104	80-120			0	15

L933786-12 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933786-12 09/07/17 23:47 • (MS) R3247705-5 09/08/17 00:13 • (MSD) R3247705-6 09/08/17 00:22

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Chloride	500	19.4	1050	1050	205	207	1	80-120	E J5	E J5	1	15

Method Blank (MB)

(MB) R3248757-1 09/11/17 15:28

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	1.17	J	0.795	10.0

L934588-01 Original Sample (OS) • Duplicate (DUP)

(OS) L934588-01 09/12/17 03:21 • (DUP) R3248757-4 09/12/17 04:01

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	U	31.7	1	1		15

L934885-03 Original Sample (OS) • Duplicate (DUP)

(OS) L934885-03 09/12/17 06:56 • (DUP) R3248757-7 09/12/17 07:09

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	U	30.5	1	1		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3248757-2 09/11/17 15:43 • (LCSD) R3248757-3 09/11/17 15:56

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	210	202	105	101	80-120			4	15

L934881-07 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L934881-07 09/12/17 05:35 • (MS) R3248757-5 09/12/17 05:48 • (MSD) R3248757-6 09/12/17 06:02

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Chloride	500	U	566	570	106	107	1	80-120			1	15

Method Blank (MB)

(MB) R3248744-1 09/12/17 14:15

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	4.19	J	0.795	10.0

L935290-01 Original Sample (OS) • Duplicate (DUP)

(OS) L935290-01 09/12/17 16:09 • (DUP) R3248744-5 09/12/17 16:18

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	3920	3950	5	1		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3248744-2 09/12/17 14:24 • (LCSD) R3248744-3 09/12/17 14:32

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	237	236	119	118	80-120			0	15

Method Blank (MB)

(MB) R3248731-1 09/12/17 14:56

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Sodium	30.7	J	9.85	100

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3248731-2 09/12/17 14:58 • (LCSD) R3248731-3 09/12/17 15:01

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Sodium	1000	1040	1030	104	103	80-120			1	20

L933766-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933766-01 09/12/17 15:03 • (MS) R3248731-6 09/12/17 15:11 • (MSD) R3248731-7 09/12/17 15:13

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Sodium	1000	809	1710	1790	90	98	1	75-125			4	20

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Abbreviations and Definitions

MDL	Method Detection Limit.
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state “ND” (Not Detected) or “BDL” (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
B	The same analyte is found in the associated blank.
E	The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL).
J	The identification of the analyte is acceptable; the reported value is an estimate.
J3	The associated batch QC was outside the established quality control range for precision.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high.
O1	The analyte failed the method required serial dilution test and/or subsequent post-spike criteria. These failures indicate matrix interference.

ACCREDITATIONS & LOCATIONS

ESC Lab Sciences is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our "one location" design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be **YOUR LAB OF CHOICE.**
* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

State Accreditations

Alabama	40660
Alaska	UST-080
Arizona	AZ0612
Arkansas	88-0469
California	01157CA
Colorado	TN00003
Conneticut	PH-0197
Florida	E87487
Georgia	NELAP
Georgia [1]	923
Idaho	TN00003
Illinois	200008
Indiana	C-TN-01
Iowa	364
Kansas	E-10277
Kentucky [1]	90010
Kentucky [2]	16
Louisiana	AI30792
Maine	TN0002
Maryland	324
Massachusetts	M-TN003
Michigan	9958
Minnesota	047-999-395
Mississippi	TN00003
Missouri	340
Montana	CERT0086
Nebraska	NE-OS-15-05
Nevada	TN-03-2002-34
New Hampshire	2975
New Jersey–NELAP	TN002
New Mexico	TN00003
New York	11742
North Carolina	Env375
North Carolina [1]	DW21704
North Carolina [2]	41
North Dakota	R-140
Ohio–VAP	CL0069
Oklahoma	9915
Oregon	TN200002
Pennsylvania	68-02979
Rhode Island	221
South Carolina	84004
South Dakota	n/a
Tennessee [1,4]	2006
Texas	T 104704245-07-TX
Texas [5]	LAB0152
Utah	6157585858
Vermont	VT2006
Virginia	109
Washington	C1915
West Virginia	233
Wisconsin	9980939910
Wyoming	A2LA

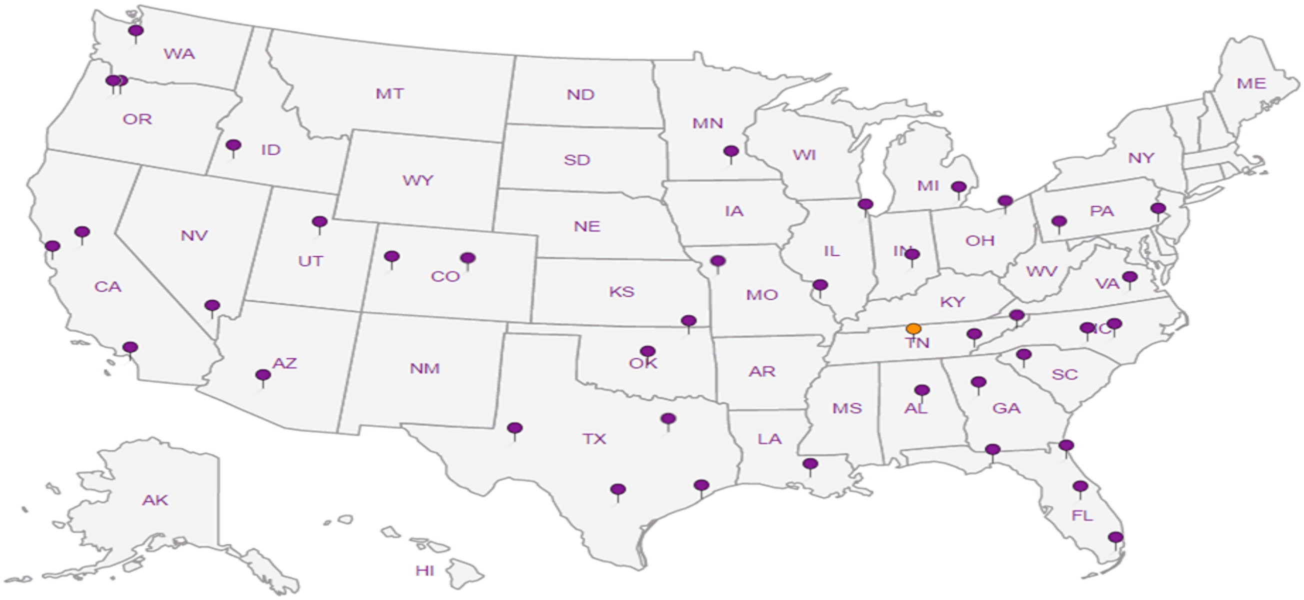
Third Party & Federal Accreditations

A2LA – ISO 17025	1461.01
A2LA – ISO 17025 [5]	1461.02
Canada	1461.01
EPA–Crypto	TN00003
AIHA-LAP,LLC	100789
DOD	1461.01
USDA	S-67674

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [n/a] Accreditation not applicable

Our Locations

ESC Lab Sciences has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. **ESC Lab Sciences performs all testing at our central laboratory.**



Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:
Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Chain of Custody Page 1 of 2

ESC LAB SCIENCES
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Report to: **Jacqueline Finck**

Email To: **Jacqueline.Finck@terracon.com**

Project Description: **Brine Pond Study**

City/State Collected: Renville, ND

Phone: **701-356-7621**
Fax:

Client Project # M1177088

Lab Project # **TERRAFND-M1177088**

Collected by (print): Jacqueline Finck

Site/Facility ID # **MINOT ND**

P.O. #

Collected by (signature): Jacqueline Finck

Immediately Packed on Ice N X Y ___

Rush? (Lab MUST Be Notified)
___ Same Day X Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

L # L933766

Table # **B009**

Acctnum:

Template: **T127398**

Prelogin: **P615920**

TSR: 341 - John Hawkins

PB: 8-19-17 GM

Shipped Via: **FedEX Standard**

Analysis / Container / Preservative

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CL ESP SAR 4ozClr-NoPres	NAICP 2ozClr-NoPres	SPCON (ec) 4ozClr-NoPres	Remarks	Sample # (lab only)
B33	Grab	SS	1'	8/30/17	850 AM	3	X	X	X		-01
B33		SS	3'		855 AM	3	X	X	X		-02
B36		SS	1'		915 AM	3	X	X	X		-03
B36		SS	3'		920 AM	3	X	X	X		-04
B37		SS	1'		900 AM	3	X	X	X		-05
B37		SS	3'		905 AM	3	X	X	X		-06
B38		SS	1'		1250 pm	3	X	X	X		-07
B38		SS	3'		1255 pm	3	X	X	X		-08
B38		SS	12		1:05 pm	3	X	X	X		-09
B39	Grab	SS	1'	8/30/17	140	3	X	X	X		-10

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other ________

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS X FedEx __ Courier ______

Tracking # 1474 0926 4929

Sample Receipt Checklist
COC Seal Present/Intact: __NP Y __N
COC Signed/Accurate: Y __N
Bottles arrive intact: Y __N
Correct bottles used: Y __N
Sufficient volume sent: Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature) Jacqueline Finck
Date: 9/1/17
Time: 300 pm
Received by: (Signature)

Trip Blank Received: Yes / [✓ No]
HCL / MeoH
TBR

Relinquished by : (Signature)
Date:
Time:
Received by: (Signature)

Temp: 3.6 °C
Bottles Received: 48

If preservation required by Login: Date/Time

Relinquished by : (Signature)
Date:
Time:
Received for lab by: (Signature)

Date: 9/2/17
Time: 0845

Hold:

Condition: NCF / [✓ OK]

Billing information:

Jacqueline Finck
860 9th St NE, Unit K
West Fargo, ND 58078

Chain of Custody Page 2 of 2

ESC
L·A·B S·C·I·E·N·C·E·S
YOUR LAB OF CHOICE
12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

Report to: **Jacqueline Finck**

Email To: **jacqueline.finck@terracon.com**

Project Description: **Brine Pond Study**

City/State Collected: **Renville, ND**

Phone: **701-356-7621**

Fax:

Client Project # **M1177088**

Lab Project # **TERRAFND-M1177088**

Collected by (print): **Jacqueline Finck**

Site/Facility ID #

P.O. #

Collected by (signature): Jacqueline Finck

Immediately Packed on Ice N X Y___

Rush? (Lab MUST Be Notified)
__ Same Day
__ Next Day
__ Two Day
__ Three Day
X Five Day
__ 5 Day (Rad Only)
__ 10 Day (Rad Only)

Quote #

Date Results Needed

L# L933766

Table #

Acctnum:

Template:

Prelogin:

TSR:

PB:

Shipped Via:

Analysis / Container / Preservative

Pres Chk

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CL ESP SAR 4oz - No Pres	NAICP 2oz - No Pres	SPCON (ec) 4oz - No Pres	Remarks	Sample # (lab only)
B39	Grab	SS	3'	8/30/17	1^{45} pm	3	X	X	X		-11
B39	Grab	SS	14'		2^{00} pm	3	X	X	X		-12
B40	Grab	SS	1'		2^{30} pm	3	X	X	X		-13
B40	Grab	SS	3'		2^{35} pm	3	X	X	X		-14
B40	Grab	SS	8'	8/30/17	2^{45} pm	3	X	X	X		-15
B41	Grab	SS	1'	8/30/17	3^{10} pm	3	X	X	X		-16
	Grab	SS				3	X	X	X		
	Grab	SS				3	X	X	X		
	Grab	SS				3	X	X	X		
	Grab	SS				3	X	X	X		

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS X FedEx __ Courier __ ______

Tracking # 1474 0926 4929

Sample Receipt Checklist
CDC Seal Present/Intact: __NP [✓ Y] __N
CDC Signed/Accurate: [✓ Y] __N
Bottles arrive intact: [✓ Y] __N
Correct bottles used: [✓ Y] __N
Sufficient volume sent: [✓ Y] __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: __Y __N

Relinquished by : (Signature) Jacqueline Finck

Date: 9/1/17

Time: 3^{00} pm

Received by: (Signature)

Trip Blank Received: Yes / [✓ No]
HCL / MeoH
TBR

Relinquished by : (Signature)

Date:

Time:

Received by: (Signature)

Temp: 3.6 °C

Bottles Received: 48

If preservation required by Login: Date/Time

Relinquished by : (Signature)

Date:

Time:

Received for lab by: (Signature)

Date: 9/2/17

Time: 0845

Hold:

Condition: NCF / [✓ OK]

ANALYTICAL REPORT

September 15, 2017

Terracon - Fargo, ND

Sample Delivery Group: L933786
Samples Received: 09/02/2017
Project Number: M1177088
Description: Brine Pond Study

Report To: Jacqueline Finck
860 9TH ST E
West Fargo, ND 58078

Entire Report Reviewed By: John V Hawkins

John Hawkins
Technical Service Representative

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Collected by	Collected date/time	Received date/time
Jaceline Finck	08/30/17 15:15	09/02/17 08:45

B41 3' L933786-01 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 10:29	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 10:29	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	5	09/07/17 18:46	09/07/17 21:53	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 10:14	CCE

Collected by	Collected date/time	Received date/time
Jaceline Finck	08/30/17 15:15	09/02/17 08:45

B41 15' L933786-02 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 10:32	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 10:32	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	10	09/07/17 18:46	09/07/17 22:02	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 10:18	CCE

Collected by	Collected date/time	Received date/time
Jaceline Finck	08/30/17 15:15	09/02/17 08:45

B42 1' L933786-03 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:08	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:08	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	10	09/07/17 18:46	09/07/17 22:28	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 10:28	CCE

Collected by	Collected date/time	Received date/time
Jaceline Finck	08/30/17 15:15	09/02/17 08:45

B42 3' L933786-04 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:11	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:11	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	10	09/07/17 18:46	09/07/17 22:37	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 10:31	CCE

Collected by	Collected date/time	Received date/time
Jaceline Finck	08/30/17 15:15	09/02/17 08:45

B42 7' L933786-05 Solid

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:13	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:13	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	10	09/07/17 18:46	09/07/17 22:46	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 10:35	CCE

B43 1' L933786-06 Solid

Collected by	Collected date/time	Received date/time
Jacueline Finck	08/30/17 15:15	09/02/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:35	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:35	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1019773	20	09/13/17 18:20	09/13/17 18:36	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 10:38	CCE

B43 3' L933786-07 Solid

Collected by	Collected date/time	Received date/time
Jacueline Finck	08/30/17 15:15	09/02/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 10:46	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 10:46	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	10	09/07/17 18:46	09/07/17 23:03	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 10:42	CCE

B43 7' L933786-08 Solid

Collected by	Collected date/time	Received date/time
Jacueline Finck	08/30/17 15:15	09/02/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 10:48	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 10:48	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	10	09/07/17 18:46	09/07/17 23:12	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 10:45	CCE

B44 1' L933786-09 Solid

Collected by	Collected date/time	Received date/time
Jacueline Finck	08/30/17 15:15	09/02/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:38	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:38	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	10	09/07/17 18:46	09/07/17 23:21	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 10:49	CCE

B44 3' L933786-10 Solid

Collected by	Collected date/time	Received date/time
Jacueline Finck	08/30/17 15:15	09/02/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:41	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:41	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	10	09/07/17 18:46	09/07/17 23:30	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 10:52	CCE

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

B44 16' L933786-11 Solid

Collected by	Collected date/time	Received date/time
Jaceuline Finck	08/30/17 15:15	09/02/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:43	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 13:43	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	10	09/07/17 18:46	09/07/17 23:38	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 10:55	CCE

B45 1' L933786-12 Solid

Collected by	Collected date/time	Received date/time
Jaceuline Finck	08/30/17 15:15	09/02/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 11:04	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 11:04	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	1	09/07/17 18:46	09/07/17 23:47	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 09:58	CCE

B45 3' L933786-13 Solid

Collected by	Collected date/time	Received date/time
Jaceuline Finck	08/30/17 15:15	09/02/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 11:07	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 11:07	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	1	09/07/17 18:46	09/08/17 00:31	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 10:59	CCE

B45 15' L933786-14 Solid

Collected by	Collected date/time	Received date/time
Jaceuline Finck	08/30/17 15:15	09/02/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 11:10	TRB
Calculated Results	WG1017864	1	09/12/17 15:07	09/13/17 11:10	TRB
Wet Chemistry by Method 9050AMod	WG1017008	1	09/07/17 15:05	09/07/17 15:05	MA
Wet Chemistry by Method 9056A	WG1017004	1	09/07/17 18:46	09/08/17 00:40	DR
Metals (ICP) by Method 6010C	WG1019675	1	09/13/17 06:58	09/13/17 11:09	CCE

B2 L933786-15 GW

Collected by	Collected date/time	Received date/time
Jaceuline Finck	08/30/17 15:15	09/02/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1018480	1	09/11/17 17:21	09/12/17 01:19	JD
Calculated Results	WG1018480	1	09/11/17 17:21	09/12/17 01:19	JD
Wet Chemistry by Method 9050A	WG1017012	1	09/06/17 01:00	09/06/17 01:00	MZ
Wet Chemistry by Method 9056A	WG1017818	1000	09/07/17 19:04	09/07/17 19:04	DR
Metals (ICP) by Method 6010B	WG1018480	50	09/11/17 17:21	09/12/17 01:19	JD

	Collected by	Collected date/time	Received date/time
B44 L933786-16 GW	Jacueline Finck	08/30/17 18:30	09/02/17 08:45

Method	Batch	Dilution	Preparation date/time	Analysis date/time	Analyst
Calculated Results	WG1018989	1	09/13/17 09:42	09/13/17 15:32	JD
Calculated Results	WG1018989	1	09/13/17 09:42	09/13/17 15:32	JD
Wet Chemistry by Method 9050A	WG1017012	1	09/06/17 01:00	09/06/17 01:00	MZ
Wet Chemistry by Method 9056A	WG1017818	1000	09/07/17 19:14	09/07/17 19:14	DR
Metals (ICP) by Method 6010B	WG1018989	180	09/13/17 09:42	09/13/17 15:32	JD

CASE NARRATIVE

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

All sample aliquots were received at the correct temperature, in the proper containers, with the appropriate preservatives, and within method specified holding times. All MDL (LOD) and RDL (LOQ) values reported for environmental samples have been corrected for the dilution factor used in the analysis. All radiochemical sample results for solids are reported on a dry weight basis with the exception of tritium, carbon-14 and radon, unless wet weight was requested by the client. All Method and Batch Quality Control are within established criteria except where addressed in this case narrative, a non-conformance form or properly qualified within the sample results. By my digital signature below, I affirm to the best of my knowledge, all problems/anomalies observed by the laboratory as having the potential to affect the quality of the data have been identified by the laboratory, and no information or data have been knowingly withheld that would affect the quality of the data.

John V Hawkins

John Hawkins
Technical Service Representative

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	14.5		1	09/13/2017 10:29	WG1017864

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	16.8		1	09/13/2017 10:29	WG1017864

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	3130		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	962		50.0	5	09/07/2017 21:53	WG1017004

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1190		100	1	09/13/2017 10:14	WG1019675

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	18.1		1	09/13/2017 10:32	WG1017864

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	20.3		1	09/13/2017 10:32	WG1017864

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	5090		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	2040		100	10	09/07/2017 22:02	WG1017004

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1870		100	1	09/13/2017 10:18	WG1019675

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	24.9		1	09/13/2017 13:08	WG1017864

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	26.2		1	09/13/2017 13:08	WG1017864

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	14500		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	7160		100	10	09/07/2017 22:28	WG1017004

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	3820		100	1	09/13/2017 10:28	WG1019675

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	29.6		1	09/13/2017 13:11	WG1017864

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	29.8		1	09/13/2017 13:11	WG1017864

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	12200		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	6300		100	10	09/07/2017 22:37	WG1017004

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	3580		100	1	09/13/2017 10:31	WG1019675

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	37.5		1	09/13/2017 13:13	WG1017864

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	35.1		1	09/13/2017 13:13	WG1017864

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	10100		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	2730		100	10	09/07/2017 22:46	WG1017004

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	4840		100	1	09/13/2017 10:35	WG1019675

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	18.6		1	09/13/2017 13:35	WG1017864

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	20.8		1	09/13/2017 13:35	WG1017864

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	20300		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	7470		200	20	09/13/2017 18:36	WG1019773

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	4220		100	1	09/13/2017 10:38	WG1019675

B43 3'

Collected date/time: 08/30/17 15:15

SAMPLE RESULTS - 07

L933786

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	21.3		1	09/13/2017 10:46	WG1017864

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	23.1		1	09/13/2017 10:46	WG1017864

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	6230		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	5200		100	10	09/07/2017 23:03	WG1017004

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	2610		100	1	09/13/2017 10:42	WG1019675

B43 7'

Collected date/time: 08/30/17 15:15

SAMPLE RESULTS - 08

L933786

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	21.4		1	09/13/2017 10:48	WG1017864

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	23.2		1	09/13/2017 10:48	WG1017864

Wet Chemistry by Method 9050AMod

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	1480		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Chloride	3890		100	10	09/07/2017 23:12	WG1017004

Metals (ICP) by Method 6010C

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/kg		mg/kg		date / time	
Sodium	2860		100	1	09/13/2017 10:45	WG1019675

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	25.1		1	09/13/2017 13:38	WG1017864

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	26.3		1	09/13/2017 13:38	WG1017864

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	6920		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	4680		100	10	09/07/2017 23:21	WG1017004

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	3720		100	1	09/13/2017 10:49	WG1019675

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	29.0		1	09/13/2017 13:41	WG1017864

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	29.3		1	09/13/2017 13:41	WG1017864

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	3240		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	3190		100	10	09/07/2017 23:30	WG1017004

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	2530		100	1	09/13/2017 10:52	WG1019675

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	44.0		1	09/13/2017 13:43	WG1017864

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	38.9		1	09/13/2017 13:43	WG1017864

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	1610		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	7090		100	10	09/07/2017 23:38	WG1017004

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	5310		100	1	09/13/2017 10:55	WG1019675

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	2.81		1	09/13/2017 11:04	WG1017864

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	2.80		1	09/13/2017 11:04	WG1017864

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	12000		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	19.4	B	10.0	1	09/07/2017 23:47	WG1017004

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	460		100	1	09/13/2017 09:58	WG1019675

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	6.69		1	09/13/2017 11:07	WG1017864

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	7.93		1	09/13/2017 11:07	WG1017864

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	3660		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	89.4		10.0	1	09/08/2017 00:31	WG1017004

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	1200		100	1	09/13/2017 10:59	WG1019675

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	3.75		1	09/13/2017 11:10	WG1017864

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	4.09		1	09/13/2017 11:10	WG1017864

Wet Chemistry by Method 9050AMod

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	1100		1	09/07/2017 15:05	WG1017008

Wet Chemistry by Method 9056A

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Chloride	60.6		10.0	1	09/08/2017 00:40	WG1017004

Metals (ICP) by Method 6010C

Analyte	Result mg/kg	Qualifier	RDL mg/kg	Dilution	Analysis date / time	Batch
Sodium	718		100	1	09/13/2017 11:09	WG1019675

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte				date / time	
Sodium Adsorption Ratio	99.6		1	09/12/2017 01:19	WG1018480

Calculated Results

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	%			date / time	
Exchangeable Sodium Percentage	59.3		1	09/12/2017 01:19	WG1018480

Wet Chemistry by Method 9050A

	Result	Qualifier	Dilution	Analysis	Batch
Analyte	umhos/cm			date / time	
Specific Conductance	98000		1	09/06/2017 01:00	WG1017012

Wet Chemistry by Method 9056A

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/l		mg/l		date / time	
Chloride	26700		1000	1000	09/07/2017 19:04	WG1017818

Metals (ICP) by Method 6010B

	Result	Qualifier	RDL	Dilution	Analysis	Batch
Analyte	mg/l		mg/l		date / time	
Calcium	2500		50.0	50	09/12/2017 01:19	WG1018480
Magnesium	749		50.0	50	09/12/2017 01:19	WG1018480
Sodium	22100		50.0	50	09/12/2017 01:19	WG1018480

Calculated Results

Analyte	Result	Qualifier	Dilution	Analysis date / time	Batch
Sodium Adsorption Ratio	64.0		1	09/13/2017 15:32	WG1018989

Calculated Results

Analyte	Result %	Qualifier	Dilution	Analysis date / time	Batch
Exchangeable Sodium Percentage	48.2		1	09/13/2017 15:32	WG1018989

Wet Chemistry by Method 9050A

Analyte	Result umhos/cm	Qualifier	Dilution	Analysis date / time	Batch
Specific Conductance	111000		1	09/06/2017 01:00	WG1017012

Wet Chemistry by Method 9056A

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
Chloride	43100		1000	1000	09/07/2017 19:14	WG1017818

Metals (ICP) by Method 6010B

Analyte	Result mg/l	Qualifier	RDL mg/l	Dilution	Analysis date / time	Batch
Calcium	8500		180	180	09/13/2017 15:32	WG1018989
Magnesium	2700		180	180	09/13/2017 15:32	WG1018989
Sodium	26500		180	180	09/13/2017 15:32	WG1018989

Method Blank (MB)

(MB) WG1017012-1 09/06/17 01:00

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	1.41			

L933698-01 Original Sample (OS) • Duplicate (DUP)

(OS) L933698-01 09/06/17 01:00 • (DUP) WG1017012-4 09/06/17 01:00

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	376	376	1	0.000		20

L933971-04 Original Sample (OS) • Duplicate (DUP)

(OS) L933971-04 09/06/17 01:00 • (DUP) WG1017012-5 09/06/17 01:00

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	505	505	1	0.000		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) WG1017012-2 09/06/17 01:00 • (LCSD) WG1017012-3 09/06/17 01:00

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	559	553	553	98.9	98.9	90.0-110			0.000	20

Method Blank (MB)

(MB) WG1017008-1 09/07/17 15:05

Analyte	MB Result umhos/cm	MB Qualifier	MB MDL umhos/cm	MB RDL umhos/cm
Specific Conductance	3.07			

L933766-13 Original Sample (OS) • Duplicate (DUP)

(OS) L933766-13 09/07/17 15:05 • (DUP) WG1017008-4 09/07/17 15:05

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	18600	18600	1	0.0538		20

L933786-07 Original Sample (OS) • Duplicate (DUP)

(OS) L933786-07 09/07/17 15:05 • (DUP) WG1017008-5 09/07/17 15:05

Analyte	Original Result umhos/cm	DUP Result umhos/cm	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Specific Conductance	6230	6220	1	0.161		20

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) WG1017008-2 09/07/17 15:05 • (LCSD) WG1017008-3 09/07/17 15:05

Analyte	Spike Amount umhos/cm	LCS Result umhos/cm	LCSD Result umhos/cm	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Specific Conductance	559	558	559	99.8	100	90.0-110			0.179	20

Method Blank (MB)

(MB) R3247705-1 09/07/17 20:25

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	4.66	J	0.795	10.0

L933786-14 Original Sample (OS) • Duplicate (DUP)

(OS) L933786-14 09/08/17 00:40 • (DUP) R3247705-7 09/08/17 00:49

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	60.6	52.9	1	14		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3247705-2 09/07/17 20:34 • (LCSD) R3247705-3 09/07/17 20:43

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	208	208	104	104	80-120			0	15

L933786-12 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933786-12 09/07/17 23:47 • (MS) R3247705-5 09/08/17 00:13 • (MSD) R3247705-6 09/08/17 00:22

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Chloride	500	19.4	1050	1050	205	207	1	80-120	E J5	E J5	1	15

Method Blank (MB)

(MB) R3249050-1 09/13/17 13:19

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Chloride	4.1	J	0.795	10.0

L935811-02 Original Sample (OS) • Duplicate (DUP)

(OS) L935811-02 09/13/17 14:11 • (DUP) R3249050-4 09/13/17 14:20

Analyte	Original Result mg/kg	DUP Result mg/kg	Dilution	DUP RPD %	DUP Qualifier	DUP RPD Limits %
Chloride	171	156	1	9		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3249050-2 09/13/17 13:27 • (LCSD) R3249050-3 09/13/17 13:36

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Chloride	200	229	235	115	117	80-120			2	15

L935811-04 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L935811-04 09/13/17 14:37 • (MS) R3249050-5 09/13/17 14:46 • (MSD) R3249050-6 09/13/17 15:13

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Chloride	500	495	1070	1030	114	107	1	80-120	E	E	3	15

QUALITY CONTROL SUMMARY

1 Cp
2 Tc
3 Ss
4 Cn
5 Sr
6 Qc
7 Gl
8 Al
9 Sc

Method Blank (MB)

(MB) R3247691-1 09/07/17 18:03

	MB Result	MB Qualifier	MB MDL	MB RDL
Analyte	mg/l		mg/l	mg/l
Chloride	U		0.0519	1.00

L934111-01 Original Sample (OS) • Duplicate (DUP)

(OS) L934111-01 09/07/17 19:45 • (DUP) R3247691-4 09/07/17 19:55

	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
Analyte	mg/l	mg/l		%		%
Chloride	9.74	9.73	1	0		15

L934486-02 Original Sample (OS) • Duplicate (DUP)

(OS) L934486-02 09/07/17 21:57 • (DUP) R3247691-7 09/07/17 22:27

	Original Result	DUP Result	Dilution	DUP RPD	DUP Qualifier	DUP RPD Limits
Analyte	mg/l	mg/l		%		%
Chloride	54.5	54.1	1	1		15

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3247691-2 09/07/17 18:13 • (LCSD) R3247691-3 09/07/17 18:23

	Spike Amount	LCS Result	LCSD Result	LCS Rec.	LCSD Rec.	Rec. Limits	LCS Qualifier	LCSD Qualifier	RPD	RPD Limits
Analyte	mg/l	mg/l	mg/l	%	%	%			%	%
Chloride	40.0	41.1	41.1	103	103	80-120			0	15

L934111-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L934111-01 09/07/17 19:45 • (MS) R3247691-5 09/07/17 20:25 • (MSD) R3247691-6 09/07/17 20:35

	Spike Amount	Original Result	MS Result	MSD Result	MS Rec.	MSD Rec.	Dilution	Rec. Limits	MS Qualifier	MSD Qualifier	RPD	RPD Limits
Analyte	mg/l	mg/l	mg/l	mg/l	%	%		%			%	%
Chloride	50.0	9.74	59.0	59.7	99	100	1	80-120			1	15

L934486-02 Original Sample (OS) • Matrix Spike (MS)

(OS) L934486-02 09/07/17 21:57 • (MS) R3247691-8 09/07/17 22:37

	Spike Amount	Original Result	MS Result	MS Rec.	Dilution	Rec. Limits	MS Qualifier
Analyte	mg/l	mg/l	mg/l	%		%	
Chloride	50.0	54.5	101	93	1	80-120	E

Method Blank (MB)

(MB) R3248443-1 09/11/17 21:06

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Calcium	U		0.0463	1.00
Magnesium	U		0.0111	1.00
Sodium	0.279	J	0.0985	1.00

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3248443-2 09/11/17 21:09 • (LCSD) R3248443-3 09/11/17 21:11

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Calcium	10.0	9.93	9.93	99	99	80-120			0	20
Magnesium	10.0	10.0	10.0	100	100	80-120			0	20
Sodium	10.0	10.4	10.4	104	104	80-120			0	20

L933668-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933668-01 09/11/17 21:14 • (MS) R3248443-5 09/11/17 21:19 • (MSD) R3248443-6 09/11/17 21:21

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Calcium	10.0	110	118	117	86	75	1	75-125			1	20
Magnesium	10.0	15.8	25.1	25.0	93	92	1	75-125			1	20
Sodium	10.0	89.5	96.8	96.7	74	73	1	75-125	V	V	0	20

Method Blank (MB)

(MB) R3249028-1 09/13/17 12:28

Analyte	MB Result mg/l	MB Qualifier	MB MDL mg/l	MB RDL mg/l
Calcium	0.0881	J	0.0463	1.00
Magnesium	U		0.0111	1.00
Sodium	0.15	J	0.0985	1.00

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3249028-2 09/13/17 12:30 • (LCSD) R3249028-3 09/13/17 12:32

Analyte	Spike Amount mg/l	LCS Result mg/l	LCSD Result mg/l	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Calcium	10.0	9.46	9.63	95	96	80-120			2	20
Magnesium	10.0	9.84	10.0	98	100	80-120			2	20
Sodium	10.0	9.49	9.63	95	96	80-120			1	20

L934011-01 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L934011-01 09/13/17 12:35 • (MS) R3249028-5 09/13/17 12:40 • (MSD) R3249028-6 09/13/17 12:42

Analyte	Spike Amount mg/l	Original Result mg/l	MS Result mg/l	MSD Result mg/l	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Calcium	10.0	80.6	88.8	89.2	82	86	1	75-125			0	20
Magnesium	10.0	26.0	34.9	35.1	89	92	1	75-125			1	20
Sodium	10.0	23.5	32.3	32.6	89	92	1	75-125			1	20

Method Blank (MB)

(MB) R3248979-7 09/13/17 12:59

Analyte	MB Result mg/kg	MB Qualifier	MB MDL mg/kg	MB RDL mg/kg
Sodium	U		9.85	100

Laboratory Control Sample (LCS) • Laboratory Control Sample Duplicate (LCSD)

(LCS) R3248979-1 09/13/17 09:51 • (LCSD) R3248979-2 09/13/17 09:54

Analyte	Spike Amount mg/kg	LCS Result mg/kg	LCSD Result mg/kg	LCS Rec. %	LCSD Rec. %	Rec. Limits %	LCS Qualifier	LCSD Qualifier	RPD %	RPD Limits %
Sodium	1000	1140	1110	114	111	80-120			2	20

L933786-12 Original Sample (OS) • Matrix Spike (MS) • Matrix Spike Duplicate (MSD)

(OS) L933786-12 09/13/17 09:58 • (MS) R3248979-5 09/13/17 10:08 • (MSD) R3248979-6 09/13/17 10:11

Analyte	Spike Amount mg/kg	Original Result mg/kg	MS Result mg/kg	MSD Result mg/kg	MS Rec. %	MSD Rec. %	Dilution	Rec. Limits %	MS Qualifier	MSD Qualifier	RPD %	RPD Limits %
Sodium	1000	460	1450	1390	99	93	1	75-125			5	20

Guide to Reading and Understanding Your Laboratory Report

The information below is designed to better explain the various terms used in your report of analytical results from the Laboratory. This is not intended as a comprehensive explanation, and if you have additional questions please contact your project representative.

Abbreviations and Definitions

MDL	Method Detection Limit.
RDL	Reported Detection Limit.
Rec.	Recovery.
RPD	Relative Percent Difference.
SDG	Sample Delivery Group.
U	Not detected at the Reporting Limit (or MDL where applicable).
Analyte	The name of the particular compound or analysis performed. Some Analyses and Methods will have multiple analytes reported.
Dilution	If the sample matrix contains an interfering material, or if concentrations of analytes in the sample are higher than the highest limit of concentration that the laboratory can accurately report, the sample may be diluted for analysis. If a value different than 1 is used in this field, the result reported has already been corrected for this factor.
Limits	These are the target % recovery ranges or % difference value that the laboratory has historically determined as normal for the method and analyte being reported. Successful QC Sample analysis will target all analytes recovered or duplicated within these ranges.
Original Sample	The non-spiked sample in the prep batch used to determine the Relative Percent Difference (RPD) from a quality control sample. The Original Sample may not be included within the reported SDG.
Qualifier	This column provides a letter and/or number designation that corresponds to additional information concerning the result reported. If a Qualifier is present, a definition per Qualifier is provided within the Glossary and Definitions page and potentially a discussion of possible implications of the Qualifier in the Case Narrative if applicable.
Result	The actual analytical final result (corrected for any sample specific characteristics) reported for your sample. If there was no measurable result returned for a specific analyte, the result in this column may state “ND” (Not Detected) or “BDL” (Below Detectable Levels). The information in the results column should always be accompanied by either an MDL (Method Detection Limit) or RDL (Reporting Detection Limit) that defines the lowest value that the laboratory could detect or report for this analyte.
Case Narrative (Cn)	A brief discussion about the included sample results, including a discussion of any non-conformances to protocol observed either at sample receipt by the laboratory from the field or during the analytical process. If present, there will be a section in the Case Narrative to discuss the meaning of any data qualifiers used in the report.
Quality Control Summary (Qc)	This section of the report includes the results of the laboratory quality control analyses required by procedure or analytical methods to assist in evaluating the validity of the results reported for your samples. These analyses are not being performed on your samples typically, but on laboratory generated material.
Sample Chain of Custody (Sc)	This is the document created in the field when your samples were initially collected. This is used to verify the time and date of collection, the person collecting the samples, and the analyses that the laboratory is requested to perform. This chain of custody also documents all persons (excluding commercial shippers) that have had control or possession of the samples from the time of collection until delivery to the laboratory for analysis.
Sample Results (Sr)	This section of your report will provide the results of all testing performed on your samples. These results are provided by sample ID and are separated by the analyses performed on each sample. The header line of each analysis section for each sample will provide the name and method number for the analysis reported.
Sample Summary (Ss)	This section of the Analytical Report defines the specific analyses performed for each sample ID, including the dates and times of preparation and/or analysis.

Qualifier	Description
B	The same analyte is found in the associated blank.
E	The analyte concentration exceeds the upper limit of the calibration range of the instrument established by the initial calibration (ICAL).
J	The identification of the analyte is acceptable; the reported value is an estimate.
J5	The sample matrix interfered with the ability to make any accurate determination; spike value is high.
V	The sample concentration is too high to evaluate accurate spike recoveries.

ACCREDITATIONS & LOCATIONS

ESC Lab Sciences is the only environmental laboratory accredited/certified to support your work nationwide from one location. One phone call, one point of contact, one laboratory. No other lab is as accessible or prepared to handle your needs throughout the country. Our capacity and capability from our single location laboratory is comparable to the collective totals of the network laboratories in our industry. The most significant benefit to our "one location" design is the design of our laboratory campus. The model is conducive to accelerated productivity, decreasing turn-around time, and preventing cross contamination, thus protecting sample integrity. Our focus on premium quality and prompt service allows us to be **YOUR LAB OF CHOICE.**
* Not all certifications held by the laboratory are applicable to the results reported in the attached report.

State Accreditations

Alabama	40660	Nevada	TN-03-2002-34
Alaska	UST-080	New Hampshire	2975
Arizona	AZ0612	New Jersey–NELAP	TN002
Arkansas	88-0469	New Mexico	TN00003
California	01157CA	New York	11742
Colorado	TN00003	North Carolina	Env375
Conneticut	PH-0197	North Carolina [1]	DW21704
Florida	E87487	North Carolina [2]	41
Georgia	NELAP	North Dakota	R-140
Georgia [1]	923	Ohio–VAP	CL0069
Idaho	TN00003	Oklahoma	9915
Illinois	200008	Oregon	TN200002
Indiana	C-TN-01	Pennsylvania	68-02979
Iowa	364	Rhode Island	221
Kansas	E-10277	South Carolina	84004
Kentucky [1]	90010	South Dakota	n/a
Kentucky [2]	16	Tennessee [1,4]	2006
Louisiana	AI30792	Texas	T 104704245-07-TX
Maine	TN0002	Texas [5]	LAB0152
Maryland	324	Utah	6157585858
Massachusetts	M-TN003	Vermont	VT2006
Michigan	9958	Virginia	109
Minnesota	047-999-395	Washington	C1915
Mississippi	TN00003	West Virginia	233
Missouri	340	Wisconsin	9980939910
Montana	CERT0086	Wyoming	A2LA
Nebraska	NE-OS-15-05		

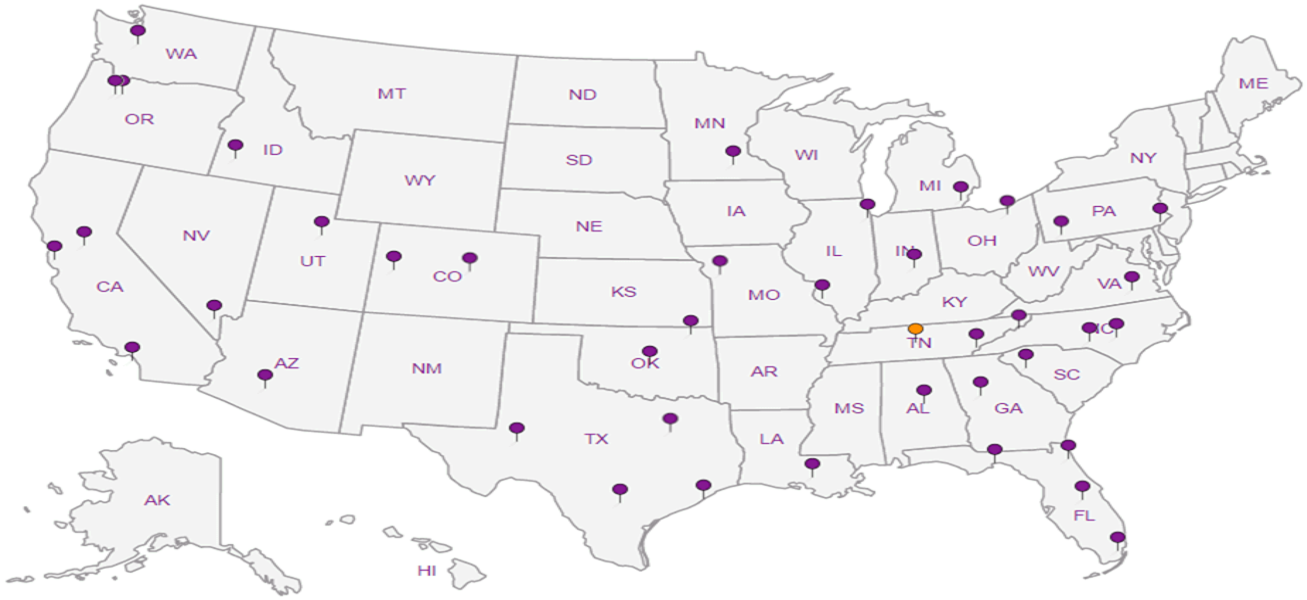
Third Party & Federal Accreditations

A2LA – ISO 17025	1461.01	AIHA-LAP,LLC	100789
A2LA – ISO 17025 [5]	1461.02	DOD	1461.01
Canada	1461.01	USDA	S-67674
EPA–Crypto	TN00003		

[1] Drinking Water [2] Underground Storage Tanks [3] Aquatic Toxicity [4] Chemical/Microbiological [5] Mold [n/a] Accreditation not applicable

Our Locations

ESC Lab Sciences has sixty-four client support centers that provide sample pickup and/or the delivery of sampling supplies. If you would like assistance from one of our support offices, please contact our main office. **ESC Lab Sciences performs all testing at our central laboratory.**



Billing Information:

Jacqueline Finck
860 9th St NE, Unit K
West Fargo, ND 58078

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page 1 of ~~4~~ 3

ESC
L·A·B S·C·I·E·N·C·E·S
YOUR LAB OF CHOICE

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L# L933786

E121

Acctnum:
Template:
Prelogin:
TSR:
PB:
Shipped Via:

Report to: **Jacqueline Finck**

Email To: jacqueline.finck@terracon.com

Project Description: **Brine Pond Study**

City/State Collected: **Renville, ND**

Phone: **701-356-7621**
Fax:

Client Project #: **M1177088**

Lab Project #: **TERRAFND-M1177088**

Collected by (print): **Jacqueline Finck**

Site/Facility ID #:

P.O. #:

Collected by (signature): Jacqueline Finck

Immediately Packed on Ice N X Y ___

Rush? (Lab MUST Be Notified)
___ Same Day
___ Next Day
___ Two Day
___ Three Day
X Five Day
___ 5 Day (Rad Only)
___ 10 Day (Rad Only)

Quote #

Date Results Needed

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CL ESP SAR 4oz - No Pres	NAICP 2oz - No Pres	SPCON (ec) 4oz - No Pres								Remarks	Sample # (lab only)
B41	Grab	SS	3'	8/30/17	315 pm	3	X	X	X									-01
B41	Grab	SS	15'		330 pm	3	X	X	X									02
B42	Grab	SS	1'		350 pm	3	X	X	X									03
B42	Grab	SS	3'		355 pm	3	X	X	X									04
B42	Grab	SS	7'		405 pm	3	X	X	X									05
B43	Grab	SS	1'		420 pm	3	X	X	X									06
B43	Grab	SS	3'		435 pm	3	X	X	X									07
B43	Grab	SS	7'		445 pm	3	X	X	X									08
B44	Grab	SS	1'		520 pm	3	X	X	X									09
B44	Grab	SS	3'	8/30/17	525 pm	3	X	X	X									10

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: ✓NP _Y _N
COC Signed/Accurate: ✓Y _N
Bottles arrive intact: ✓Y _N
Correct bottles used: ✓Y _N
Sufficient volume sent: ✓Y _N
If Applicable
VOA Zero Headspace: _Y _N
Preservation Correct/Checked: ✓Y _N

Relinquished by : (Signature) Jacqueline Finck
Date: 9/1/17
Time: 300 pm
Received by: (Signature)
Trip Blank Received: Yes / [✓ No]
HCL / MeoH
TBR

Relinquished by : (Signature)
Date:
Time:
Received by: (Signature)
Temp: 3.2 °C
Bottles Received: 48
If preservation required by Login: Date/Time

Relinquished by : (Signature)
Date:
Time:
Received for lab by: (Signature)
Date: 9-2-17
Time: 845
Hold:
Condition: NCF / [✓ OK]

Billing information:

Jacqueline Finck
860 9th St NE, Unit K
West Fargo, ND 58078

Pres Chk

Analysis / Container / Preservative

Chain of Custody Page 2 of ~~1~~3

ESC
L·A·B S·C·I·E·N·C·E·S
YOUR LAB OF CHOICE
12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

Report to: **Jacqueline Finck**

Email To: jacqueline.finck@terracon.com

Project Description: **Brine Pond Study**

City/State Collected: **Renville, ND**

Phone: **701-356-7621**
Fax:

Client Project #: M1177088

Lab Project #: TERRAFND-M1177088

L# L933786

Table #

Collected by (print): **Jacqueline Finck**

Site/Facility ID #

P.O. #

Acctnum:

Template:

Prelogin:

TSR:

PB:

Shipped Via:

Collected by (signature): Jacqueline Finck

Immediately Packed on Ice N X Y ___

Rush? (Lab MUST Be Notified)
___ Same Day X Five Day
___ Next Day ___ 5 Day (Rad Only)
___ Two Day ___ 10 Day (Rad Only)
___ Three Day

Quote #

Date Results Needed

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CL ESP SAR 4oz - No Pres	NAICP 2oz - No Pres	SPCON (ec) 4oz - No Pres	Remarks	Sample # (lab only)
B44	Grab	SS	16'	8/30/17	5:45 pm	3	X	X	X		-11
B45	Grab	SS	1'		12^{15} pm	3	X	X	X		12
B45	Grab	SS	3'		12^{20} pm	3	X	X	X		13
B49	Grab	SS	15'	8/30/17	12^{35} pm	3	X	X	X		14
	Grab	SS				3	X	X	X		
	Grab	SS				3	X	X	X		
	Grab	SS				3	X	X	X		
	Grab	SS				3	X	X	X		
	Grab	SS				3	X	X	X		
	Grab	SS				3	X	X	X		

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH ______ Temp ______

Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: ✓NP __Y __N
COC Signed/Accurate: ✓Y __N
Bottles arrive intact: ✓Y __N
Correct bottles used: ✓Y __N
Sufficient volume sent: ✓Y __N
If Applicable
VOA Zero Headspace: __Y __N
Preservation Correct/Checked: ✓Y __N

Relinquished by : (Signature) Jacqueline Finck | Date: 9/1/17 | Time: 3^{00} pm | Received by: (Signature)

Trip Blank Received: Yes / [✓ No]
HCL / MeoH
TBR

Relinquished by : (Signature) | Date: | Time: | Received by: (Signature)

Temp: 3.2 °C | Bottles Received: 48

If preservation required by Login: Date/Time

Relinquished by : (Signature) | Date: | Time: | Received for lab by: (Signature)

Date: 9-2-17 | Time: 845

Hold:

Condition: NCF / [✓ OK]

Terracon - Fargo, ND

860 9TH ST E
West Fargo, ND 58078

Billing Information:
Levi Seff
860 9TH ST E
West Fargo, ND 58078

Pres Chk

Chain of Custody Page 3 of 3

ESC
LAB SCIENCES
a subsidiary of Pace Analytical

12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

Report to: **Jacqueline Finck**

Email To: **Jacqueline.Finck@terracon.com**

Project Description: **Brine Pond Study**

City/State Collected: Renville, ND

Phone: **701-356-7621**
Fax:

Client Project # M1177088

Lab Project # **TERRAFND-M1177088**

L# L933786

Table #

Acctnum: **TERRAFND**
Template: **T127227**
Prelogin: **P615134**
TSR: **341 - John Hawkins**
PB: CMB:25-17
Shipped Via: **FedEX Priority**

Collected by (print): Jacqueline Finck

Site/Facility ID # **MINOT ND**

P.O. #

Collected by (signature): Jacqueline Finck

Immediately Packed on Ice N ___ Y X

Rush? (Lab MUST Be Notified)
___ Same Day
___ Next Day
___ Two Day
___ Three Day
___ Five Day
___ 5 Day (Rad Only)
___ 10 Day (Rad Only)

Quote #

Date Results Needed

Analysis / Container / Preservative

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	CHLORIDE 125mlHDPE-NoPres	CL ESP SAR 4ozClr-NoPres	ESP NAICP SAR 250mlHDPE-HNO3	NAICP 2ozClr-NoPres	SPCON (ec) 4ozClr-NoPres	SPCON 250mlHDPE-NoPres					Remarks	Sample # (lab only)
B2	Grab	GW	0	8/30/17	3^{15} pm	3	X		X			X						-15
B44	Grab	GW	0	8/30/17	6^{30} pm	3	X		X			X						16
		~~GW~~				~~3~~	~~X~~		~~X~~			~~X~~						
		~~GW~~				~~3~~	~~X~~		~~X~~			~~X~~						

* Matrix:
SS - Soil AIR - Air F - Filter
GW - Groundwater B - Bioassay
WW - WasteWater
DW - Drinking Water
OT - Other________

Remarks:

pH ______ Temp ______
Flow ______ Other ______

Samples returned via:
__ UPS __ FedEx __ Courier __ ______

Tracking #

Sample Receipt Checklist
COC Seal Present/Intact: ✓NP _Y _N
COC Signed/Accurate: ✓Y _N
Bottles arrive intact: ✓Y _N
Correct bottles used: ✓Y _N
Sufficient volume sent: ✓Y _N
If Applicable
VOA Zero Headspace: _Y _N
Preservation Correct/Checked: ✓Y _N

Relinquished by : (Signature) Jacqueline Finck
Date: 9/1/17
Time: 3^{00} pm
Received by: (Signature)
Trip Blank Received: Yes [✓ No]
HCL / MeoH
TBR

Relinquished by : (Signature)
Date:
Time:
Received by: (Signature)
Temp: 3.2 °C
Bottles Received: 48
If preservation required by Login: Date/Time

Relinquished by : (Signature)
Date:
Time:
Received for lab by: (Signature)
Date: 9-2-17
Time: 845
Hold:
Condition: NCF / [✓ OK]

AGVISE
LABORATORIES

604 Highway 15 West
P.O. Box 510
Northwood, ND 58267

(701) 587-6010
FAX (701) 587-6013

email: agvise@polarcomm.com
Homepage: www.agvise.com

AGVISE Soil Characterization Report

Submitted For:
COREY LINDEMAN

Submitted By: TE7421
TERRACON CONSULTANTS INC
860 9TH ST NE UNIT K

WEST FARGO, ND 58078

Field ID = NA
Co-op/Contr. ID = B-1
Township = NA
County = NA
Section =

Sample ID = 1-3 FT
Quarter =

Date Received = 10/11/17
Date Reported = 10/12/17

AGVISE Lab No = 114,409
AGVISE Ref No = 14,530,491

Cation Exchange Capacity (meq/100 g) 48.1

Base Saturation Data

Cation	Percent	ppm
Potassium	2.0	371
Calcium	45.4	4368
Magnesium	25.7	1486
Sodium	26.9	2979

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AGVISE Soil Characterization Report

Submitted For:
COREY LINDEMAN

Submitted By: TE7421
TERRACON CONSULTANTS INC
860 9TH ST NE UNIT K

WEST FARGO, ND 58078

Field ID = NA
Co-op/Contr. ID = B-4
Township = NA
County = NA
Section =

Sample ID = 1-3 FT
Quarter =

Date Received = 10/11/17
Date Reported = 10/12/17

AGVISE Lab No = 114,427
AGVISE Ref No = 14,530,492

Cation Exchange Capacity (meq/100 g) 39.0

Base Saturation Data

Cation	Percent	ppm
Potassium	2.2	331
Calcium	48.1	3748
Magnesium	14.5	679
Sodium	35.2	3160

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Homepage: www.agvise.com

AGVISE Soil Characterization Report

Submitted For:
COREY LINDEMAN

Submitted By: TE7421
TERRACON CONSULTANTS INC
860 9TH ST NE UNIT K

WEST FARGO, ND 58078

Field ID = NA
Co-op/Contr. ID = B-6
Township = NA
County = NA
Section =

Sample ID = 1-3 FT
Quarter =

Date Received = 10/11/17
Date Reported = 10/12/17

AGVISE Lab No = 114,436
AGVISE Ref No = 14,530,493

Cation Exchange Capacity (meq/100 g) 41.6

Base Saturation Data

Cation	Percent	ppm
Potassium	1.9	307
Calcium	47.2	3922
Magnesium	11.8	588
Sodium	39.2	3746

AGVISE LABORATORIES

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AGVISE Soil Characterization Report

Submitted For:
COREY LINDEMAN

Submitted By: TE7421
TERRACON CONSULTANTS INC
860 9TH ST NE UNIT K

WEST FARGO, ND 58078

Field ID = NA
Co-op/Contr. ID = B-7
Township = NA
County = NA
Section =

Sample ID = 1-3 FT
Quarter =

Date Received = 10/11/17
Date Reported = 10/12/17

AGVISE Lab No = 114,443
AGVISE Ref No = 14,530,494

Cation Exchange Capacity (meq/100 g) 37.0

Base Saturation Data

Cation	Percent	ppm
Potassium	2.0	294
Calcium	54.9	4059
Magnesium	15.9	707
Sodium	27.1	2303

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Homepage: www.agvise.com

AGVISE Soil Characterization Report

Submitted For:
COREY LINDEMAN

Submitted By: TE7421
TERRACON CONSULTANTS INC
860 9TH ST NE UNIT K

WEST FARGO, ND 58078

Field ID = NA
Co-op/Contr. ID = B-12
Township = NA
County = NA
Section =

Sample ID = 1-3 FT
Quarter =

Date Received = 10/11/17
Date Reported = 10/12/17

AGVISE Lab No = 114,454
AGVISE Ref No = 14,530,495

Cation Exchange Capacity (meq/100 g) 55.0

Base Saturation Data

Cation	Percent	ppm
Potassium	2.3	502
Calcium	31.9	3509
Magnesium	12.5	828
Sodium	53.2	6741

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AGVISE Soil Characterization Report

Submitted For:
COREY LINDEMAN

Submitted By: TE7421
TERRACON CONSULTANTS INC
860 9TH ST NE UNIT K

WEST FARGO, ND 58078

Field ID = NA
Co-op/Contr. ID = B-13
Township = NA
County = NA
Section =

Sample ID = 1-3 FT
Quarter =

Date Received = 10/11/17
Date Reported = 10/12/17

AGVISE Lab No = 114,464
AGVISE Ref No = 14,530,496

Cation Exchange Capacity (meq/100 g) 38.4

Base Saturation Data

Cation	Percent	ppm
Potassium	2.0	297
Calcium	55.0	4223
Magnesium	12.7	586
Sodium	30.3	2679

AGVISE LABORATORIES

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Northwood, ND 58267

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AGVISE Soil Characterization Report

Submitted For:
COREY LINDEMAN

Submitted By: TE7421
TERRACON CONSULTANTS INC
860 9TH ST NE UNIT K

WEST FARGO, ND 58078

Field ID = NA
Co-op/Contr. ID = B-18
Township = NA
County = NA
Section =

Sample ID = 1-3 FT
Quarter =

Date Received = 10/11/17
Date Reported = 10/12/17

AGVISE Lab No = 114,507
AGVISE Ref No = 14,530,497

Cation Exchange Capacity (meq/100 g) 45.1

Base Saturation Data

Cation	Percent	ppm
Potassium	0.5	96
Calcium	42.7	3854
Magnesium	41.5	2246
Sodium	15.2	1577

AGVISE LABORATORIES

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Northwood, ND 58267

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AGVISE Soil Characterization Report

Submitted For:
COREY LINDEMAN

Submitted By: TE7421
TERRACON CONSULTANTS INC
860 9TH ST NE UNIT K

WEST FARGO, ND 58078

Field ID = NA
Co-op/Contr. ID = B-39
Township = NA
County = NA
Section =

Sample ID = 1-3 FT
Quarter =

Date Received = 10/11/17
Date Reported = 10/12/17

AGVISE Lab No = 114,518
AGVISE Ref No = 14,530,498

Cation Exchange Capacity (meq/100 g) 24.9

Base Saturation Data

Cation	Percent	ppm
Potassium	2.8	268
Calcium	54.7	2722
Magnesium	22.2	663
Sodium	20.4	1165

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Northwood, ND 58267

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AGVISE Soil Characterization Report

Submitted For:
COREY LINDEMAN

Submitted By: TE7421
TERRACON CONSULTANTS INC
860 9TH ST NE UNIT K

WEST FARGO, ND 58078

Field ID = NA
Co-op/Contr. ID = B-45
Township = NA
County = NA
Section =

Sample ID = 1-3 FT
Quarter =

Date Received = 10/11/17
Date Reported = 10/12/17

AGVISE Lab No = 114,526
AGVISE Ref No = 14,530,499

Cation Exchange Capacity (meq/100 g) 36.2

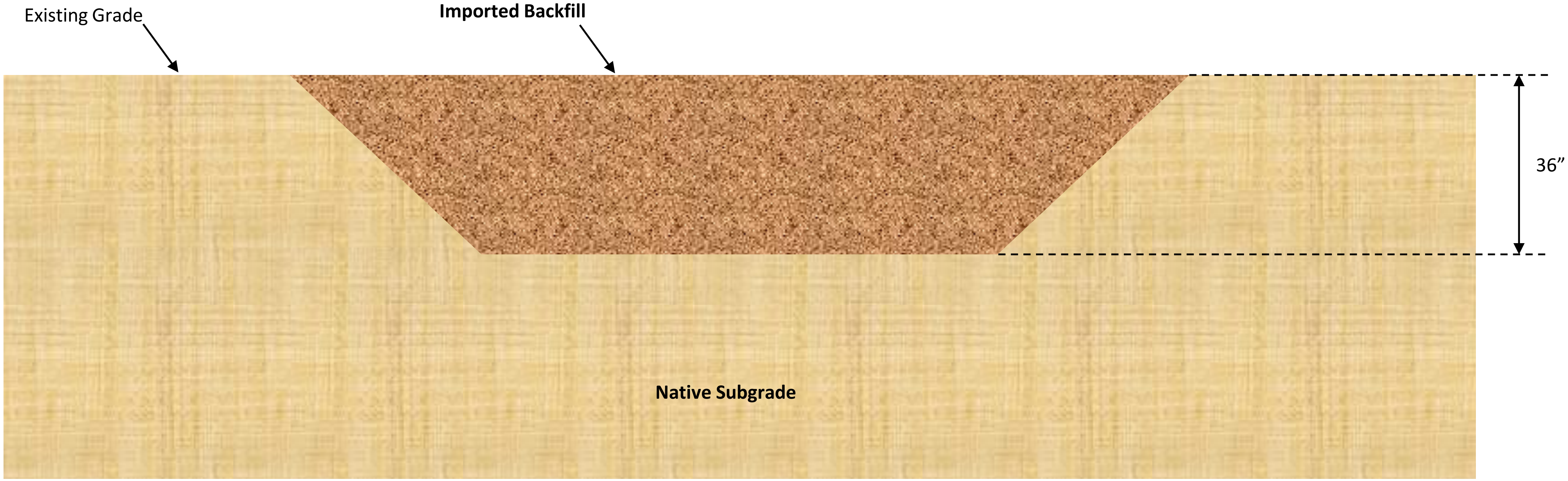
Base Saturation Data

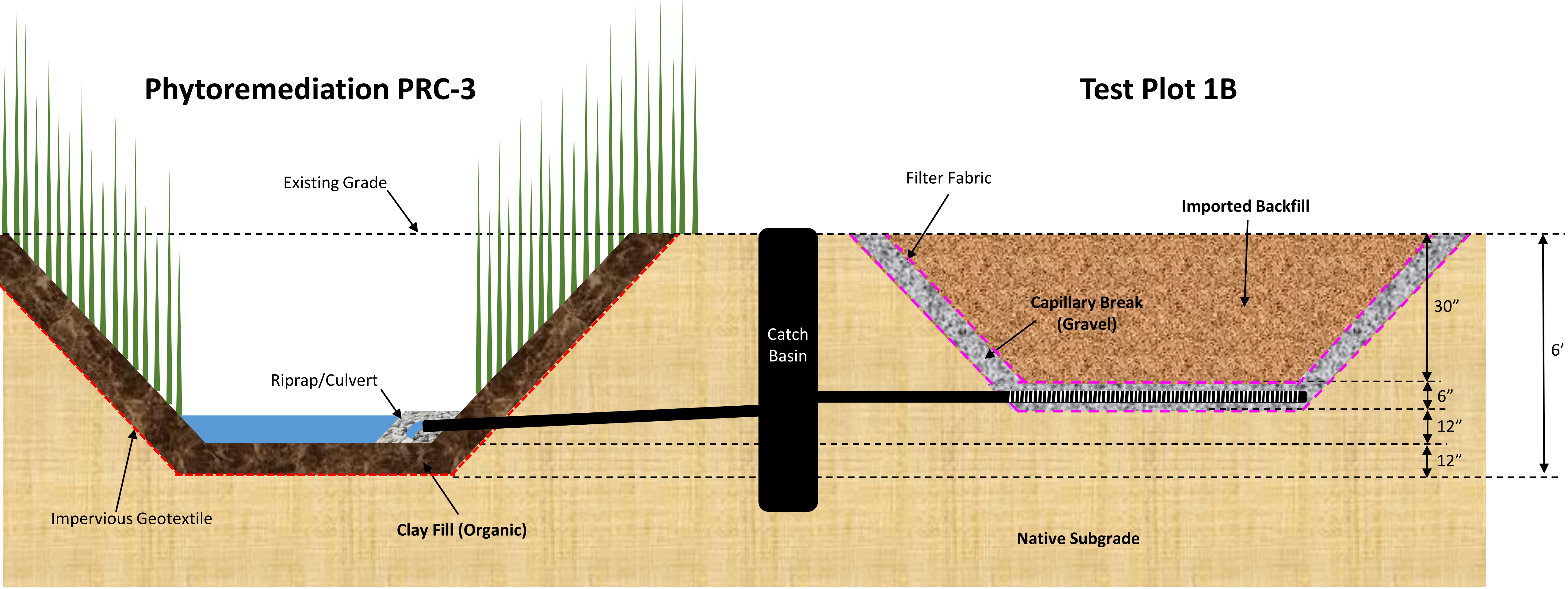
Cation	Percent	ppm
Potassium	0.8	107
Calcium	51.3	3715
Magnesium	38.5	1674
Sodium	9.4	784

APPENDIX E – ILLUSTRATIONS OF CROSS-SECTIONS OF TEST PLOTS AND PRCS

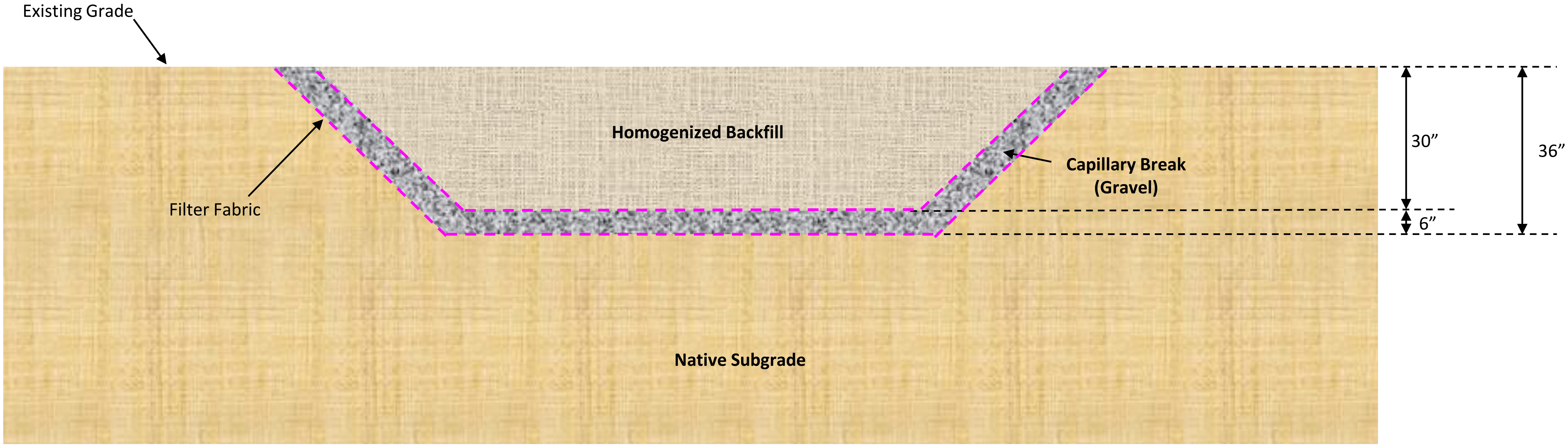
Drawing 01 Plan View of Proposed Test Plots
Drawing 02 Cross Sections of Proposed Test Plots

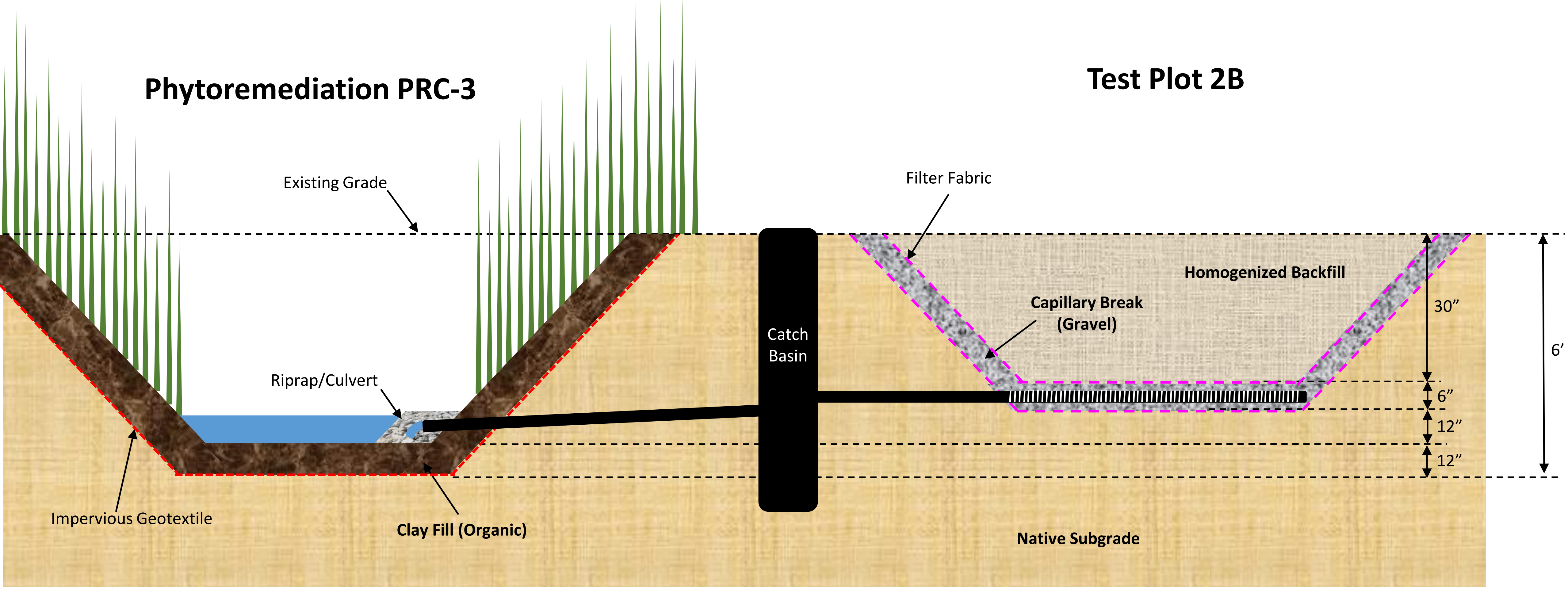
Test Plot 1A

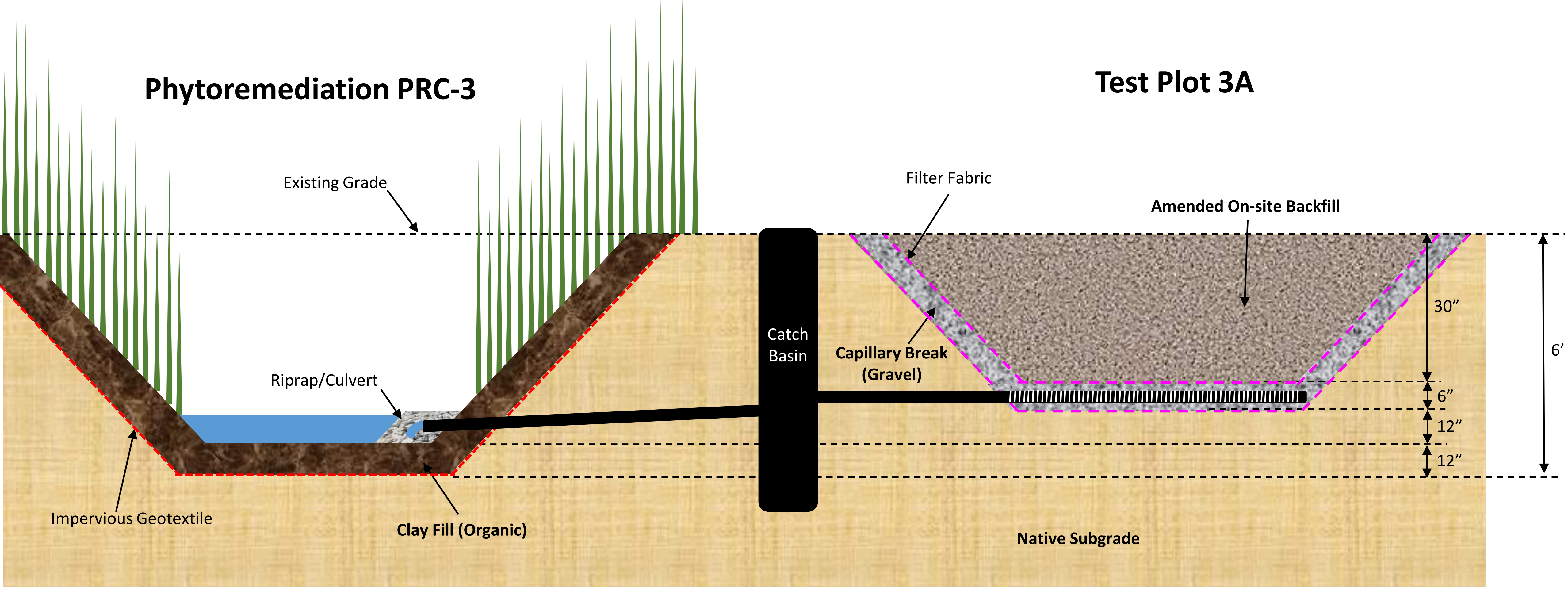


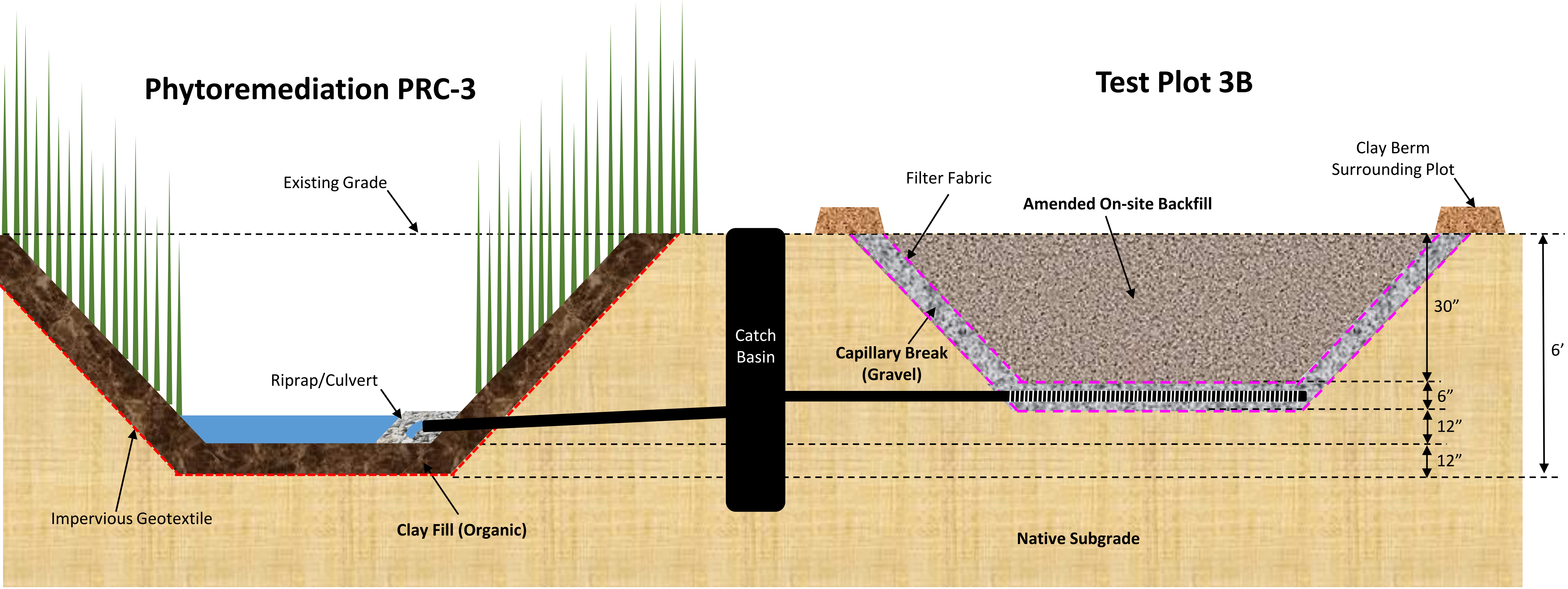

Phytoremediation PRC-3
Test Plot 1B
Existing Grade
Filter Fabric
Imported Backfill
Capillary Break
(Gravel)
Catch
Basin
Riprap/Culvert
30”
6”
12”
12”
6’
Impervious Geotextile
Clay Fill (Organic)
Native Subgrade

Test Plot 2A


Existing Grade
Filter Fabric
Homogenized Backfill
Capillary Break
(Gravel)
Native Subgrade
30”
36”
6”


Phytoremediation PRC-3
Test Plot 2B
Existing Grade
Filter Fabric
Homogenized Backfill
Capillary Break
(Gravel)
Catch
Basin
Riprap/Culvert
Impervious Geotextile
Clay Fill (Organic)
Native Subgrade
30”
6”
12”
12”
6’

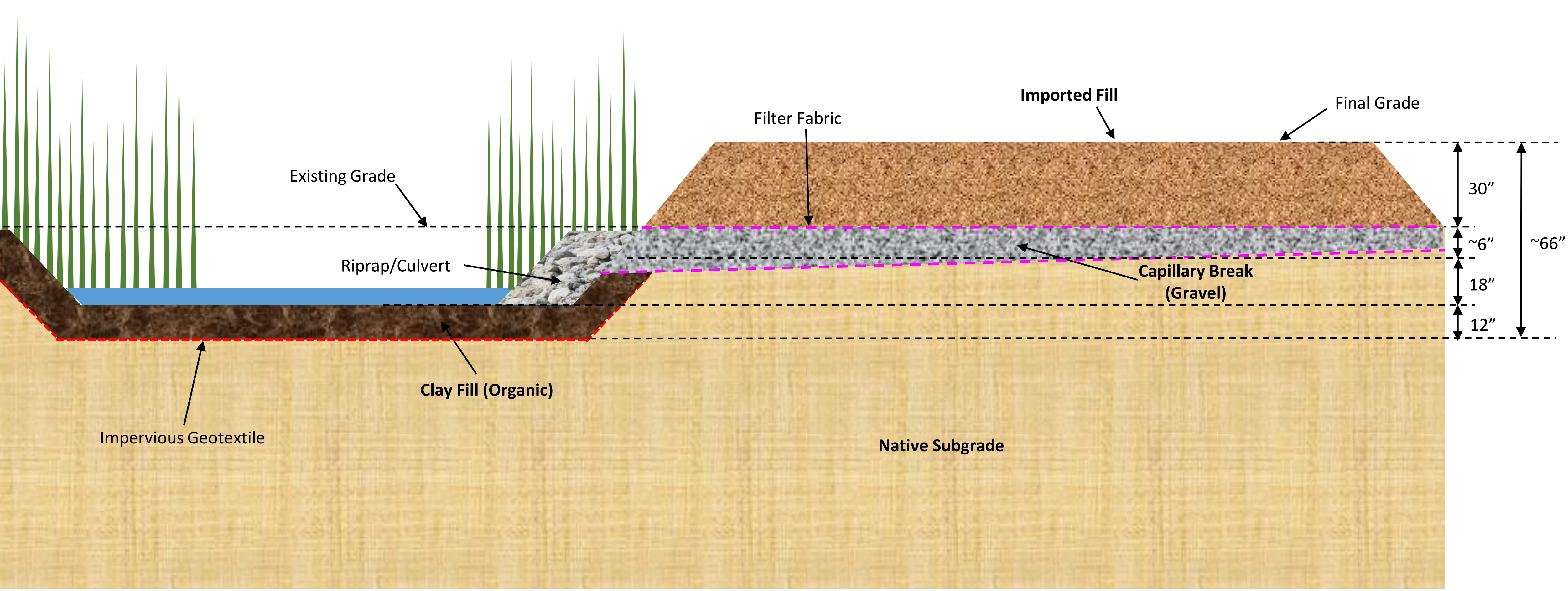

Phytoremediation PRC-3
Test Plot 3A
Existing Grade
Filter Fabric
Amended On-site Backfill
Catch Basin
Capillary Break (Gravel)
Riprap/Culvert
30”
6’
6”
12”
12”
Impervious Geotextile
Clay Fill (Organic)
Native Subgrade



Phytoremediation PRC-3
Test Plot 3B
Existing Grade
Riprap/Culvert
Impervious Geotextile
Clay Fill (Organic)
Catch Basin
Filter Fabric
Clay Berm Surrounding Plot
Amended On-site Backfill
Capillary Break (Gravel)
Native Subgrade
30”
6”
12”
12”
6’

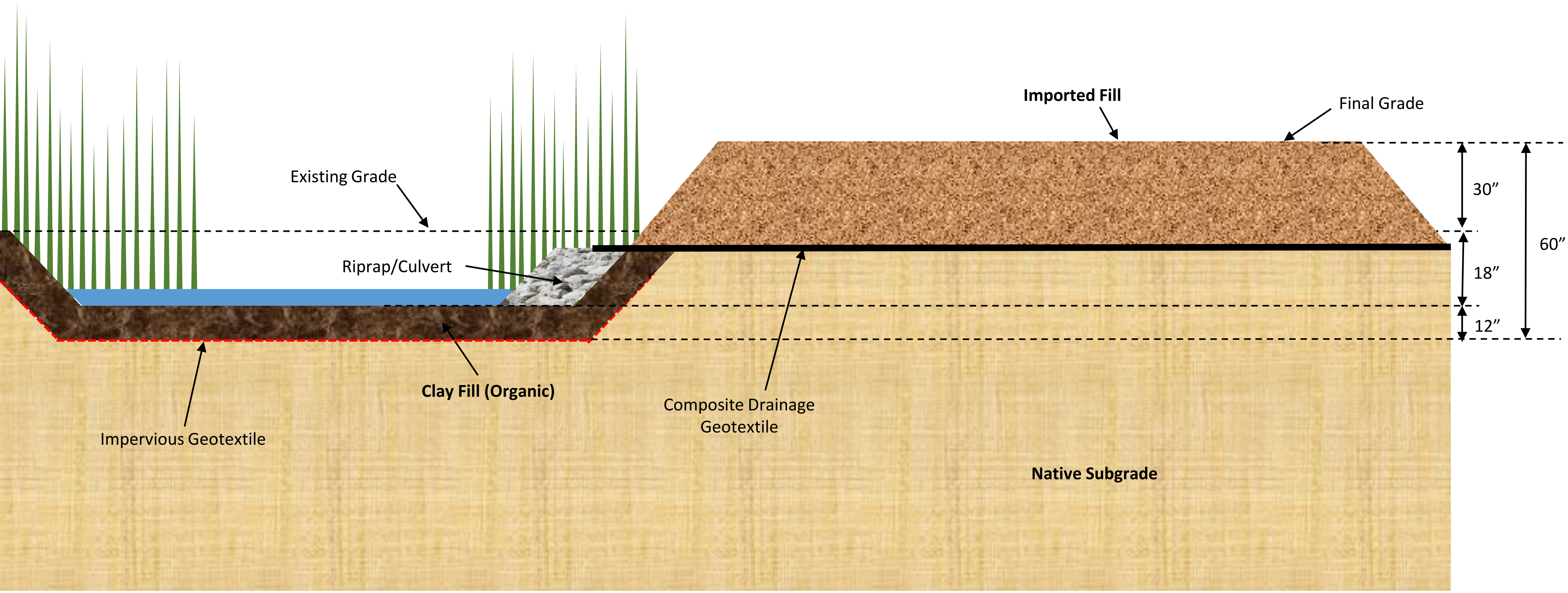
Phytoremediation PRC-2

Test Plot 5A

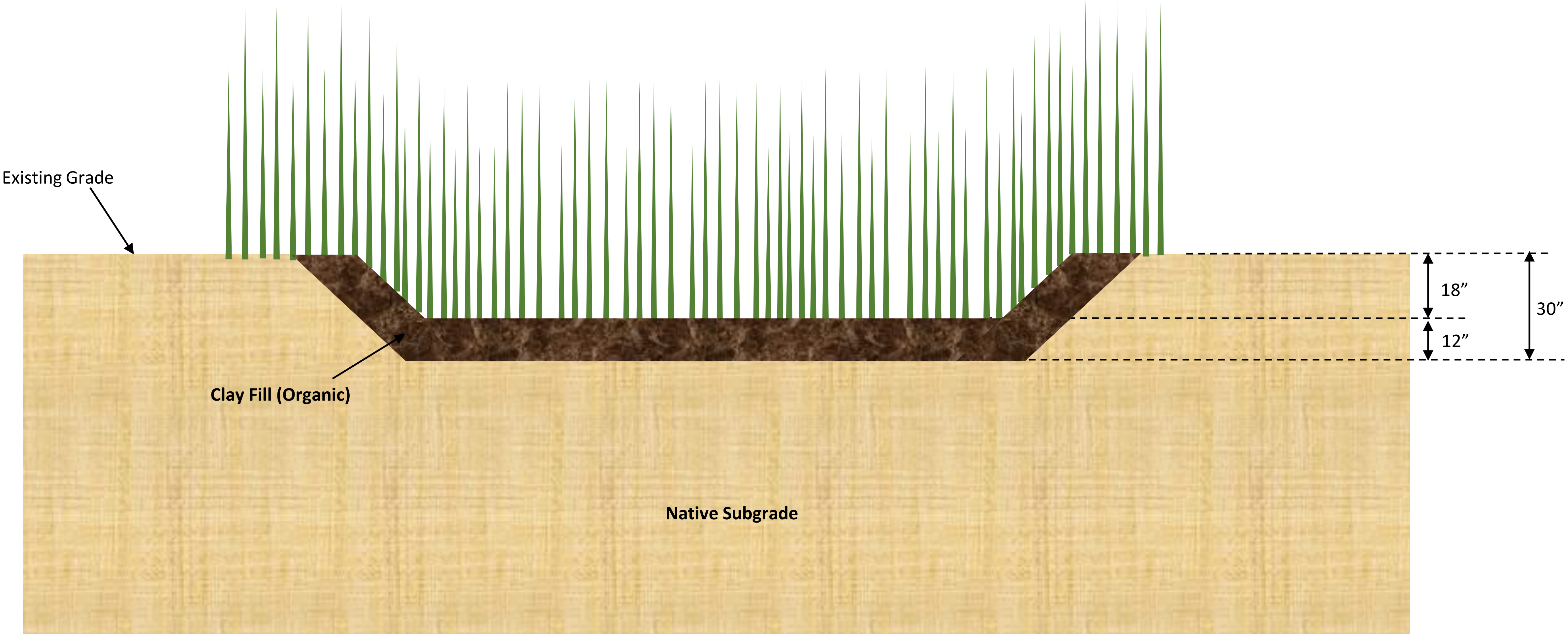


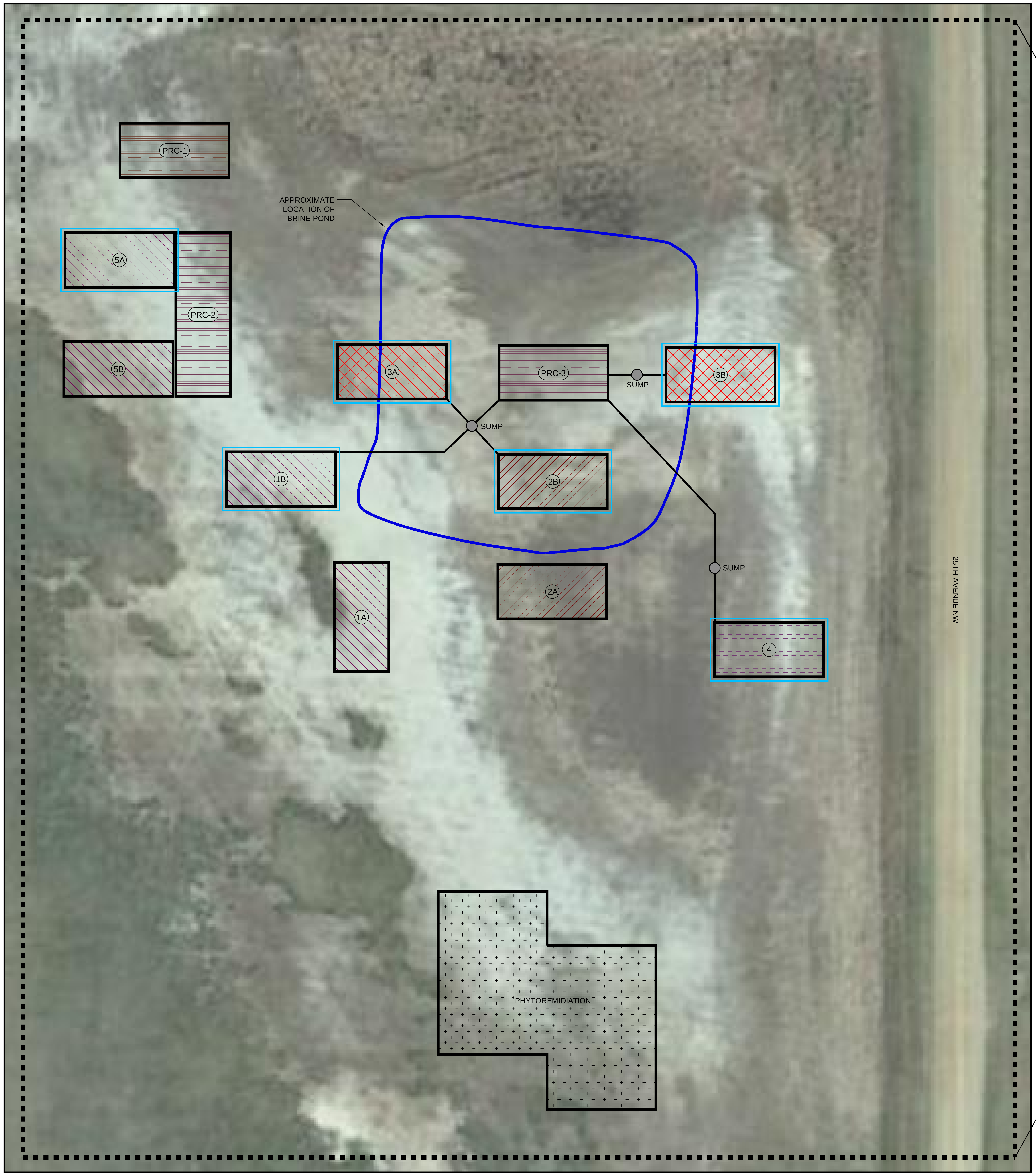
Phytoremediation PRC-2

Test Plot 5B

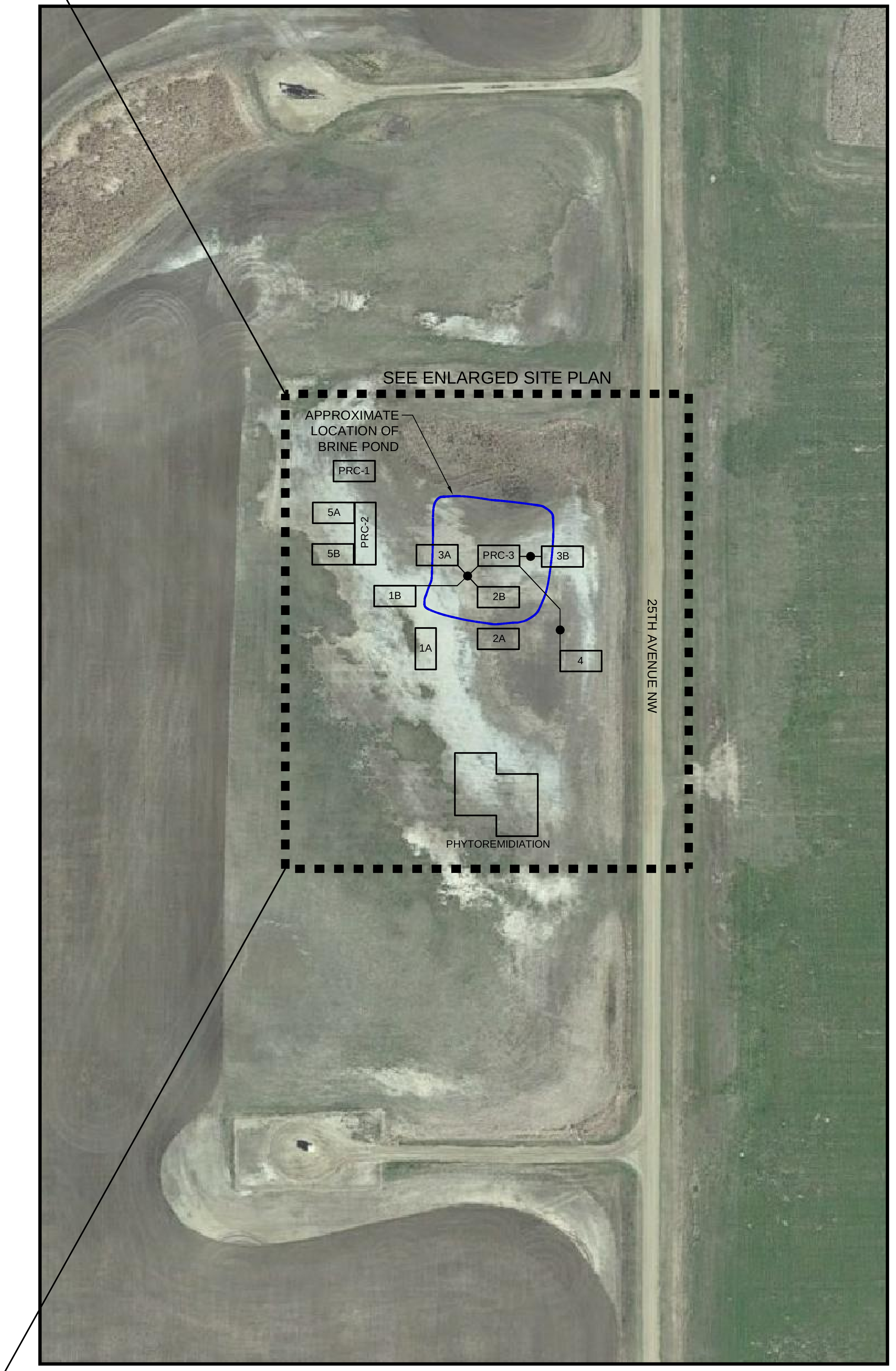


Phytoremediation Cell PRC-1





ENLARGED SITE PLAN



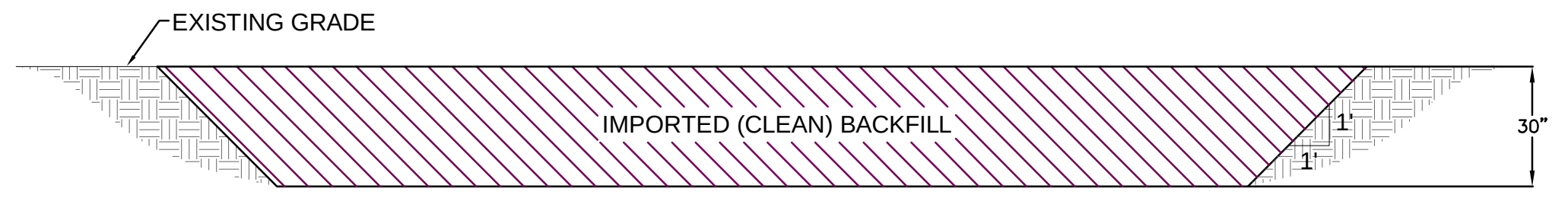
AERIAL SITE PLAN (IMAGE PROVIDED BY GOOGLE EARTH)

REV.	DATE	BY	DESCRIPTION
1		DFS	TEST CELL LOCATIONS; COVER OPTIONS
2	09.13.17	DFS	REVISED PER COMMENTS
3	09.18.17	DFS	REVISED PER COMMENTS
3	09.20.17	DFS	REVISED PER COMMENTS
3	10.12.17	DFS	ADDED TEST CELLS, REVISED CELL LOCATIONS AND CROSS-SECTIONS

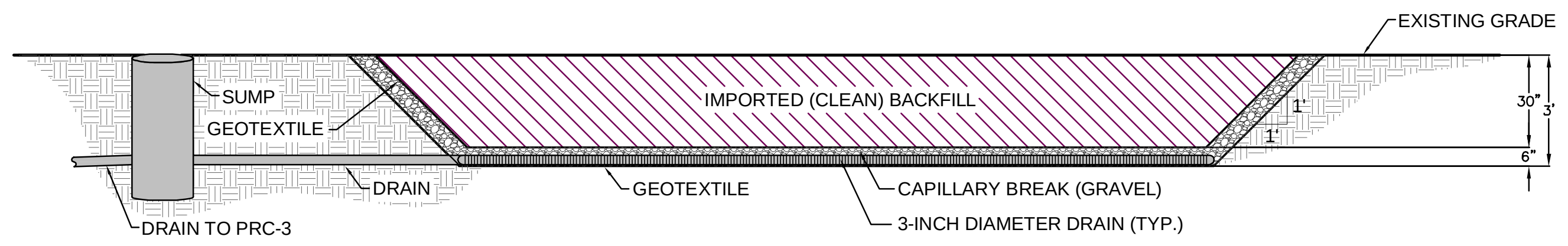
NDIC BRINE REMEDIATION STUDY
NE 1/4 S26-T161N-82W
BOTTINEAU COUNTY, NORTH DAKOTA

01

DESIGNED BY:	DFS
DRAWN BY:	CPD
APPVD. BY:	DFS
SCALE:	AS-SHOWN
DATE:	08.31.2017
JOB NO.	M1177088
ACAD NO.	M1177088-01
SHEET NO.:	01 OF 02

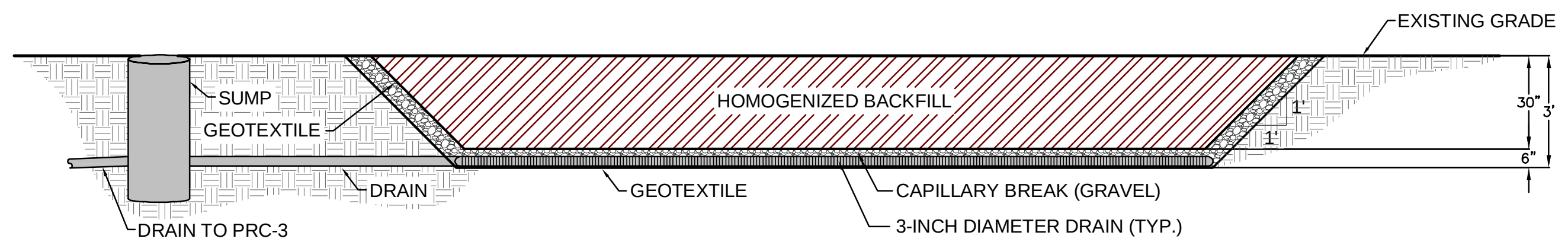


CONCEPTUAL TEST CELL 1A - CROSS SECTION
1/2"=1'-0"



CONCEPTUAL TEST CELL 1B - CROSS SECTION
1/2"=1'-0"

CONCEPTUAL TEST CELL 2A - CROSS SECTION
1/2"=1'-0"



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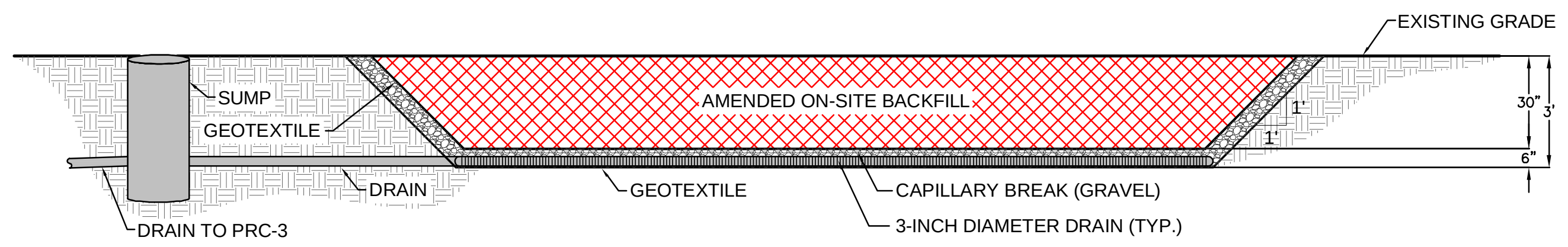

CONCEPTUAL TEST CELL 3A - CROSS SECTION
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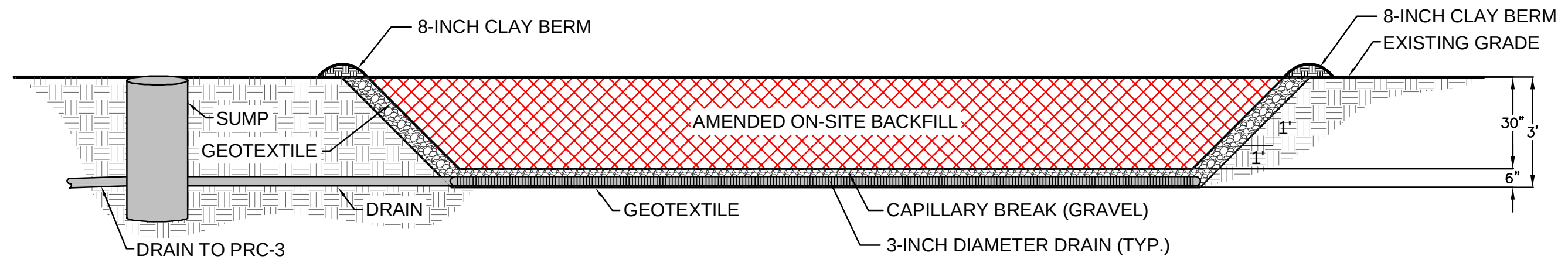
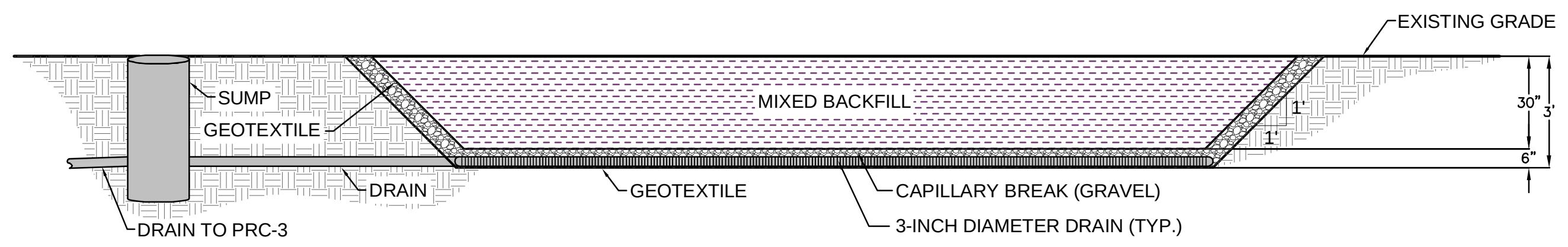
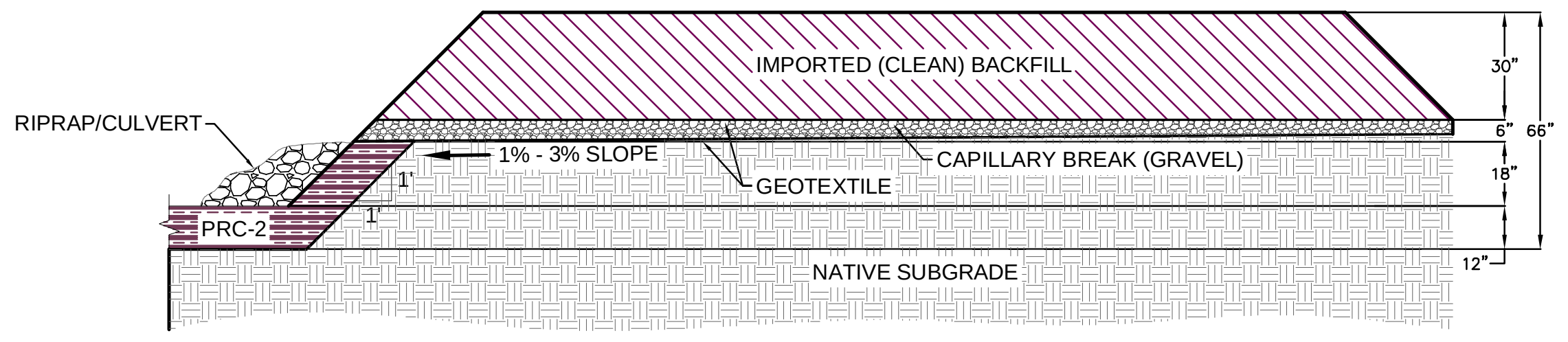


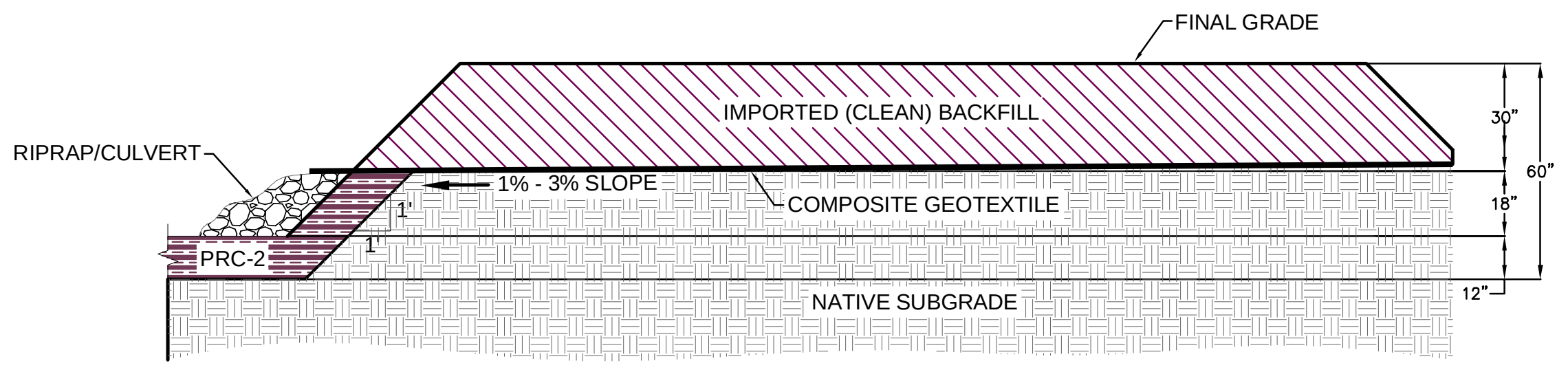
CONCEPTUAL TEST CELL 3B - CROSS SECTION
1/2"=1'-0"



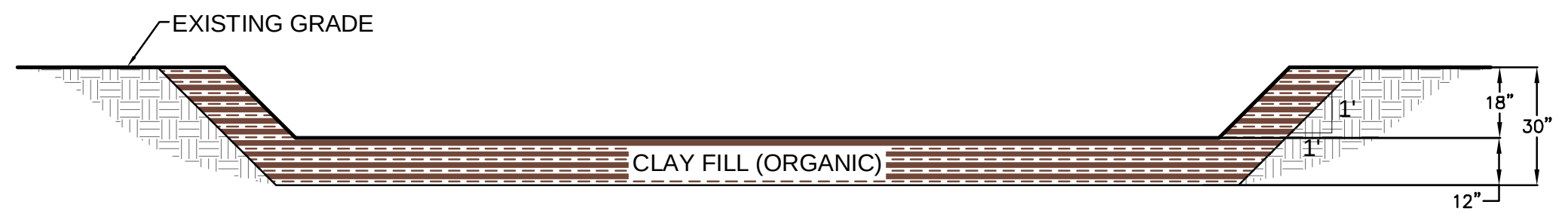
CONCEPTUAL TEST CELL 4 - CROSS SECTION
1/2"=1'-0"



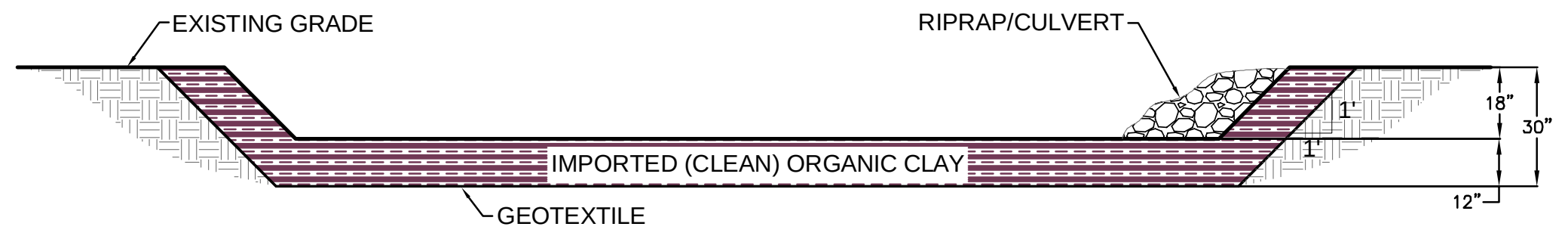
CONCEPTUAL TEST CELL 5A - CROSS SECTION
1/2"=1'-0"



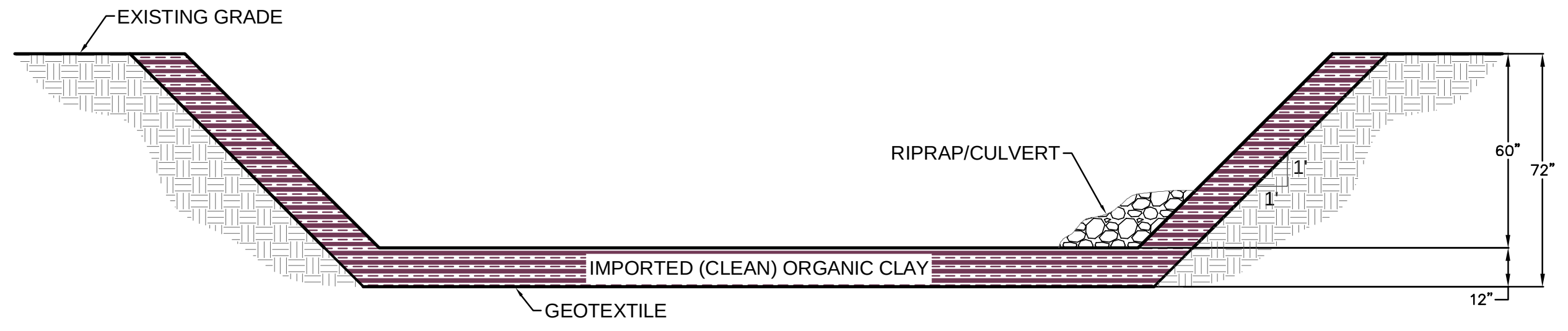
CONCEPTUAL TEST CELL 5B - CROSS SECTION
1/2"=1'-0"



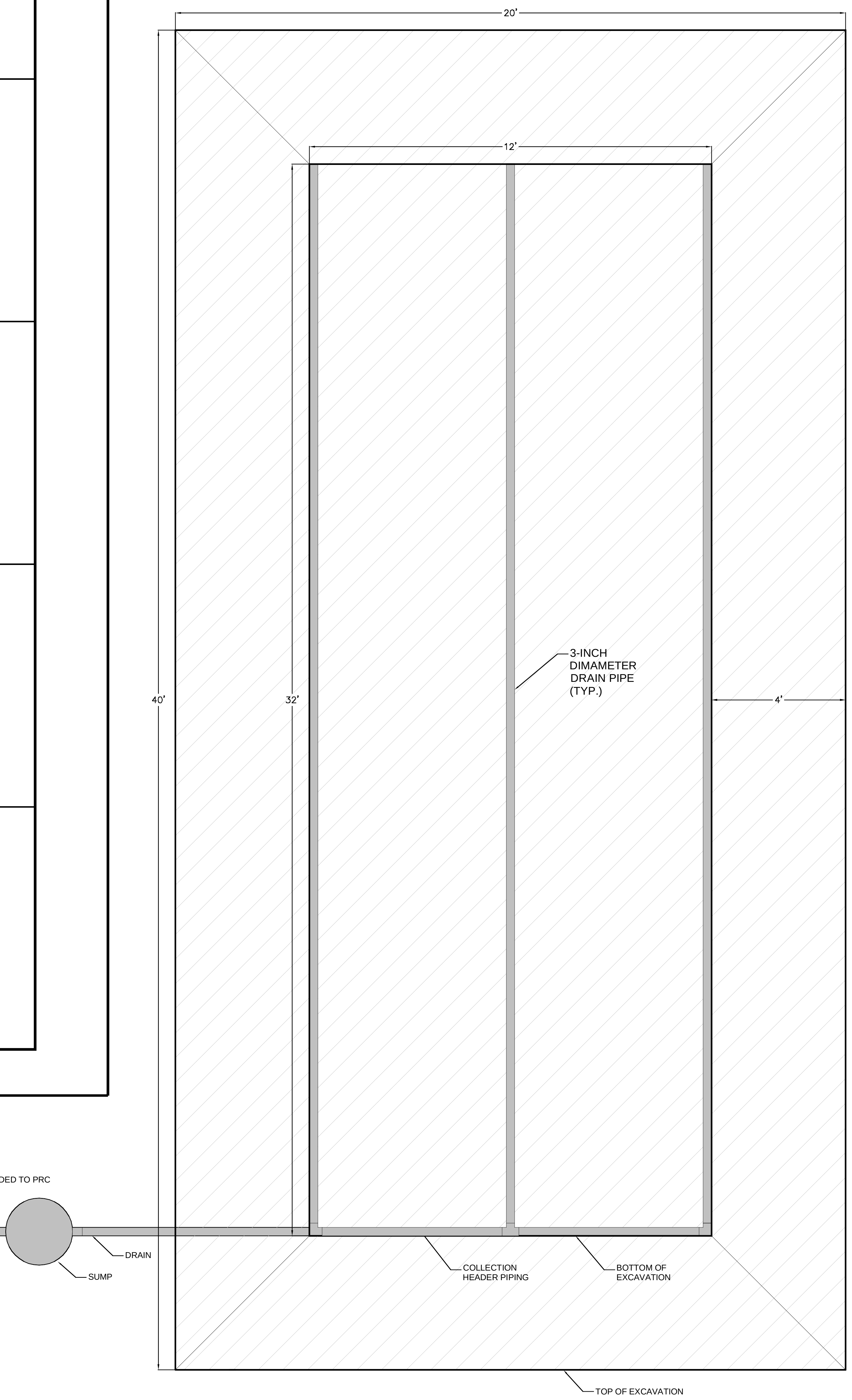
CONCEPTUAL TEST CELL PRC-1 - CROSS SECTION
1/2"=1'-0"



CONCEPTUAL TEST CELL PRC-2 - CROSS SECTION
1/2"=1'-0"



CONCEPTUAL TEST CELL PRC-3 - CROSS SECTION
1/2"=1'-0"



CONCEPTUAL TEST CELL WITH CAPILLARY BREAK - PLAN VIEW
1/2"=1'-0"

REV.	DATE	BY	DESCRIPTION
1		DFS	TEST CELL LOCATIONS; COVER OPTIONS
2	09.13.17	DFS	REVISED PER COMMENTS
3	09.18.17	DFS	REVISED PER COMMENTS
3	09.20.17	DFS	REVISED PER COMMENTS
3	10.12.17	DFS	ADDED TEST CELLS, REVISED CELL LOCATIONS AND CROSS-SECTIONS

NDIC BRINE REMEDIATION STUDY
NE 1/4 S26-T161N-82W
BOTTINEAU COUNTY, NORTH DAKOTA

NORTH DAKOTA
OIL AND GAS DIVISION

GSI
ENVIRONMENTAL

Terracon
Consulting Engineers and Scientists

02

DESIGNED BY:	DFS
DRAWN BY:	CPD
APPVD. BY:	DFS
SCALE:	AS-SHOWN
DATE:	08.31.2017
JOB NO.	M1177088
ACAD NO.	M1177088-02
SHEET NO.:	02 OF 02

December 21, 2017

North Dakota Department of Mineral Resources – Oil & Gas Division
600 East Boulevard Avenue Dept. 405
Bismarck, ND 58505-0840

Attn: Mr. Cody VanderBusch – Reclamation Specialist
P: [701] 328-8018
E: cwvanderbusch@nd.gov

Re: Q2 Quarterly Report (Oct. 1, 2017 to Dec. 31, 2017)
NDIC Brine Remediation Study
NE ¼ S26-T161N-82W (48.746589, -101.256850)
Bottineau County, North Dakota
Terracon Project No. M1177088

Dear Mr. VanderBusch:

This letter, serving as the quarterly report, provides an update of our progress on the NDIC Brine Remediation Study for the site located near Renville, North Dakota, and in our laboratory. Below, we describe the accomplishments made during Quarter 1 (Q1) and Quarter 2 (Q2), as well as, what we plan to begin or continue in Quarter 3 (Q3).

Per our original work plan, our baseline assessment of the site included subsurface exploration and soil sampling/testing to determine the boundaries of the original brine pond and the extent of the brine leak. Surface field-testing methods were also used to determine and map areas impacted by brine. Upon completion of the subsurface exploration and soil sampling/testing, we designed, then implemented, test plots at various locations of which contained different brine concentrations. As part of the field study, nine different test plots were installed at the site to analyze the impact of the applied remediation techniques. Three phytoremediation cells (PRCs) were also installed as drainage features on the site.

After completion of the fieldwork, during the end of Q1 (July 1, 2017 to September 30, 2017) and at the beginning of Q2 (October 1, 2017 to December 31, 2017), a Baseline Site Assessment Report was prepared for the project which includes the results of our subsurface exploration/sampling and field/laboratory soil and water testing. The Baseline Assessment Report also contains commentary on our test plot design and implementation (including photographs taken during construction of the test plots). See Appendix A for the complete Baseline Site Assessment Report.

During Quarter 2, our study progressed from field testing and construction to laboratory-based experimentation using different potential brine-reducing soil additives. During our field testing program, bulk sampling of brine-impacted soils was performed. The bulk soil samples were separated into the following three categories based on brine concentration/impact (through the use of electrical conductivity (EC) readings):

- 3,500 to 6,500 µS/cm (low)
- 10,000 to 14,000 µS/cm (medium)
- 16,000 to 20,000 µS/cm (high)

For our laboratory-based experimentation, 144 soil cells, containing various combinations and concentrations of selected potential brine-reducing additives, were prepared. The potential brine-reducing additives blended with the soils from the site are as follows:

- Gypsum pellets/granules
- Sulfuric acid (15% v/v solution)
- Wheat straw
- 10-20-10 fertilizer
- BioFlora™ bacterial-activated fertilizer
- Sugar beet molasses (waste product containing approximately 50% sugar)
- Sugar beet pulp (waste product containing approximately 2-3% sugar)

Based on past research, a key component to remediating brine contamination revolves around neutralizing the chlorides in the soil by means of adding gypsum to the soil, or sulfuric acid mixed into the soils, which reacts and creates gypsum. However, based on our experience and research, microbial growth may be equally important to reducing the sodium portion of the brine. Molasses and pulp are bi-products created from the result of sugar beet manufacturing, common to eastern North Dakota. Sugar applied to soil, along with a microbial source, is a good food source for bacteria; and since the molasses and pulp are waste products, we decided they would be viable additives to the amended soils containing the bacterial-activated fertilizer. Because sugar beet manufacturing facilities are located in the eastern portion of the state, transportation costs for importing the materials to typical brine sites (primarily located in the western portion of the state) may be cost prohibitive. Costs and economic feasibility of the amendment additives will be evaluated at a later date.

As mentioned above, 144 test cells were completed in Q2. Cylinder molds with a 6-inch diameter and 12-inch height were used to construct the cells. Approximately one inch of pea gravel along with a layer of filter fabric was placed in the bottom of each cell to reduce sediment transport during rainfall simulation and promote drainage. Small holes were also drilled near the base of the cylinder for drainage. A drainage system was constructed to allow the cells to drain to bulk collection sources. Soil mixtures containing various types and concentrations of the additives identified above were then compacted into the cylinders.

The average annual precipitation for the area surrounding the site is about 20 inches per year. The cells will be watered bi-weekly to simulate the average precipitation. An identical set of cells were constructed using the same components; however, the precipitation added will be equivalent to 35 inches annually. The addition of more water will simulate more of a wet cycle compared to the current drought conditions that western North Dakota is in currently. Water samples from our bulk collection sources are being sent to a laboratory for analytical testing for EC, sodium, and chlorides on a monthly basis. The water sources are "field" tested for EC and chlorides using an EC meter (Spectrum Technologies, Inc. Model No. 2265FSTP) and chloride QuanTab® titration test strips, respectively.

Watering and testing of the soil test cells will continue through Q3 (January 1, 2018 to March 31, 2018). In addition to testing and monitoring, several crop types will be planted in the cells that indicate a reduction in brine concentration. The seedlings will be monitored for qualitative growth and hardiness. Because the chemical processes of many of the amendments occur over time, we plan to plant the seeds in mid- to late-February 2018; preferably, after a decrease in the brine concentration is observed (based on EC and chloride testing).

Several new test cells will be constructed using non-amended soils and will be seeded with various crops as well as phytoremediation plant types, such as cattails. This portion of the study will be used see which brine concentrations the crop can tolerate, if any. These test cells will be completed (construction and seeding) towards the end of Q3 or beginning of Q4 (April 1, 2018 to June 30, 2018).

If you have any questions concerning this report, please contact us.

Sincerely,
Terracon Consultants, Inc.

Corey D. Lindeman, EI
Staff Engineer

Daniel F. Schneider, CHMM
National Director
Site Investigation and Remediation
Principal

Appendix A: Baseline Site Assessment Report

March 30, 2018

North Dakota Department of Mineral Resources – Oil & Gas Division
600 East Boulevard Avenue Dept. 405
Bismarck, ND 58505-0840

Attn: Mr. Cody VanderBusch – Reclamation Specialist
P: [701] 328-8018
E: cwvanderbusch@nd.gov

Re: Q3 Quarterly Progress Report (January 1, 2018 to March 30, 2018)
NDIC Brine Remediation Study
NE ¼ S26-T161N-82W (48.746589, -101.256850)
Bottineau County, North Dakota
Terracon Project No. M1177088

Dear Mr. VanderBusch:

This letter, serving as the quarterly report, provides an update of our progress on the NDIC Brine Remediation Study for the site located near Renville, North Dakota, and in our laboratory bench scale testing. Below, we discuss the progress of the project achieved during Quarter 1 (Q1) and Quarter 2 (Q2), and more detailed description for Quarter 3 (Q3), as well as, what we plan to begin or continue in Quarter 4 (Q4).

Brief Overview of Previously Reported Work

Per our original work plan, our baseline assessment of the site included subsurface exploration and soil sampling/testing to determine the boundaries of the original brine pond and the extent of the brine release. Field-testing methods as previously discussed in our Baseline Site Assessment Report, dated December 21, 2017, and were also used to determine and map areas impacted by brine. Upon completion of the subsurface exploration and soil sampling/testing, Terracon designed, then implemented, 12 test plots at various locations of which contained different brine concentrations (refer to Baseline Site Assessment). As part of the field study, nine different test plots were installed at the site to analyze the impact of various applied remediation techniques and construction. Three phytoremediation cells (PRCs) were also installed as potential brine-impacted plot “flush water” remediation alternatives on the site.

After completion of the fieldwork, during the end of Q1 (July 1, 2017 to September 30, 2017) and at the beginning of Q2 (October 1, 2017 to December 31, 2017), a Baseline Site Assessment Report was prepared for the project which includes the results of our subsurface exploration/sampling and field/laboratory soil and water testing. The Baseline Assessment Report

also contained commentary on our various test plot designs and implementation, including photographs taken during construction of the field test plots.

Laboratory Test Cell Construction and Testing

During Q2, our study progressed from field testing and construction to laboratory-based experimentation using different potential brine-reducing soil additives. During our field testing program, bulk sampling of brine-impacted soils was performed. For our laboratory-based experimentation, 156 total soil cells, containing various combinations and concentrations of selected potential brine-reducing additives, were prepared (see attached table). The potential brine-reducing additives blended with the soils and testing frequencies were discussed in detail in our Q2 report.

In the Q2 report, we originally constructed 144 test cells; however, we added a basic sand amendment (12 additional cells), which includes the various EC level soils with additions of 200 and 600 grams of clean, coarse sand to identify if simply increasing the permeability of the soil would have an effect on the EC levels when flushed with tap water. Watering and testing of the soil test cells continued to March 9, 2018, which resulted in 12 weeks of total testing.

Two sets of each amendment concentration were constructed to test two water frequencies. The first watering frequency was simulating the average annual rainfall of about 20 inches for the site area, and for an excessively wet year with estimated rainfall of about 30 inches. The cells were tested for EC levels weekly prior to the weekly watering since water content in soils will affect the measurement. The total volume of water added to the cells was approximately 3 months of each respective annual rainfall frequency.

Any water which seeped out from the cells was directed to two locations, which each collected approximately one-half of the water seeped. The water was collected in a clean 5-gallon bucket and was tested weekly for EC levels and chlorides through field testing methods. Once per month, a sample was collected from each of the collection areas and sent to the analytical laboratory for testing EC levels, chlorides, and sodium. The weekly EC and chloride values always exceeded the maximum values of the testing methods, 20,000 µS/cm and 6,000 mg/L, respectively. We are currently waiting for the 3rd month results from the laboratory. The table below illustrates the analytical test results from our first two monthly samples.

Sample Date [1]	EC, µmhos/cm	Chloride, mg/L	Sodium, mg/L
12/15/2018 Sample 1 (test cells 1 to 80)	111[2]	40,000	21,400
1/15/2018 Sample 1 (test cells 1 to 80)	111,000	42,200	23,500
1/15/2018 Sample 2 (test cells 81 to 156)	90,600	37,000	18,500

1. No seeped water was available in the collection bucket during the December 15, 2018 sampling occurrence.
2. Based on the value compared to later data, there seems to be a typo on the laboratory report received from ESC Laboratories. We are waiting on clarification from the laboratory on this issue.

The following table indicates the preliminary results of the difference in EC levels from the initial EC to the 12-week EC readings. Further data analysis is currently being completed for the large data set. Final data results will be included in the upcoming Q4 (April 1 to June 30, 2018) report. The control test cells consisted of soil collected from the site with no amendments added. The watering frequency remained the same for the controls compared to the other cells.

Based on our preliminary results, the control test cells appear to have the greatest average reduction in EC levels with Amendment 7 in a close 2nd place. At this point, it is unclear why the non-amended soils (controls) performed the best. It is possible that some of the amendment components hindered water flow compared to the non-amended soils which would result in less salts being transported.

Amendment No.	Amendment Description	Average EC Reduction
1	BioFlora spray/fertilizer	42%
2	Straw/gypsum/beet molasses/fertilizer	12%
3	Straw/gypsum/beet molasses/Bioflora spray/fertilizer	22%
4	Straw/gypsum/beet pulp/BioFlora spray/fertilizer	24%
5	Straw/sulfuric acid/BioFlora spray/fertilizer	40%
6	Straw/gypsum/BioFlora spray/fertilizer	50%
7	Straw/sulfuric acid-gypsum mix/BioFlora spray/fertilizer	53%
8	Clean, coarse sand	40%
Controls	No soil amendments added	54%

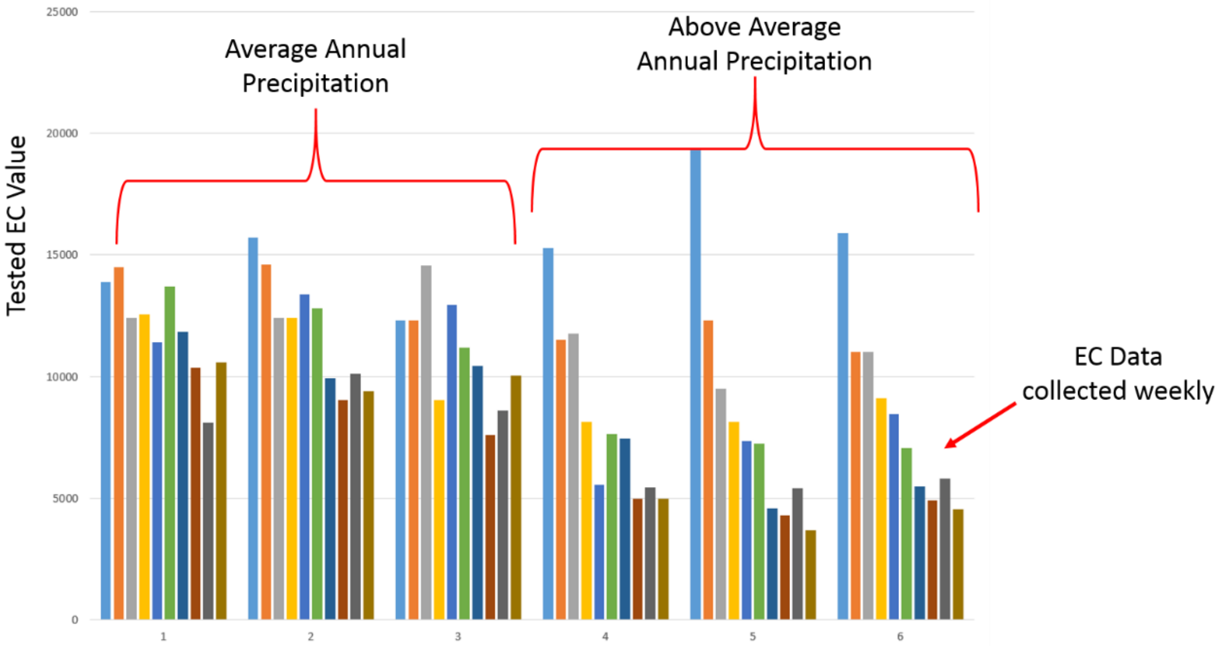


Image 1: Example of how the data sets were organized for the collected weekly EC levels.

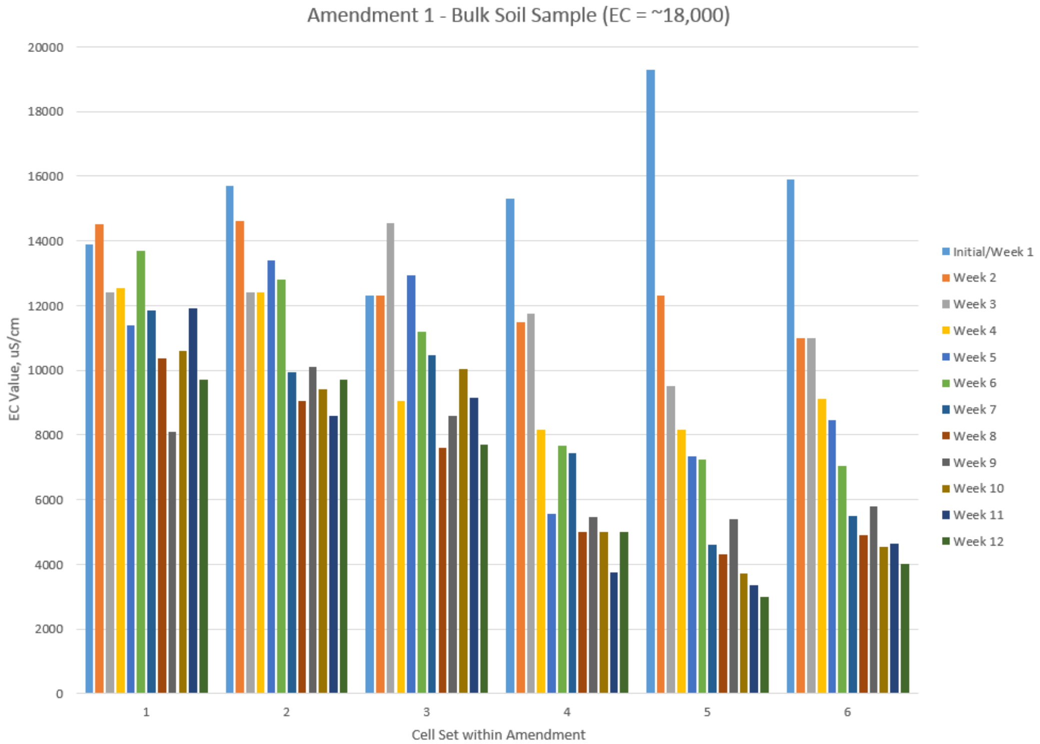


Image 2: Additional example illustrating the weekly data collected for Amendment 6.

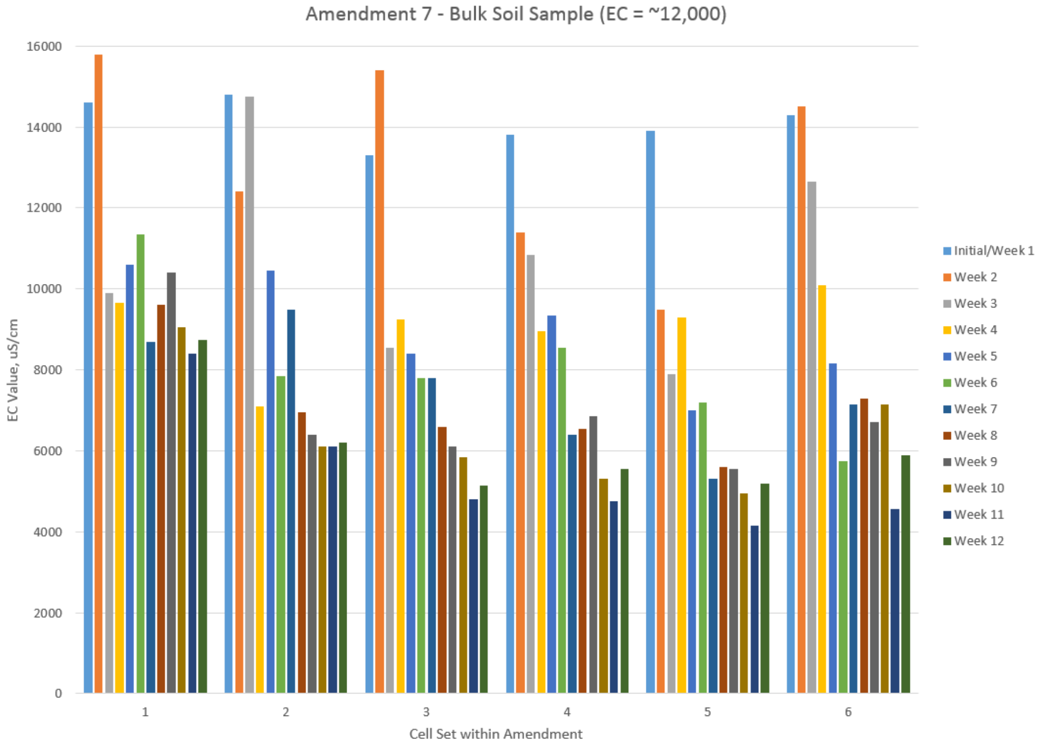


Image 3: Chart illustrating the weekly data collected for the Amendment 7 test cells.

Crop Planting and Germination in Laboratory Test Cells

Once the 12 weeks of EC data was collected, several crop types were planted in the tested cells. Commercial-grade crop seeds including canola (rape seed), soybeans, alfalfa (highly salt tolerant strain), sunflowers, and barley were obtained from Agassiz Seed & Supply and Precision Seed (a Pioneer Seed subsidiary) and planted during March 14-15, 2018.

Image 4: Constructed plant enclosure with LED grow lights to entice plant growth.

A single row of soybean seeds were planted down the center of the cylinder mold, splitting the cell into two sections, then further split in the four quadrants for the remaining seed types as to keep the seeds in order for tracking growth.

Images 5 & 6: Terracon laboratory technician planting seeds in test cells.

Once planted, each cell was initially watered with 200 mL to saturate the soil and provide the needed moisture for germination. Watering of the cells was performed on an as-needed basis due to variance in observed surface dryness, which typically consisted of a few light sprays of tap water every few days since the grow tent kept moisture fairly well.

As the seeds started to spout, the date where the spouts appeared are being recorded and compared to the date of planting to record the rate of germination. At the time of this report, the cells which had 12-week EC levels below approximately 4,000 µS/cm have been more successful regarding germination as depicted in Image 8 below. As time progresses, we will examine the germination rate versus EC level. Further analysis regarding whether the germination success was primarily in the cells which contained soil which was originally below 4,000 µS/cm were more or less successful than cells which were reduced to less than 4,000 µS/cm from higher EC levels. Findings from this portion of the project will be included in the Q4 report.

Image 7 & 8: An example of seedlings growing and the varying success of germination between cells after approximately 7 days after planting.

Soil Column Construction and Testing

Another aspect of our study included constructing a larger scale test cell to attempt to test the effectiveness of a gravel capillary break and/or installing drain tile. This experiment is being performed to attempt to indicate how salts transport through a soil column when watered from above, similar to rainfall, and watering up from the bottom (similar to a rising groundwater level and/or to simulate spring thaw conditions). The soils placed in our columns included from top to bottom: 4 inches of topsoil, 36 inches of 8,000 to 12,000 EC soil with straw added, 12 inches of pea gravel which include a 1-inch diameter screen for drainage, 18 inches of 14,000 to 15,000 EC soil, followed by non-impacted silt/clay soil mixture.

Two columns were constructed (A and B). The constructed soils were similar in each; however, Column B included an additional drain (attempt at simulating drain tile) between the highly-impacted soil layer and the non-impacted silt/clay soils at the bottom. The drain screen was surrounded by an additional layer of pea gravel. The following images depict the schematic and construction of the columns and the finished columns.

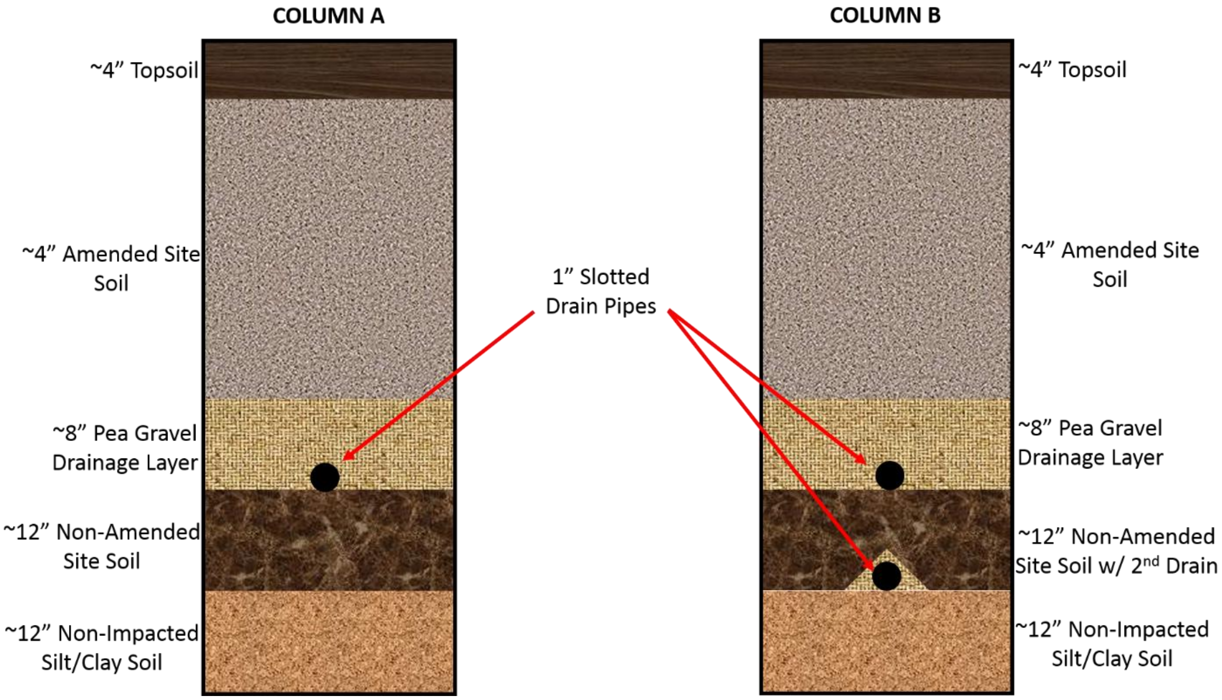


Image 9: Schematics of the soil test columns (not-to-scale).

Images 10 & 11: Wood construction of the test columns.

Images 12 & 13: Attaching the Plexiglas in the front of the columns and the finished columns.

Once the columns were constructed, heavy water flooding was performed between EC testing (at five locations down the column) in the columns to simulate salt transport downward due to rainfall and additional "site" flooding. Approximately 40 inches of water was added to each cell over a 5-week span. EC levels were measured at one-foot intervals moving downward through the column prior to each weekly watering event. The following table illustrates the EC measurements recorded during the 5-week watering period.

	1/17/2018		1/26/2018		2/9/2018		2/13/2018		2/15/2018	
	Column A	Column B	Column A	Column B	Column A	Column B	Column A	Column B	Column A	Column B
Location 1 (Top)	6,100	8,200	3,000	2,900	900	1,200	1,500	1,300	2,000	1,200
Location 2	12,600	8,400	7,500	4,500	2,800	1,900	2,400	1,600	1,900	1,500
Location 3	10,200	9,800	14,800	10,000	5,800	2,800	2,800	2,200	2,600	2,100
Location 4	14,900	14,500	17,000	18,500	12,100	6,800	9,600	4,700	8,200	3,900
Location 5 (Bottom)	1,200	1,300	9,700	16,500	16,600	16,400	14,800	11,400	12,300	11,400

As expected, EC values decreased at the top of the columns as more water was added; however, the efficiency of the drainage layers appeared to be less successful due to a drastic increase in EC levels in the bottom, non-impacted soil layer. The planned next stage in testing for this portion of the project is to attempt to add water from the bottom of the column and record EC values over time to indicate if the salt migrates back up into the now relatively non-impacted soil layer above the capillary break. For this experiment, the drain tile style drainage was filled with impermeable fill, so both columns will be similar. This is an on-going investigation and will be finished in the beginning of Q4. Final discussion for this experiment will be included in the upcoming Q4 report.

Quarter 4 will consist of continuing with the recording of the plant growth progress. Also, we will be returning to the field test plots to test the EC readings after spring thaw (most likely late in Q4 due to the current weather/ground conditions).

If you have any questions concerning this report, please contact us.

Sincerely,
Terracon Consultants, Inc.

Corey D. Lindeman, EI
Staff Engineer

Daniel F. Schneider, CHMM
National Director
Site Investigation and Remediation
Principal

Attachments: Construction Details of Laboratory Test Cells

Construction Details of Laboratory Test Cells

Amendment No.	Cylinder No.	Part 1	Part 2	Part 3	Part 4	Part 5	Part 6
1	1	14.8 lbs 5000EC soil	10 mL BioF	30 g Fert	--	--	--
	2	14.8 lbs 5000EC soil	20 mL BioF	30 g Fert	--	--	--
	3	14.8 lbs 5000EC soil	30 mL BioF	30 g Fert	--	--	--
	4	14.8 lbs 5000EC soil	10 mL BioF	30 g Fert	--	--	--
	5	14.8 lbs 5000EC soil	20 mL BioF	30 g Fert	--	--	--
	6	14.8 lbs 5000EC soil	30 mL BioF	30 g Fert	--	--	--
	7	14.8 lbs 12000EC soil	10 mL BioF	30 g Fert	--	--	--
	8	14.8 lbs 12000EC soil	20 mL BioF	30 g Fert	--	--	--
	9	14.8 lbs 12000EC soil	30 mL BioF	30 g Fert	--	--	--
	10	14.8 lbs 12000EC soil	10 mL BioF	30 g Fert	--	--	--
	11	14.8 lbs 12000EC soil	20 mL BioF	30 g Fert	--	--	--
	12	14.8 lbs 12000EC soil	30 mL BioF	30 g Fert	--	--	--
	13	14.8 lbs 18000EC soil	10 mL BioF	30 g Fert	--	--	--
	14	14.8 lbs 18000EC soil	20 mL BioF	30 g Fert	--	--	--
	15	14.8 lbs 18000EC soil	30 mL BioF	30 g Fert	--	--	--
	16	14.8 lbs 18000EC soil	10 mL BioF	30 g Fert	--	--	--
	17	14.8 lbs 18000EC soil	20 mL BioF	30 g Fert	--	--	--
	18	14.8 lbs 18000EC soil	30 mL BioF	30 g Fert	--	--	--
2	19	14.8 lbs 5000EC soil	23 g straw	70 g gyp	100 mL mol	30 g Fert	--
	20	14.8 lbs 5000EC soil	29 g straw	94 g gyp	150 mL mol	30 g Fert	--
	21	14.8 lbs 5000EC soil	36 g straw	117 g gyp	200 mL mol	30 g Fert	--
	22	14.8 lbs 5000EC soil	23 g straw	70 g gyp	100 mL mol	30 g Fert	--
	23	14.8 lbs 5000EC soil	29 g straw	94 g gyp	150 mL mol	30 g Fert	--
	24	14.8 lbs 5000EC soil	36 g straw	117 g gyp	200 mL mol	30 g Fert	--
	25	14.8 lbs 12000EC soil	23 g straw	70 g gyp	100 mL mol	30 g Fert	--
	26	14.8 lbs 12000EC soil	29 g straw	94 g gyp	150 mL mol	30 g Fert	--
	27	14.8 lbs 12000EC soil	36 g straw	117 g gyp	200 mL mol	30 g Fert	--
	28	14.8 lbs 12000EC soil	23 g straw	70 g gyp	100 mL mol	30 g Fert	--

Amendment No.	Cylinder No.	Part 1	Part 2	Part 3	Part 4	Part 5	Part 6
	29	14.8 lbs 12000EC soil	29 g straw	94 g gyp	150 mL mol	30 g Fert	--
	30	14.8 lbs 12000EC soil	36 g straw	117 g gyp	200 mL mol	30 g Fert	--
	31	14.8 lbs 18000EC soil	23 g straw	70 g gyp	100 mL mol	30 g Fert	--
	32	14.8 lbs 18000EC soil	29 g straw	94 g gyp	150 mL mol	30 g Fert	--
	33	14.8 lbs 18000EC soil	36 g straw	117 g gyp	200 mL mol	30 g Fert	--
	34	14.8 lbs 18000EC soil	23 g straw	70 g gyp	100 mL mol	30 g Fert	--
	35	14.8 lbs 18000EC soil	29 g straw	94 g gyp	150 mL mol	30 g Fert	--
	36	14.8 lbs 18000EC soil	36 g straw	117 g gyp	200 mL mol	30 g Fert	--
3	37	14.8 lbs 5000EC soil	23 g straw	70 g gyp	100 mL mol	10 mL BioF	30 g Fert
	38	14.8 lbs 5000EC soil	29 g straw	94 g gyp	150 mL mol	20 mL BioF	30 g Fert
	39	14.8 lbs 5000EC soil	36 g straw	117 g gyp	200 mL mol	30 mL BioF	30 g Fert
	40	14.8 lbs 5000EC soil	23 g straw	70 g gyp	100 mL mol	10 mL BioF	30 g Fert
	41	14.8 lbs 5000EC soil	29 g straw	94 g gyp	150 mL mol	20 mL BioF	30 g Fert
	42	14.8 lbs 5000EC soil	36 g straw	117 g gyp	200 mL mol	30 mL BioF	30 g Fert
	43	14.8 lbs 12000EC soil	23 g straw	70 g gyp	100 mL mol	10 mL BioF	30 g Fert
	44	14.8 lbs 12000EC soil	29 g straw	94 g gyp	150 mL mol	20 mL BioF	30 g Fert
	45	14.8 lbs 12000EC soil	36 g straw	117 g gyp	200 mL mol	30 mL BioF	30 g Fert
	46	14.8 lbs 12000EC soil	23 g straw	70 g gyp	100 mL mol	10 mL BioF	30 g Fert
	47	14.8 lbs 12000EC soil	29 g straw	94 g gyp	150 mL mol	20 mL BioF	30 g Fert
	48	14.8 lbs 12000EC soil	36 g straw	117 g gyp	200 mL mol	30 mL BioF	30 g Fert
	49	14.8 lbs 18000EC soil	23 g straw	70 g gyp	100 mL mol	10 mL BioF	30 g Fert
	50	14.8 lbs 18000EC soil	29 g straw	94 g gyp	150 mL mol	20 mL BioF	30 g Fert
	51	14.8 lbs 18000EC soil	36 g straw	117 g gyp	200 mL mol	30 mL BioF	30 g Fert
	52	14.8 lbs 18000EC soil	23 g straw	70 g gyp	100 mL mol	10 mL BioF	30 g Fert
	53	14.8 lbs 18000EC soil	29 g straw	94 g gyp	150 mL mol	20 mL BioF	30 g Fert
	54	14.8 lbs 18000EC soil	36 g straw	117 g gyp	200 mL mol	30 mL BioF	30 g Fert
	55	14.8 lbs 5000EC soil	23 g straw	70 g gyp	100 g pulp	10 mL BioF	30 g Fert
	56	14.8 lbs 5000EC soil	29 g straw	94 g gyp	150 g pulp	20 mL BioF	30 g Fert
	57	14.8 lbs 5000EC soil	36 g straw	117 g gyp	200 g pulp	30 mL BioF	30 g Fert

Amendment No.	Cylinder No.	Part 1	Part 2	Part 3	Part 4	Part 5	Part 6
4	58	14.8 lbs 5000EC soil	23 g straw	70 g gyp	100 g pulp	10 mL BioF	30 g Fert
	59	14.8 lbs 5000EC soil	29 g straw	94 g gyp	150 g pulp	20 mL BioF	30 g Fert
	60	14.8 lbs 5000EC soil	36 g straw	117 g gyp	200 g pulp	30 mL BioF	30 g Fert
	61	14.8 lbs 12000EC soil	23 g straw	70 g gyp	100 g pulp	10 mL BioF	30 g Fert
	62	14.8 lbs 12000EC soil	29 g straw	94 g gyp	150 g pulp	20 mL BioF	30 g Fert
	63	14.8 lbs 12000EC soil	36 g straw	117 g gyp	200 g pulp	30 mL BioF	30 g Fert
	64	14.8 lbs 12000EC soil	23 g straw	70 g gyp	100 g pulp	10 mL BioF	30 g Fert
	65	14.8 lbs 12000EC soil	29 g straw	94 g gyp	150 g pulp	20 mL BioF	30 g Fert
	66	14.8 lbs 12000EC soil	36 g straw	117 g gyp	200 g pulp	30 mL BioF	30 g Fert
	67	14.8 lbs 18000EC soil	23 g straw	70 g gyp	100 g pulp	10 mL BioF	30 g Fert
	68	14.8 lbs 18000EC soil	29 g straw	94 g gyp	150 g pulp	20 mL BioF	30 g Fert
	69	14.8 lbs 18000EC soil	36 g straw	117 g gyp	200 g pulp	30 mL BioF	30 g Fert
	70	14.8 lbs 18000EC soil	23 g straw	70 g gyp	100 g pulp	10 mL BioF	30 g Fert
	71	14.8 lbs 18000EC soil	29 g straw	94 g gyp	150 g pulp	20 mL BioF	30 g Fert
	72	14.8 lbs 18000EC soil	36 g straw	117 g gyp	200 g pulp	30 mL BioF	30 g Fert
5	73	14.8 lbs 5000EC soil	23 g straw	60 mL SA	10 mL BioF	30 g Fert	--
	74	14.8 lbs 5000EC soil	29 g straw	80 mL SA	20 mL BioF	30 g Fert	--
	75	14.8 lbs 5000EC soil	36 g straw	100 mL SA	30 mL BioF	30 g Fert	--
	76	14.8 lbs 5000EC soil	23 g straw	60 mL SA	10 mL BioF	30 g Fert	--
	77	14.8 lbs 5000EC soil	29 g straw	80 mL SA	20 mL BioF	30 g Fert	--
	78	14.8 lbs 5000EC soil	36 g straw	100 mL SA	30 mL BioF	30 g Fert	--
	79	14.8 lbs 12000EC soil	23 g straw	60 mL SA	10 mL BioF	30 g Fert	--
	80	14.8 lbs 12000EC soil	29 g straw	80 mL SA	20 mL BioF	30 g Fert	--
	81	14.8 lbs 12000EC soil	36 g straw	100 mL SA	30 mL BioF	30 g Fert	--
	82	14.8 lbs 12000EC soil	23 g straw	60 mL SA	10 mL BioF	30 g Fert	--
	83	14.8 lbs 12000EC soil	29 g straw	80 mL SA	20 mL BioF	30 g Fert	--
	84	14.8 lbs 12000EC soil	36 g straw	100 mL SA	30 mL BioF	30 g Fert	--
	85	14.8 lbs 18000EC soil	23 g straw	60 mL SA	10 mL BioF	30 g Fert	--
	86	14.8 lbs 18000EC soil	29 g straw	80 mL SA	20 mL BioF	30 g Fert	--

Amendment No.	**Cylinder No.**	**Part 1**	**Part 2**	**Part 3**	**Part 4**	**Part 5**	**Part 6**
	87	14.8 lbs 18000EC soil	36 g straw	100 mL SA	30 mL BioF	30 g Fert	--
	88	14.8 lbs 18000EC soil	23 g straw	60 mL SA	10 mL BioF	30 g Fert	--
	89	14.8 lbs 18000EC soil	29 g straw	80 mL SA	20 mL BioF	30 g Fert	--
	90	14.8 lbs 18000EC soil	36 g straw	100 mL SA	30 mL BioF	30 g Fert	--
6	91	14.8 lbs 5000EC soil	29 g straw	30 g Fert	20 mL BioF	--	--
	92	14.8 lbs 5000EC soil	94 g gyp	30 g Fert	20 mL BioF	--	--
	93	14.8 lbs 5000EC soil	29 g straw	94 g gyp	20 mL BioF	30 g Fert	--
	94	14.8 lbs 5000EC soil	29 g straw	94 g gyp	--	--	--
	95	14.8 lbs 5000EC soil	29 g straw	30 g Fert	20 mL BioF	--	--
	96	14.8 lbs 5000EC soil	94 g gyp	30 g Fert	20 mL BioF	--	--
	97	14.8 lbs 5000EC soil	29 g straw	94 g gyp	20 mL BioF	30 g Fert	--
	98	14.8 lbs 5000EC soil	29 g straw	94 g gyp	--	--	--
	99	14.8 lbs 12000EC soil	29 g straw	30 g Fert	20 mL BioF	--	--
	100	14.8 lbs 12000EC soil	94 g gyp	30 g Fert	20 mL BioF	--	--
	101	14.8 lbs 12000EC soil	29 g straw	94 g gyp	20 mL BioF	30 g Fert	--
	102	14.8 lbs 12000EC soil	29 g straw	94 g gyp	--	--	--
	103	14.8 lbs 12000EC soil	29 g straw	30 g Fert	20 mL BioF	--	--
	104	14.8 lbs 12000EC soil	94 g gyp	30 g Fert	20 mL BioF	--	--
	105	14.8 lbs 12000EC soil	29 g straw	94 g gyp	20 mL BioF	30 g Fert	--
	106	14.8 lbs 12000EC soil	29 g straw	94 g gyp	--	--	--
	107	14.8 lbs 18000EC soil	29 g straw	30 g Fert	20 mL BioF	--	--
	108	14.8 lbs 18000EC soil	94 g gyp	30 g Fert	20 mL BioF	--	--
	109	14.8 lbs 18000EC soil	29 g straw	94 g gyp	20 mL BioF	30 g Fert	--
	110	14.8 lbs 18000EC soil	29 g straw	94 g gyp	--	--	--
	111	14.8 lbs 18000EC soil	29 g straw	30 g Fert	20 mL BioF	--	--
	112	14.8 lbs 18000EC soil	94 g gyp	30 g Fert	20 mL BioF	--	--
	113	14.8 lbs 18000EC soil	29 g straw	94 g gyp	20 mL BioF	30 g Fert	--
	114	14.8 lbs 18000EC soil	29 g straw	94 g gyp	--	--	--
	115	14.8 lbs 5000EC soil	29 g straw	60 mL SA/94 g gyp		10 mL BioF	30 g Fert

Amendment No.	Cylinder No.	Part 1	Part 2	Part 3	Part 4	Part 5	Part 6
7	116	14.8 lbs 5000EC soil	29 g straw	80 mL SA/94 g gyp		20 mL BioF	30 g Fert
	117	14.8 lbs 5000EC soil	29 g straw	100 mL SA/94 g gyp		30 mL BioF	30 g Fert
	118	14.8 lbs 5000EC soil	29 g straw	60 mL SA/94 g gyp		10 mL BioF	30 g Fert
	119	14.8 lbs 5000EC soil	29 g straw	80 mL SA/94 g gyp		20 mL BioF	30 g Fert
	120	14.8 lbs 5000EC soil	29 g straw	100 mL SA/94 g gyp		30 mL BioF	30 g Fert
	121	14.8 lbs 12000EC soil	29 g straw	60 mL SA/94 g gyp		10 mL BioF	30 g Fert
	122	14.8 lbs 12000EC soil	29 g straw	80 mL SA/94 g gyp		20 mL BioF	30 g Fert
	123	14.8 lbs 12000EC soil	29 g straw	100 mL SA/94 g gyp		30 mL BioF	30 g Fert
	124	14.8 lbs 12000EC soil	29 g straw	60 mL SA/94 g gyp		10 mL BioF	30 g Fert
	125	14.8 lbs 12000EC soil	29 g straw	80 mL SA/94 g gyp		20 mL BioF	30 g Fert
	126	14.8 lbs 12000EC soil	29 g straw	100 mL SA/94 g gyp		30 mL BioF	30 g Fert
	127	14.8 lbs 18000EC soil	29 g straw	60 mL SA/94 g gyp		10 mL BioF	30 g Fert
	128	14.8 lbs 18000EC soil	29 g straw	80 mL SA/94 g gyp		20 mL BioF	30 g Fert
	129	14.8 lbs 18000EC soil	29 g straw	100 mL SA/94 g gyp		30 mL BioF	30 g Fert
	130	14.8 lbs 18000EC soil	29 g straw	60 mL SA/94 g gyp		10 mL BioF	30 g Fert
	131	14.8 lbs 18000EC soil	29 g straw	80 mL SA/94 g gyp		20 mL BioF	30 g Fert
	132	14.8 lbs 18000EC soil	29 g straw	100 mL SA/94 g gyp		30 mL BioF	30 g Fert
Controls	133	14.8 lbs 5000EC soil	--	--	--	--	--
	134	14.8 lbs 5000EC soil	--	--	--	--	--
	135	14.8 lbs 12000EC soil	--	--	--	--	--
	136	14.8 lbs 12000EC soil	--	--	--	--	--
	137	14.8 lbs 18000EC soil	--	--	--	--	--
	138	14.8 lbs 18000EC soil	--	--	--	--	--
	139	14.8 lbs 5000EC soil	--	--	--	--	--
	140	14.8 lbs 5000EC soil	--	--	--	--	--
	141	14.8 lbs 12000EC soil	--	--	--	--	--
	142	14.8 lbs 12000EC soil	--	--	--	--	--
	143	14.8 lbs 18000EC soil	--	--	--	--	--
	144	14.8 lbs 18000EC soil	--	--	--	--	--

Amendment No.	Cylinder No.	Part 1	Part 2	Part 3	Part 4	Part 5	Part 6
8	145	14.8 lbs 5000EC soil	200 g Sand	--	--	--	--
	146	14.8 lbs 5000EC soil	670 g Sand	--	--	--	--
	147	14.8 lbs 5000EC soil	200 g Sand	--	--	--	--
	148	14.8 lbs 5000EC soil	670 g Sand	--	--	--	--
	149	14.8 lbs 12000EC soil	200 g Sand	--	--	--	--
	150	14.8 lbs 12000EC soil	670 g Sand	--	--	--	--
	151	14.8 lbs 12000EC soil	200 g Sand	--	--	--	--
	152	14.8 lbs 12000EC soil	670 g Sand	--	--	--	--
	153	14.8 lbs 18000EC soil	200 g Sand	--	--	--	--
	154	14.8 lbs 18000EC soil	670 g Sand	--	--	--	--
	155	14.8 lbs 18000EC soil	200 g Sand	--	--	--	--
	156	14.8 lbs 18000EC soil	670 g Sand	--	--	--	--

Notes:

BioF = BioFlora Fertilizer
gyp = gypsum
Fert = 10-20-10 fertilizer
SA = 15%(vol) sulfuric acid
mol = sugar beet molasses
pulp = sugar beet pulp (wet pressed)

June 29, 2018

North Dakota Department of Mineral Resources – Oil & Gas Division
600 East Boulevard Avenue Dept. 405
Bismarck, ND 58505-0840

Attn: Mr. Cody VanderBusch – Reclamation Specialist
P: [701] 328-8018
E: cwvanderbusch@nd.gov

Re: Q4 Quarterly Progress Report (April 1, 2018 to June 30, 2018)
NDIC Brine Remediation Study
NE ¼ S26-T161N-82W (48.746589, -101.256850)
Bottineau County, North Dakota
Terracon Project No. M1177088

Dear Mr. VanderBusch:

This letter, serving as the quarterly report, provides an update of our progress on the NDIC Brine Remediation Study for the site located near Renville, North Dakota, and in our laboratory bench scale testing. Below, we discuss the progress of the project achieved during Quarter 1 (Q1), Quarter 2 (Q2), Quarter 3 (Q3), and more detailed description for Quarter 4 (Q4), as well as, what we plan to begin or continue in Quarter 5 (Q5).

Brief Overview of Previously Reported Work

Per our original work plan, our baseline assessment of the site included subsurface exploration and soil sampling/testing to determine the boundaries of the original brine pond and the extent of the brine release. Field-testing methods as previously discussed in our Baseline Site Assessment Report, dated December 21, 2017, and were also used to determine and map areas impacted by brine. Upon completion of the subsurface exploration and soil sampling/testing, Terracon designed, then implemented, 12 test plots at various locations of which contained different brine concentrations (refer to Baseline Site Assessment). As part of the field study, nine different test plots were installed at the site to analyze the impact of various applied remediation techniques and construction. Three phytoremediation cells (PRCs) were also installed as potential brine-impacted plot “flush water” remediation alternatives on the site.

After completion of the fieldwork, during the end of Q1 (July 1, 2017 to September 30, 2017) and at the beginning of Q2 (October 1, 2017 to December 31, 2017), a Baseline Site Assessment Report was prepared for the project which includes the results of our subsurface exploration/sampling and field/laboratory soil and water testing. The Baseline Assessment Report

also contained commentary on our various test plot designs and implementation, including photographs taken during construction of the field test plots.

Quarter 3 (January 1, 2018 to March 31, 2018) focused on the collecting and analyzing data obtained from testing and observing the laboratory test cells, planting crop seeds in the test cells, and salt migration in larger-scale column test cells. A total of 156 laboratory test cells were constructed with seven (7) different amendments to test success rates of each. Along with the amendments, a set of control test cells containing no alterations were also constructed. Each test cell was watered weekly and tested for EC to document any decreases observed (12 weeks total). All cells appeared to indicate reduction in EC measurements with some amendments performing better than others.

In addition to small-scale laboratory test cells, two larger-scale test columns were constructed. These test columns were designed and constructed to simulate and test a drainage layer separating amended soil from deeper brine-impacted soils and deeper clean soil stratum. As expected, EC values decreased at the top of the columns as more water was added; however, the efficiency of the drainage layers appeared to be less successful due to a drastic increase in EC levels in the bottom, non-impacted soil layer.

Quarter 3 also included planting and monitoring germination of crop plants in the laboratory test cells. Each cell was planted with five types of crop seeds including: alfalfa, barley, soybeans, sunflowers, and canola. During the latter part of Q3 and into Q4 (April 1, 2018 to June 30, 2018) the cells were monitored for germination and data was analyzed to indicate which plant type, if any, had more success in brine-impacted soils, and if the addition of amendments increased or decreased the germination rate.

Fieldwork continued in Q4 through activities including tilling and planting crop seeds within the field test plots. Similar to the laboratory test cells, five plant types were planted in rows to observe germination and plant growth.

Further details of activities in Q4 and plans for Q5 (July 1, 2018 to September 30, 2018) are discussed in the following paragraphs.

Germination Rates in Laboratory Test Cells

The 156 laboratory test cells were observed and recorded for germination of the five varieties of crops for about one month, which was about the time when newly germinated plants ceased. The data was collected and analyzed for total germination success (Figure 1) and comparing germination rates with the soil EC value at the time of planting (Figure 2). Figure 1 is preliminary and will contain at least one more set of planting data, which will be completed in Q5. Based on preliminary results, barley appeared to germinate the most successfully of the crops planted by a significant margin. This data is a bit unexpected since we planted a “salt tolerant” variety of alfalfa and it was the second least successful germinator. Although barley was the best germinator, the results indicate poor conditions after three months of normal precipitation with just over 50 percent being the most successful germination rate.

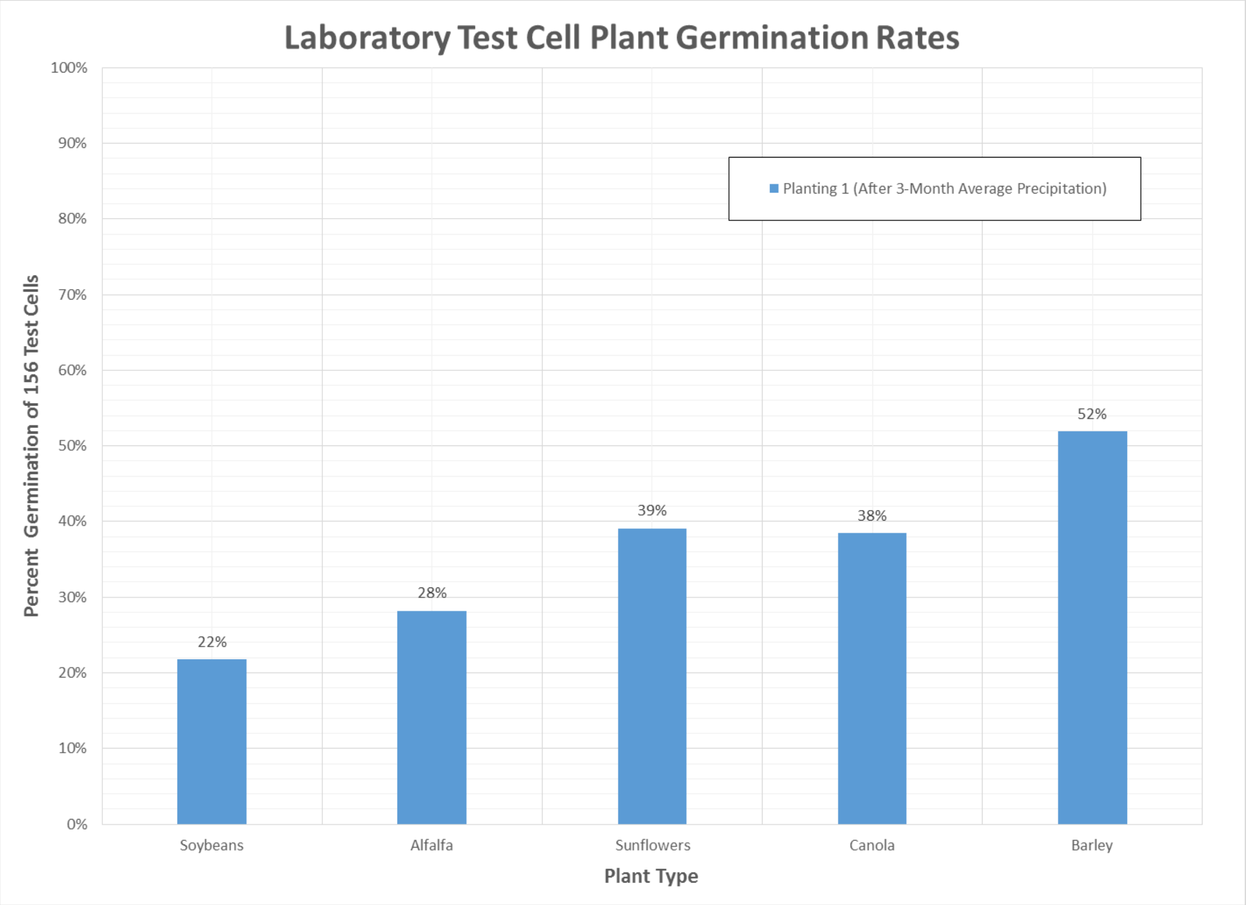


Figure 1: Laboratory test cell preliminary germination rate results from our first planting.

Of the plants that did germinate, the results indicate that germination is most successful in soils with EC values of less than 3,000 µS/cm (refer to Figure 2). Electrical conductivity values of greater than 3,000 µS/cm appear to have a fairly drastic effect on germination rates dropping them from 80 to 100 percent down to less than 70 percent within a range of 3,000 to 4,000 µS/cm, diminishing to rates below 20 percent thereafter. Preliminary results indicate that whichever method is used to amend the soil at a brine-impacted site, in hopes of returning the land to its original land use (likely agriculture), should reduce the EC values to less than 3,000 µS/cm for successful plant growth. Further discussion about this data and future plans for this portion of the project are discussed in the latter sections of this report.

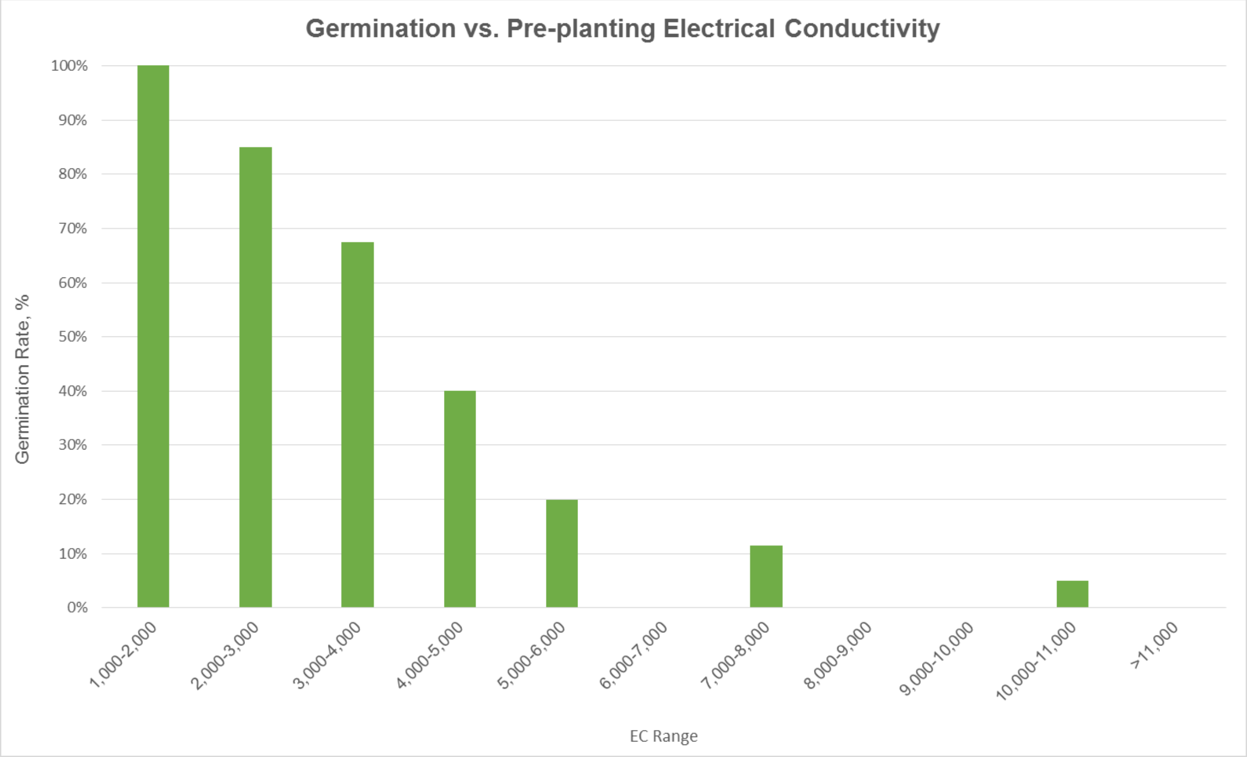


Figure 2: Illustration of the results of germination rate compared to the EC value at the time of seed planting.

Field Test Plot Updates

The field test plots were tilled and planted using a small-scale seeder to achieve consistent seed depth, row width, and row straightness. Five rows of each of the five crop varieties were planted in each test plot. The seeds were sown at approximately 1 ½ inches in depth and the rows were about 20 feet long (the approximate width of the plots). We performed a site visit on June 12, 2018 to check on the germination progress and water if needed. The area had experienced reasonably heavy rains after planting, so the plots were fairly moist. Germination success varied between plots fairly drastically with several of the plots indicating positive growth and others with little to no germination occurring (Figures 3-5).

During our visit on June 12th, we also observed the phytoremediation cells (PRC) to see if vegetation had been growing in them. The cattail transplants in PRC-1 and PRC-3 appeared to be growing successfully, along with other plant types and weeds (Figures 6-7). Phytoremediation cell 2 contained vast plant growth containing primarily weeds consisting mainly of lambsquarters and kochia (Figure 8). In the early stages of Q5, Terracon personnel will be observing and recording the plants growing at the site and in our cells as part of our on-going monitoring; and adding data to our original vegetation survey.

Figure 3: Image of successful germination at test plot 1B.

Figure 4: Image of minimal germination within test plot 3B.

Figure 5: Image of successful germination at test plots 5A (background) and 5B (foreground).

Figure 6: Image of plant growth in PRC-1.

Figure 7: Image of plant growth and retained water in PRC-3.

Figure 8: Image of plant growth in PRC-2.

Continued Laboratory Test Cell Testing

After the laboratory germination from the first stage of planting had concluded, the plants were removed from the test cells. Our initial EC data included 12 weeks of testing during a period of regular watering to simulate typical rainfall in western North Dakota (about 1.6 inches per month). We decided to obtain additional data from the test cells by simulating a high volume flooding situation. Over the span of about two weeks, approximately 13 inches and 20 inches equivalent of rainfall was allowed to percolate through the two sets of cells, respectively. Adding the flood water to our original watering volume, the total amount of water introduced to the cells was equivalent to 20 inches (average annual rainfall) and 30 inches (above average annual rainfall) of rainfall, respectively.

After flooding the cells had been completed, we measured the EC values in the same fashion as our 12-week data set. Based on the results, dramatic decreases in EC levels were observed. The table below illustrates the average change in EC values for each amendment type from our original 12-week data set, as well as, the average change after our 2-week water flooding event.

Amendment No.	Amendment Description	Average EC Reduction	Average EC Reduction After 1-Yr Flooding
1	BioFlora spray/fertilizer	42%	77%
2	Straw/gypsum/beet molasses/fertilizer	12%	66%
3	Straw/gypsum/beet molasses/Bioflora spray/fertilizer	22%	71%
4	Straw/gypsum/beet pulp/BioFlora spray/fertilizer	24%	75%
5	Straw/sulfuric acid/BioFlora spray/fertilizer	40%	81%
6	Straw/gypsum/BioFlora spray/fertilizer	50%	83%
7	Straw/sulfuric acid-gypsum mix/BioFlora spray/fertilizer	53%	80%
8	Clean, coarse sand	40%	80%
Controls	No soil amendments added	54%	81%

As indicated in the table above, there were drastic decreases in EC values after performing water flooding. During the latter portion of the 2-week watering period, over 40 test cells, which contained remaining crop seeds from our original planting had germinated. During our original germination data collection, these cells indicated little to no germination. This appears to indicate that even in brine-rich soils, the seeds do not necessarily die, but more so may become dormant until brine levels are reduced to a tolerable level.

Another observation of collected EC data was that in each amendment method, the results indicated a typically higher reduction in EC values of high-level EC soils (~18,000 µS/cm) and less drastically decreases in lower-level EC soils (~5,000 µS/cm) after water flooring was performed. The table below illustrates the EC level decreases with respect to each soil EC level for each amendment method.

EC Soil Level	**Soil Amendment Number/EC Reduction**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8** [1]	**Control**
~5,000 µS/cm	61%	45%	49%	58%	64%	68%	64%	66%	66%
~12,000 µS/cm	82%	71%	79%	79%	85%	89%	86%	89%	85%
~18,000 µS/cm	87%	83%	86%	89%	92%	92%	90%	84%	91%

1. Amendment number 8 was the only amendment method to not indicate the trend of greater reduction with higher original EC level soil.

Quarter 5 Planned Activities

Although the EC levels decreased dramatically after water flooding occurred, there is still potential for chlorides to be present. Since brine contamination is determined by EC values and chloride concentrations, in the early portion of Q5 the test cells will be field tested for chloride concentrations. The results of the chloride testing may indicate whether the water flooding did indeed reduce the total brine in the soils, or simply lowered the EC values without removing the chlorides. If chlorides are within a tolerable level, we will be planting a second set of seeds in the laboratory test cells to retest germination. This information will be useful to indicate how much water is needed to flush brine out of soil. Based on literature, common values assumed to be needed to reduce brine is a 2-year equivalent in rainfall. We are hoping to illustrate that less water can be used to reduce brine contamination to tolerable levels.

Continuation of field test plots’ plant growth will also be on-going during Q5. Also, we will be returning to the field site to test the EC readings in the later part of summer to determine if there has been any change in EC levels within the test plots.

If you have any questions concerning this report, please contact us.

Sincerely,
Terracon Consultants, Inc.

for

Corey D. Lindeman, EI
Staff Engineer

Daniel F. Schneider, CHMM
National Director
Site Investigation and Remediation
Principal

September 28, 2018

North Dakota Department of Mineral Resources – Oil & Gas Division
600 East Boulevard Avenue Dept. 405
Bismarck, ND 58505-0840

Attn: Mr. Cody VanderBusch – Reclamation Specialist
P: (701) 328-8018
E: cwvanderbusch@nd.gov

Re: Q5 Quarterly Progress Report (July 1, 2018 to Septemebr 30, 2018)
NDIC Brine Remediation Study
NE ¼ S26-T161N-82W (48.746589, -101.256850)
Bottineau County, North Dakota
Terracon Project No. M1177088

Dear Mr. VanderBusch:

This letter, serving as the quarterly report, provides an update of our progress on the NDIC Brine Remediation Study for the site located near Renville, North Dakota. Below, we summarize the progress of the project achieved during Quarters 1 – 4 (Q1 – Q4) with more detailed description for Quarter 5 (Q5), and our plan for Quarter 6 (Q6).

Brief Overview of Previously Reported Work

Per our original work plan, our baseline assessment of the site included subsurface exploration and soil sampling/testing to determine the boundaries of the original brine pond and the extent of the brine release. Field-testing methods, as previously discussed in our Baseline Site Assessment Report, dated December 21, 2017, were also used to determine and map impacted areas.

Upon completion of the subsurface exploration and soil sampling/testing, Terracon designed and implemented 12 test plots at various locations which contained different brine concentrations (refer to Baseline Site Assessment). As part of the field study, nine of the 12 test plots were installed at the site to analyze the impact of various applied remediation techniques and plot construction. Three phytoremediation cells (PRCs) were also installed to assess potential brine-impacts remediation using “flush water” remediation alternatives.

After completion of the fieldwork during the end of Q1 (July 1, 2017 to September 30, 2017) and at the beginning of Q2 (October 1, 2017 to December 31, 2017), a Baseline Site Assessment Report was prepared for the project which included the results of our subsurface exploration/sampling and field/laboratory soil and water testing. The Baseline Assessment Report

also contained commentary on our various test plot designs and implementation, including photographs taken during construction of the field test plots.

Quarter 3 (January 1, 2018 to March 31, 2018) focused on collecting and analyzing data obtained from testing and observing laboratory test cells, planting crop seeds in test cells, and salt migration in larger-scale column test cells. A total of 156 laboratory test cells were constructed with seven different amendments to test electrical conductivity (EC) measurement rates. A set of control test cells containing no alterations were also constructed.

Each test cell was watered weekly and tested for EC to document observed measurements for a total of 12 weeks total. Based upon of the results of the lab study, all cells appeared to indicate reduction in EC measurements with some amendments performing better than others.

Two larger-scale test columns were designed and constructed to simulate and test a drainage layer separating amended soil from deeper brine-impacted soils and deeper non-Brine impacted soil stratum. Approximately 40 inches of water was added to the cell over a 5-week span and allowed to drain through the column. As expected, EC values decreased at the top of the columns as more water was added; however, the efficiency of the drainage layers appeared to be less successful due to a significant increase in EC levels in the bottom, non-impacted soil layer. The dissolved chloride in the brine appears to be mobilized and transported from the upper column and deposited in the lower stratum of the column.

Quarter 3 also included planting and monitoring germination of crop plants in the laboratory test cells. Each cell was planted with five types of crop seeds including: alfalfa, barley, soybeans, sunflowers, and canola. During the latter part of Q3 and into Q4 (April 1, 2018 to June 30, 2018) the cells were monitored for germination and data was collected and analyzed to indicate which plant type (s), if any, had more success germinating in brine-impacted soils, and if the addition of amendments increased or decreased the observed germination rate.

Quarter 4 focused on planting crop seeds within the field tests plots and observing germination rates. Please refer to the Q4 Quarterly Progress Report (April 1, 2018 to June 30, 2018) for details of activities and findings related to germination rates in laboratory test cells, field test plot updates, and additional observation in amended laboratory test cells.

Quarter 5 (July 1, 2018 to September 30, 2018) focused on the following tasks:

- Ongoing monitoring of field test plots;
- Germination of a subsequent round of seeding the laboratory test cells;
- Fresh water flushing of field test plots 3A and 3B with high volumes of water to reduce EC;
- Collecting EC data in field test plots pre- and post-flushing; and
- Planting winter wheat in the field test plots (except test plots 3B and all PRCs).

Further details of activities in Q5 and plans for Q6 (October 1, 2018 to December 31, 2018) are discussed in the following paragraphs.

Subsequent Seeding in Laboratory Test Cells

After laboratory germination from the first stage of planting had concluded, the plants were extracted from the test cells. Initial EC data included 12 weeks of testing during a period of regular watering to simulate typical rainfall in western North Dakota (about 1.6 inches per month). EC values reduced rapidly during the early weeks of this testing period, however the EC value rate of reduction stalled over the course of the 12-week testing period.

A second period of testing was conducted to test the impact of high-volume water flooding on further reducing EC values beyond the stalled rates of reduction at the end of the 12-week average precipitation period. Two sets of test cells were flooded over a 2-week period, simulating an average annual precipitation equivalent in the first set (20 inches) and an above-average annual precipitation equivalent in the second set (30 inches). The equivalent to approximately 13 inches of precipitation was introduced to the first set of test cells and the equivalent to 20 inches of precipitation was introduced to the second set of test cells. The added water was allowed to percolate through the two sets of cells prior to the simulated flooding events. Additional water was then added to simulate approximately 20 inches of rainfall in the first set of test cells (average annual rainfall) and 30 inches in the second set of test cells (above average annual rainfall).

Significant decreases in EC levels were observed after flooding the cells had been completed. The table below illustrates the average change in EC values for each amendment type from the original 12-week data set and the average change after the 2-week simulated flooding event.

Amendment No.	Amendment Description	Average EC Reduction After 12-Week Period	Average EC Reduction After 1-Yr Flooding
1	BioFlora spray/fertilizer	42%	77%
2	Straw/gypsum/beet molasses/fertilizer	12%	66%
3	Straw/gypsum/beet molasses/Bioflora spray/fertilizer	22%	71%
4	Straw/gypsum/beet pulp/BioFlora spray/fertilizer	24%	75%
5	Straw/sulfuric acid/BioFlora spray/fertilizer	40%	81%
6	Straw/gypsum/BioFlora spray/fertilizer	50%	83%
7	Straw/sulfuric acid-gypsum mix/BioFlora spray/fertilizer	53%	80%
8	Clean, coarse sand	40%	80%
Controls	No soil amendments added	54%	81%

As indicated in the table above, significant decreases in EC values were observed after simulated water flooding (Figure 1). During the latter portion of the 2-week simulated flood event period, over 40 test cells containing remaining crop seeds from our original planting germinated. During our original germination data collection, these cells indicated little to no germination. The germination post-flooding appears to indicate the seeds remained dormant until brine levels were reduced to a level capable of supporting germination.

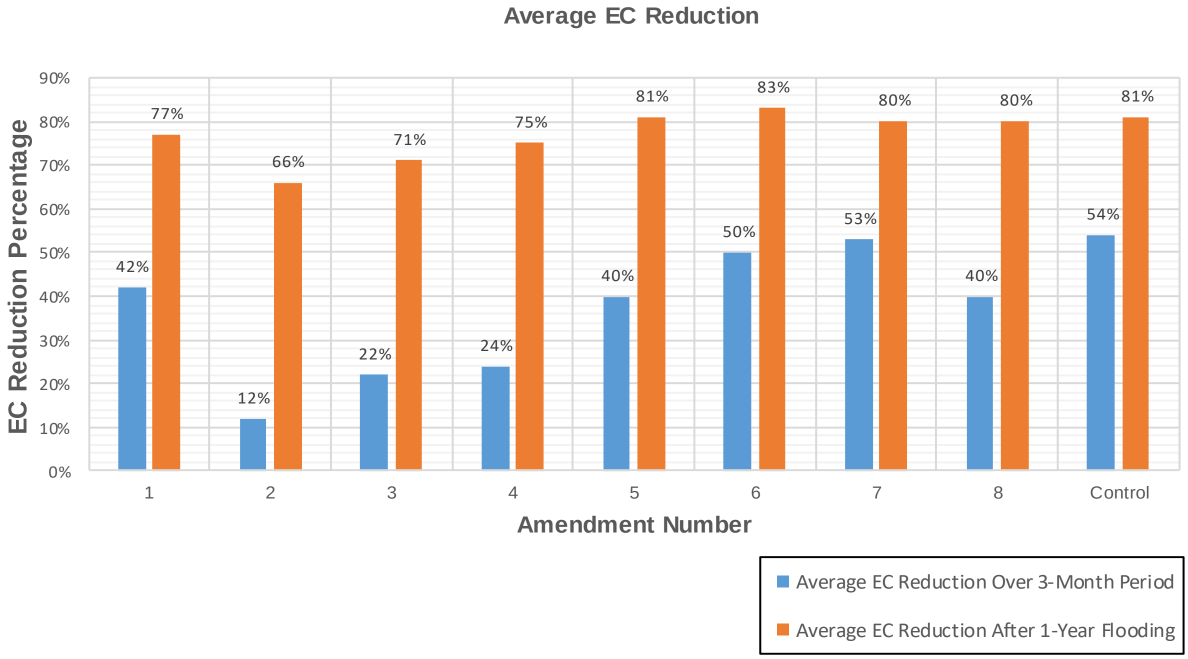


Figure 1: Average EC reduction over a 3-month period compared to 1-year simulated flooding event.

EC values also indicated a typically higher reduction in high-level EC soils (~18,000 µS/cm) and less reduction in lower-level EC soils (~5,000 µS/cm) after simulated flooding. All test cell soil EC values following the flood event were below 3,000 µS/cm. Laboratory data from Amendment 6 is presented below to illustrate the reduction of soil EC levels (Figures 2-4 on the following pages). The table on the following page illustrates EC level decreases with respect to each soil EC level for each amendment method.

EC Soil Level	**Soil Amendment Number/EC Reduction Post-Flooding**								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**[1]	**Control**
~5,000 µS/cm	61%	45%	49%	58%	64%	68%	64%	66%	66%
~12,000 µS/cm	82%	71%	79%	79%	85%	89%	86%	89%	85%
~18,000 µS/cm	87%	83%	86%	89%	92%	92%	90%	84%	91%

Amendment number 8 was the only amendment method to not indicate the trend of greater reduction with higher original EC level soil.

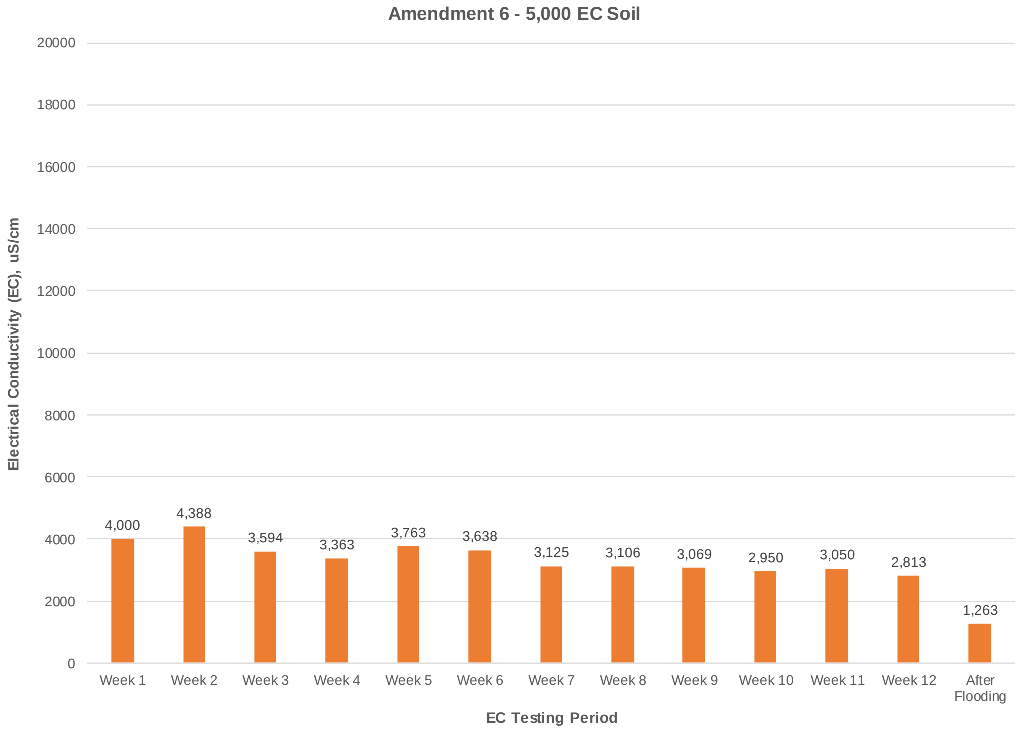


Figure 2: Example of EC changes from Amendment 6 EC 5,000 µS/cm soils.

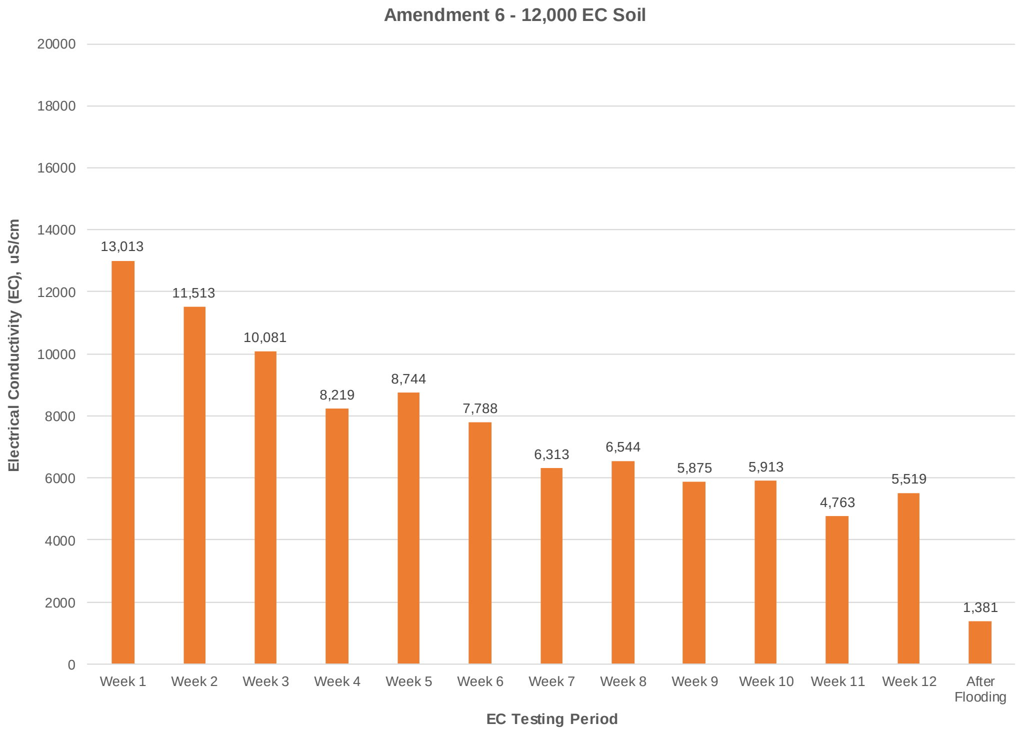


Figure 3: Example of EC changes from Amendment 6 EC 12,000 µS/cm soils.

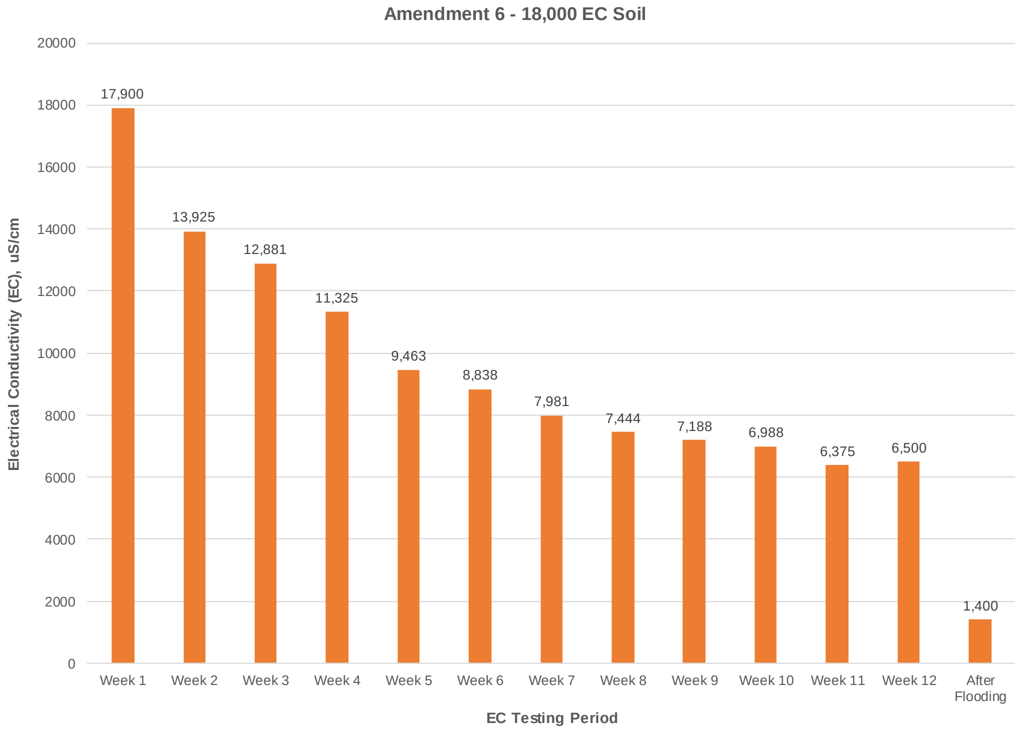


Figure 4: Example of EC changes from Amendment 6 EC 18,000 µS/cm soils.

Germination Rates in Laboratory Test Cells

Following the 2-week simulated flooding event of soils and subsequent reduced EC levels, the 156 laboratory test cells were replanted with the same crop types planted during the laboratory tests conducted in Q4 (soybean, alfalfa, sunflowers, barley, and canola). The test cells were observed and germination notes were recorded for each of the five varieties of crops for approximately one month. This timeframe represents the point at which newly germinated plants ceased.

The data was collected and analyzed for crop germination success for all crop types and compared to the results following the 3-month average precipitation tests conducted in Q4 (Figure 5). A 100% germination rate was observed in the laboratory test cells following the 2-week simulated flood event regardless of original EC values and amendment methods used (Figure 6 on the following page).

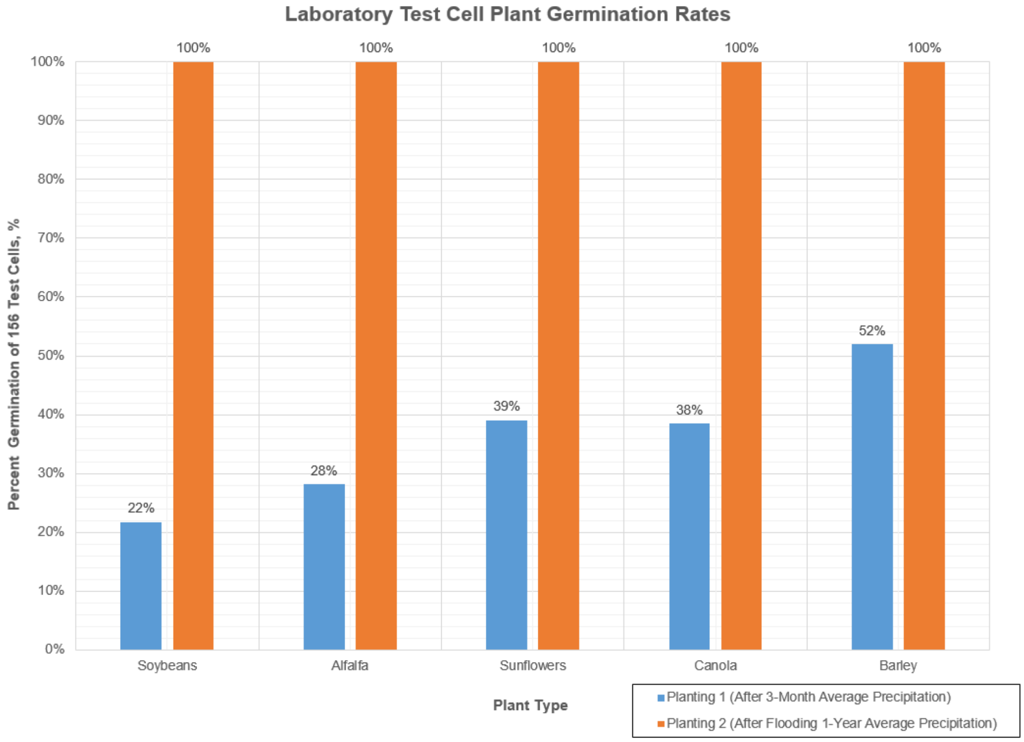


Figure 5: Comparison of germination rates between test cell plantings using flooding vs natural precipitation.

Figure 6: Image of successful germination of Planting 2.

Field Test Plot Updates

Ongoing monitoring was conducted of the field test plots after seeding to collect general observations related to plant growth (germination). These observations are ongoing and will be presented in the Q6 final report.

Based on the simulated flooding data in the laboratory test cells and subsequent planting and germination rates, test plots 3A and 3B were flooded with water simulating approximately one year of precipitation. Potable water was delivered to the site by truck and used to flood 3B (Figure 7). Water recycled from PRC 3 was used to flood test plot 3A (Figure 7 on the following page). EC values for PRC 3 were taken prior to the recycling the water into test plot 3A. A comparison was made of the effectiveness of the source of the water and general observations were made. As expected, test plot 3B showed significant decreases in EC relative to test plot 3A due to lower EC and chlorides present in the potable water compared to source water recycled from PRC 3. Data supporting these observations and additional details will be presented in the Q6 final report.

An EC and chlorides survey was performed of the selected test plots and PRCs to be compared to the baseline assessment data. This data and comparison will be presented in the Q6 final report.

Planting winter wheat was conducted on the remaining test plots at the site except test plot 3B and PRCs. Planting of the crops (soybeans, alfalfa, sunflowers, barley, and canola) was conducted in test plot 3B based on the observed reduction of EC post-flooding and forecasted weather at the time of planting. Observations of germination for this cell will be reported in the Q6 final report.

Figure 7: Test plot 3B after simulated 1-year flooding event.

Figure 8: Test plot 3A after simulated 1-year flooding event.

Q6 Planned Activities

Terracon will prepare the final report for the study as part of Q6 activities. The final report will include general observations of the first round of planting in the test plots, observations of subsequent planting in the test plots, post-remediation EC and chloride survey results and comparisons to the original baseline assessment results, as well as conclusions and recommendations for test pilot projects based on the research conducted.

If you have any questions concerning this report, please contact us.

Sincerely,
Terracon Consultants, Inc.

(for)

Jonathan B. Ellingson
Project Director

Daniel F. Schneider, CHMM
National Director
Site Investigation and Remediation Principal

Preliminary Final Report

NDIC Brine Remediation Study
Bottineau County, North Dakota

January 4, 2019

Terracon Project No. M1177088

Prepared for:

NDIC Oil and Gas Division
Bismarck, North Dakota

Prepared by:

Terracon Consultants, Inc.
West Fargo, North Dakota

January 4, 2019

Terracon

Mr. Cody VanderBusch
Reclamation Specialist
NDIC Oil and Gas Division
600 East Boulevard Avenue Dept. 405
Bismarck, ND 58505-0840

Office 701-328-8020
Cell 701-391-1959

Re: Preliminary Final Report
NDIC Brine Remediation Study
NE ¼ S26-T161N-82W (48.746589, -101.256850)
Bottineau County, North Dakota
Terracon Project No. M1177088

Dear Mr. VanderBusch:

Terracon Consultants, Inc. (Terracon) is pleased to submit the attached Preliminary Final Report for the NDIC Brine Remediation Study at the above-referenced site located near Renville in Bottineau County, North Dakota. Below, we summarize the progress of the project achieved during Quarters 1-5 (Q1-Q5) with more detailed description for Quarter 6 (Q6) followed by our preliminary final report with findings and recommendations based on the data and observations to date. A final report will be issued pending review of the attached Preliminary Final Report by the NDIC and additional observations made in our study.

Sincerely,
Terracon Consultants, Inc.

Jonathan B. Ellingson, CPG
Principal, Office Manager

Leif H. Schonteich
Leif H. Schonteich, CSP, CHMM
Project Manager

Leif H. Schonteich (for)
Daniel F. Schneider, P.E.*, CHMM
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EXECUTIVE SUMMARY

The goal of this project was to gain valuable knowledge of techniques and results for remediating salt from the soil surrounding historical brine ponds. The objectives were to reclaim these impacted areas and return the areas back to productive crop land by researching test methods for remediation to minimize removing soil from the site, determine which methods work were successful to re-establish selected growing crops, ranking the methods based on the cost, reduction in soil salinity, and the health and vigor of the crops. A secondary objective was to provide criteria for guidance for methods and application rates for consideration in remediating brine impacts of varying concentrations at future sites.

Upon completion of the subsurface exploration and soil sampling/testing, Terracon designed and implemented 12 field test plots (test plots) at various locations within the selected brine-impacted site which contained different brine concentrations measured as electrical conductivity (EC) and chlorides. As part of the field study, nine of the test plots installed were to analyze the impact of various applied remediation techniques and three test plots were installed as phytoremediation cells (PRCs) to assess potential brine-impacts to water removed from specified test plots using phytoremediation.

The study progressed from field testing and construction to laboratory-based experimentation using different potential brine-reducing soil additives. During our field testing program, bulk sampling of brine-impacted soils was performed. For our laboratory-based experimentation, 156 total soil cells, containing various combinations and concentrations of selected potential brine-reducing additives, were prepared.

Another aspect of our study included constructing a larger scale test column to test the effectiveness of a gravel capillary break and/or installing drain tile. This experiment was performed to determine salt transport mechanisms through a soil column when watered from above, simulating to rainfall, and watering up from the bottom (simulating rising groundwater level).

Based on the observations of our activities conducted for the test plots, test cells, and test columns, Terracon recommends the following activities:

- Ongoing monitoring and maintenance of the test plots for at least two additional growing seasons to observe EC and chloride levels.
- Observing winter wheat germination in the spring.
- Native vegetation observations in the spring to observe if EC and community observations remain consistent over time and a correlation can be observed between soil EC and plant community development.
- Collecting and analyzing EC data from the test plots in the spring.
- A larger scale pilot project to test amending soil with gypsum and flushing with clean water as in Plot 3B.

PRELIMINARY FINAL REPORT
NDIC Brine Remediation Study
Bottineau County, North Dakota
Terracon Project No. M1177088
January 4, 2019

1.0 INTRODUCTION

1.1 Previous Work

Per our original work plan, our baseline assessment of the site included subsurface exploration and soil sampling/testing to determine approximate boundaries of the original brine pond and the extent of the brine release. Field-testing methods, as previously discussed in our Baseline Site Assessment Report, dated December 21, 2017, were also used to assess impacted areas.

Upon completion of the subsurface exploration and soil sampling/testing, Terracon designed and implemented 12 field test plots (test plots) at various locations which contained different brine concentrations (refer to Baseline Site Assessment Report) measured as electrical conductivity (EC) and chlorides. As part of the field study, nine of the test plots installed were to analyze the impact of various applied remediation techniques and three test plots were installed as phytoremediation cells (PRCs) to assess potential brine-impacts to water removed from specified test plots using phytoremediation.

After completion of the fieldwork during the end of Quarter 1 (Q1) (July 1, 2017 to September 30, 2017) and at the beginning of Quarter 2 (Q2) (October 1, 2017 to December 31, 2017), a Baseline Site Assessment Report was prepared for the project which included the results of our subsurface exploration/sampling and field/laboratory soil and water testing. The Baseline Site Assessment Report also contained commentary on various test plot designs and implementation, including photographs taken during construction of the test plots.

Quarter 3 (Q3) (January 1, 2018 to March 31, 2018) focused on collecting and analyzing data obtained from testing and observing laboratory test cells (test cells), planting crop seeds in the test cells, and salt migration in larger-scale test columns (test columns). A total of 156 test cells were constructed with seven different amendments to measure EC. A set of control test cells containing no alterations were also constructed.

Each test cell was watered weekly and tested for EC for 12 weeks. Based upon of the results of the EC measurements, the test cells appeared to indicate reduction in EC with some amendments performing better than others.

Two larger-scale test columns were designed and constructed to simulate and test a drainage layer separating amended soil from deeper impacted soils and deeper non-impacted soil stratum.

Approximately 40 inches of water was added to the test columns over a 5-week span and allowed to drain through each test column. As expected, EC values decreased at the top of the test columns as more water was added; however, the efficiency of the drainage layers appeared to be less successful due to an increase in EC levels in the bottom, non-impacted soil layer. The dissolved chloride in the brine appears to be mobilized and transported from the upper test column and deposited in the lower stratum of the test column.

Q3 also included planting and monitoring germination of crop plants in the test cells. Each test cell was planted with five types of crop seeds including: alfalfa, barley, canola, soybeans, and sunflowers. During the latter part of Q3 and into Quarter 4 (Q4) (April 1, 2018 to June 30, 2018) the test cells were monitored for germination and data was collected and analyzed to indicate plant type(s), if germination occurred, germination success in impacted soils, and if the addition of amendments increased or decreased the observed germination rate.

Q4 focused on planting crop seeds within the tests plots and observing germination rates. Please refer to the Q4 Quarterly Progress Report (April 1, 2018 to June 30, 2018) for details of activities and findings related to germination rates in test cells in the laboratory, test plot updates, and additional observation from amended test cells.

Quarter 5 (Q5) focused on ongoing monitoring of test plots and observations on germination rates within the test cells, flushing test plots Plot 3A and Plot 3B with high volumes of water and evaluating reduction in EC, collecting final EC measurements for the test plots and planting winter wheat. Please refer to the Q5 Quarterly Progress Report (July 1, 2018 to September 30, 2018) for a detailed reporting of the activities during this period.

Quarter 6 (Q6) focused on the following:

- Collecting and analyzing EC data from test plots;
- Collecting and analyzing chloride data from the test cells;
- Observation of winter wheat germination in Plots 1A, 1B, 2A, 3A, 4, 5A and 5B and second crop germination in Plot 3B;
- Cost comparison of remediation methods used; and
- Compiling data for the Preliminary Final Report.

1.2 Summary of Q6 Activities and Results

Test plot ECs were recorded as a baseline prior to test plot construction, immediately following construction of the test plots, prior to flushing in Plots 3A and 3B, and following removal of the first planting of crops in September 2018.

1.2.1 EC Data Observations

Terracon field screened EC using an EC meter (Spectrum Technologies, Inc. Model No. 2265FSTP) with a stainless-steel probe inserted directly into soil to assess the presence of salts in the soil. The EC meter provides a direct reading in microsiemens per centimeter (µS/cm). Based on our experience, the measurements within a one square foot area of similar soil type can typically vary by as much as 500 µS/cm from the average tested values.

Baseline EC readings were collected in a grid spacing at approximate 20-foot on center during the Baseline Assessment. Subsequent EC readings were collected in a grid spacing at approximately 2-foot on center upon construction of the test plots. EC readings were limited to the surface, one-foot below surface, and two feet below surface. The table below presents average EC for each test plot.

Table No. 1 –Test Plot Average EC Observations

Period	1A	1B	2A	2B	3A	3B	4	5A	5B
2017 Baseline (µS/cm)	13,545	16,679	3,290	8,857	11,342	9,945	7,284	14,640	15,390
2017 Post-Construction (µS/cm)	2,452	2,474	5,555	5,529	14,993	9,429	4,935	1,319	1,388
2018 Pre-Flush (µS/cm)	-	-	-	-	10,258	8,946	-	-	-
Fall 2018 (µS/cm)	2,665	4,206	4,290	-	10,371	4,332	4,899	1,279	1,457

-Data not collected

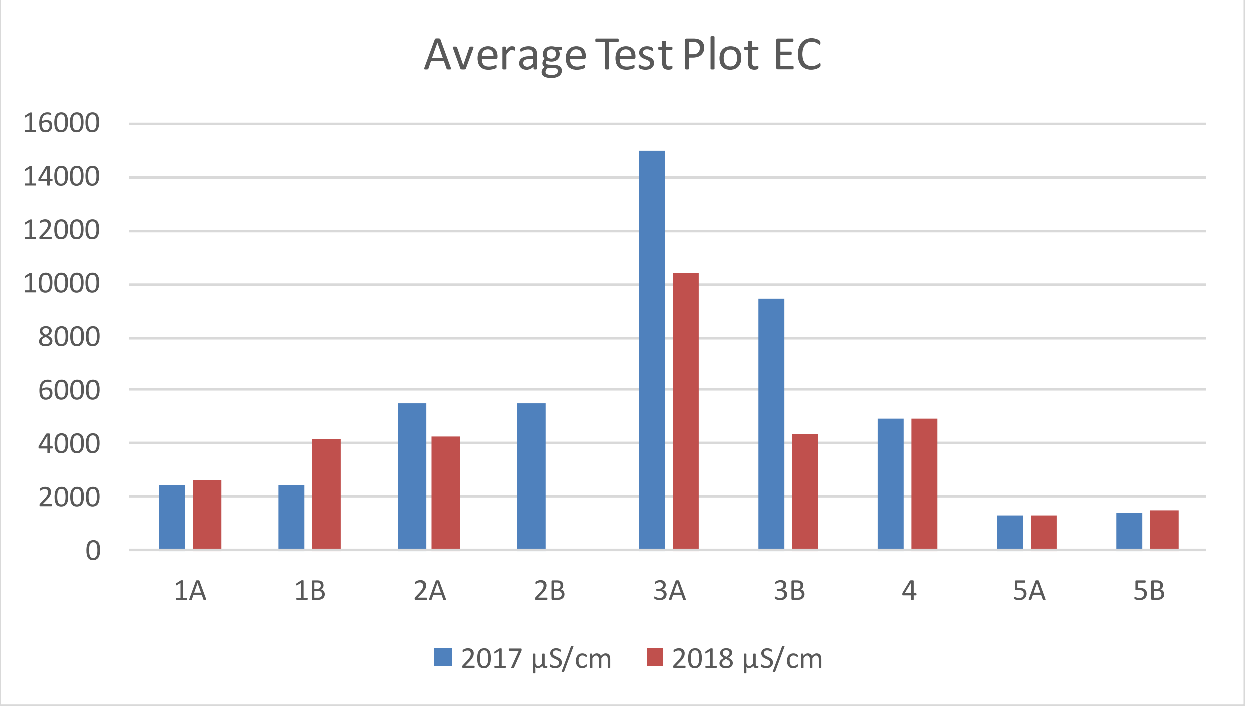

Figure 1: Average EC of each test plot from Fall 2017 to Fall 2018

The observations made from the EC measured during the study:

- Plots 1A and 1B increased indicating recontamination of the test plots. Recontamination determined to be attributable to surface waters infiltrating the test plots by higher than normal precipitation in June;
- Plot 2A decreased;
- Plot 2B was inundated by higher than normal precipitation in June and fall 2018 EC measurements were not made;
- Plots 3A and 3B EC decreased;
- Plot 4 EC remained approximately the same; and
- Plot 5A and 5B remained approximately the same.

For the purpose of this study, statistical confidence was not calculated. Generalizations are made from observed data from field measurements.

1.2.2 Laboratory Field Chlorides

Terracon field-tested soil samples with QuanTab® titration test strips to measure chloride content in laboratory test cells following the simulated 12-week simulated flooding period. Test cell samples were obtained from the top and bottom half of each test cell. Chloride concentrations ranged from below detection limits of 37 milligrams per liter (mg/L) to 486 mg/L (Appendix C, Table 1). Chloride concentrations below detection limits were found in 202 of the 312 samples collected from the top and bottom halves of the test cells.

1.2.3 Second Planting Observations

The original crops planted were removed at the end of the growing season. The test plots were tilled and replanted to observe germination of winter wheat except Plot 3B. Plot 3B was replanted with the five crops planted during the original planting period to test the effectiveness of flushing with fresh water. Second planting observations for germination were made October 30, 2018:

- Winter wheat germinated in Plots 1A, 5A, and 5B;
- Winter wheat did not germinate in Plots 1B, 2A, 2B, and 3A; and
- Alfalfa and barley germinated in Plot 3B.

1.2.4 Cost Comparison of Remediation Methods

Cost comparison of remediation methods used in the study are presented in section 5.3 of this report.

2.0 SCOPE OF SERVICES

The objective of this Preliminary Final Report is to summarize project results and achievements which also provides a data result package, cost summary analysis, and photographs of before and after conditions.

2.1 Standard of Care

Terracon's services were performed in a manner consistent with generally accepted practices of the profession undertaken in similar studies in the same geographical area during the same time. Terracon makes no warranties, either express or implied, regarding the findings, conclusions, or recommendations. Please note that Terracon does not warrant the work of laboratories, regulatory agencies, or other third parties supplying information used in the preparation of the report. These reporting services were performed in accordance with the scope of services agreed with you, our client, as reflected in our proposal (Terracon Proposal No. PM1177088 dated August 25, 2017) and were not restricted by American Society of Testing and Materials (ASTM) E1903-11.

2.2 Additional Scope Limitations

Findings, conclusions, and recommendations resulting from these services are based upon information derived from the on-site activities and other services performed under this scope of services; such information is subject to change over time. Certain indicators of the presence of hazardous substances, petroleum products, or other constituents may have been latent, inaccessible, unobservable, non-detectable, or not present during these services. We cannot represent that the site contains no hazardous substances, toxic materials, petroleum products, or other latent conditions beyond those identified during this assessment. Subsurface conditions may vary from those encountered at specific borings or wells or during other surveys, tests, assessments, investigations, or exploratory services. The data, interpretations, findings, and our recommendations are based solely upon data obtained at the time and within the scope of these services.

2.3 Reliance

This report has been prepared for the exclusive use of NDIC Oil and Gas Division and any authorization for use or reliance by any other party (except a governmental entity having jurisdiction over the site) is prohibited without the express written authorization of NDIC Oil and Gas Division and Terracon. Any unauthorized distribution or reuse is at NDIC Oil and Gas Division's sole risk. Notwithstanding the foregoing, reliance by authorized parties will be subject to the terms, conditions, and limitations stated in the proposal, Preliminary Final Report, and Contract between the State of North Dakota and Terracon. The limitation of liability defined in the terms and conditions is the aggregate limit of Terracon's liability to NDIC Oil and Gas Division and all relying parties unless otherwise agreed in writing.

3.0 FIELD ACTIVITIES

Terracon conducted the fieldwork under a site-specific health and safety plan (HASP) developed for this project. Work was performed using Occupational Safety and Health Agency (OSHA) Level D work attire consisting of hard hats, safety glasses, reflective vests, hearing protection, protective gloves, and protective boots.

3.1 Vegetation Study

A vegetation study was conducted to determine if the presence of specific plant species or plant communities at the site could potentially delineate the extent of contaminated soils. A survey of plant species was conducted at the southern portion of the site in Fall 2017. EC for identified plant species was determined by field testing surface and 1-foot depth soils. Observed EC was not evaluated above or below the thriving threshold, determined as a species having an apparent tolerance or preference to site conditions. However, the range of EC can be estimated based on plant species present. The table below presents general observations of EC for the plant species identified.

Table No. 2: Plant Species EC Observations

Species	Root System	Surface EC (µS/cm)	1-foot depth (µS/cm)
Alfalfa	Tap: Deep	300	3,300
Curly Dock	Tap: Shallow	400	2,600
Dogbane[2]	Rhizomatous/Branched: Deep	500	1,700
Cattail[2]	Rhizomatous and Fibrous: Shallow	2,200	2,300
Sweet Clover	Fibrous: Deep	2,300	4,100
Western Wheatgrass	Rhizomatous	2,400	3,500
Swtichgrass	Fibrous: Deep	2,400	3,500
Foxtail Barley[2]	Fibrous: Shallow	2,400	4,000
Spearscale[1]	Tap: Deep	3,300	8,000
Perennial Sow Thistle	Tap: Deep	3,500	3,500
Diffuse Knapweed	Tap with Laterals: Deep	3,500	3,500
Russian Thistle/Tumbleweed[1]	Tap with Extensive Laterals: Deep	6,800	9,800

[1] Salt/Alkaline Thriving [2] Water Thriving

Four plant species communities were selected from the overall grouping of plant species, observed soil EC, and aerial photography. Community A contained observed soil EC of 0-2,300 µS/cm and plant species with EC tolerance within this range. Community B contained observed soil EC between 2,200-4,000 µS/cm and plant species with EC tolerance within this range. Community C soil EC tolerance between 3,300-9,800 µS/cm and plant species with EC tolerance within this range. Community D contained observed soil EC of 9,500+ µS/cm and was populated nearly exclusively with Russian Thistle.

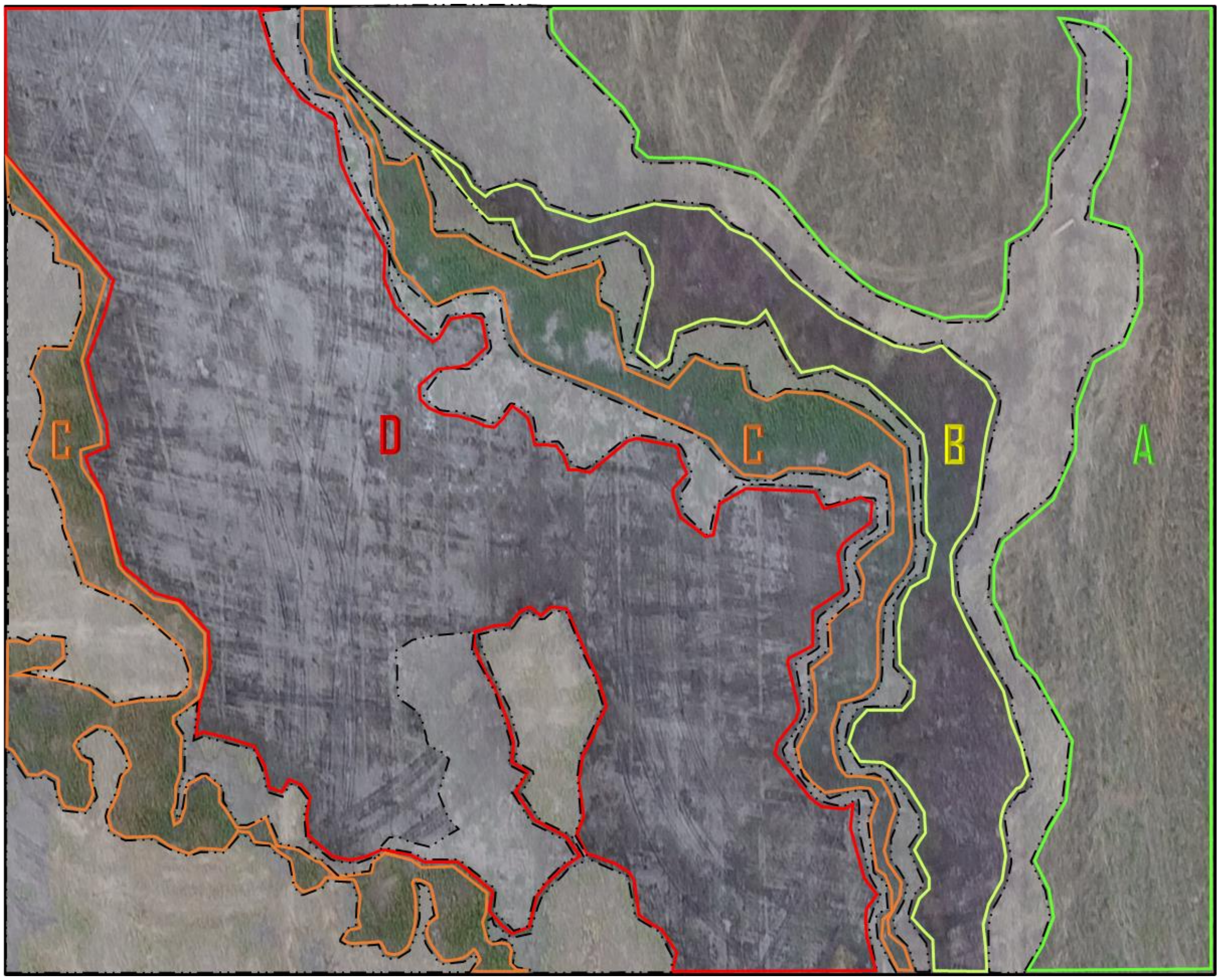

Figure 2: Plant species community illustration

3.2 Crop Planting

The test plots were planted with the same five crops planted in the laboratory test cells. Five rows of each crop were planted. Crop growth was monitored over the course of three months. Following the 2018 growing season, the crops were removed and EC was measured. Plots 1A, 1B, 2A, 4, 5A, and 5B were tilled and replanted with winter wheat for germination observations. Plot 3B was tilled and replanted with the five crops previously planted for germination observations.

3.3 Precipitation Observations

Historical precipitation data was obtained from The National Weather Service (NWS) Forecast Office web site for Minot, North Dakota (approximately 37 miles south of site) and this information was used in the study. Exact local weather condition data was not obtained. Recorded precipitation from the NWS site in June 2018 was recorded as 4.47 inches (normal: 3.58 inches).

3.4 Electrical Conductivity

Nine test plots were tested for initial baseline EC prior to construction, after construction in Fall 2017, and after one growing season in Fall 2018. Surface EC readings were collected during the baseline study in a grid spacing at approximate 20-foot on center and were limited to the surface, one-foot depth, and 2-feet depth. Surface EC readings were collected in Fall 2017 and Fall 2018 in a grid spacing at approximate 2-foot on center and were limited to the surface, one-foot depth, and 2-feet depth. Surface EC readings for plots 3A and 3B were collected in July 2018 prior to flushing in a grid spacing at approximate 2-foot on center and were limited to the surface, one-foot depth, and 2-feet depth.

3.5 Test Plots

Nine test plots were constructed in November 2017 to evaluate EC reduction efficiency of different methods and associated costs. The methods tested include excavating and replacing brine-impacted/contaminated soil with off-site imported soil, homogenizing higher EC soil with lower EC soil from the site, amending contaminated soil with gypsum, mixing contaminating soil with imported uncontaminated soil, and adding clean soil over unexcavated contaminated soil. Uncontaminated soil was imported from Bottineau, North Dakota and field screened for EC prior to use.

Capillary breaks consisting of either gravel or composite geotextile were installed to evaluate the efficacy of these systems at mitigating capillary suction and resulting recontamination from surrounding impacted soils. Flushing with flush water obtained from PRC-3 and clean potable water was performed to observe the efficacy of contaminant removal. Clean potable water was imported from the Westhope Water Depot in Westhope, North Dakota. The full EC value data set can be found in Appendix C.

Please refer to the Baseline Assessment report for details of construction for the nine test plots. The following table summarizes construction details for the nine test plots.

Table No. 3: Test Plot Construction

	1A	1B	2A	2B	3A	3B	4	5A	5B
Remedial Approach:	Excavate and replace	Excavate and replace	Excavate and homogenize	Excavate and homogenize	Excavate and amend (gypsum)	Excavate and amend (gypsum)	Excavate and mix with clean	Above grade fill	Above grade fill
Capillary Break:	No	Yes (gravel)	No	Yes (gravel)	Yes (gravel)	Yes (gravel)	Yes (gravel)	Yes (gravel)	Yes (composite geotextile)
Amendment:	No	No	No	No	Yes	Yes	No	No	No
Irrigation:	No	No	No	No	No	Yes	No	No	No

Further discussion of the activities and results for each test plot are presented below. A summary of EC data, germination observations, and cost comparisons of each remediation technique are presented in Section 5 of the report.

3.5.1 Plot 1A

Plot 1A consisted of excavating approximately 30 inches of the existing soil and replacing with non-brine impacted imported backfill up to grade. The excavation slopes within the test plot were approximately 2:1 (H:V).

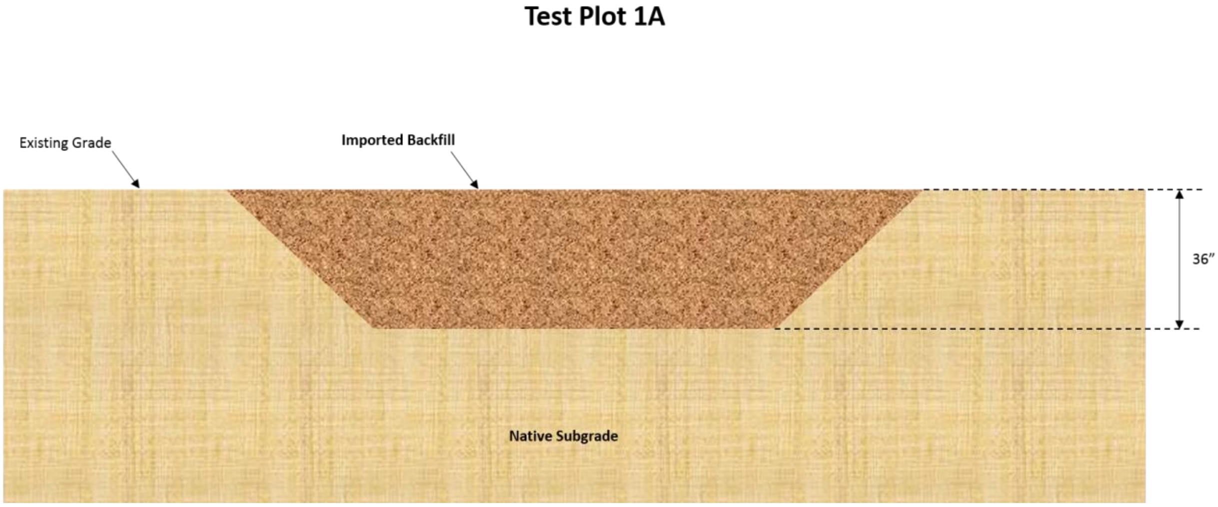

Figure 3: Test Plot 1A construction cross-section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, and after one growing season in September 2018. Two planting periods were conducted for Plot 1A. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 4: Plot 1A EC Averages

Depth	Baseline (µS/cm)	Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change
Surface EC	14,785	1,947	2,336	-	**+19%**
1-Foot EC	17,997	1,881	2,904	-	**+54%**
2-Foot EC	7,852	3,529	2,756	-	**-22%**

-Data not collected as of the writing of this report

EC measurements following test plot construction decreased as the contaminated soil had been removed and replaced with non-impacted imported soil. Increases in EC at the surface and 1-foot depths and decreases at 2-foot depths were observed between post-construction measurements and Fall 2018 measurements which indicate potential recontamination from the surface.

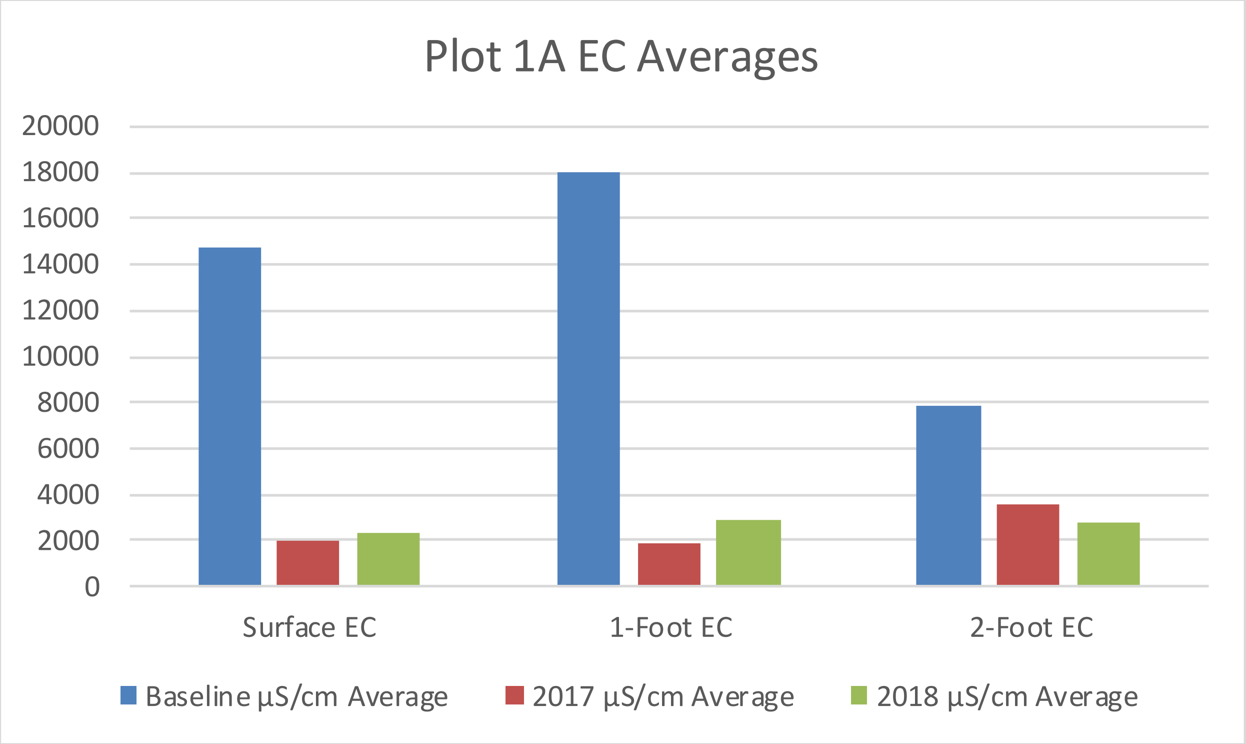

Figure 4: Plot 1A EC averages pre- and post-impacted soil replacement

Evidence of flooding from above normal precipitation at the site was observed in early July which caused surface water runoff from outside the test plot. However, decreases in EC following overland flooding from rain are likely attributable to the relatively high soil EC following construction in Fall 2017. Germination of the five crops planted was observed after the first planting and germination of winter wheat was observed after the second planting.

May 9, 2018: 1st planting

July 10, 2018: 1st germination (germination of five crops observed)

October 30, 2018: 2nd germination (winter wheat germination observed)

Please refer to Appendix A, Exhibits 1-3 for Plot 1A EC mapping.

3.5.2 Plot 1B

Plot 1B consisted of excavating approximately 36 inches of the existing soil. Excavation slopes were approximately 2:1 (H:V). A layer of geotextile (base separation layer) was placed at the base of the excavation. Six inches of gravel was placed at the base and up the sides of the excavation; a second layer of geotextile was placed above the gravel (upper separation layer). Approximately 30 inches of imported non-impacted backfill was placed, bringing the plot up to grade. A sump pit/drainage system drained into Phytoremediation Cell 3 (PRC-3).

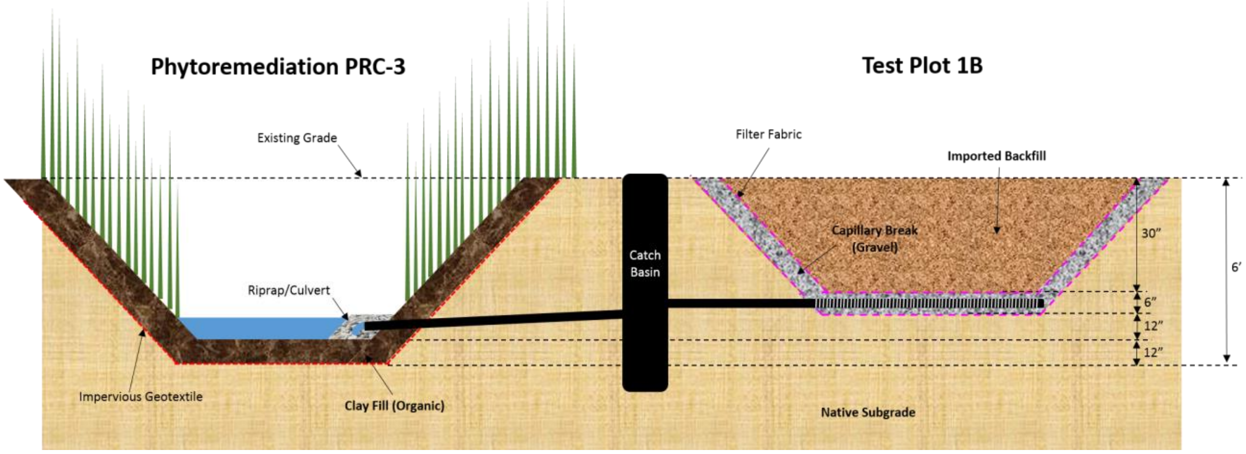

Figure 5: Test Plot 1B construction cross-section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, and after one growing season in September 2018. Two planting periods were conducted for Plot 1B. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 5: Plot 1B EC Averages

Depth	Baseline (µS/cm)	Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change
Surface EC	19,503	1,113	5,571	-	**+401%**
1-Foot EC	14,907	3,249	3,722	-	**+15%**
2-Foot EC	15,627	3,062	3,326	-	**+9%**

-Data not collected

EC measurements following test plot construction decreased as the contaminated soil had been removed and replaced with non-impacted imported soil. Increases in EC at the surface, 1-foot, and 2-foot depths were observed between post-construction measurements and Fall 2018 measurements which indicate potential recontamination from the surface.

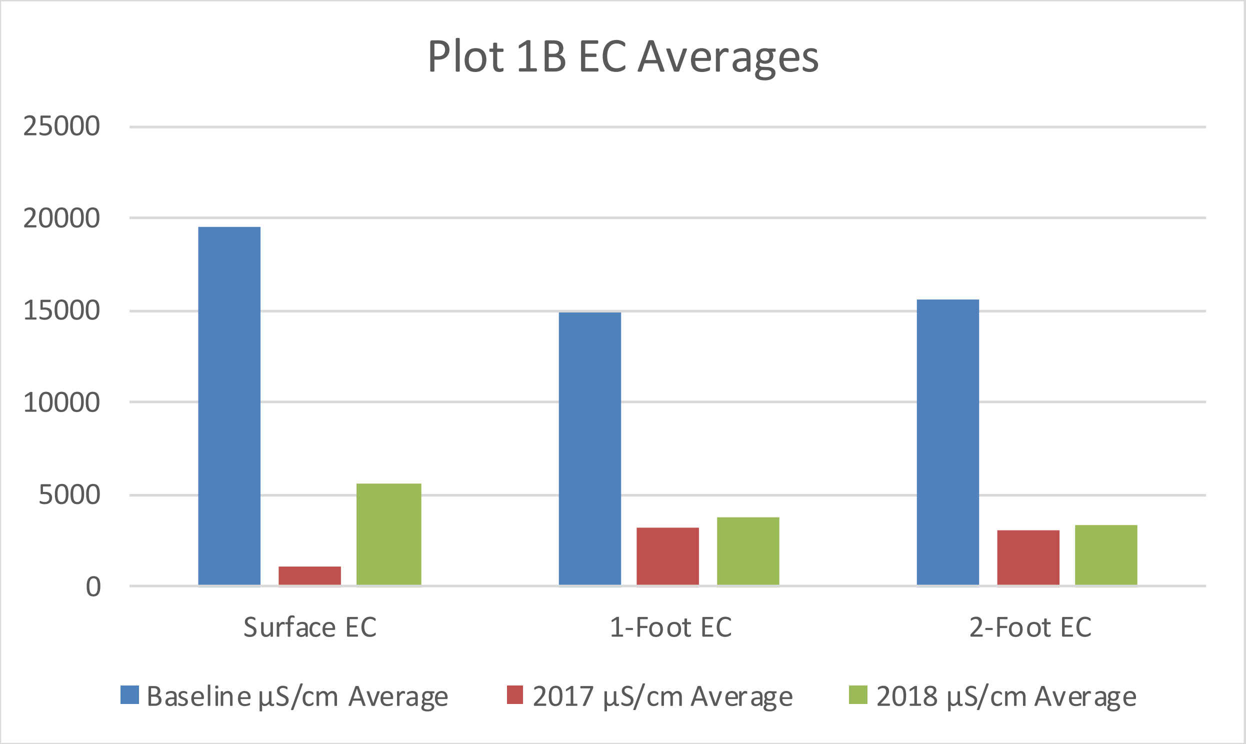

Figure 6: Plot 1B EC averages pre- and post-soil excavation and capillary break installation

Evidence of flooding from above normal precipitation at the site was observed in early July which caused surface water runoff from outside the test plot. However, increases in EC following overland flooding from rain are likely attributable to the relatively low soil EC following construction in Fall 2017. Germination of the five crops was observed after the first planting and germination of winter wheat was observed after the second planting.

May 9, 2018: 1st planting

July 5, 2018: 1st germination (germination of five crops observed)

October 30, 2018: 2nd germination (winter wheat germination not observed)

Please refer to Appendix A, Exhibits 4-6 for Plot 1B EC mapping.

3.5.3 Plot 2A

Plot 2A consisted of excavating approximately 36 inches of existing soil with slopes of approximately 2:1 (H:V). Approximately 30 inches of homogenized soil was placed, bringing the excavation up to grade. The homogenized soil consisted of mixing the excavated soils with less more brine-impacted soils obtained from just north of this plot area.

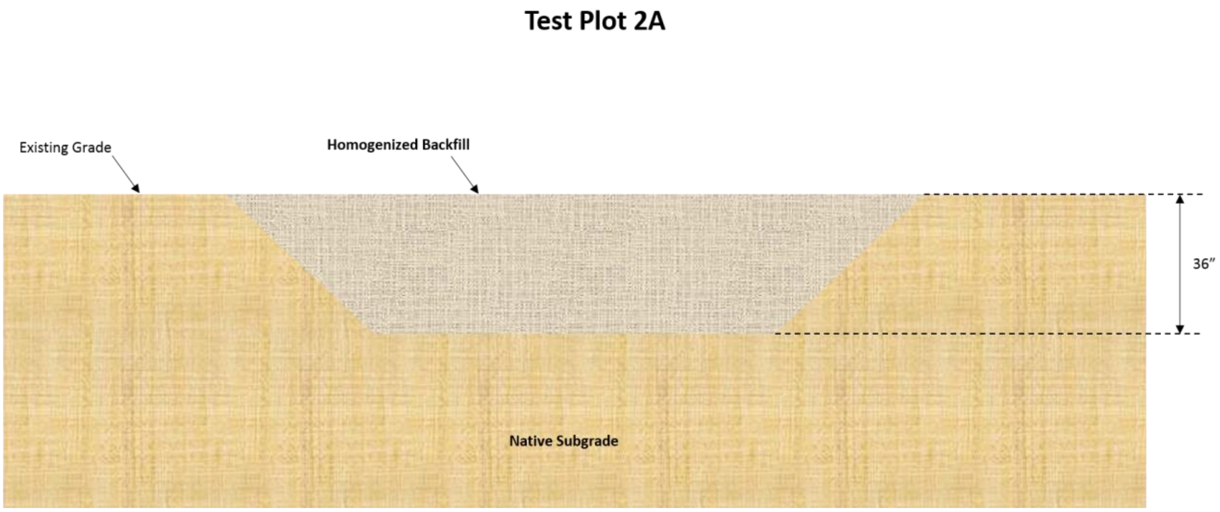

Figure 7: Test Plot 2A construction cross-section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, and after one growing season in September 2018. Two planting periods were conducted for Plot 2A. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 6: Plot 2A EC Averages

Depth	Baseline (µS/cm)	Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change
Surface EC	2,792	7,171	4,295	-	**-40%**
1-Foot EC	3,700	5,044	4,204	-	**-17%**
2-Foot EC	3,377	4,451	4,370	-	**-2%**

-Data not collected

EC measurements following test plot construction increased as the contaminated soil had been homogenized with higher EC soil. Decreases in EC at the surface, 1-foot depth, and 2-foot depth were observed between post-construction measurements and Fall 2018 measurements.

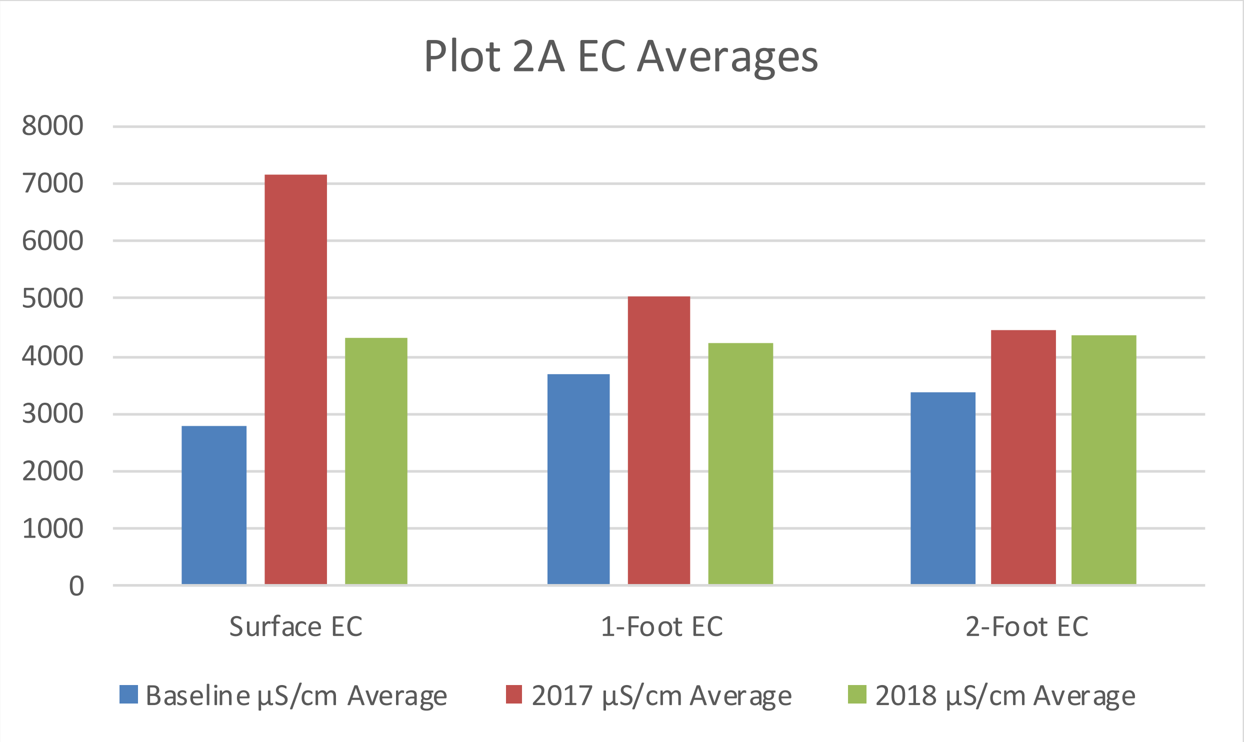

Figure 8: Plot 2A EC averages pre- and post-soil homogenizing without capillary break constructed

Evidence of flooding from above normal precipitation at the site was observed in early July. However, decreases in EC following overland flooding from rain are likely attributable to the relatively high soil EC compared to Plots 1A and 1B following construction in Fall 2017. Germination of barley was observed after the first planting and germination of winter wheat was not observed after the second planting.

May 9, 2018: 1st planting

June 13, 2018: 1st germination (germination of barley observed)

October 30, 2018: 2nd germination (no germination observed)

Please refer to Appendix A, Exhibits 7-9 for Plot 2A EC mapping.

3.5.4 Plot 2B

Plot 2B consisted of excavating approximately 36 inches of existing soil, with slopes of approximately 2:1 (H:V). A layer of geotextile was placed over the excavated area, and six inches of gravel was placed at the base and up the sides of the excavation. A layer of geotextile was placed over the gravel, then approximately 30 inches of homogenized soil was placed, bringing the excavation up to grade. The homogenized soil consisted of mixing the excavated soils with less brine-impacted soils obtained from just south of this plot area (Plot 2A area). A sump pit/drainage system drained into PRC-3.

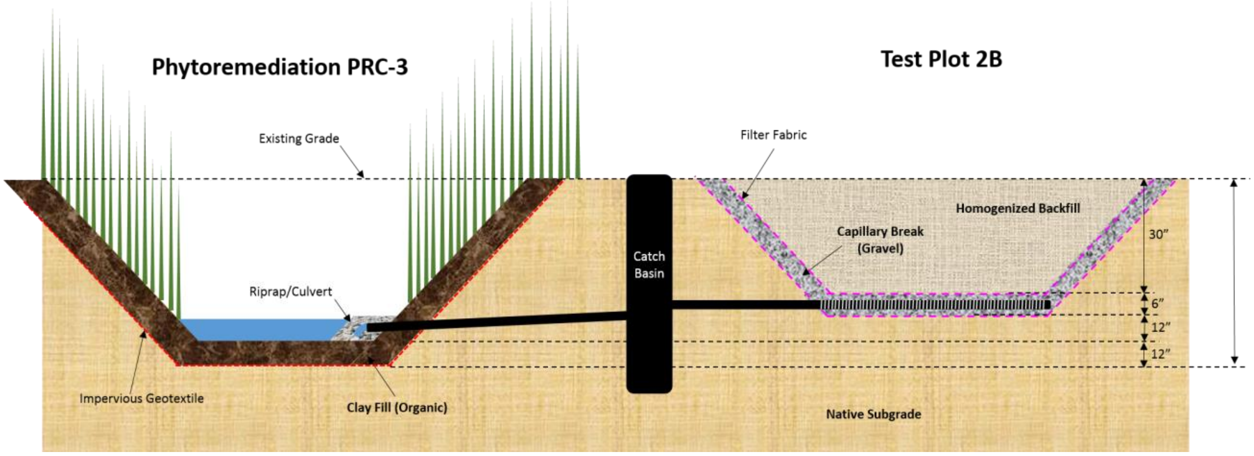

Figure 9: Test Plot 2B construction cross-section

Baseline EC measured prior to test plot construction and after test plot construction in 2017. Two planting periods were conducted for Plot 2B. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 7: Plot 2B EC Averages

Depth	Baseline (µS/cm)	Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change
Surface EC	8,566	6,645	-	-	-
1-Foot EC	9,478	4,891	-	-	-
2-Foot EC	8,526	5,051	-	-	-

-Data not collected; data not collected for 2018 due to disturbances of the test plot

EC measurements following test plot construction decreased as the contaminated high EC soil had been homogenized with low EC soil. Fall 2018 EC measurements were not taken due to disturbances to the test plot from hauling water to the site for flushing Plot 3B, poor germination observations from the first planting, and evidence of significant flooding from above normal precipitation in early July 2018.

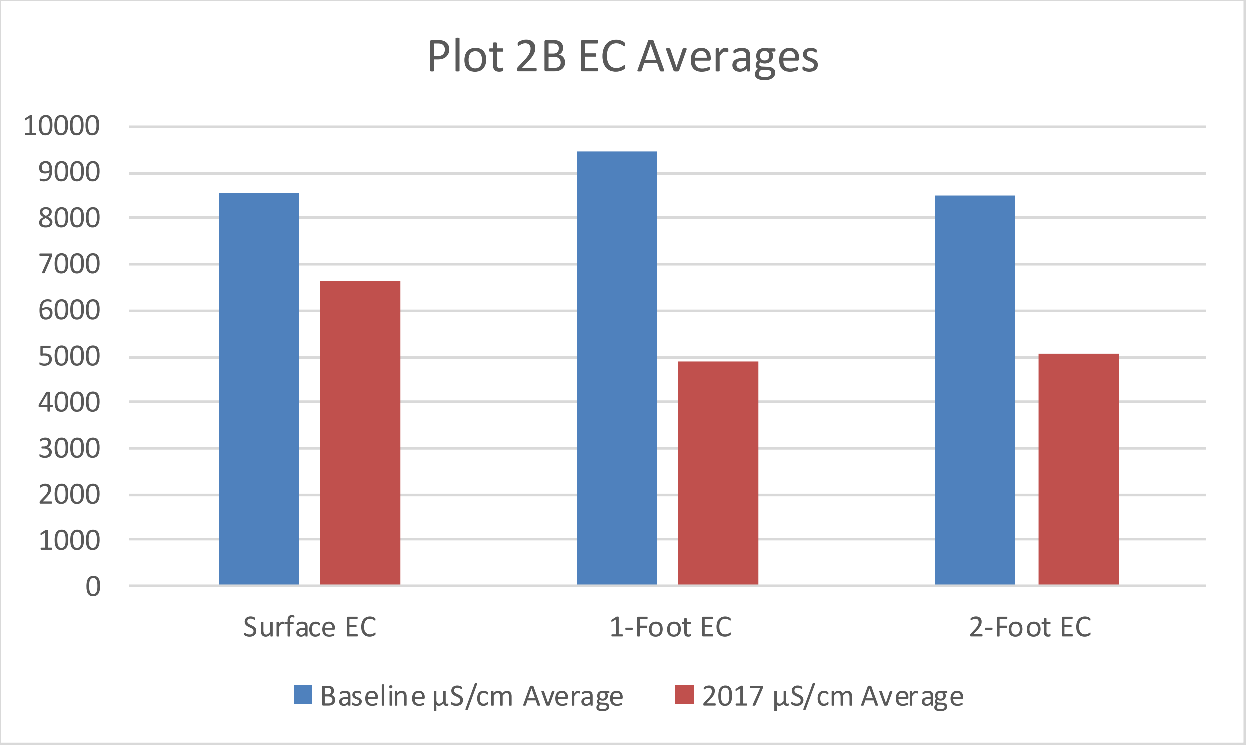

Figure 10: Plot 2B EC averages pre- and post-soil homogenizing with capillary break constructed

Germination of barley was observed after the first planting and germination of winter wheat was not observed after the second planting.

May 9, 2018: 1st planting

July 5, 2018 1st germination (germination of barley observed)

October 30, 2018: 2nd germination (no germination observed)

Plot 2B EC mapping was not created due to lack of 2018 data.

3.5.5 Plot 3A

Plot 3A consisted of excavating approximately 36 inches of existing soil, with slopes of approximately 2:1 (H:V). A layer of geotextile was placed over the excavated area, and six inches of gravel was placed at the base and sides of the excavation. A second layer of geotextile was placed over the gravel and approximately 30 inches of amended soil was placed, bringing the excavation up to grade. The amended soil consisted of excavated soil from the plot mixed with gypsum. A sump pit/drainage system drained to PRC-3.

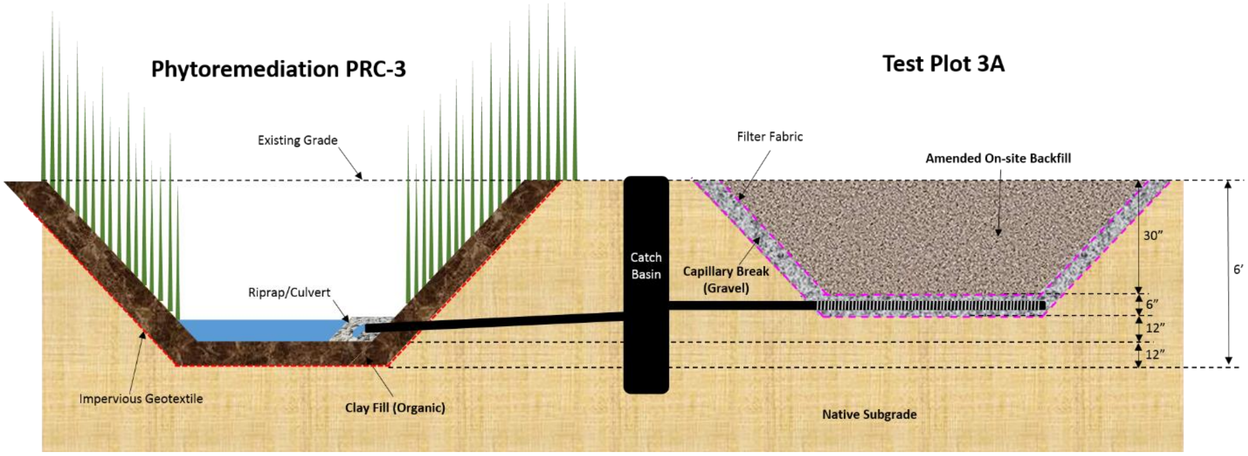

Figure 12: Test Plot 3A construction cross-section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, after one growing season in September 2018 and after flushing with water obtained from PRC-3 in September 2018. Two planting periods were conducted for Plot 3A. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 8: Plot 3A EC Averages

Period	Baseline (µS/cm)	Fall 2017 (µS/cm)	2018 Pre-Flush (µS/cm)	Post-Flush 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change
Surface EC	13,618	15,115	9,174	9,233	-	**-32%**
1-Foot EC	10,837	15,976	10,258	11,596	-	**-27%**
2-Foot EC	9,570	13,889	9,174	10,285	-	**-26%**

-Data not collected

EC measurements following test plot construction increased at the surface, 1-foot depth, and 2-foot depth due to the addition of gypsum as an amendment. The addition of gypsum is known to increase EC in soil until flushed with water. EC increases were observed between post-construction measurements and Summer 2018 pre-flush measurements. Negligible change in EC at the surface and an increase in EC at the 1-foot and 2-foot depths was observed following flushing of the test plot with water from PRC-3. EC from PRC-3 water was 16,300 µS/cm prior to flushing.

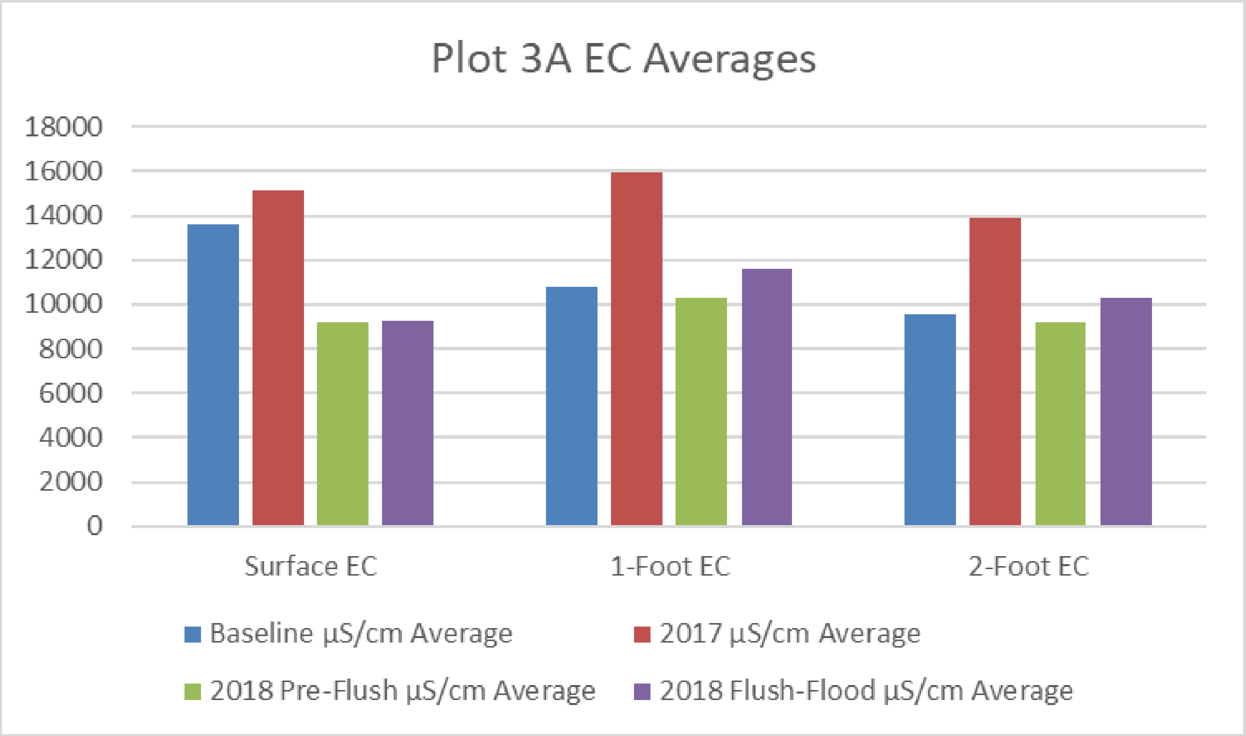

Figure 13: Plot 3A EC averages pre- and post-soil excavation and capillary layer construction pre- and post-potable water flushing

Germination of the five crops was not observed after the first planting and germination of winter wheat was not observed after the second planting.

May 9, 2018: 1st planting

July 17, 2018: 1st germination (no germination observed)

October 30, 2018: 2nd germination (no germination observed)

Please refer to Appendix A, Exhibits 10-15 for Plot 3A EC mapping.

3.5.6 Plot 3B

Plot 3B consisted of excavating approximately 36 inches of existing soil with slopes of approximately 2:1 (H:V). A layer of geotextile was placed over the excavated area, and six inches of gravel was placed at the base and sides of the excavation. A second layer of geotextile was placed over the gravel and approximately 30 inches of amended soil was placed up to grade. The amended soil consisted of mixing excavated soil with gypsum. An 8-inch berm was constructed around the edge of the plot to maintain irrigation water within the plot area. A sump pit/drainage system drained to PRC-3.

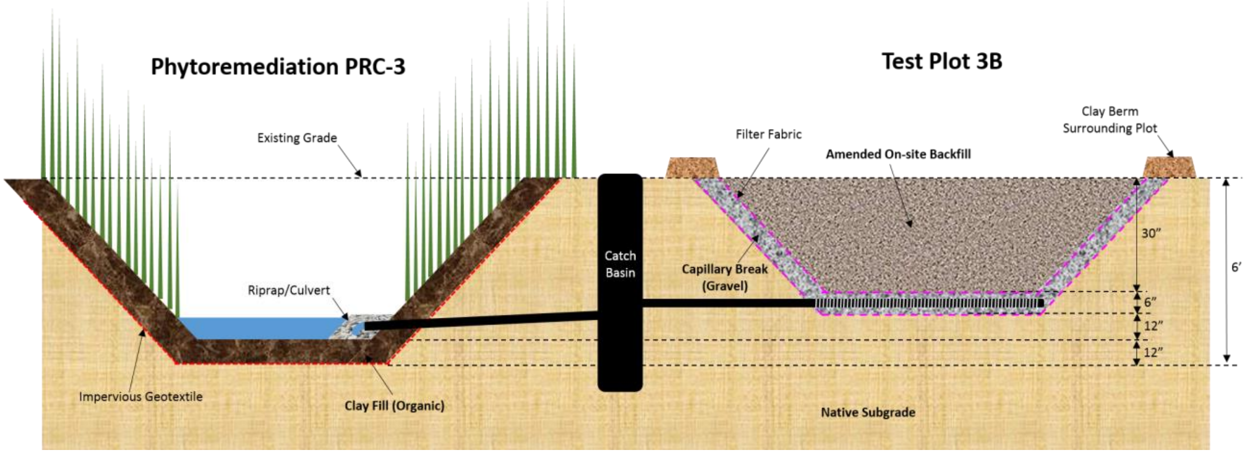

Figure 14: Test Plot 3B construction cross- section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, after one growing season in September 2018, and after flushing with non-impacted, imported water in September 2018. Two planting periods were conducted for Plot 3B. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with the five crops.

Table No. 9: Plot 3B EC Averages

Depth	Baseline (µS/cm)	Fall 2017 (µS/cm)	2018 Pre-Flush (µS/cm)	Fall 2018 Post-Flush 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change
Surface EC	13,165	9,685	8,178	2,194	-	**-77%**
1-Foot EC	8,367	9,350	8,946	4,921	-	**-47%**
2-Foot EC	8,302	6,253	10,452	5,880	-	**-36%**

-Data not collected

EC measurements following test plot construction decreased at the surface and 2-foot depth and increased at the 1-foot depth. An increase in EC similar to Plot 3A with the addition of gypsum as an amendment was not observed due to water irrigation of the test plot. EC decreases at the surface and 1-foot depth and increases at the 2-foot depth were observed between post-construction measurements and Summer 2018 pre-flushing measurements. Decreases in EC at the surface, 1-foot depth, and 2-foot depth were observed following flushing of the test plot with non-impacted imported water. Field tested EC from the imported water was observed at 1,500 µS/cm prior to flushing.

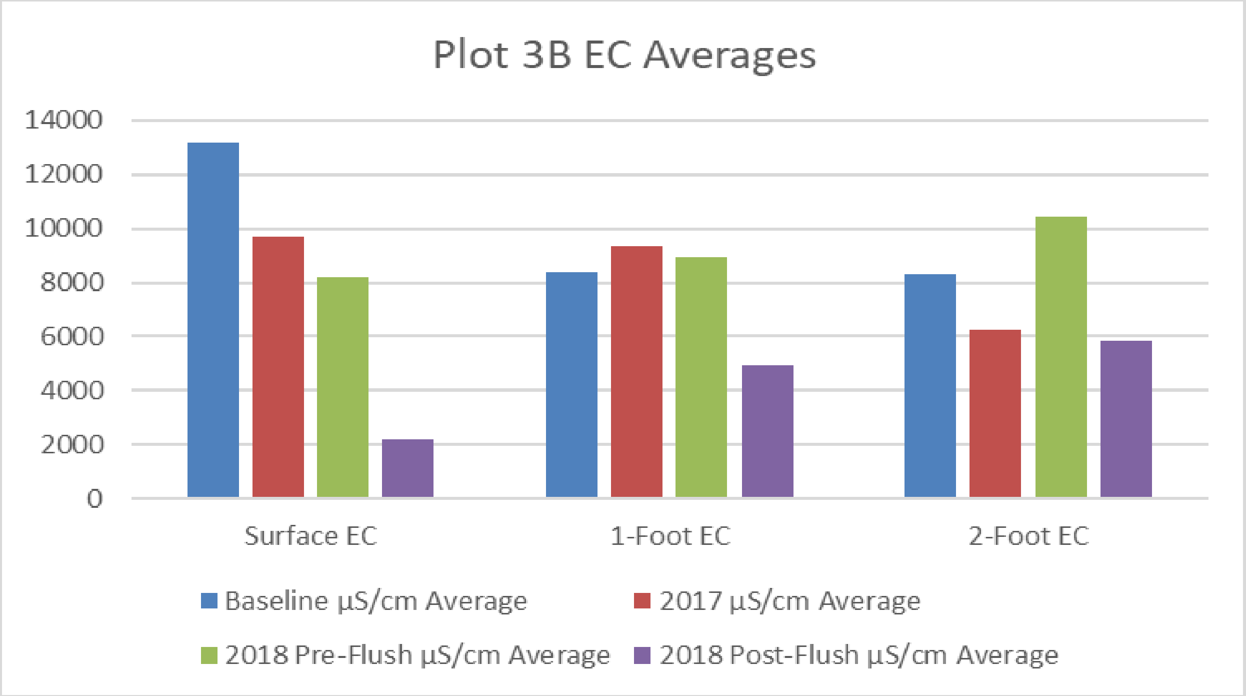

Figure 15: Plot 3B EC averages pre- and post-soil excavation and capillary layer construction pre- and post-potable water flushing

Germination of barley was observed after the first planting and germination of alfalfa and barley was observed after the second planting.

May 9, 2018: 1st planting

June 13, 2018: 1st germination (barley germination observed)

October 30, 2018: 2nd germination (alfalfa and barley germination observed)

Please refer to Appendix A, Exhibits 16-21 for Plot 3B EC mapping.

3.5.7 Plot 4

Plot 4 consisted of removing approximately 36 inches of the most highly impacted soil within the center of the test plot. The remaining soil within the test plot area was excavated and mixed with non-impacted soil from onsite borrow sources, with slopes should 2:1 (H:V). A layer of geotextile was placed over the excavated area, and six inches of gravel was placed at the base and sides of the excavation. A second layer of geotextile was placed over the gravel, then the approximately 30 inches of mixed soil was placed bring the plot up to grade. A sump pit/drainage system drained into PRC-3.

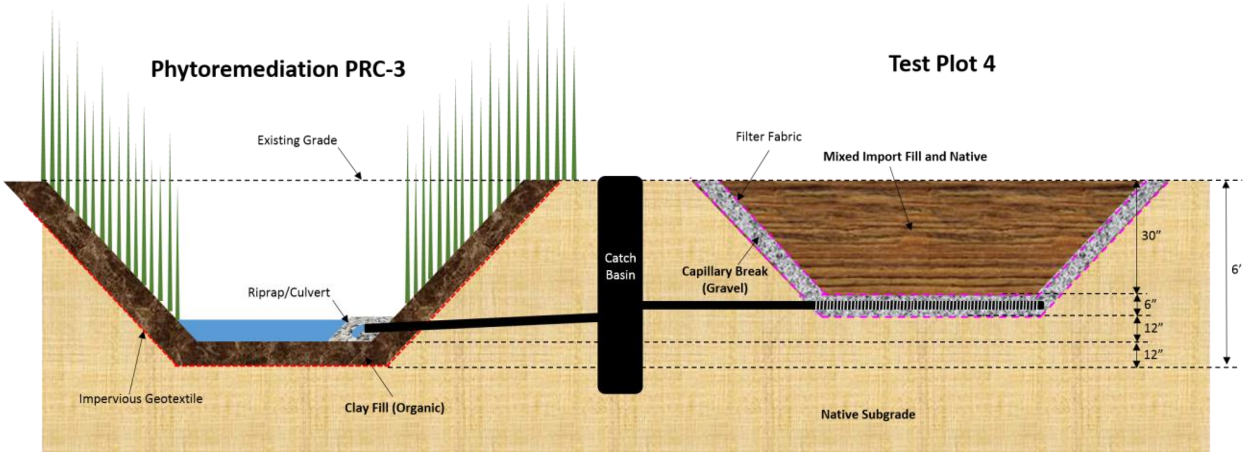

Figure 16: Test Plot 4 construction cross-section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, and after one growing season in September 2018. Two planting periods were conducted for Plot 4.

The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 10: Plot 4 EC Averages

Depth	Baseline (µS/cm)	Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change
Surface EC	9,173	4,348	6,061	-	**+39%**
1-Foot EC	6,745	4,956	4,850	-	**-2%**
2-Foot EC	5,935	5,501	3,785	-	**-36%**

-Data not collected

EC measurements following test plot construction decreased as imported soil was homogenized with contaminated soil. An increase in EC at the surface and decreases at 2-foot depth and 1-foot depth were observed between post-construction measurements and Fall 2018 measurements which indicate potential recontamination from the surface.

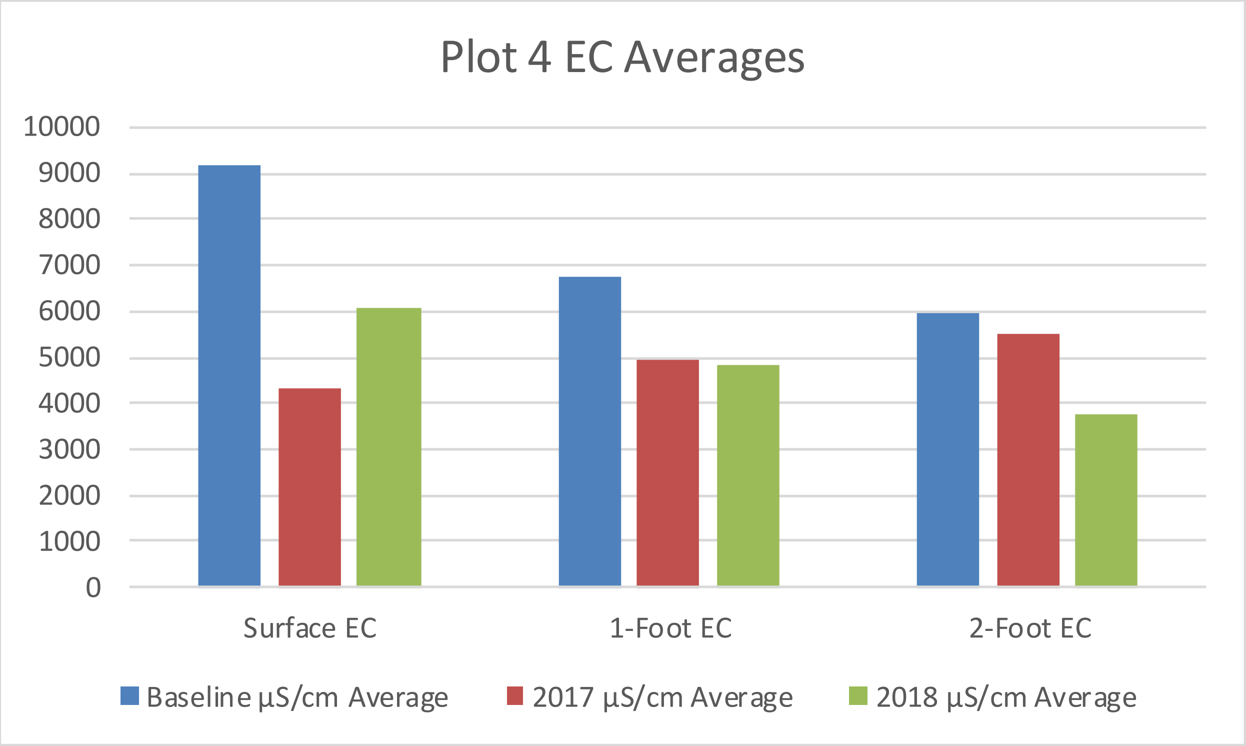

Figure 17: Plot 4 EC averages pre- and post-soil homogenization with imported soil and capillary layer construction

Evidence of flooding from above normal precipitation at the site was observed in early July which caused surface water runoff from outside the test plot. This runoff is most likely the source of recontamination. Germination of the five crops was observed after the first planting and germination of winter wheat was observed after the second planting.

May 9, 2018: 1st planting

June 13, 2018: 1st germination (germination of five crops observed)

October 30, 2018: 2nd germination (winter wheat germination observed)

Please refer to Appendix A, Exhibits 22-24.

3.5.8 Plot 5A

Plot 5A consisted of grading the ground level approximately 2.5 percent sloping downward towards PRC-2. A layer of geotextile was placed at grade over the contaminated soil; six inches of gravel was placed and extended laterally to PRC-2; a layer of geotextile was placed; approximately 30 inches of imported (non-impacted) soil was placed on top of the geofabric/gravel section with side slopes of 2:1 (H:V). The gravel layer and geotextile extended approximately 24 inches further than the imported (non-impacted) soil extent on the sides not in contact with PRC-2. The remaining side sloped into PRC-2 for drainage.

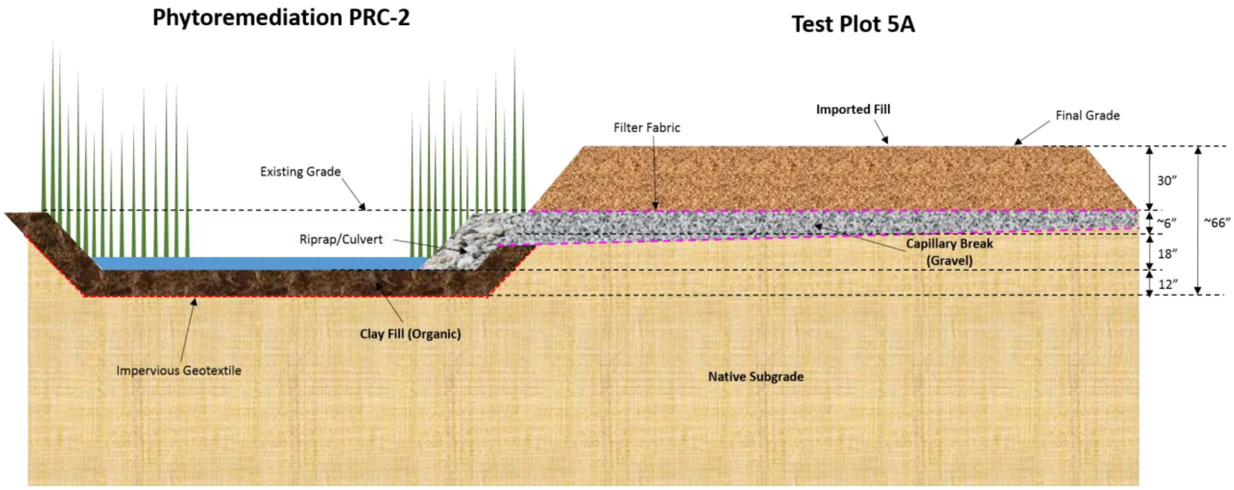

Figure 18: Test Plot 5A construction cross-section

EC of in-place soils was measured prior to test plot construction. EC of the imported soils were measured after test plot construction in 2017 and after one growing season in September 2018. Two planting periods were conducted for Plot 2A. The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 11: Plot 5A EC Averages

Depth	Contaminated Soil 2017 (µS/cm)	Post-construction Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change
Surface EC	17,982	1,256	1,215	-	**-3%**
1-Foot EC	15,405	1,236	1,352	-	**+9%**
2-Foot EC	10,533	1,464	1,268	-	**-13%**

-Data not collected

EC measurements following test plot construction were collected from the imported soil placed over the geotextile. Negligible change in EC at the surface, 1-foot depth, and 2-foot depth was observed between post-construction measurements and Fall 2018 measurements of the soils placed over the geotextile. Impact on contaminated soil below the imported soil is not known as tests were limited to the imported soil.

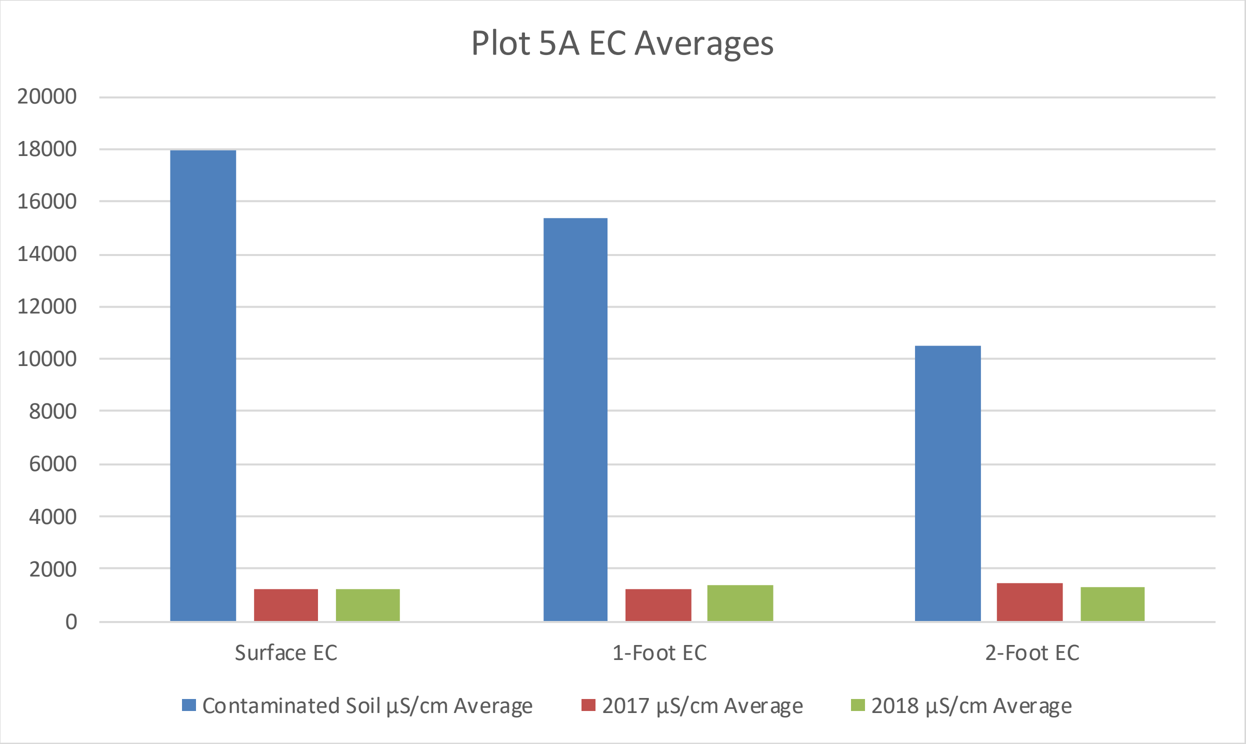

Figure 19: Plot 5A EC averages pre- and post-placing soil over contaminated soil and capillary layer construction

Germination of the five crops was observed after the first planting and germination of winter wheat was observed after the second planting.

May 9, 2018: 1st planting

June 13, 2018: 1st germination (germination of five crops observed)

October 30, 2018: 2nd germination (winter wheat germination observed)

Please refer to Appendix A, Exhibits 25-27 for Plot 5A EC mapping.

3.5.9 Plot 5B

Plot 5B consisted of grading the ground approximately 2.5 percent sloping downward towards PRC-2. A layer of composite geotextile (i.e. geonet, RoaDrain, etc.) was placed at grade and extended laterally to PRC-2 over the contaminated soil. Approximately 30 inches of imported (non-impacted) soil was placed on top of the geofabric/gravel section with side slopes of 2:1 (H:V). The composite geotextile extended approximately 24 inches further than the imported soil on the sides not in contact with PRC-2. The remaining side was extended into PRC-2 approximately 6-12 inches.

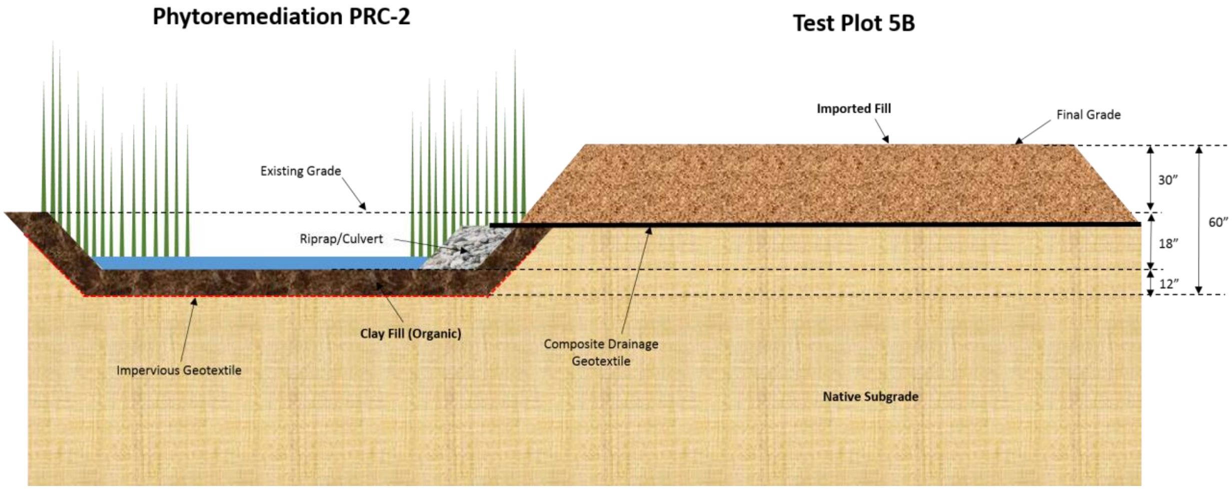

Figure 20: Test Plot 5B construction cross-section

Baseline EC was measured prior to test plot construction, after test plot construction in 2017, and after one growing season in September 2018. Two planting periods were conducted for Plot 5B.

The first planting period consisted of planting five rows of each of the five crops. The test plot was cleared, tilled, and replanted with winter wheat that was randomly broadcasted.

Table No. 12: Plot 5B EC Averages

Depth	Contaminated Soil 2017 (µS/cm)	Post-Construction Fall 2017 (µS/cm)	Fall 2018 (µS/cm)	2019 (µS/cm)	Fall 2017 to Fall 2018 Percent Change
Surface EC	18,153	1,322	1,421	-	**+7%**
1-Foot EC	14,502	1,358	1,487	-	**+10%**
2-Foot EC	13,515	1,484	1,462	-	**-1%**

-Data not collected

EC measurements following test plot construction were collected from the imported soil placed over the geotextile. Negligible change in EC at the surface, 1-foot depth, and 2-foot depth was observed between post-construction measurements and Fall 2018 measurements of the soils placed over the geotextile. Impact on contaminated soil below the imported soil is not known as tests were limited to the imported soil.

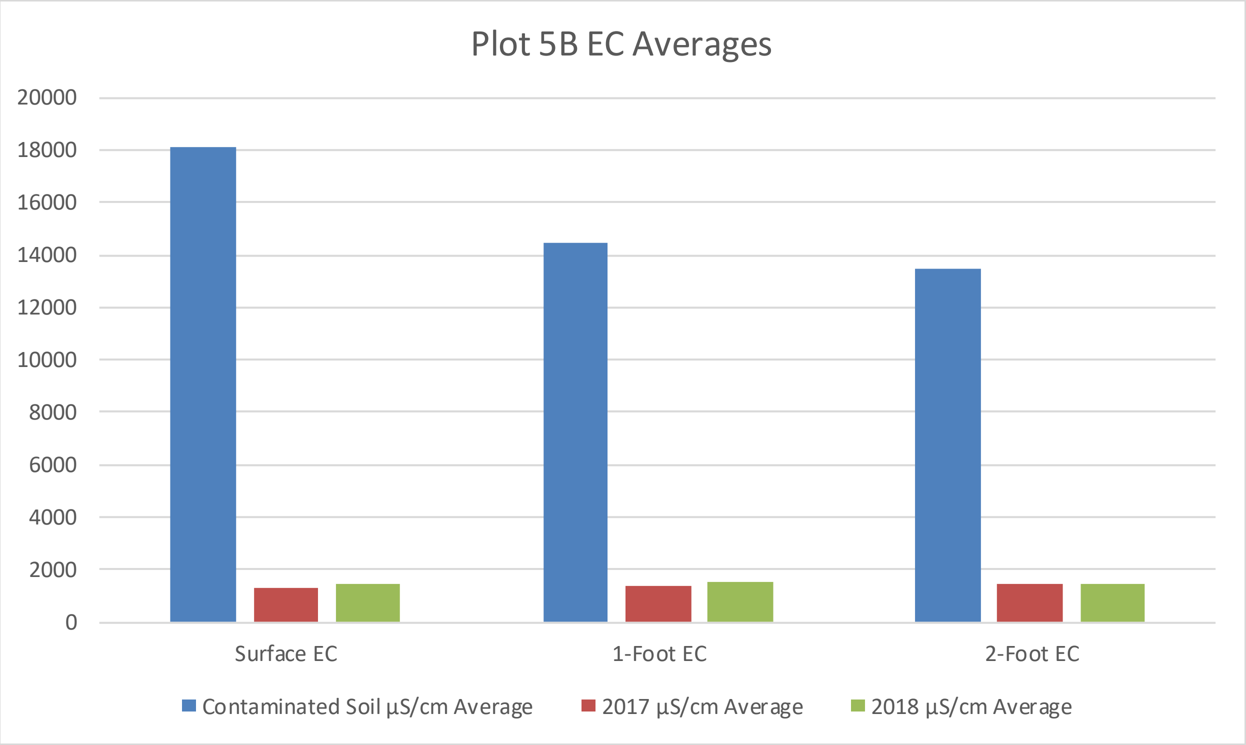

Figure 21: Plot 5B EC averages pre- and post-placing soil over contaminated soil and geotextile placement

Germination of the five crops was observed after the first planting and germination of winter wheat was observed after the second planting.

May 9, 2018: 1st planting

June 13, 2018: 1st germination (germination of five crops observed)

October 30, 2018: 2nd germination (winter wheat germination observed)

Please refer to Appendix A, Exhibits 28-30 for Plot 5B EC mapping.

3.5.10 PRC-1

Phytoremediation Cell 1 (PRC-1) consisted of excavating approximately 30 inches of soil, with slopes of approximately 2:1 (H:V). Approximately six inches of imported non-impacted clay was placed at the bottom and sides of the excavation leaving a 24-inch deep subsurface depression. No test plots drained into PRC-1. Cattails were planted in three sections (thirds) in this plot: transplanted rhizomes spaced every 2-4 feet in a third; rhizomes that were split up and spread out evenly in a third; and the remaining third of the PRC was planted with cattail seeds.

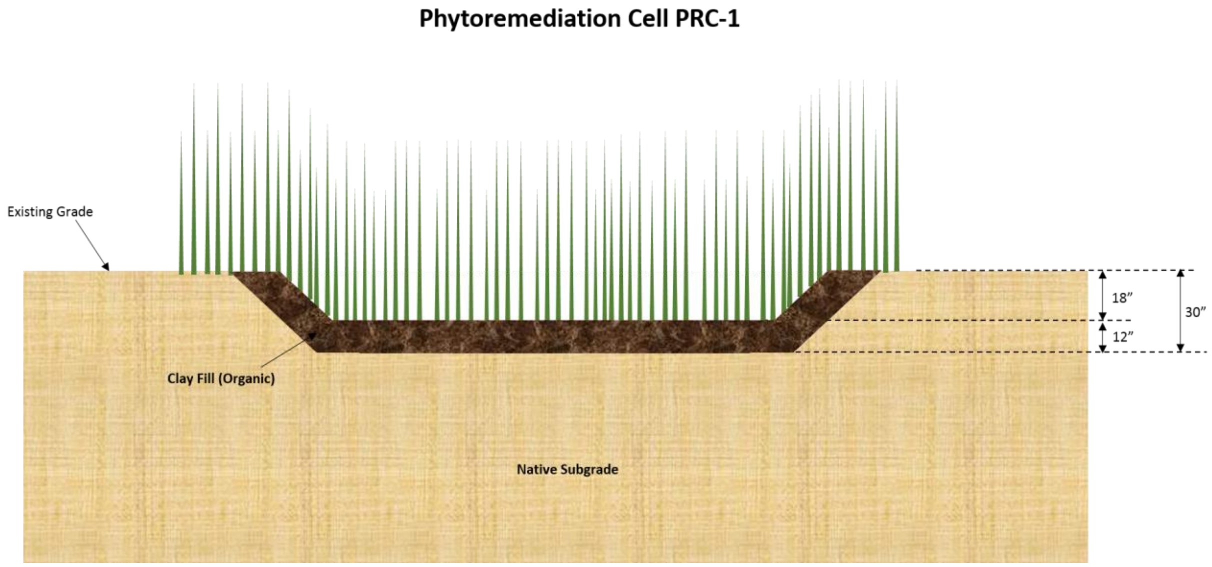

Figure 22: PRC-1 construction cross-section

May 9, 2018

September 10, 2018

October 30, 2018

3.5.11 PRC-2

Phytoremediation Cell 2 (PRC-2) consisted of excavating approximately 30 inches of soil, with slopes of approximately 2:1 (H:V). A layer of impermeable geotextile was placed at the bottom and sides of the excavated area, and 12 inches of imported non-impacted clay was placed at the bottom and sides of the excavation leaving an 18-inch deep subsurface depression. Test Plots 5A and 5B drained into PRC-2.

Please refer to test plot diagrams for Plots 5A and 5B above for a detailed representation of the PRC-2 construction cross-section.

May 9, 2018

September 10, 2018

3.5.12 PRC-3

Phytoremediation Cell 3 (PRC-3) consisted of excavating approximately 72 inches of soil, with slopes of approximately 1:1 (H:V). A layer of impermeable geotextile was placed at the bottom and sides of the excavation, and 12 inches of imported non-impacted clay was placed at the bottom and up the sides of the excavation leaving a 60-inch deep low-lying area. Plots 1B, 2, 3A, 3B, and 4 drained into PRC-3. Water from PRC-3 was used to flush Plot 3A in August 2018. EC from field testing was observed to be 16,300 µS/cm prior to 2018 flushing.

Please refer to test plot diagrams for Plots 1B, 2B, 3A, 3B, and 4 above for a detailed representation of the PRC-3 construction cross-section.

May 9, 2018

September 10, 2018

October 30, 2018

4.0 LABORATORY ANALYTICAL RESULTS

Soil and/or water sample(s) were analyzed for the following constituents and characteristics:

- Specific conductance (USEPA method 9050A Mod)
- Chlorides (USEPA method 9056A)
- Sodium (and selected metals) (USEPA method 6010C)

Analytical results from laboratory test cell amendments in Table 1 [Test Cell Soil Samples], water drained from test plots following flooding with water in Table 2 [Test Cell Post-Flood Water], and water prior to flushing in Table 3 [Test Plot Pre-Flush Water (PRC-3)] are located in Appendix D.

After collecting each sample in laboratory-provided containers, Terracon recorded the sample time on each container label in permanent ink and place the filled containers in an ice-filled cooler for transport. The samples and completed chain-of-custody forms were shipped via overnight courier to Environmental Science Corporation Laboratory Services (ESC) in Mt. Juliet, Tennessee, a National Environmental Laboratory Accreditation Program (NELAP)-accredited laboratory provided the analytical services.

Data summary tables and laboratory analytical/test reports and chain-of custodies recorded are attached in Appendix D. The following sections present the results of the laboratory testing.

4.1 Laboratory Test Cells - Soil

Composite soil samples were collected for EC and chlorides from test cells after flushing with water. Please see results and data tables in Appendix D.

Non-amended test cell samples (Control EC 5,000, Control EC 12,0000, and Control EC 18,000) acted as control samples. EC measurements were reported at 242 micromhos per centimeter (µmhos/cm), 13,900 µmhos/cm, and 562 µmhos/cm, respectively. Chlorides were reported at 59 mg/L, 10,400 mg/L, and 179 mg/L, respectively.

Amendment 1 test cell samples (Amend 1 EC 5,000, Amend 1 EC 12,0000, and Amend 1 EC 18,000) contained added BioFlora® and fertilizer. EC measurements were reported at 664 µmhos/cm, 1,670 µmhos/cm, and 1,030 µmhos/cm, respectively. Chlorides were reported at 92 mg/L, 121 mg/L, and 193 mg/L, respectively.

Amendment 2 test cell samples (Amend 2 EC 5,000, Amend 2 EC 12,0000, and Amend 2 EC 18,000) contained added straw, gypsum, sugar beet molasses, and fertilizer. EC measurements were reported at 2,380 µmhos/cm, 2,870 µmhos/cm, and 3,170 µmhos/cm, respectively. Chlorides were reported at 63 mg/L, 220 mg/L, and none detected, respectively.

Amend 3 test cell samples (Amend 3 EC 5,000, Amend 3 EC 12,0000, and Amend 3 EC 18,000) contained added straw, gypsum, sugar beet molasses, BioFlora®, and fertilizer. EC measurements were reported at 1,910 µmhos/cm, 4,060 µmhos/cm, and 2,790 µmhos/cm, respectively. Chlorides were reported at 48 mg/L, 242 mg/L, and 140 mg/L, respectively.

Amendment 4 test cell samples (Amend 4 EC 5,000, Amend 4 EC 12,0000, and Amend 4 EC 18,000) contained added straw, gypsum, beet pulp, BioFlora®, and fertilizer. EC measurements were reported at 2,400 µmhos/cm, 2,730 µmhos/cm, and 1,330 µmhos/cm, respectively. Chlorides were reported at 42 mg/L, 99 mg/L, and 120 mg/L, respectively.

Amendment 5 test cell samples (Amend 5 EC 5,000, Amend 5 EC 12,0000, and Amend 5 EC 18,000) contained added straw, sulfuric acid, BioFlora®, and fertilizer. EC measurements were reported at 2,570 µmhos/cm, 1,180 µmhos/cm, and 1,780 µmhos/cm, respectively. Chlorides were reported at 55 mg/L, 204 mg/L, and 172 mg/L, respectively.

Amendment 6 test cell samples (Amend 6 EC 5,000, Amend 6 EC 12,0000, and Amend 6 EC 18,000) contained an added straw, gypsum, BioFlora®, and fertilizer. EC measurements were reported at 3,010 µmhos/cm, 641 µmhos/cm, and 2,390 µmhos/cm, respectively. Chlorides were reported at 47 mg/L, 68 mg/L, and 68 mg/L, respectively.

Amendment 7 test cell samples (Amend 7 EC 5,000, Amend 7 EC 12,0000, and Amend 7 EC 18,000) contained added straw, a solution of sulfuric acid and gypsum, BioFlora, and fertilizer. EC measurements were reported at 1,050 µmhos/cm, 2,180 µmhos/cm, and 2,070 µmhos/cm, respectively. Chlorides were reported at 54 mg/L, 126 mg/L, and 176 mg/L, respectively.

Amendment 8 test cell samples (Amend 7 EC 5,000, Amend 7 EC 12,0000, and Amend 7 EC 18,000) contained added clean, coarse sand. EC measurements were reported at 246 µmhos/cm, 499 µmhos/cm, and 764 µmhos/cm, respectively. Chlorides were reported at 54 mg/L, 78 mg/L, and 535 mg/L, respectively.

4.2 Laboratory Test Cell - Water

An effluent composite water sample from the test cells following the 12-week simulated flooding period was analyzed for EC and chlorides for characterization. EC of the sample was reported at 30,700 µmhos/cm. Sodium concentration of the sample was reported at 5,480 mg/L. Chloride concentration of the sample was reported at 8,930 mg/L.

4.3 PRC-3 Effluent Sample - Water

An effluent water sample from PRC-3 prior to being utilized for flushing of Plot 3A was analyzed for EC and concentrations of chlorides and sodium. EC of the sample measured 4,510 µmhos/cm.

Chloride concentration of the sample was 1,130 mg/L. Sodium concentration of the sample was 665 mg/L.

5.0 FIELD RESULTS AND OBSERVATIONS

5.1 Electrical Conductivity (EC) Results

Terracon field screened electrical conductivity as mentioned in Section 1.2.1. EC measurements for each test plot were averaged and compared.

5.1.1 Surface EC Measurements

Surface EC measurements for the nine test plots were collected and are presented below.

Table No. 13 – Surface EC Measurement Averages

Period and Change	1A	1B	2A	2B	3A	3B	4	5A	5B
Baseline (µS/cm)	17,997	19,503	2,792	8,566	13,618	13,165	9,173	17,982	18,153
2017 post-construction (µS/cm)	1,881	1,112	7,171	6,645	15,115	9,685	4,348	1,256	1,322
2018 pre-flush (µS/cm)	-	-	-	-	9,174	8,178	-	-	-
Fall 2018 (µS/cm)	2,904	5,571	4,295	-	9,233	2,194	6,061	1,215	1,421
2017/18 percent change	54%	401%	-40%	-	-39%	-77%	39%	-3%	7%

- Data not collected

The following observations were made from Fall 2018 post-construction to Fall 2018:

- EC was observed to <u>increase</u> Plot 1A by approximately 54%;
- EC was observed to <u>increase</u> in Plot 1B by approximately 401%;
- EC was observed to <u>decrease</u> in Plot 2A by approximately 40%;
- EC was observed to <u>decrease</u> in Plot 3A by approximately 39%;
- EC was observed to <u>decrease</u> in Plot 3B by approximately 77%;
- EC was observed to <u>increase</u> in Plot 4 by approximately 39;
- EC was observed to <u>decrease</u> in Plot 5A by approximately 3%; and
- EC was observed to <u>increase</u> in Plot 5B by approximately 7%.

Recontamination most likely occurred from surface water runoff and resulting infiltration. Surface EC increases at Plots 1A, 1B and Plot 4. Plot 2A surface EC decreased. Difference in EC change from runoff is likely attributable to Plot having a higher Fall 2017 EC than Plot 1A, Plot 1B or Plot 4. EC value data set can be found in Appendix C.

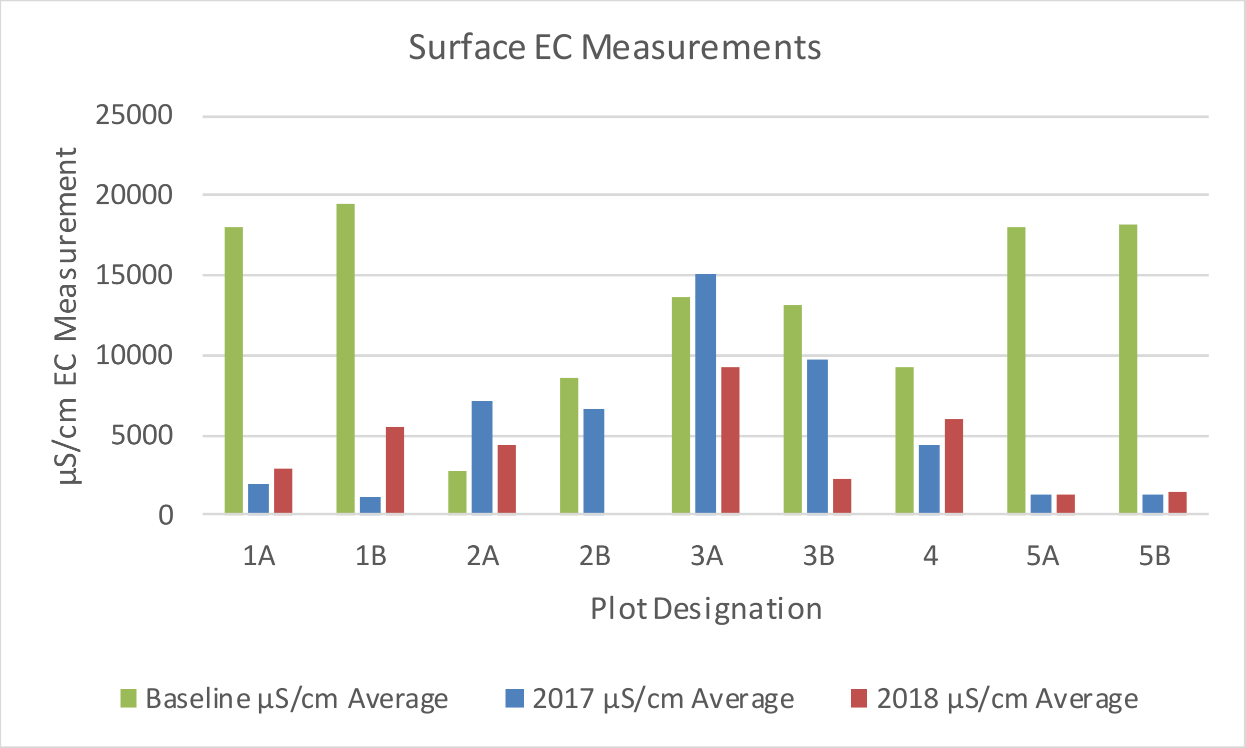

Figure 23: Average surface EC for the nine test plots

5.1.2 1-Foot EC Measurements

One-foot depth EC measurements for the nine test plots were collected and are presented below.

Table No. 14 – 1-Foot Depth EC Averages

Period and Change	1A	1B	2A	2B	3A	3B	4	5A	5B
Baseline (µS/cm)	14,785	14,907	3,700	9,478	10,837	8,367	6,745	15,405	14,502
2017 post-construction (µS/cm)	1,947	3,249	5,044	4,891	15,976	9,350	4,956	1,236	1,358
2018 pre-flush (µS/cm)	-	-	-	-	10,258	8,946	-	-	-
Fall 2018 (µS/cm)	2,336	3,722	4,204	-	11,596	4,921	4,850	1,353	1,487
2017/18 percent change	20%	15%	-17%	-	-27%	-47%	-2%	9%	10%

- Data not obtained

The following observations were made from Fall 2018 post-construction to Fall 2018:

- EC was observed to <u>increase</u> in Plot 1A by approximately 20%;
- EC was observed to <u>increase</u> in Plot 1B by approximately 15%;
- EC was observed to <u>decrease</u> in Plot 2A by approximately 17%;
- EC was observed to <u>decrease</u> in Plot 3A by approximately 27%;
- EC was observed to <u>decrease</u> in Plot 3B by approximately 47%;

- EC was observed to <u>decrease</u> in Plot 4 by approximately 2%;
- EC was observed to <u>increase</u> in Plot 5A by 9%; and
- EC was observed to <u>decrease</u> in Plot 5B by 10%.

Recontamination most likely occurred from surface water runoff infiltrating to 1-foot depths. 1-foot depth EC increased at Plots 1A and Plot 1B. Plot 2A and Plot 4 1-foot EC decreased. This difference in EC change from runoff is likely attributable to Plot 2A and Plot 4 having a higher Fall 2017 EC than Plot 1A or Plot 1B. EC value data set can be found in Appendix C.

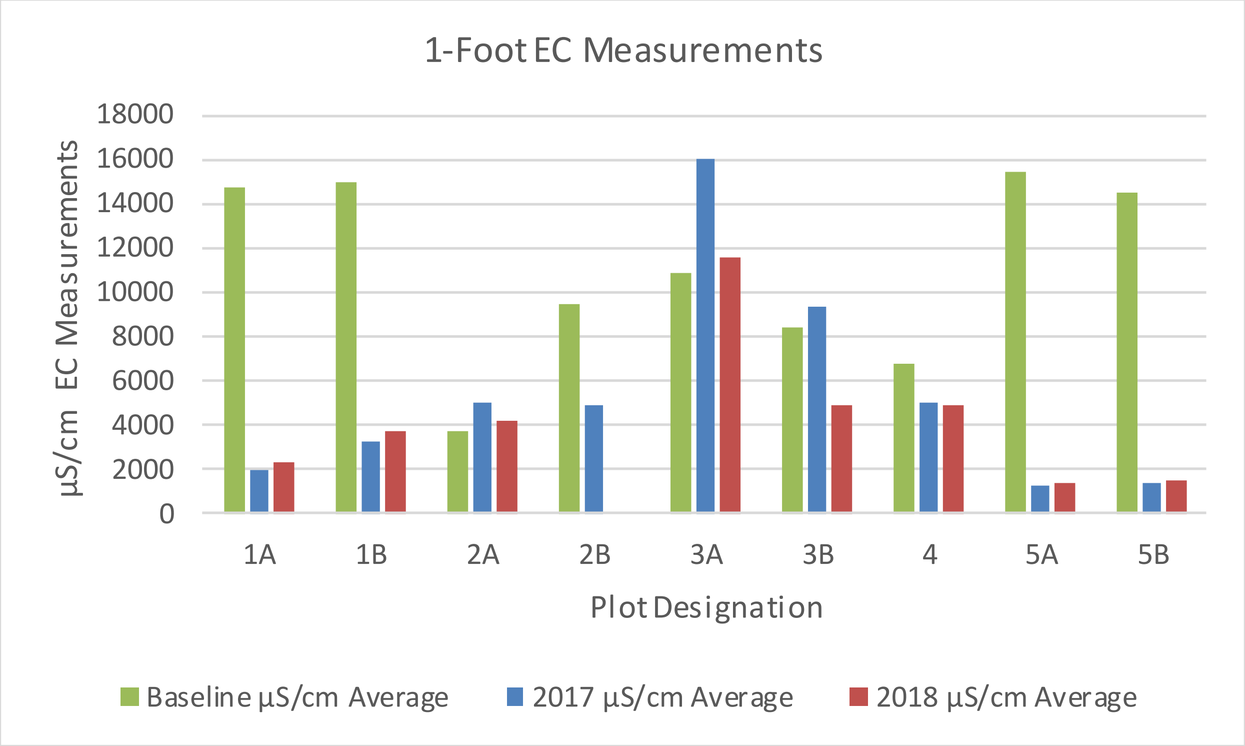

Figure 24: Average 1-foot depth EC for the nine test plots

5.1.3 2-Foot EC Measurements

Two-foot depth EC measurements for the nine test plots were collected and are presented below.

Table No. 15 – 2-Foot Depth EC Averages

Period and Change	1A	1B	2A	2B	3A	3B	4	5A	5B
Baseline (µS/cm)	7,852	15,627	3,377	8,526	9,570	8,302	5,935	10,533	13,515
2017 post-construction (µS/cm)	3,529	3,062	4,451	5,051	13,889	9,253	5,501	1464	1,484
2018 pre-flush (µS/cm)	-	-	-	-	9,174	10,452	-	-	-
Fall 2018 (µS/cm)	2,756	3,326	4,370	-	10,285	5,880	3,785	1,268	1,462
2017/18 percent change	-22%	9%	-2%	-	-26%	-36%	-31%	-13%	-1%

-Data not collected

The following observations were made from Fall 2018 post-construction to Fall 2018:

- EC was observed to decrease in Plot 1A by approximately 22%;
- EC was observed to increase in Plot 1B by approximately 9%;
- EC was observed to decrease in Plot 2A by approximately 2%;
- EC was observed to decrease in plot 3A by approximately 26%;
- EC was observed to decrease in plot 3B by approximately 36%;
- EC was observed to decrease in Plot 4 by approximately 31%;
- EC was observed to decrease in Plot 5A by approximately 13%; and
- EC was observed to decrease in Plot 5B by approximately 1%.

EC value data set can be found in Appendix C.

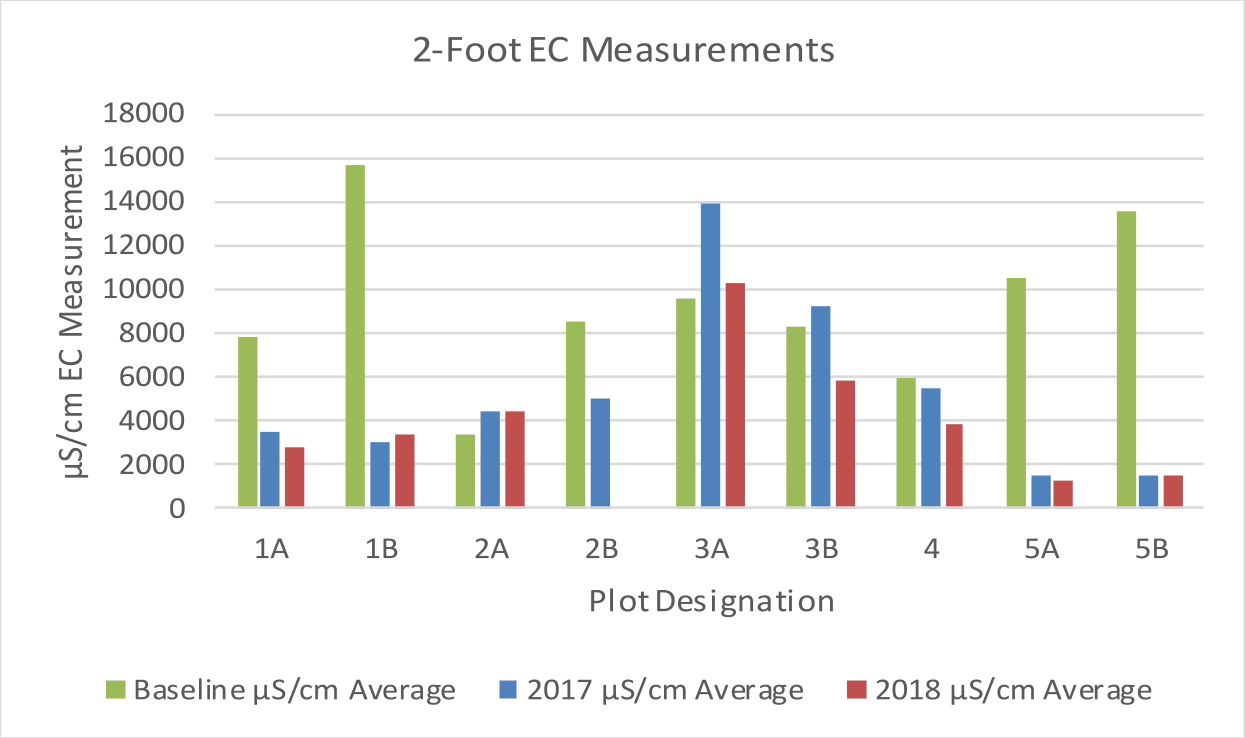

Figure 25: Average 2-foot depth EC for the nine test plots

5.2 Germination Observations

Following the construction of the test plots, each test plot was planted in spring of 2018 with five rows each of the five crops (alfalfa, barley, canola, soybean, and sunflower). Germination observations were made in June 2018 and growth observations were made through the growing season. Data is presented in Table 16 below.

Table No. 16 – Germination Observations by Planting

Planting Period	1A	1B	2A	2B	3A	3B	4	5A	5B
First Planting Germination	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Second Planting Germination	Yes	No	No	No	No	Yes	Yes	Yes	Yes

Germination and growth of alfalfa, barley, canola, and soybeans was observed in Plot 1A and Plot 1B (Table 17). Germination of barley was observed in test plots Plot 2A and 2B. No germination was observed for the five crops in Plot 3A. Germination of a small amount of barley and no other crops was observed in Plot 3B. Germination and growth of barley, canola, and sunflower was observed in Plot 4. Germination and growth for the five crops was observed in Plots 5A and 5B, however soybean growth was sparse.

Table No. 17 – First Planting Germination Observations

Crop Type	1A	1B	2A	2B	3A	3B	4	5A	5B
Alfalfa	Yes	Yes	No	No	No	No	No	Yes	Yes
Barley	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes
Canola	Yes	Yes	No	No	No	No	Yes	Yes	Yes
Soybean	Yes	Yes	No	No	No	No	No	Yes	Yes
Sunflower	Yes	Yes	No	No	No	No	Yes	Yes	Yes

Crops were removed from the test plots following germination and plant growth observations over one growing season. Plots 1A, 1B, 2A, 2B, 3A, 4, 5A and 5B were tilled and planted with winter wheat. Test plot 3B was replanted with the original five crops types to test the effectiveness of flushing on germination (Table 18).

Germination of winter wheat was observed in Plots 1A, 4, 5A, and 5B. Germination was not observed in Plots 1B, 2A, 2B, and 3A. Germination of alfalfa and barley was observed in Plot 3B, with no germination of the other crops observed.

Table No. 18 – Second Planting Germination Observations

Crop Type	1A	1B	2A	2B	3A	3B	4	5A	5B
Alfalfa	-	-	-	-	-	Yes	-	-	-
Barley	-	-	-	-	-	Yes	-	-	-
Canola	-	-	-	-	-	No	-	-	-
Soybean	-	-	-	-	-	No	-	-	-
Sunflower	-	-	-	-	-	No	-	-	-
Winter Wheat	Yes	No	No	No	No	-	Yes	Yes	Yes

-Crops types not planted during second planting

5.3 Cost Summary Analysis

Approximate cost of construction for each test plot was calculated (Table 19). A detailed breakdown of the costs of each test plot and construction component is presented in Appendix B.

Table No. 19 – Cost Estimates (USD)

Cost ($$)	**1A**	**1B**	**2A**	**2B**	**3A**	**3B**	**4**	**5A**	**5B**
Per Plot	15,208	19,984	8,405	13,594	13,949	16,449	13,594	14,925	14,292
Per 1-Acre Site	468,875	615,762	258,992	418,875	429,813	506,842	418,875	459,866	440,362

The cost of each test plot is listed below from least to most expensive. Please refer to Table 3 above for test plot construction details.

- $8,405 for the method used in Plot 2A;
- $13,594 for the method used in Plots 2B and 4;
- $13,949 for the method used in Plot 3A;
- $14,292 for the method used in Plot 5B;
- $14,925 for the method used in Plot 5A;
- $15,208 for the method used in Plot 1A;
- $16,449 for the method used in Plot 3B; and
- $19,984 for the method used in Plot 1B.

The costs for remediation per acre were extrapolated from test plot costs and scale of the NDIC Site 3 project. Variable costs (such as disposal, excavation, material, etc.) were based on costs observed during NDIC Site 3 and other remediation projects for NDIC by Terracon.

The cost of each test plot is listed below from least expensive to most expensive for the test plots that were selected for water flooding/flushing. The cost of water used for flushing in Plot 3B was based on scaling up the cost of procuring and transporting water to the site via trucking. The final report will consider reducing this cost by obtaining suitable water from a local well or rural water source.

- $258,992 for the method used in Plot 2A;
- $418,875 for the method used in Plots 2B and 4;
- $429,813 for the method used in Plot 3A;
- $440,362 for the method used in Plot 5B;
- $459,866 for the method used in Plot 5A;
- $468,875 for the method used in Plot 1A;
- $506,842 for the method used in Plot 3B; and
- $615,762 for the method used in Plot 1B.

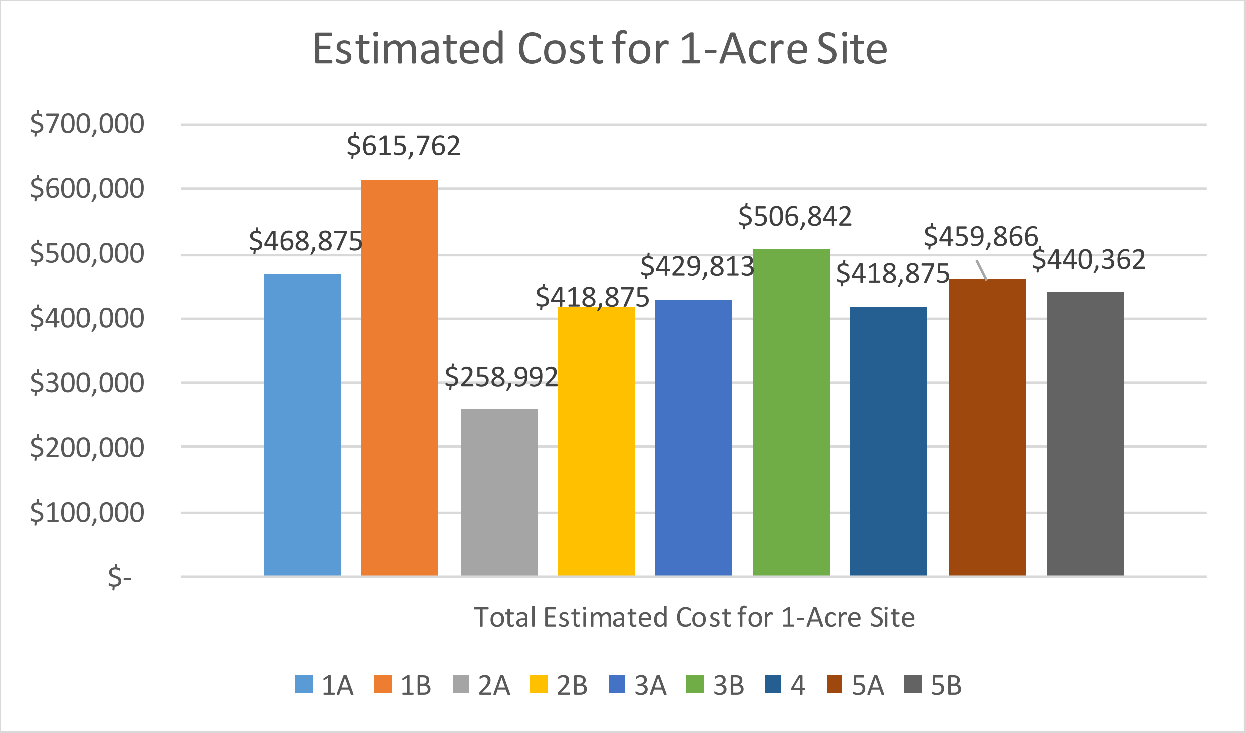

Figure 26: Cost comparison for 1-acre site

6.0 FINDINGS

Homogenizing contaminated soils in Plots 2A and 2B was the least expensive remedial construction method and least expensive method with a drainage system, respectively. EC increased in Plot 2A baseline readings and 2018, however flooding of the plots from above normal precipitation in June 2018 most likely recontaminated the soils in the test plots. Germination was only observed for Barley in Plot 2A, and no germination was observed for other crops planted for either the first or second planting period.

Replacing contaminated soil with clean soil in Plots 1A and 1B were the third and first most expensive methods, respectively. Germination was successful for the five crop types for both test plots and winter wheat for the two planting periods at test plot 1A. However, construction of a drainage system increased the cost above other methods. These methods require disposal of contaminated soil and importing non-impacted soil.

Amending contaminated soil and flushing with water obtained from PRC-3 did not reduce EC in Plot 3A. Flushing with clean water reduced EC in Plot 3B to near the maximum optimal EC for germination of ~3,000 µS/cm. Importing water for flushing amended soil is the second most expensive method of those tested, however does not require importing clean soil or disposal of contaminated soil. The cost of water used for flushing in Plot 3B was based on scaling up the cost of transporting water to the site via trucking. Less expensive sources of water may lower the price of this remedial construction methods.

Homogenizing contaminated soil with non-impacted soil in Plot 4 decreased EC. Germination was observed for both planting periods. EC did not decrease to below the optimal maximum EC for germination of ~3,000 µS/cm. Negligible change in EC was observed between post-construction and Fall 2018. This method was the least expensive for germination and growth observations, however observed EC reduction was less than in Plots 2A, 2B, and 3A.

Placing non-impacted soil above contaminated soil in Plots 5A and 5B was less expensive than excavating and replacing contaminated soil with non-impacted soil. EC in Plots 5A and 5B maintained well below the lab-tested optimal maximum of ~3,000 µS/cm. Negligible changes were observed in EC between the gravel capillary break system used in Plot 5A and the geosynthetic material used in Plot 5B, however the cost of the geosynthetic material for a 1-acre site was $19,504 less expensive than a gravel break for similar EC observations. These methods were the third and fourth most expensive. This method requires non-impacted soil to be imported. Contaminated soils are not removed from the site or treated onsite.

7.0 RECOMMENDATIONS

Based on the observations of our activities conducted for the test plots, test cells, and test columns, Terracon recommends the following activities:

- Ongoing monitoring and maintenance of the test plots for at least two additional growing seasons to observe EC and chloride levels.
- Observing winter wheat germination in the spring.
- Native vegetation observations in the spring to observe if EC and community observations remain consistent over time and a correlation can be observed between soil EC and plant community development.
- Collecting and analyzing EC data from the test plots in the spring.
- A larger scale pilot project to test amending soil with gypsum and flushing with clean water as in Plot 3B.

APPENDIX A – EXHIBITS

Exhibits 1-3 – Test 1A EC Maps
Exhibits 4-6 – Test Plot 1B EC Maps
Exhibits 7-9 – Test Plot 2A EC Maps
Exhibits 10-15 – Test Plot 3A EC Maps
Exhibits 16-21 – Test Plot 3B EC Maps
Exhibits 22-24 – Test Plot 4 EC Maps
Exhibits 25-27 – Test Plot 5A EC Maps
Exhibits 28-30 – Test Plot 5B EC Maps