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Field Trials and Long-Term Monitoring of Microbially-Induced Desaturation for the
Treatment of Liquefiable Silty Soils

by

Kayla Rae Sorenson

A thesis submitted in partial fulfillment of the
requirements for the degree of

Master of Science
in
Civil and Environmental Engineering

Thesis Committee:
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Portland State University
2021

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Abstract

Earthquake liquefaction hazards in silty soils are a critical problem in Portland, Oregon, and other areas around the world. This is a particular problem for existing facilities founded on liquefiable soils, for which there exists no cost-effective liquefaction mitigation solution at the present time. It is essential from both a seismic safety and a seismic resilience perspective to be able to mitigate potentially liquefiable soils underneath existing structures, and to do so in a cost-effective manner. Recent studies suggest that liquefaction mitigation using microbially-induced desaturation (MID) may provide this capability.

The objective of MID is to reduce earthquake-induced excess pore water pressure generation compared to saturated soil, and thereby reduce the potential for triggering liquefaction. A field study of liquefaction mitigation using MID was performed at two sites in Portland in the summer of 2019. Low plasticity liquefiable silts were treated with MID by injecting a treatment solution to stimulate native bacteria for a duration of four weeks.

Monitoring at both sites indicated that the liquefiable soils were successfully desaturated. The persistence of desaturation was monitored for eight months post-treatment at one site and is ongoing at the other site (20 months so far). The monitoring data indicate that the induced desaturation has persisted through seasonal fluctuations of the ground water table since the end of treatment. These data, which document MID longevity, are particularly important to establish MID as a viable option for liquefaction mitigation for use not only in silty soils, but also underneath existing structures for which there is no other mitigation method available.

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List of Abbreviations

ASCE	American Society of Civil Engineers
bgs	below ground surface
CEI	Critical Energy Infrastructure
CL	low plasticity clay
<i>cm</i>	centimeter
CSZ	Cascadia Subduction Zone
DOGAMI	Oregon Department of Geology and Mineral Industries
DPCH	direct push crosshole
Δu	pore water pressure
EC	electrical conductivity
<i>g</i>	gram
GH	general hardness
GWT	ground water table
HSA	hollow stem auger
I_c	soil behavior index
<i>kg</i>	kilogram
KH	carbonate hardness
<i>kPa</i>	kilopascal
L	liter
M	magnitude
m	meter
<i>mg</i>	milligram

MID	microbially induced desaturation
MIDP	microbially induced desaturation and precipitation
ML	low plasticity silt
mol	mole
<i>mS</i>	millisiemen
PDX	Portland International Airport
PI	plasticity index
PPT	pore pressure transducer
PVC	polyvinyl chloride
ρ_{dry}	dry density
SC	screening test
SCPT	seismic cone penetration test
SPT	standard penetration test
S_r	saturation ratio
USCS	United Soil Classification System
V_s	shear wave velocity
V_p	pressure wave velocity
w_L	liquid limit
w_n	in-situ water content
w_P	plastic limit

Chapter 1: Introduction

1.1: Seismic Hazards in Pacific Northwest

The primary seismic hazard for the Pacific Northwest is an earthquake produced by the Cascadia Subduction Zone (CSZ). The CSZ is a 965 km (600 mile) fault that runs from northern Vancouver Island in Canada to northern California as seen in Figure 1.1 and is located between 100 km and 160 km (110 – 160 miles) off the Oregon coast (OOEM). Historical evidence indicates at least 40 major (Magnitude [M] > 7.5) CSZ earthquakes since 9845 BCE (Goldfinger et al. 2012), with the last major earthquake being a M9.0 occurring on Jan 26, 1700 (Satake et al. 1996).

Figure 1.1: The CSZ in relation to the Pacific Northwest of the United States, and the tectonic plates that make up the CSZ. Image adapted from Atwater et al. 2005.

In addition to the CSZ, the seismicity in Oregon is also affected by shallow crustal faults. Portland, Oregon has three known inter-crustal faults that run throughout the metro area

that are referred to as the Portland Hills Fault zone, as seen in Figure 1.2. There is indirect evidence that this fault zone can produce large magnitude earthquakes (M6.8 – M7.2) every 1,000 years (Wong et al. 2001).

Figure 1.2: Shallow inter-crustal faults located within the Portland, Oregon Metro area.

Image source: Washington County Emergency Management.

1.2: Liquefaction Hazard in Oregon

Liquefaction (or cyclic softening) is a term that is used when saturated, loosely compacted soils temporarily lose their strength and stiffness, and exhibit the characteristic of a liquid during earthquake shaking. The applied stress increases the soil's pore water pressure (Δu), which in turn decreases the shear strength of the soil.

Portland, Oregon, and the surrounding Willamette Valley were subjected to the Missoula Floods, a series of flood events that occurred between 15,000 and 13,000 years ago. These flooding events left behind substantial layers of alluvial sediments, primarily composed of silt, sand, and organic-rich clays. The maximum thickness of the combined sediment layers is approximately 45 meters (Hull 1991). These Quaternary sediments, combined with dredged soils from the Columbia and Willamette rivers, have high liquefaction susceptibility as seen in Figure 1.3 and as categorized by the Oregon Department of Geology and Mineral Industries (DOGAMI) (Bauer et al. 2012).

Figure 1.3: Liquefaction susceptibility of Portland area soils as defined by DOGAMI 2012, in relation to the two field trial sites, Sunderland and Harborton.

Several factors are used to determine whether or not a fine-grained soil is liquefiable, the most notable being the soil's liquid limit (w_L), the in-situ water content (w_n), and the plasticity index (PI). w_L is defined as the water content at which soil changes from a plastic

state to a liquid state; w_n is the ratio of the weight of water to the weight of soil solids; and PI is the difference between w_L and the plastic limit (w_p) (the plastic limit being defined as the water content at which soil changes from a solid state to a plastic state). Low plasticity soils ($PI < 18$) are considered moderately susceptible to liquefaction, and soils where $PI < 12$ are considered to be highly susceptible to liquefaction (Bray and Sancio 2006).

1.3: Existing Ground Improvement Methods for Liquefaction Mitigation

Current liquefaction mitigation methods aim to either (i) increase the soil density or (ii) increase the soil strength. Increasing the density through methods such as vibro-compaction or surcharge loading aims to reduce the amount of Δu that can be generated during a shaking event – the soil will dilate creating larger voids that the pore fluid can inhabit, allowing the soil to have a higher threshold for applied stress before Δu generation occurs. Strengthening the soil works in several ways, from allowing Δu to quickly drain from the soil (stone columns), to increasing the soil's stiffness (soil cement mixing).

There are several methods for liquefaction mitigation besides those previously mentioned. However, only a fraction of these methods are suitable to mitigate fine-grained soils, and even fewer are suitable to treat fine-grained soils beneath existing structures. The lack of a sufficient mitigation method is a cause for concern for areas around the globe. Sites that have not been properly mitigated against liquefaction (or mitigated at all) face liquefaction-induced ground deformations, lateral spreading, and site-specific liquefaction concerns.

The critical energy infrastructure (CEI) hub in Portland has the concern of significant environmental damage due to spilled fuel contamination in the Willamette River (Wang et al. 2012). The methods that can treat fine-grained soils under existing structures are usually cost-prohibitive and often cannot be used due to unique challenges at individual sites; the CEI hub is composed of aging fuel tanks which strong vibrations may damage. Therefore, there is a strong need for a non-disruptive ground improvement method that is cost-effective for fine-grained liquefiable soils and can be applied beneath existing structures.

1.4: Microbially Induced Desaturation for Liquefaction Mitigation

An emerging method to non-disruptively treat low plasticity fine-grained soils underneath existing structures is microbially-induced desaturation (MID). MID is performed by injecting a solution that contains calcium nitrate, calcium acetate, and trace elements into the subsurface. The treatment solution stimulates the growth of native bacteria that oxidize the acetate by reducing the nitrate, producing dissolved inorganic carbon and nitrogen gas as a byproduct (O'Donnell et al. 2017a). The relatively insoluble nitrogen gas displaces a small percentage of the fluid's pore water, which in turn reduces the soil's saturation ratio (S_r). Liquefaction only occurs when the $S_r > 99.5\%$ (Valle-Molina and Stokoe 2012); previous laboratory tests on sand show that cyclically induced Δu may be reduced to values between 95% and 50% when S_r reduces from 100% to 95% (He et al. 2013, Vega-Posada et al. 2014).

Field trials utilizing MID were performed from August to September 2019 at two sites in Portland, Oregon. This was the first time MID was performed at the field scale in the United States.

1.5: Thesis outline

The contents in this thesis have been submitted as a conference paper to the 2021 ASCE Lifelines conference and a journal paper to be submitted to the ASCE Geotechnical and Geoenvironmental Engineering Journal with the following citations:

Sorenson, K., Preciado, A.M., Moug, D., Khosravifar, K., van Paassen, L., Kavazanjian, E., Stokoe, K., and Menq, F. “Field Monitoring of the Persistence of Microbially Induced Desaturation for Mitigation of Earthquake Induced Soil Liquefaction in Silty Soil”. *Submitted to ASCE Lifelines Conference, 2021.*

Moug, D., Sorenson, K., Khosravifar, A., Preciado, A.M., Stallings Young, E., van Paassen, L.,

Kavazanjian, E., Zhang, B., Stokoe, K., Menq, F., Wang, Y. “Field Trials of Microbially Induced Desaturation in Low Plasticity Silt”. *Submitted to the Journal of Geotechnical and Geoenvironmental Engineering, 2021*

Chapter 2 of this thesis describes the field trial site locations including the geotechnical explorations, the MID field setup, and the soil classification and liquefaction susceptibility of subsurface soil units at each site.

Chapter 3 of this thesis describes the chemical composition of the treatment solution, how the treatment solution was applied, and the automated control system that was used to

induce a seepage gradient to facilitate the application of the treatment solution throughout the subsurface.

Chapter 4 of this thesis describes the various monitoring data that were collected before, during, and after the completion of the MID field trials. These data can be broadly defined as (a) pertaining to the application of the treatment solution during the four-week field trial period and (b) evaluating the effectiveness of the treatment after the four-week field trial period. Data categorized as (a) include injection rates and pressures, electrical conductivity of the treatment solution as a means of monitoring the chemical reaction and as a means of observing the subsurface seepage path, and strip-tests to qualitatively observe larger trends in the progress of the MID reaction between the injection well and the extraction wells. Data categorized as (b) include crosshole pressure-wave velocity measurements, a vertical array of embedded sensors that measure water content and bulk electrical conductivity, pre- and post-treatment seismic cone penetration tests, and direct soil sample of the treated soils.

Chapter 5 of this thesis presents the conclusions of these field trials up until 20 months post-treatment, and recommendations for future tests to better understand and assess the viability of MID as a liquefaction mitigation method.

Chapter 2: Site Descriptions

The two sites chosen for MID treatment are located by critical lifelines: the Sunderland site is located by the Portland International Airport (PDX) and the Harborton site is located by the CEI hub. The CEI hub handles 90% of all the liquid fuel (gasoline, diesel, natural gas, etc.) for the entire state of Oregon and 100% of the jet fuel for PDX (Wang et al. 2012). Both sites are underlain by low plasticity soils that are considered susceptible to liquefaction and damaging ground deformations during strong earthquake shaking. Both sites and their proximity to nearby critical lifelines can be seen in Figure 1.3; the Sunderland site is underlain by soils similar to PDX and the Columbia river levees, and the Harborton site is underlain by soils similar to the CEI hub.

2.1: Sunderland Site

The Sunderland site is underlain by Holocene-aged floodplain alluvium from the Columbia River (Hull 1991). These floodplain deposits typically overlay coarse river sand deposits. However, the coarse-grained deposits were not encountered in this study.

Geotechnical characterization activities for the Sunderland site included sampling, lab testing, and in-situ testing. The layout of the geotechnical explorations are shown in Figure 2.1. Hollow-stem auger (HSA) drilling was performed for installation of the injection and extraction wells as part of the MID treatment system. Appendix A contains the field logs that were filled out during the well installation and Appendix B contains the finished boring logs. During HSA drilling, soil samples were obtained with split-spoon samplers from

standard penetration tests (SPTs) and by Shelby tube sampling. Hand-augured samples were obtained near the targeted treatment zone.

Figure 2.1: Areal view of the Sunderland site, including geotechnical explorations, MID treatment system, and the targeted treatment zone.

The interpreted site conditions are summarized in Figure 2.3a. The site is primarily composed of low plasticity silt to about 6.1 m below the ground surface (bgs). The boundary between brown and gray silt at about 2.25 m bgs is likely due to oxidation-induced soil color change in the vadose zone above the water table. This boundary can be seen in Figure 2.2. A summary of the measured w_p , w_L , and w_n values obtained from soil samples is shown in Figure 2.3b. The w_L , w_p , w_n , and corresponding PI values for individual tests can be found in Appendix C. Generally, the w_n at the site is close to or larger than w_L (the ratio of w_n/w_L ranges from 0.89 to 1.27). The average PI of the soils is 14. Grain size distribution was characterized using hydrometer tests and No. 200 sieve washes to further classify the soil via the Unified Soil Classification System (USCS) as presented in Figure 2.3c. The individual hydrometer and No. 200 wash values for each test

can be found in Appendix D. Fining upward sequences with larger coarse contents at about 2.5 m and 6.5 m bgs are interpreted to be soils deposited during flooding events. The soils classify as low plasticity silt (ML) or lean clay (CL) as indicated by the plasticity chart in Figure 2.3d. Based on index testing, 9 out of 48 samples of the soils sampled are classified as susceptible to liquefaction, 26 out of 48 samples are classified as moderately susceptible to liquefaction, and 13 out of 48 samples are not susceptible based on Bray and Sancio (2006) as seen in Figure 2.3e. 46 out of 48 samples are susceptible to cyclic softening based on Boulanger and Idriss (2006).

Figure 2.2: Sunderland split-spoon sampler collected from 1.98 m to 2.44 m bgs showing the delineation between brown and gray silt.

The water table at the site fluctuates seasonally but is also influenced by the water level in an adjacent drainage canal. Over the course of 23 months the measured groundwater table (GWT) depth ranged from 1.5 m to 0.0 m bgs with observed ponding of up to 0.43 m on site; the water table depth was 1.1 m bgs at the time of MID application.

Figure 2.3: Sunderland (a) idealized soil profile, (b) Atterberg limits, (c) clay, silt, and coarse-grained content by percentage with depth, (d) USCS classification using the plasticity chart, and (e) liquefaction susceptibility according to Bray and Sancio 2006.

2.2: Harborton Site

The soils in the area of the Harborton site (considered to be representative of the CEI hub) are composed of Willamette river-deposited soils and fill soils dredged from the river (Wang et al. 2012). Similar to the Sunderland site, geotechnical characterization activities for the Harborton site included sampling, lab testing, and in-situ testing. HSA drilling was performed for installation of injection and extraction wells as part of the MID treatment system, and during HSA drilling soil samples were obtained with split-spoon samplers from SPTs; Shelby tubes and hand-augured samples were obtained within the targeted treatment zone. Figure 2.4 shows the layout of the geotechnical explorations at the Harborton site. Appendix E contains the field logs that were fill out during the well installation and Appendix F contains the finished boring logs.

Figure 2.4: Areal view of the Harborton site, including geotechnical explorations, MID treatment system, and the targeted treatment zone.

The interpreted site conditions at Harborton are summarized in Figure 2.5a. The site is primarily composed of interbedded non-plastic and low plasticity silt to about 5.25 m bgs. Over half of the specimens tested were classified as non-plastic. Atterberg index testing was performed; the resulting w_p , w_L and w_n values are shown in Figure 2.5b. Hollow symbols represent w_n of non-plastic specimens. The w_L , w_p , and w_n values for individual tests can be found in Appendix G. w_n at the Harborton site is close to or less than w_L (the ratio of w_n/w_L ranges from 0.78 to 1.28). The low plasticity silt had an average PI of 13, which was interbedded with non-plastic silt. The grain size distribution was characterized using hydrometer tests and No. 200 sieve wash tests to further classify the soil via the USCS, the results of which are presented in Figure 2.5c. The individual hydrometer and No. 200 wash values for each test can be found in Appendix H. The soils classify as non-plastic or as indicated on the plasticity chart in Figure 2.5d; non-plastic soils are not plotted. Based on index testing, 6 out of 13 soil samples are classified as susceptible to liquefaction, 4 out of 13 samples are classified as moderately susceptible, and 3 out of 13 samples are not susceptible based on Bray and Sancio (2006) as seen in Figure 2.5e. An additional 19 soil samples could not be classified according to this criterion, as no w_L value could be obtained; these samples are not plotted. 11 out of 13 samples are susceptible to cyclic softening based on Boulanger and Idriss (2006).

The water table at the time of well installation in July was measured at approximately 2.3 m bgs. The GWT at the site likely undergoes fluctuations with the Willamette River water level and seasonal seepage from hills located to the south-west of the site.

Figure 2.5: Harborton (a) idealized soil profile, (b) Atterberg limits, (c) clay, silt, and coarse-grained content by percentage with depth, (d) USCS classification using the plasticity chart, and (e) liquefaction susceptibility according to Bray and Sancio 2006.

Chapter 3: MID Field Trials

MID field trials for liquefaction mitigation of fine-grained soils were performed at both the Sunderland and Harborton sites. The MID treatment was performed by injecting a substrate solution into the subsurface. The treatment method and field trial design are described herein.

3.1: Treatment Solution and Chemical Reactions

MID relies on native denitrifying bacteria, which oxidize organic carbon (electron donor) in conditions where the groundwater is depleted of dissolved oxygen by reducing nitrate (electron acceptor), and produces $N_2(g)$, biomass, and dissolved inorganic carbon. Dissolved inorganic carbon may form carbon dioxide gas ($CO_2(g)$) or, in the presence of dissolved calcium ions (Ca^{2+}), precipitate as calcium carbonate ($CaCO_3$). The MID process is the first stage of the microbially induced desaturation and precipitation (MIDP) process as detailed in O'Donnell et al. (2017a,b) and Stallings Young et al. (2020), in which ground improvement is achieved through biogenic gas formation and mineral precipitation. Although both desaturation and precipitation improve the cyclic resistance ratio for loose granular soils, the amount of substrates needed to sufficiently reduce S_r may be 10 to 40 times less than the required amount to reach a sufficient level of cementation (O'Donnell et al. 2017a,b, Pham et al. 2017, 2018b). MID can mitigate the triggering of liquefaction by increasing the compressibility of the pore fluid and preventing Δu build up during cyclic loading. Studies on desaturated sand showed a reduction in cyclic loading-induced Δu when compared to saturated conditions (O'Donnell et al. 2017b, Yegian et al. 2007, Wang et al. 2020).

The stoichiometry of the denitrification reaction varies depending on the carbon source and bacteria growth rate. Most reported studies on MIDP used calcium acetate as an organic carbon and calcium source. However, other organic carbon sources, such as ethanol in solution (Mousavi & Ghayoomi 2021), may be used. The reduction of nitrate (NO_3^-) to $\text{N}_{2(\text{g})}$ involves several steps, which can result in the accumulation of the intermediate products nitrite (NO_2^-), nitric oxide (NO), and nitrous oxide (N_2O). By using acetate ($\text{C}_2\text{H}_3\text{O}_2^-$) as the carbon source, and assuming full conversion of NO_3^- to $\text{N}_{2(\text{g})}$ and a maximum growth rate of biomass ($\text{CH}_{1.8}\text{O}_{0.5}\text{N}_{0.2}$) the stoichiometry of the reaction is estimated by Pham et al. (2017) as:

When biomass growth is limited, for example due to lack of nutrients or inhibited by accumulation of intermediate nitrogen compounds, the reaction may follow the stoichiometry of the catabolic reaction (zero biomass growth):

Depending on the biomass growth rate, the molar substrate ratio ($\text{C}_2\text{H}_3\text{O}_2^-:\text{NO}_3^-$) may vary roughly between 1.2:1 to 0.6:1 (van Paassen et al. 2010, Pham et al. 2018a).

Accumulation of intermediate products should be avoided, since NO_2^- and NO are environmental toxins and inhibit the denitrification reaction, and NO is a strong greenhouse gas. To ensure full conversion of NO_3^- to $\text{N}_{2(g)}$, the molar substrate ratio should be sufficiently high to ensure the reaction is not $\text{C}_2\text{H}_3\text{O}_2^-$ (electron donor) limited. At the same time the total substrate concentrations should not be too high, as high NO_3^- concentrations can also inhibit the denitrification reaction (Van Paassen et al. 2010; Pham et al., 2018a,b; Glass & Silverstein, 1998).

Both maximum and zero biomass growth conditions result in an increase in pH and alkalinity. At neutral pH, bicarbonate (HCO_3^-) is the dominate inorganic carbon product from the above reactions. If available, Ca^{2+} may react with HCO_3^- to precipitate CaCO_3 :

Release of protons (H^+) due to the precipitation of CaCO_3 buffers the alkalinity production of the denitrification reaction, allowing the pH to remain close to neutral. Under acidic conditions some of the HCO_3^- that remains in the solution may speciate to form $\text{CO}_{2(g)}$:

3.2: Application Method

The MID treatment solution was applied to the subsurface through a central injection well. The injection well was surrounded by four equally spaced extraction wells located 3.5 m

from the injection well. The layout of the wells and the associated instrumentation for both sites is shown in Figure 2.1 and Figure 2.4. The wells were installed in holes drilled with a 10-inch HSA. 2-inch diameter schedule 40 PVC casings were installed and were screened with 0.01-inch slot size. The wells at Sunderland were screened from 1.5 m to 6.1 m depth and at Harborton were screened from 3.0 m to 4.6 m depth. The extraction wells pumped out groundwater that was used for (i) the treatment solutions and (ii) to induce seepage gradients to encourage migration of the treatment solution. The target zone for treatment was the circular area centered around the injection well with a radius of 3.5 m, and with a height equal to the screened interval at each site.

The extracted groundwater was stored in a 3780 L (1000 gallon) tank that was referred to as the “extraction tank” as seen in Figure 3.1. Groundwater was extracted using plastic submersible pumps with capacities up to 7.6 L/min, which were activated via float switches as seen in Figure 3.2 and Figure 3.3. The pumps turned on and off through an automated control system. This control system was comprised of motor speed controllers, delay timers, and float switches as shown in Figure 3.4. The float switches were used to cutoff the power source to the pump when the water level dropped below the top of the well screen. This ensured that desaturation was not induced by drawing the GWT into the target zone (i.e., below the well screen), and that the pumps did not run dry and burn out. The motor controls reduced the voltage supplied to the pumps for lower, more sustained pumping rates in these fine-grained soils. The delay timers were used to turn pumps on after a time interval following water level recovery above the float switch. These timers

ensured that the on/off signals to the pump were not dominated by rapid drawdown and recovery from pumping well loss.

Figure 3.1: Schematic showing the MID system, which included an extraction tank for collecting the extracted groundwater, a mixing tote where the calcium acetate and calcium nitrate were added, and an injection tank from which the treatment solution was injected into the subsurface.

Figure 3.2: Left – a perspective shot of the submersible pump and right – the submersible pump as set up in the field.

Figure 3.3: Left – a perspective shot of the float switch and right – the float switch as set up in the field.

Figure 3.4: The automated control system which controlled the extraction pumps, comprised of motor controllers and delay timers.

To prepare the substrate solutions, a 1040 L (275 gallon) tote was filled with water. A high flow trash pump circulated water as one 22.7 kg bag of calcium nitrate (YaraLiva® Calcinit®, CAS No: 15245-12-2), then one 20 kg bag of calcium acetate (Niacet, CAS No: 62-54-4) were added. Circulation continued until the substrates were in solution. The mixed solutions were transferred to a 3780 L tank called the “injection tank” that was filled with water by the trash pump to uniformly dilute the solution to the target concentration. The initial target nitrate concentration at both sites was 0.05 mol/L with a molar substrate ratio of approximately 1.08:1. City water was used in addition to the extracted groundwater at the Sunderland site for dilution, and only extracted groundwater was used at the Harborton site. At the Sunderland site 0.25 mg/L Miracle-Gro® All Purpose Plant Food and 0.06 mg/L Epsom Salt were initially added to provide nutrients and trace minerals to stimulate growth of indigenous denitrifying bacteria. However, after several days of treatment the reaction rate in the substrate solution became very high and a significant portion of the reaction occurred in the injection tank. Therefore, after treatment day 7 the additional nutrients and trace minerals were left out, and after day 12 the concentration was changed from about 0.05 mol/L to 0.10 mol/L (2 bags of each substrate per injection tank) to lower the reaction rate and allow the substrates to migrate a longer distance from the injection well before being consumed. The treatment solution at the Harborton site was consistently prepared at 0.05 mol/L and without addition of nutrients or trace minerals.

The treatment solution was gravity fed into the injection well. Additional injection pressures were applied when the researchers were on-site through an in-line pump installed near the well head at the Sunderland site, or a sump pump in the injection tank at the

Harborton site. It was advantageous to inject the treatment solution within 12 hours of mixing so that the MID reactions would take place predominately in the subsurface. The project team also aimed to inject the treatment solution without applying too much injection pressure to prevent soil fracturing, however this was challenging as biomass built up within the injection well and the surrounding filter pack. To reduce biomass clogging, the injection wells were purged and plunged using a surge block tool when the injection flow rates decreased and injection pressure increased. Additionally, the injection wells were treated with about 0.5 L of 3% hydrogen peroxide daily to dissolve the accumulating biomass.

At Sunderland, the treatment solution was applied for 33 days (from 14 August 2019 to 16 September 2019), and a total of 55m³ of solution was injected replacing 58% of the native pore fluid in the targeted treatment zone. The treatment solution was applied for 34 days at Harborton (21 August 2019 to 22 September 2019), and a total of 17.6 m³ of solution was injected replacing 58% of the native pore fluid in the targeted treatment zone; the volume of pore fluid was calculated assuming a porosity of 50% and fully saturated initial conditions.

Chapter 4: Treatment Monitoring

Several different methods of monitoring were used before, during, and after MID application to (i) obtain baseline values, (ii) monitor the seepage path and effectiveness of MID treatment, and (iii) check the longevity and viability of MID as a liquefaction mitigation method. These methods include measurements of pressure wave velocity, bulk electrical conductivity, flow rates and injection pressures, chemical analyses, in-situ moisture contents through instrumentation, sampling and lab testing, and measurements of the water table over time.

4.1: Before Treatment

Seismic cone penetration tests (SCPTs) were performed at both the Sunderland site and the Harborton site before the start of treatment to obtain baseline values of shear wave (V_s) and pressure wave (V_p) velocities, the GWT, and the soil's behavior type index (I_c). These values were critical in determining which of these two sites would be better suited for additional in-situ testing using NHERI@UTexas large mobile shakers and the corresponding embedded sensor array. The results of the large mobile shaker tests are described in Preciado et al. 2021. Both Sunderland and Harborton profiles are shown in Figure 4.1.

Using the I_c profiles, it was decided that the embedded sensor array would be installed at the Sunderland site. Sunderland had consistent I_c values ranging between 2.6 and 2.95 with few outliers; Robertson 2009 correlates this I_c range as silt mixtures – clayey silt to silty

clay. Harborton had a range of values, indicating that the soil profile consisted of a mixture of sands, silts, clays, and organic soils.

Upon determining that the embedded sensor array was going to be installed at the Sunderland site, a direct push crosshole test (DPCH) and liquefaction screening tests (SC) were performed according to Stokoe et al. 2020; the screening test locations are seen in Figure 4.3. The embedded sensor array is composed of four pairs of 3D geophones located at different depths, with each pair having a metal source rod driven to the same depth. Four pore pressure transducers (PPTs) were embedded between each pair of 3D geophones, but at shallower depths as seen in Figure 4.2. Each source rod and 3D geophone pair act as a crosshole test, allowing for the collection of V_s and V_p data, and each PPT allows for GWT and Δu measurements. V_s , V_p , and GWT data will be presented later; Δu is not included in this paper.

Figure 4.1: The V_p , V_s , and I_c values of Sunderland (a – c) and Harborton (d – f).

Figure 4.2: Top – top view of the embedded sensor array. Bottom – cross-section view of the 3D geophones and PPTs with depth.

Figure 4.3: The Sunderland screening test locations relative to the TREX baseplate and the targeted treatment zone.

Once the array was in place, wells were drilled at both Sunderland and Harborton, although only Sunderland has the sensor array. The specifications were described previously in the *Application Method* section.

4.2: During Treatment

Injection flow rates, treatment solution volumes, injection pressures, electrical conductivity, and the chemical breakdown of the treatment solution were measured and recorded to monitor the effectiveness of the MID treatment and to track the seepage path and subsurface progress of the treatment solution.

4.2.1: Injection Flow Rates

Injection flow rates and volumes were recorded to study the relationship between volume of treatment solution injected and when MID reactions were observed. The flow rates at

both sites are shown in Figure 4.4 and are estimated from (i) changes in water pressure over a one-hour moving average measured by a submersible datalogger (CTD-divers, Van Essen instruments) in the injection tank (solid line), and (ii) observed values at an in-line flowmeter (green circles). In several cases the flowmeter values are larger than those estimated from change in water pressure. These discrepancies are most common soon after starting pumping injection.

Figure 4.4: Injection treatment solution flow rate estimated from change of water levels in injection tank and flow gauge (a) Sunderland site, (b) Harborton site.

At Sunderland, the injection flow rates from day 0 to 5 were less than 4 L/min. During this period, the treatment solution was gravity fed from the injection tank that was placed on a hill approximately 2 m higher than the injection well. Initial flow rates decreased after day 3, likely due to biomass buildup at the well screens and filter pack. Injection pumping was implemented on day 5 at Sunderland, and after day 12 the additional measures to mitigate biomass clogging were fully implemented. Pumped injection was used from the start of treatment at Harborton and methods to prevent biomass clogging were used after day 5. With injection by pumping and biomass clogging mitigation measures, the flow rates were

about 6 to 15 L/min at Sunderland and 1 to 2 L/min at Harborton. The difference in flow rates between the two sites is attributed to the different length of the well screens and distinct hydrogeologic properties.

The cumulative volumes of injected treatment solution are presented in Figure 4.5. The total volume was approximately 55 m³ at Sunderland and 18 m³ at Harborton. These volumes are equivalent to approximately 60% of the total pore volume of the target zone, assuming 50% porosity at both sites. The end of treatment was primarily driven by schedule constraints; however, these injection volumes were sufficient to achieve desaturation at both sites.

Figure 4.5: Cumulative volume of injected treatment solution at (a) Sunderland site, and (b) Harborton site.

Pressures at the injection well head are shown in Figure 4.6. The solid line shows the pressure contribution from the treatment solution height in the injection tank. The green symbols show the pressure reading at the well head from a pressure gauge, which was composed of pressure from the treatment solution height and injection pumping. There are

elevated pressures at Sunderland for days 0 to 12 that then reduced after day 12 when biomass mitigation measures were implemented. There are instances when the measured pressure is less than the pressure from the solution height; this may be due to biomass buildup and hydraulic head loss in the plumbing from the injection tank. Injection pressures measured at the well head at Sunderland after day 12 remained below 30 *kPa*, at Harborton throughout treatment values remained below 25 *kPa*.

Figure 4.6: Injection pressures for (a) Sunderland site, and (b) Harborton site.

4.2.2: Electrical Conductivity

Electrical conductivity (EC) measurements provided information on subsurface migration of the treatment solution and progress of the MID reaction. The EC relates to fluid salinity. Since the treatment solution had a larger salinity than the native groundwater, the EC measured in the treatment solution was larger than the EC measured for native groundwater. The treatment solution substrates are all dissolved salts and the MID reaction products are either gas, solid minerals, or biomass; therefore, the EC is also a direct

measure of substrate consumption. Specifically, decreasing EC in the treatment solution was a sign that the MID reaction was taking place.

EC was measured in the injection and extraction tank water with the submersible dataloggers, these results are plotted in Figure 4.7. At Sunderland, the initial EC in the treatment solution (Figure 4.7a) was approximately 10 *mS/cm* from day 0 to day 12 and then increased to approximately 20 *mS/cm* when the solution concentration increased from 0.05 to 0.10 mol/L. Decreasing EC in the Sunderland injection solution from day 2 to day 12 indicated that the MID reaction was occurring in the injection tank prior to injection. After day 12 the treatment solution concentration was increased, and city water was used to mix the treatment solution which slowed the biochemical conversion in the injection tank. EC of the treatment solution at Harborton (Figure 4.7b) was about 10 *mS/cm* for the 0.05 mol/L treatment solution. Decreasing EC of the treatment solution in the injection tank was observed after day 12 at Harborton, which indicated an increased metabolic conversion rate. Considering no additional nutrients or trace minerals were added to Harborton treatment solutions, it is likely that the extracted groundwater used for the treatment solution was the source of these nutrients, allowing accumulation of indigenous denitrifying microbes and increased microbial activity in the injection tank.

Figure 4.7: Electrical conductivity measured by suspended divers in the treatment solution and the extracted water at (a) Sunderland and (b) Harborton.

EC at the extraction tank reflects the average value of water from the four extraction wells. The datalogger was installed in a 1 L container that collected extracted water before the water overflowed to fill the extraction tank. This allowed changes in EC to be constrained over a narrower time range than if the datalogger was suspended in the extraction tank water. The background level of EC was characterized with groundwater extracted to mix the first treatment solution and was approximately 1.0 mS/cm at Sunderland and 0.7 mS/cm at Harborton. Increased EC of the extracted groundwater signaled that the treatment solution had traveled from the injection well to one or more extraction wells. At both sites, the extracted groundwater throughout treatment had lower EC than the injected treatment

solution, likely due to the combined effects of substrate consumption during the MID reaction and mixing with native groundwater.

Throughout treatment at Sunderland, EC of the extracted water increased during injection pumping and decreased under gravity fed injection. The relationship is closely examined in Figure 4.8 which shows injection volume, and EC of extracted and injected water from 12:00 on day 14 to 12:00 on day 15. The average injection rate was 6 L/min during injection pumping (black line), and 0.22 L/min during gravity feed (dashed black line). Injection pumping started at 13:30 on day 14, and an increase in extracted water EC was measured at 14:00 (i.e., 30 min after injection pumping started). At 15:30 the injection was switched to gravity feed and extracted water EC decreased until 19:00. A similar pattern is observed the following day when the remaining treatment solution was injected by pumping starting at 07:30 and extracted water EC started increasing at 08:05. The relation between injection flow rate and EC in the extracted groundwater illustrates how the reactive transport is affected by the hydrological boundary conditions. The increase in EC in the extraction wells indicates the presence of highly preferential pathways during injection pumping that channel the treatment solution between the injection well and at least one extraction well. This is also supported by Figure 4.7a that shows a notable increase in extracted water EC following the increase of the treatment solution concentration after day 12.

Figure 4.8: Electrical conductivity in the injection and extraction tanks 24 hours (Sunderland).

At the Harborton site, extracted water EC does not appear to be related to injection pumping. As shown in Figure 4.7b, extracted water EC increases from background EC about 0.5 days into treatment, and remains between 3 and 6 mS/cm until day 10 when the EC decreases to 1 to 2 mS/cm . The decrease in EC is likely due to the increased MID reaction rate in the subsurface, where after 10 days of treatment the MID reaction was occurring at a sufficiently fast rate that most substrates were consumed by the point the injected solution reached the extraction wells.

4.2.3: Strip Tests

Additional monitoring of the treatment solution and extracted groundwater was performed to estimate concentrations of NO_3^- and NO_2^- , carbonate hardness (KH), general hardness (GH), and pH. Measurements were performed with color changing strip tests (API® 5-in-

1 Test Strips) by submersing the strips into fluid and matching the resultant color to a value range specified by the manufacturer. Often the fluid was diluted to bring concentrations within the test range, and the results were corrected for the dilution factor. The strip tests do not have high accuracy; however, they were performed regularly to qualitatively observe larger trends in the progress of the MID reaction between the injection well and extraction wells.

The strip test results for the injected solution and extracted water at the Sunderland site are summarized in Figure 4.9(a-e). Generally, the NO_3^- concentration decreased from 800-8000 *mg/L* in the injected solution to 0-3200 *mg/L* in the extracted water (Figure 4.9a). Figure 4.9b shows some presence of NO_2^- , an intermediate product of reactions (1) and (2), in the extracted water. Slightly elevated NO_3^- and NO_2^- concentrations in extracted water may be due to seepage through a highly preferential pathways that did not complete the MID reaction before reaching the extraction well. Many of these elevated concentrations were measured during injection pumping with similar trends as observed for EC and discussed for Figure 4.8. Since values decrease during gravity feed, the treatment solution outside of this highly preferential pathway likely completed the conversion from NO_3^- to $\text{N}_{2(g)}$. pH values in Figure 4.9 do not show overall differences between the injected solution and extracted groundwater, which likely reflects that the MID reaction is self-buffering. Data for KH and GH were obtained during the later period of treatment (Figure 4.9d,e). KH is a measure of HCO_3^- and CO_3^{2-} in solution and may increase due to reactions (1) and (2), then decrease due to reactions (3) and (4). GH closely relates to the concentration of Ca^{2+} and other divalent cations. The reduction of GH and KH between the injection and

extraction wells may be attributed to consumption of inorganic carbon and Ca^{2+} by bioprecipitate (reactions 3 and 4), alternatively cation exchange (discussed above) may be consistent with decreasing GH. Final indicator strip tests were performed at all the Sunderland wells on day 33. These final measurements report very little NO_3^- , NO_2^- , KH, and GH, and a pH about 7.5, signaling that the MID reaction had completed in the subsurface by this time. However, it should be noted that the wells were not completely purged according to standard sampling procedures (EPA 2013). Instead, approximately 15 L of water was extracted before collecting water for a strip test.

Strip test data from the Harborton site generally indicate that the MID reaction completed in the subsurface. The results in Figure 4.9f show that NO_3^- concentrations were reduced to 0 between the injection and extraction wells. The presence of NO_2^- (Figure 4.9g) in the injected solution may be an intermediate product of the MID reaction taking place in the injection tank; however, the concentration decreased to 0 in the extracted water, likely due to subsurface completion of the denitrification reaction. Figure 4.9h shows a general pH increase between injection and extraction wells; while a pH increase is expected from the OH^- product in reaction (1), the slight increase in pH indicates possible CaCO_3 precipitation and CO_2 gas formation (reactions 3 and 4) that buffered a larger pH increase. KH and GH decreased between injection and extraction water (Figure 4.9i,j) which is attributed to possible occurrence of reactions (3) and (4).

Figure 4.9: Strip test results to indicate progress of MID reaction and water quality for the injected solution and extracted groundwater for (a-e) Sunderland and (f-j) Harborton sites.

4.3: After Treatment

To check the longevity and viability of MID as a liquefaction mitigation method, V_p , subsurface bulk EC, and in-situ moisture contents were monitored both during and after the MID field trials, while direct saturation ratio measurements and GWT levels were monitored solely after treatment.

4.3.1: Compression Wave Velocity (V_p)

V_p was monitored at both sites, as an indication of change in S_r . For soils with $S_r > 99.5\%$, the measured V_p will be approximately 1500 m/s. Theoretically, when S_r drops below approximately 98.5%, V_p drops to about 400 m/s (Valle-Molina and Stokoe, 2012). Post-treatment V_p measurements were performed with SCPT both inside and outside of the target treatment zone to (i) evaluate MID in various locations in the target zone, and (ii) see if the treatment solution had travelled beyond the target treatment zone. The location of post-treatment SCPT-measured seismic velocity profiles are shown in Figure 2.1 and Figure 2.4 for both sites; Figure 4.10 shows the SCPT V_p profiles for both sites. At Sunderland, post-treatment V_p measurements consistently show V_p around 400 m/s in the target zone, indicating the MID successfully desaturated the soil at these profile locations. The SCPT profile outside the treatment zone at Sunderland shows $V_p < 600$ m/s until 5 m bgs; this may indicate that there was migration of the treatment solution or the produced gas outside the target zone. Similarly, the post-treatment V_p profiles at the Harborton site indicate reduced V_p from pre-treatment conditions both inside and outside the target treatment zone.

Figure 4.10: V_p measurements using SPCTs, DPCH, and crosshole methods at (a) Sunderland and (b) Harborton.

The crosshole array installed at the Sunderland site allowed for regular V_p measurements. Instructions for how to install the required software, set up the equipment, collect, filter, and format the data, and how to analyze the data can be found in Appendices I – N. The array consists of seismic source rods and geophones within the target treatment zone (Figure 2.1 and Figure 4.2). The array measured V_p at 1.45 m, 1.85 m, 2.55 m, and 4.55 m bgs with the distance between geophones being 0.90 m (i.e., V_p is averaged over 0.90 m).

The V_p and V_s arrival times at each receiver were manually selected based on the geophone voltage time series. In this study, both upward and downward impacts were imposed on the source rod to create reversed polarities in the time series, which helps determine wave arrival times. These arrival times and the manual selections can be seen in Appendices O, P, and Q, for data collected before, during, and after treatment, respectively. Examples of these time series and selection of pressure wave arrival times are shown in Figure 4.11 for measurements taken at 2.55 m bgs performed 5 days before treatment and 43 days after the start of treatment. The data in Figure 4.11 show how the pressure wave travel time between the two receivers increased over the course of treatment. It can also be noted that the pressure wave amplitude reduced following MID treatment, which is also an indication of decreasing S_r (Valle Molina & Stokoe, 2012).

In addition to V_p measurements, the sensor array was used for in-situ cyclic testing with the NHERI@UTexas shaker trucks T-Rex and Rattler. Pre-treatment analysis of the soil is described in Preciado et al. 2021; post-treatment analyses are still ongoing at this time.

Crosshole V_p measurements were taken before the treatment solution was applied, daily during the treatment application, and at least monthly since the treatment ended. The time series of V_p is shown in Figure 4.12. Measured V_p dropped to about 400 m/s in all sensors about 15 days into MID treatment. V_p remained between 200 m/s and 600 m/s for 20 months after treatment indicating that S_r persists at less than 98.5%.

Figure 4.11: Travel-time records of pressure-wave measured during the crosshole testing at 2.55 m depth performed pre-treatment (5 days before start of treatment) and post-treatment (43 days after the start of treatment).

Figure 4.12: V_p crosshole time history measurements at Sunderland.

4.3.2:Electrical Conductivity

TEROS 12 (Metergroup) sensors were installed at both sites in a vertical array to measure the bulk EC and the dielectric capacitance of the soil and pore fluid. The sensors were installed at discrete depths between 0.9 m and 5.8 m mid-way between the injection well and an extraction well (Figure 2.1 and Figure 2.4). The individual TEROs sensors with regards to their respective targeted treatment zone are shown in Figure 4.13. Six sensors were installed at Sunderland with all located within the target zone except for the 0.9 m depth sensor; five sensors were installed at Harborton with the sensors at 3.4 m and 4.0 m depths located inside the target zone. Sensors at Sunderland were installed by lowering the sensors into the borehole and backfilling with native soil, whereas at Harborton the sensor pins were inserted into the borehole sidewall which is the proposed methodology by the manufacturer. It is expected that the installation method affected the measurements as discussed below. The TEROs 12 sensors rely on a battery source to relay the captured data to a cloud storage system. These batteries were stolen for a period of time; a linear interpolation was done to fill in the lost data.

Figure 4.13: Side view of the TEROS sensors at (a) Sunderland and (b) Harborton, in relation to their respective target treatment zone.

The bulk EC measured by the sensors relate to changes of groundwater salinity, as previously described. The bulk EC over time measured by the TEROS sensor array are plotted in Figure 4.14. At the Sunderland site (Figure 4.14a), the seepage front arrived at the sensor array at approximately day 22 as indicated by the sharp increase in bulk EC. A rise in bulk EC was also observed at the shallowest sensor that was above the treatment interval, indicating the injected substrate solution seeped above the screened interval. It appears that the treatment solution did not reach all the sensors in the targeted treatment interval; for example, there is no noticeable increase in bulk EC at 2.7 m that can be attributed to the treatment solution. The variability in the observed EC indicates that the treatment solution was not homogeneously distributed throughout the target zone, likely due to preferential flow paths. The bulk EC continued to rise even after the injection of treatment solution was stopped, which was unexpected. The gradual increase in EC after injection could be the result of migration of unreacted substrates from the high permeable flow paths to zones of lower permeability through diffusion or buoyancy driven convective transport. The observation that EC did not drop to background values could be the result of an incomplete conversion, an excess of calcium acetate remaining, or due to cation exchange, which is common in fine-grained soils. For example, calcium ions in the substrate solution may replace sodium ions in clay minerals, leaving highly soluble sodium bicarbonate in the groundwater.

At Harborton, the treatment solution arrived at the sensor at 4.6 m depth around day 6 of treatment, as shown in Figure 4.14b. Measured bulk EC increased at the 4.0 m and 3.4 m sensors on day 10 and at the 2.1 m sensor on day 15. Following the increase in bulk EC

there is a decrease that can be attributed to the MID reaction reducing salinity. The different arrival times of the treatment solution indicate that although there existed preferential seepage pathways, the treatment solution also migrated through non-preferential areas. It is notable that the treatment solution reached the 2.1 m sensor although it is outside the target treatment depth interval.

The TEROS sensors were also able to estimate the volumetric moisture contents, which were then converted to gravimetric moisture contents (w_n) using the average dry density measured on post-treatment Shelby tube samples. The estimated Sunderland ρ_{dry} is 1.09 g/cm^3 and 1.19 g/cm^3 for Harborton. Figure 4.15 shows w_n interpreted on this basis.

The change in w_n interpreted by the sensors was used to interpret corresponding changes in S_r . The estimated S_r values over time are shown in Figure 4.16. For the sensors installed at depths where measured V_p was greater than 1500 m/s, the initial S_r was assumed to be 100%. All other sensors were plotted at an initial S_r of 98.5%, assuming that S_r is no greater than 98.5% for V_p smaller than 1500 m/s (Valle-Molina & Stokoe 2012). Note that there is considerable uncertainty in estimating the initial S_r based on V_p for the very shallow sensors close to the ground water table, as the S_r - V_p relationships are highly nonlinear and not well-established for silts. All sensors, including those outside the target zone, showed a decrease in S_r during the treatment period (based upon a decrease in V_p). At Sunderland, S_r decreased by 2% to 8% during the treatment period, and between 6% and 9% at the Harborton site. At the Sunderland site w_n continued to drop even after treatment. This could be due to a redistribution of the generated gas, but considering the sensors at Sunderland

were lowered into the borehole, the decrease in w_n could also be attributed to the consolidation of the backfill material. However, for many of the sensors a sharp decrease in the w_n corresponded to an increase then decrease in bulk EC, indicating that the arrival and conversion of substrates had a direct effect on the w_n and S_r . S_r decreases outside the target intervals were likely due to migration of the treatment solution or produced gas outside the target zone. All sensors show that w_n remained below pre-treatment values from the end of treatment. The 4.57 m bgs sensor at Harborton shows an anomaly with $S_r > 100\%$; similar anomalies in volumetric moisture content measurements have been observed at the lab scale and are still under investigation (Stallings-Young et al. 2020). As of July 9, 2020, the Harborton site is under construction and data collection has ceased; measurements continue to be taken at the Sunderland site.

Figure 4.14: Bulk EC measured by in-situ sensors at (a) Sunderland and (b) Harborton.

Figure 4.15: w_n interpreted from in-situ sensors at (a) Sunderland and (b) Harborton.

Figure 4.16: Interpreted S_r at (a) Sunderland and (b) Harborton.

4.3.3: Direct measurements of saturation ratio

Shelby tube samples were collected pre- and post-treatment at both sites. S_r was directly measured by measuring the bulk density, w_n and an assumed specific gravity of 2.65. Measured S_r was corrected for gas volume changes between in-situ total vertical stress and atmospheric pressure with the Ideal Gas Law (Gallant and Finno 2017).

Figure 4.16 shows the average measured S_r plotted on the sampling date. The S_r from 25 pre-treatment samples from depths 4.26 m to 5.24 m at Sunderland is 95.4%; the S_r from 18 post-treatment samples from depths 3.29 m – 5.27 m at Sunderland is 70.1%. The S_r from three post-treatment samples from depths 2.70 m – 2.92 m at Harborton is 67%; additional testing is planned using pre-treatment Harborton samples. While the sample-measured S_r values differ from the interpreted S_r values from in-situ sensors, they both indicate a notable decrease due to MID treatment, which is also supported by the V_p measurements shown in Figure 4.12. The difference between the sample-measured S_r values and the in-situ sensors could be due to moisture loss during transportation and storage of the Shelby tubes.

4.3.4: Water levels

Ground water levels were measured to observe if the persistence of MID was affected by seasonal water table fluctuations. Water levels at the Sunderland site were directly measured in the injection and extraction wells and calculated using the PPTs installed within the sensor array and from the dissipation tests performed during SCPT testing. The water level measurements over time are shown in Figure 4.17. Seasonal water table

fluctuations were between 1.5 m bgs and the ground surface (with observed ponding). These data and the monitoring data shown in previous figures show that the induced desaturation was not affected by the seasonal water table fluctuations, as V_p and w_n remain below pre-treatment values 23 months after treatment. Water levels were not monitored at the Harborton site.

Figure 4.17: Water levels over time at the Sunderland site.

Chapter 5: Summary, Conclusions, and Recommendations for Future Work

5.1: Summary

MID field trials were performed at two sites of liquefiable low plasticity fine-grained soils in Portland, Oregon in an effort to find a non-disruptive liquefaction mitigation method for essential lifelines. The field trial sites were located close to PDX International Airport and the CEI hub; both sites having soils that are reflective of the general conditions of nearby critical infrastructure.

The MID treatment solution of calcium nitrate and calcium acetate was applied through injection and extraction wells that were installed 3.5 m apart and screened over the target treatment depth interval (between 1.5 m to 6.1 m bgs). The treatment was applied for one month at each site.

S_r was monitored by several methods before, during, and after MID treatment with the goal of evaluating the effectiveness and longevity of MID treatment at the field-scale. Monitoring included pre- and post-treatment SCPTs from both field trial sites, measurements of S_r on soil samples from both sites, interpreted S_r from in-situ sensors, and crosshole V_p measurements at the Sunderland site. Although exact values of S_r are difficult to determine, all methods show a decrease in S_r between pre- and post-treatment conditions in the targeted treatment zone. Additionally, SCPTs performed outside the targeted zone indicates that MID extended beyond the extraction wells.

5.2: Conclusion

V_p and w_n remained at values that indicate $S_r < 98.5\%$ persisted for 20 months following MID treatment at Sunderland and 8 months following MID treatment at Harborton (the site is now under construction, so ongoing monitoring is not possible). Furthermore, at the Sunderland site, S_r does not appear to be affected by water table fluctuations, including flooding at the ground surface.

5.3: Recommendations for Future Work

Continued research from these field trial sites may inform future liquefaction mitigation efforts. Monitoring at Sunderland will continue for the next several years, including measurements of V_p , bulk EC and conductivity, and additional lab testing. This lab testing will include developing a V_p - S_r plot for non-plastic and low-plasticity soils to better estimate the percentage of desaturation in these types of fine-grained soil. It will also include further analyses of the sub-surface distribution of the MID treatment via direct measurements of S_r .

These efforts will provide important data to assess the long-term persistence of MID as a viable, non-invasive option for mitigating liquefaction in low plasticity fine-grained soils. If proved effective, this method can provide a solution to reduce liquefaction risk at existing infrastructure and lifelines.

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Appendix A: Field Logs of Well Installation – Sunderland

Project <u>NSF- RAPID</u>				Hole No. <u>NORTH</u>		
Purpose <u>EXTRACTION</u>						
Site Name <u>SUNDERLAND</u>				Driller <u>CASCADE</u>		
Hole Location				Recorder <u>KAYLA</u>		
PSU Site Personnel <u>DIANE, ARASH, MELISSA, KAYLA</u>						
Start Date <u>8/5 4/10/30</u>				End Date		
Total Depth		Equipment		Ground Elevation		
Sample Type						
"U" - Undisturbed Shelby tube "N" - Standard Penetration (SPT)				Hole completion		
Depth (FEET)	Sample Type, No.	Measured Rec. ()	SPT Driving Resistance	Graphic Log	Soil Material Description Soil name, USCS, color, plasticity, moisture, consistency, relative density, texture, cementation, structure, origin. Other comments.	Drilling methods, size, and remarks Water level / date
4'- 6.5'	U ₁				SHELBY TUBE → DRIVEN 24" RECOVERY 23"	6" HCA
6.5'- 8.5'	N ₁		111		BROWN w/ MOTTLE, VERY STIFF, NO ORGANICS, MOIST, MED TO LOW PLASTICITY, SILT, POCKETS OF GRAY SILT, STIFFNESS DECREASES DOWNWARD, SANDIER NEAR BOTTOM	
14'- 16.5'	U ₂				SHELBY TUBE → DRIVEN 24" RECOVERY 24" FULL RECOVERY, POSSIBLY OVER STUFFED	
16.5'- 18'	N ₂		100		FULL RECOVERY DARK GRAY, TRACE ORGANICS MED STIFF TO MED SOFT TO SOFT MED PLASTICITY, 80% SILT, 20% CLAY, 2% FINE SAND TOP VERY WET, MOIST ON BOTTOM	21' eotH 1' of heave after auger pulled for install.

WELL INSTALLATION LOG

Project NSF RAPID				Hole No. Su-Ex-E		
Purpose EXTRACTION						
Site Name SUNDERLAND				Driller ARTURO MADRIGAL (CASCADIA)		
Hole Location				Recorder M. PRECIADO		
PSU Site Personnel PRECIADO, GRENSON, MONG, KHOSRAVITAR						
Start Date 05/06/19 @ 11:30 am				End Date		
Total Depth		Equipment CME 75 TRACKER		Ground Elevation		
Sample Type				Hole completion		
"U" - Undisturbed Shelby tube "N" - Standard Penetration (SPT)						
Depth ()	Sample Type, No.	Measured Rec. ()	SPT Driving Resistance	Graphic Log	Soil Material Description Soil name, USCS, color, plasticity, moisture, consistency, relative density, texture, cementation, structure, origin. Other comments.	Drilling methods, size, and remarks Water level / date
5.0'- 7.5'	U ₁	18"			MEASURED 12" FROM TOP OF TUBE 1" RECOVERY: 18"	6" HSA
7.5'- 9'	N ₁	18"	0-0-0		FULL RECOVERY - HOMOGENEOUS SAMPLE VERY BROWN W/ GREY MOTTLING - DARK BROWN LUMPS POCKETS - MEDIUM STIFF - WET TO MOIST (ML) LOW-MEDIUM PLASTICITY SILT W/ TRACE CLAY MICACEOUS SILT - MEDIUM TO HIGH DILATANCY	
10'- 12.5'	U ₂	0"			NO RECOVERY	
12.5'- 14'	N ₂	18"	1-1-1		FULL RECOVERY - (ML) TOP 6": ROCKY GREY HOMOGENEOUS MOIST SILT BOTTOM 10": MEDIUM STIFF, BLOCKY, MEDIUM TO HIGH PLASTICITY SILT W/ CLAY (MH) 1" THICK BROWN SOIL POCKET, LOW PLASTICITY SILT (ML)	
15'- 17.5'	U ₃	20"			MEASURED 10" FROM TOP OF TUBE	
17.5'- 19'	N ₃		0-0-0		FULL RECOVERY. TRACE ORGANICS VERY SOFT IN THE TOP 1/3" HOMOGENEOUS IN COLOR (GRAY). MEDIUM COH BLOCKY STRUCTURE. SLOW-MEDIUM DILATANCY MOIST-WET. SMALL AMOUNT OF MICA MEDIUM PLASTICITY CLAYEY SILT (ML)	

Project NSF RAPID				Hole No. Su Ex E (FAN WELL)		
Purpose EXTRACTION WELL						
Site Name SUNDERLAND			Driller ARTURO MADRIGAL			
Hole Location			Recorder M. PRECIADO			
PSU Site Personnel PRECIADO - SOREMON, MOUG, KHORAVIPAR						
Start Date 08/06/19			End Date 08/06/19			
Total Depth		Equipment CHE 75		Ground Elevation		
Sample Type				Hole completion		
"U" - Undisturbed Shelby tube "N" - Standard Penetration (SPT)						
Depth ()	Sample Type, No.	Measured Rec. ()	SPT Driving Resistance	Graphic Log	Soil Material Description Soil name, USCS, color, plasticity, moisture, consistency, relative density, texture, cementation, structure, origin. Other comments.	Drilling methods, size, and remarks Water level / date
20'- 22.5'	U ₄				MEASURED DIST. FROM TOP: 2" *OVERSTUFFED*	10" HJA
22.5'- 24'	N ₄	18"	Weight of Hammer 0-0-1		FULL RECOVERY - GREY HOMOGENEOUS TO IL SAMPLE. LOW PLASTICITY SILTY SAND. VERY DILATIVE. MKA. FINE SANDS, SOFT MOIST TO WET	

Project <u>NSI RAPID</u>				Hole No. <u>SOUTH WELL</u>		
Purpose						
Site Name <u>SUNDERLAND</u>			Driller <u>CASCADE (ARTURO)</u>			
Hole Location			Recorder <u>PSU (KAYLA)</u>			
PSU Site Personnel <u>ARASH K. MELISSA P. KAYLA S.</u>						
Start Date <u>8/5 910</u>			End Date <u>8/5 1150</u>			
Total Depth <u>20'</u>		Equipment <u>CME 15 TRACKER</u>		Ground Elevation		
Sample Type "U" - Undisturbed Shelby tube "N" - Standard Penetration (SPT)				Hole completion <u>YES</u>		
Depth (FEET)	Sample Type, No.	Measured Rec. ()	SPT Driving Resistance	Graphic Log	Soil Material Description Soil name, USCS, color, plasticity, moisture, consistency, relative density, texture, cementation, structure, origin. Other comments.	Drilling methods, size, and remarks Water level / date
6.4- 6.5	U ₁				SHELBY TUBE → DRIVEN 30" RECOVERY 27"	10" HSA ↓
8.5- 9	U ₂		0 0 1		GRAY W/ BROWN SILT (ML) ^{VERY SOFT} STICKY, MEDIUM STIFF, STIFFNESS INCREASING W/ DEPTH, GRAY STIFFER THAN BROWN, WET, MOIST TRACE ORGANICS, MEDIUM PLASTICITY	
9- 11.5	U ₂				SHELBY TUBE → DRIVEN 30" RECOVERY 28"	
11.5- 13	U ₂		1 1 2		GRAY SILT TOP 6" BROWN ^{SILT} MEDIUM ^{TO LOW} DILATANCY, MOIST, ^{SOFT} MEDIUM PLASTICITY, MEDIUM STIFF	
14- 16.5	U ₃				SHELBY TUBE → DRIVEN 30" RECOVERY 25.5"	
16.5- 18	U ₃		0 0 0		VERY SOFT, DARK GRAY, MOIST TO WET TOP 8" WET, TRACE ORGANICS FEELS STIFF TO TOUCH TOP 8" SANDY SILT	

[illegible]

WELL INSTALLATION LOG

Project NSF RAPID		Hole No. SOUTH WELL	
Purpose EXTRACTION			
Site Name SUNDERLAND		Driller ARTURO CASCADE	
Hole Location		Installation Date 8/5	
PSU Site Personnel DIANE ARASH, MELISSA, KAYLA			
Depth to Water 4.5'			
Surface Completion			

Handwritten Notes:

- # BAGS (50 lb) 19
- # BENTONITE SEAL (50 lb bags) 2
- Filter Pack Material: SAND
- PVC Slot Size: Schedule 40
- PVC Diameter: 2"
- Hole Diameter: 10"

Dimensions:

- Backfill grout: 2'
- Bentonite seal: 4"
- Filter Pack Material: 4.5'
- Total depth: 19.5'

Project <u>NSF RAPID</u>				Hole No. <u>WEST 2 Su Ex W</u>		
Purpose <u>EXTRACTION</u>						
Site Name <u>SUNDERLAND</u>			Driller <u>CASCADE / ARTURO</u>			
Hole Location <u>WEST</u>			Recorder <u>KAYLA S. MELISSA</u>			
PSU Site Personnel <u>DIANE, MELISSA, KAYLA</u>						
Start Date <u>8/6 240</u>			End Date <u>8/6 9:46am</u>			
Total Depth		Equipment		Ground Elevation		
Sample Type				Hole completion		
"U" - Undisturbed Shelby tube "N" - Standard Penetration (SPT)						
Depth ()	Sample Type, No.	Measured Rec. ()	SPT Driving Resistance	Graphic Log	Soil Material Description Soil name, USCS, color, plasticity, moisture, consistency, relative density, texture, cementation, structure, origin. Other comments.	Drilling methods, size, and remarks Water level / date
5'- 15'- 2.5'- 9'	U ₁ N ₁	23" 18"	0 0 1		SHELBLY TUBE → DRIVEN 24" RECOVERED 23" SPT → DRIVEN: 18" → FULL RECOVERY BOTTOM 6" → LIGHT TO MEDIUM GREENISH GREY MICACEOUS SOFT WET CLAY SILT MEDIUM PLASTICITY TOP FOOT: BROWN W/ DARK BROWN MOTTLED SILENT SILT W/ TRACE SAND (ML) MEDIUM PLASTICITY (RAGGED SEPARATELY)	6" HSA
15'- 17.5'- 17.5'- 19'	U ₂ N ₂	12" 18"	0 0 1		SHELBLY TUBE → DRIVEN 24" RECOVERED 12" N ₂ → FULL RECOVERY TRACE ORGANICS, ^{BLUEISH} GREY, SOFT, WET TO MOIST CLAY-SILT (CL-ML) MEDIUM TO LOW PLASTICITY. TRACE SAND ON THE TOP HALF. BLOCKY TEXTURE	6" HSA

WELL INSTALLATION LOG

Project <u>NSF RAPID</u>		Hole No. <u>Su Ex W</u>
Purpose <u>EXTRACTION</u>		
Site Name <u>SUNDERLAND</u>		Driller <u>ARTURO MADRIGAL - CASCADE</u>
Hole Location		Installation Date <u>08/06/19 @ 10am</u> / 1045
PSU Site Personnel <u>KAYLA SORENSEN, ARACH KODIAVITAR, DIANE MOUS, MELISSA PERCINO</u>		
Depth to Water		
Surface Completion

BAGS OF SAND
LIT 11

Cement monument

Backfill grout

Bentonite seal

SODIUM BENTONITE
 2 x 50^{lb} bags.

Filter Pack Material:
 SILICA SAND
 16 x 50^{lb} bags

PVC Slot Size:
 SCHEDULE 40

PVC Diameter: 2"

Hole Diameter: 10"

.5'

Project NSF RAPID MIDP		Hole No. S-1nj					
Purpose Injection well							
Site Name Sunderland		Driller Arturo - Cascade					
Hole Location		Recorder DMM					
PSU Site Personnel DMM -							
Start Date 5-Aug-2019		End Date					
Total Depth		Equipment 6" HSA	Ground Elevation				
Sample Type		Hole completion					
"U" - Undisturbed Shelby tube "N" - Standard Penetration (SPT)							
Depth (ft)	Sample Type, No.	Measured Rec. (ft)	SPT Driving Resistance	Graphic Log	Soil Material Description	Drilling methods, size, and remarks	Water level / date
4' - 6.5'	V1	25'			light brown moist with clay coming up		
6.5' - 8'	N1				@ 4' shelly tube sample full recovery, likely overfilled asked Arturo to push 2.25' inc + time		
8' - 11.5'	V2				6.5' GRAY w/ BROWN MOTTLE LIGHT GRAY BROWN, SOFT, WET (12" TOP) MED LIGHT GRAY, MOIST TO WET MED STIFF TO SOFT, CL-ML BROWN LAMINATIONS 1-2 MM		
11.5' - 13'	N2				SHELBY TUBE → DRIVEN 30" RECOVERY ~5" SOL VIBRILY SLIDING WHEN BEING CAPPED		
					LIGHTER BROWN, SOFT @ TSD 2" TEST SIMILAR TO ABOVE, MED STIFF		

Project				Hole No.	
Depth ()	Sample Type, No.	Measured Rec. ()	SPT Driving Resistance	Graphic Log	Soil Material Description Soil name, USCS, color, plasticity, moisture, consistency, relative density, texture, cementation, structure, origin. Other comments.
14' 16.5'	U ₂				SHELBY TUBE → DRIVEN 24" RECOVERY 24"
16.5' 18'	N ₂		000		TRACE SAND, SLIGHT ORGANIC SHELL, SIMILAR TO ABOVE BUT SLIGHTLY DARKER, TRACE ORGANICS MED PLASTICITY
19' 21.3'	U ₄				SHELBY TUBE → DRIVEN 24" RECOVERY 24" LET TUBE SIT ~ 5 MIN TO ENSURE RECOVERY
21.5' 23'	N ₄		000		DARK GRAY W/ BROWN LAMINATIONS (~ 1/2 mm) TRACE ORGANICS, VERY WET VERY SOFT, MED PLASTICITY SILTY CLAY

WELL INSTALLATION LOG

Project <u>NSF RAPID</u>		Hole No. <u>INJECTION</u>
Purpose		
Site Name <u>SUNDERLAND</u>	Driller <u>CASCADE</u>	
Hole Location	Installation Date <u>8/5</u>	
PSU Site Personnel <u>DIANE ARASH MELISA KAYLA</u>		
Depth to Water <u>5.0'</u>		
Surface Completion		

BAGS OF SAND
17

BAGS OF BENTONITE
2

Cement monument

Backfill grout

Bentonite seal

Filter Pack Material:
SILICA SAND
(50^{lb} bags) = _____ bags

PVC Slot Size:

PVC Diameter: 2.5"

Hole Diameter: 10" (OD)
HSA

10+ 11

[illegible]

Appendix B: Finished Boring Logs – Sunderland

Portland State UNIVERSITY						PROJECT: NSF - Microbial Induced Desaturation			BORING ID: Su_Ex_N			
						LOCATION: 9699 NE Sunderland Ave, Portland Oregon			WELL ID: Su_Ex_N			
						DRILLING CONTRACTOR: Cascade Drilling/Arturo			NORTHING: 45.59371		EASTING: -122.63879	
						DRILLING EQUIPMENT: CME 75 Tracker			GROUND SURFACE ELEV.: 14.11'		TOC ELEVATION: 13.74'	
						DRILLING METHOD: 10" Hollow Stem Auger (6" ID)			TOTAL DEPTH: 20'		DEPTH TO WATER: 6.2'	
LOGGED BY: KRS			SAMPLING METHOD: Shelby tube and split-spoon sampler			DATE STARTED: 8/5/2019		DATE COMPLETED: 8/5/2019				
Depth (feet)	Sample Type	% REC	# Blows	USCS	Graphic Log	Description	LL PL PI	Water Content (%)	Coarse Silt Clay (%)	Well Diagram	Well Construction	
0						Low plasticity brown SILT (ML)					Flush mounted 12" cover	
2											5 ft of 2 in dia., Sch. 40 PVC solid riser	
4				ML							Equilibrium	
6	U1	23'/24"									After Well Development	
8	N1	100	1 1 1			Brown w/ mottle, very stiff. Moist, pockets of gray silt, stiffness decreases downward, sandier near bottom.	37 25 12	46	9 74 17			
10						Low plasticity greenish-gray SILT (ML)					15 ft of 2 in dia., Sch. 40 PVC slotted screen	
12												
14				ML								
16	U2	24'/24"				Possibly overstuffed						
18	N2	100	1 0 0			Dark gray, trace organics, stiff to medium soft/soft, top very wet, moist on bottom.	52 28 24	57	2 78 20			
20											Bottom of well at 20 ft bgs End of exploration at 20 ft bgs	
NOTES: Water level was taken after well development on August 23, 2019

Portland State UNIVERSITY				PROJECT: NSF - Microbial Induced Desaturation				BORING ID: Su_Ex_E				
				LOCATION: 9699 NE Sunderland Ave, Portland Oregon				WELL ID: Su_Ex_E				
				DRILLING CONTRACTOR: Cascade Drilling/Arturo				NORTHING: 45.59367		EASTING: -122.63879		
				DRILLING EQUIPMENT: CME 75 Tracker				GROUND SURFACE ELEV.: 14.07'		TOC ELEVATION: 13.52'		
				DRILLING METHOD: 10" Hollow Stem Auger (6" ID)				TOTAL DEPTH: 24'		DEPTH TO WATER: 6.5'		
LOGGED BY: AMP				SAMPLING METHOD: Shelby tube and split-spoon sampler				DATE STARTED: 8/5/2019		DATE COMPLETED: 8/5/2019		
Depth (feet)	Sample Type	% REC	# Blows	USCS	Graphic Log	Description	LL PL PI	Water Content (%)	Coarse Silt Clay (%)	Well Diagram	Well Construction	
0				ML		Low plasticity brown SILT (ML)					Flush mounted 12" cover	
2												5 ft of 2 in dia., Sch. 40 PVC solid riser
4												Equilibrium
6	U1	18"/24"										After Well Development
8	N1	100	0 0 0	ML		Low plasticity greenish-gray SILT (ML) Brown mottling, dark brown dry lumps. Medium stiff. Wet to moist. Trace clay micaceous silt, medium to high dilatancy.	29 23 5	33	6 76 18			
10												
12	U2	0"/24"										
14	N2	100	1 1 1			Top 6": Blocky gray homogeneous moist silt. Bottom 12": Medium stiff, blocky, silt with clay.	46 28 18	48	1 80 19		15 ft of 2 in dia., Sch. 40 PVC slotted screen	
16	U3	20"/24"										
18	N3	100	0 0 0			Trace organics, very soft in top third, homogenous in color (gray). Medium soft blocky structure, slow to medium dilatancy, moist to wet. Small amount of mica.	36 24 12	40	1 78 21			
20												
22	U4	28"/24"				Overstuffed					Bottom of well at 20 ft bgs	
24	N4	100	0 0 1	SM		Low plasticity gray silty SAND (SM). Very dilative, mica, fine sands, soft, moist to wet.	39 28 12	44	10 77 13		End of exploration at 24 ft bgs	
NOTES: Water level was taken after well development on August 23, 2019												
<div><div> Solid riser</div><div> Grout</div><div> Bentonite seal</div><div> Screen</div><div> Filter pack</div><div> End cap</div><div> Soil</div></div>

Portland State UNIVERSITY				PROJECT: NSF - Microbial Induced Desaturation				BORING ID: Su_Ex_S					
				LOCATION: 9699 NE Sunderland Ave, Portland Oregon				WELL ID: Su_Ex_S					
				DRILLING CONTRACTOR: Cascade Drilling/Arturo				NORTHING: 45.59361		EASTING: -122.63886			
				DRILLING EQUIPMENT: CME 75 Tracker				GROUND SURFACE ELEV.: 13.89'		TOC ELEVATION: 13.86'			
				DRILLING METHOD: 10" Hollow Stem Auger (6" ID)				TOTAL DEPTH: 23'		DEPTH TO WATER: 6.4'			
LOGGED BY: KRS				SAMPLING METHOD: Shelby tube and split-spoon sampler				DATE STARTED: 8/5/2019		DATE COMPLETED: 8/5/2019			
Depth (feet)	Sample Type	% REC	# Blows	USCS	Graphic Log	Description	LL PL PI	Water Content (%)	Coarse Silt Clay (%)	Well Diagram	Well Construction		
0				ML		Low plasticity brown SILT (ML)					Flush mounted 12" cover		
2												5 ft of 2 in dia., Sch. 40 PVC solid riser	
4	U1	27"/30"										Equilibrium	
6	N1	100	0 0 1			Brown w/ gray silt, sticky, very soft, stiffness increasing with depth, gray stiffer than brown, moist, trace organics.	39 23 16	45	4 73 23			After Well Development	
8				ML		Low plasticity greenish-gray SILT (ML)						15 ft of 2 in dia., Sch. 40 PVC slotted screen	
10	U2	28"/30"											
12	N2	100	1 1 2			Top 6" brown silt, remaining gray. Medium to slow dilatancy, moist, soft.	39 26 13	38	1 77 22				
14													
16	U3	26"/30"											
18	N3	100	0 0 0			Very soft, dark gray, moist to wet, trace organics, stiff to touch, top 8" sandy silt.	44 25 19	46	6 77 17				
20	U4	28"/30"											Bottom of well at 20 ft bgs
22	N4	100	0 0 0			Low plasticity SILT with sand (ML) Dark gray, very moist, some organics, very soft.	33 32 1	33	23 67 10				End of exploration at 23 ft bgs
24				SM									
NOTES: Water level was taken after well development on August 23, 2019													
<div><div> Solid riser</div><div> Grout</div></div> <div><div> Bentonite seal</div><div> Screen</div></div> <div><div> Filter pack</div><div> end cap</div></div> <div> Soil</div>

Portland State UNIVERSITY					PROJECT: NSF - Microbial Induced Desaturation			BORING ID: Su_Inj				
					LOCATION: 9699 NE Sunderland Ave, Portland Oregon			WELL ID: Su_Inj				
					DRILLING CONTRACTOR: Cascade Drilling/Arturo			NORTHING: 45.59364		EASTING: -122.63881		
					DRILLING EQUIPMENT: CME 75 Tracker			GROUND SURFACE ELEV.: 14'		TOC ELEVATION: 14.25'		
					DRILLING METHOD: 10" Hollow Stem Auger (6" ID)			TOTAL DEPTH: 23'		DEPTH TO WATER: 9.4'		
LOGGED BY: DMM/KRS					SAMPLING METHOD: Shelby tube and split-spoon sampler			DATE STARTED: 8/5/2019		DATE COMPLETED: 8/5/2019		
Depth (feet)	Sample Type	% REC	# Blows	USCS	Graphic Log	Description	LL PL PI	Water Content (%)	Coarse Silt Clay (%)	Well Diagram	Well Construction	
0				ML		Low plasticity brown SILT (ML)					Flush mounted 12' cover	
2						Light brown moist cuttings.						5 ft of 2 in dia., Sch. 40 PVC solid riser
4	U1	24"/24"										
6	N1a	100	0 0 0				Medium to light gray w/ brown mottle, soft, top 2" wet, medium stiff to soft, 1-2mm brown laminations.	30 23 7	38		13 71 16	
8	N1b						37 24 13	39	5 78 17			
				ML		Low plasticity greenish-gray SILT (ML)
10	U2	5"/24"				Soil visibly sliding when tube was being recovered.						15 ft of 2 in dia., Sch. 40 PVC slotted screen
12	N2	100	0 1 1			Lighter brown, top 2' soft; similar to above.	45 23 22	45	4 75 21			
14												
16	U3	24"/24"										
18	N3	100	0 0 0			Trace sand, slight organic smell, trace organics, slightly darker than above	47 27 20	52	2 78 20			
20	U4	24"/24"										Bottom of well at 20 ft bgs End of exploration at 20 ft bgs
22	N4	100	0 0 0			Dark gray w/ brown laminations (1-2mm), trace organics, very wet, very soft.	52 37 14	52	9 77 14			
24												
NOTES: Water level was taken after well development on August 23, 2019												
<div><div> Solid riser</div><div> Grout</div><div> Bentonite seal</div><div> Screen</div><div> Filter pack</div><div> end cap</div><div> Soil</div></div>

Portland State <small>UNIVERSITY</small>	PROJECT: NSF - Microbial Induced Desaturation		BORING ID: Su_Ha1		
	LOCATION: 9699 NE Sunderland Ave, Portland Oregon		WELL ID: Su_Ha1		
	DRILLING CONTRACTOR: Portland State (AK, DMM, AMP, KRS)		NORTHING: 45.59364	EASTING: -122.63881	
	DRILLING EQUIPMENT: N/A		GROUND SURFACE ELEV.: 14'		TOC ELEVATION:
	DRILLING METHOD: Hand Auger		TOTAL DEPTH: 12'	DEPTH TO WATER: 3.6'	
	LOGGED BY: KRS		SAMPLING METHOD: Bagged Samples		DATE STARTED: 7/20/2019

Depth (feet)	Sample Type	USCS	Graphic Log	Description	Water Table	LL PL PI	Water Content (%)	Coarse Silt Clay (%)
0				Low plasticity brown SILT (ML)				
2	N1			Dark brown mottle		37 24 13	33	3 76 21
4	N2	ML		Slight organics, wet, trace sand	▼	55 37 18	54	1 71 28
6	N3			Slight organics, wet, trace sand		39 28 11	43	6 74 20
8	N4			Green-gray clay		42 27 15	45	3 77 17
10	N5			Low plasticity greenish-gray SILT (ML)		46 31 15	41	1 76 23
12		ML		Stiffer than above, trace organics, wet				
14	N6			Soft, wet		35 26 9	31	3 83 14

NOTES:

Portland State UNIVERSITY				PROJECT: NSF - Microbial Induced Desaturation		BORING ID: Su_Ex_N_U2		
				LOCATION: 9699 NE Sunderland Ave, Portland Oregon		WELL ID: Su_Ex_N_U2		
				DRILLING CONTRACTOR: Portland State (AK, DMM, AMP, KRS)		NORTHING: 45.59371	EASTING: -122.63879	
				DRILLING EQUIPMENT: CME 75 Tracker		GROUND SURFACE ELEV.: 14.11'	TOC ELEVATION: 13.74'	
				DRILLING METHOD: 10" Hollow Stem Auger (6" ID)		TOTAL DEPTH: 20'	DEPTH TO WATER: 6.2'	
LOGGED BY: KRS		SAMPLING METHOD: Shelby Tube		DATE STARTED: 8/5/2019		DATE COMPLETED: 8/5/2019		
Depth (feet)	Sample Type	USCS	Graphic Log	Description		LL PL PI	Water Content (%)	Coarse Silt Clay (%)
14.00				Low plasticity greenish-gray SILT (ML)				
14.25								
14.50								
14.75								
15.00	U2_G1			Easy to extrude and trim.		57 38 19	53	1 72 27
15.25	U2_G2			Small voids.		47 34 13	47	0 76 24
15.50	U2_G3			Low plasticity greenish-gray silt.		42 27 15	46	1 81 18
15.75	U2_G4	ML		Easy to extrude.		50 33 17	59	1 82 17
16.00	U2_G5			Low plasticity greenish-gray silt.		47 29 18	50	4 78 18
16.25	U2_G6			Low plasticity greenish-gray silt.		47 31 16	53	3 82 15
16.50	U2_G7			Low plasticity greenish-gray silt.		48 30 18	53	1 72 27
16.75	N2			Dark gray, trace organics, stiff to medium soft/soft, top very wet, moist on bottom.		52 28 24	57	2 78 20
17.00								
NOTES:

Portland State <small>UNIVERSITY</small>				PROJECT: NSF - Microbial Induced Desaturation	BORING ID: Su_Ex_E_U3		
				LOCATION: 9699 NE Sunderland Ave, Portland Oregon	WELL ID: Su_Ex_E_U3		
				DRILLING CONTRACTOR: Portland State (AK, DMM, AMP, KRS)	NORTHING: 45.59367	EASTING: -122.63879	
				DRILLING EQUIPMENT: CME 75 Tracker	GROUND SURFACE ELEV.: 14.07'	TOC ELEVATION: 13.52'	
				DRILLING METHOD: 10" Hollow Stem Auger (6" ID)	TOTAL DEPTH: 24'	DEPTH TO WATER: 6.5'	
LOGGED BY: KRS				SAMPLING METHOD: Shelby Tube	DATE STARTED: 8/5/2019	DATE COMPLETED: 8/5/2019	
Depth (feet)	Sample Type	USCS	Graphic Log	Description	LL PL PI	Water Content (%)	Coarse Silt Clay (%)
15.00				Low plasticity greenish-gray SILT (ML)			
15.25							
15.50							
15.75	U3_T1			Small voids	52 36 17	50	--
16.00	U3_T2			Small voids	43 35 9	49	--
16.25	U3_T3			Small voids	45 27 18	44	--
16.50	U3_T4	ML		Small voids	43 32 11	44	--
16.75	U3_T5			Minor organics	55 33 22	56	--
17.00	U3_T6			Minor organics	57 40 18	62	--
17.25	U3_T7			Medium organics	64 39 25	64	--
17.50				Trace organics, very soft in top third, homogeneous in color (gray). Medium soft blocky texture, slow to medium dilatancy, moist to wet. Small amounts of mica.			
17.75	N3				36 24 12	40	1 78 21
18.00							
NOTES:

Portland State UNIVERSITY				PROJECT: NSF - Microbial Induced Desaturation		BORING ID: Su_Ex_S_U3			
				LOCATION: 9699 NE Sunderland Ave, Portland Oregon		WELL ID: Su_Ex_S_U3			
				DRILLING CONTRACTOR: Portland State (AK, DMM, AMP, KRS)		NORTHING: 45.59361		EASTING: -122.63886	
				DRILLING EQUIPMENT: CME 75 Tracker		GROUND SURFACE ELEV.: 13.89'		TOC ELEVATION: 13.86'	
				DRILLING METHOD: 10" Hollow Stem Auger (6" ID)		TOTAL DEPTH: 23'		DEPTH TO WATER: 6.4'	
LOGGED BY: KRS		SAMPLING METHOD: Shelby Tube		DATE STARTED: 8/5/2019		DATE COMPLETED: 8/5/2019			
Depth (feet)	Sample Type	USCS	Graphic Log	Description	LL PL PI	Water Content (%)	Coarse Silt Clay (%)		
14.00		ML		Gray silt.					
14.25									
14.50	U3_M1				Difficult to extrude.	50 33 17	46	0 73 27	
14.75	U3_M2				Blocky texture.	49 30 19	40	0 73 27	
15.00	U3_M3				Easy to extrude.	46 26 19	43	2 79 19	
15.25	U3_M4				Trace sand.	43 29 14	46	5 81 14	
15.50	U3_M5				Blocky texture. Trace sand and organics.	38 30 8	45	25 63 12	
15.75	U3_M6				Fractures within specimen.	46 29 17	53	--	
16.00	U3_M7				Some sand and organics.	45 33 12	49	--	
16.25	U3_M8				Trace sand.	43 32 11	52	--	
16.50				Very soft, dark gray, moist to wet, trace organics, stiff to touch, top 3" sandy silt.					
16.75									
17.00									
17.25	N3				44 25 19	46	6 77 17		
17.50									
17.75									
18.00									
NOTES:

Portland State UNIVERSITY		PROJECT: NSF - Microbial Induced Desaturation		BORING ID: Su_Ex_W_U2			
		LOCATION: 9699 NE Sunderland Ave, Portland Oregon		WELL ID: Su_Ex_W_U2			
		DRILLING CONTRACTOR: Portland State (AK, DMM, AMP, KRS)		NORTHING: 45.59365	EASTING: -122.63884		
		DRILLING EQUIPMENT: CME 75 Tracker		GROUND SURFACE ELEV.: 13.86'		TOC ELEVATION: 13.56'	
		DRILLING METHOD: 10" Hollow Stem Auger (6" ID)		TOTAL DEPTH: 20'		DEPTH TO WATER: 5.2'	
LOGGED BY: KRS		SAMPLING METHOD: Shelby Tube		DATE STARTED: 8/6/2019		DATE COMPLETED: 8/6/2019	
Depth (feet)	Sample Type	USCS	Graphic Log	Description	LL PL PI	Water Content (%)	Coarse Silt Clay (%)
16.00				Low plasticity greenish-gray SILT (ML)			
16.25							
16.50	U2_G1	ML		Minor voids	56 35 21	48	--
16.75	U2_G2			Minor voids	--	47	--
17.00	U2_G3			Easy to extrude. Minor organics.	--	48	--
17.25	U2_G4			Wet, extremely soft, trace sand	--	57	--
17.50				Blueish-gray, trace organics, soft, wet to moist. Trace sand in top half, blocky texture.			
17.75	N2				47 25 22	56	2 81 17
18.00							
NOTES:							

Appendix C: Atterberg Limits – Sunderland

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland		Date Collected:	July 18, 2019	
Borehole:	Su_Ha1	Sample Number:	N1	Depth (ft-ft):	1.45 1.70 Average Depth (ft): 1.58

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	6.5	4.9	1.6	32.7	85	1	6.8	5.5	1.3	23.6
2	3.0	2.2	0.8	36.4	27	2	7.0	5.5	1.5	27.3
3	5.1	3.7	1.4	37.8	19	3	6.7	5.4		
4	2.8	2.0	0.8	40.0	9					

Liquid Limit: 37
 Plastic Limit: 24
 Plasticity Index: 13

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: CL

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: July 18, 2019	
Borehole:	Su_Ha1	Sample Number:	N2	Depth (ft-ft):	3.6 4.6 Average Depth (ft): 4.10

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	15.4	10.0	5.4	54.0	14	1	7.8	5.7	2.1	36.8
2	12.5	7.9	4.6	58.2	8	2	7.4	5.7	1.7	29.8
3	14.6	9.5	5.13	54.0	75	3	7.5	5.5		
4	15.7	10.2	5.5	53.9	38	4	7.7	5.4		

Liquid Limit: 55
 Plastic Limit: 37
 Plasticity Index: 18

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: MH

Procedure Done By: Melissa P.

Project: NSF - Microbial Induced Desaturation

Location: Sunderland

Date Collected: July 18, 2019

Borehole: Su_Ha1

Sample Number: N3

Depth (ft-ft): 4.9 5.8

Average Depth (ft): 5.35

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	10.6	7.4	3.2	43.2	11	1	7.6	6.0	1.6	26.7
2	15.4	10.9	4.5	41.3	18	2	7.9	6.1	1.8	29.5
3	10.4	7.4	3.0	40.5	20	3	7.5	5.9	1.6	27.1
4	12.8	9.3	3.5	37.6	26	4	8.2	6.4	1.8	28.1
5	14.6	10.6	4.0	37.7	33					

Liquid Limit: 39
Plastic Limit: 28
Plasticity Index: 11

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation

Location: Sunderland

Date Collected: July 18, 2019

Borehole: Su_Ha1

Sample Number: N4

Depth (ft-ft): 7.4 8.0

Average Depth (ft): 7.70

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	4.2	2.9	1.3	44.8	43	1	6.3	4.9	1.4	28.6
2	5.1	3.4	1.7	50.0	14	2	12.2	9.2	3	32.6
3	6.2	3.9	2.3	59.0	7	3	9.8	7.7	2.1	27.3
4	5.3	3.8	1.5	39.5	13					
5	5.8	4.3	1.5	34.9	30					

Liquid Limit: 42
Plastic Limit: 28
Plasticity Index: 14

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: July 18, 2019	
Borehole:	Su_Ha1	Sample Number:	N5	Depth (ft-ft):	9.3 9.8 Average Depth (ft): 9.55

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	5.5	3.9	1.6	41.0	120	1	11.3	8.6	2.7	31.4
2	4.2	2.9	1.3	44.8	48	2	6.3	5.0	1.3	26.0
3	5.0	3.5	1.5	42.9	16	3	9.6	7.4	2.2	29.7
4	6.5	4.2	2.3	54.8	6					

Liquid Limit: 46
Plastic Limit: 31
Plasticity Index: 15

Total amount of materials passing sieve
No. 40: 100 %

Fines
Classification: ML

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation

Location: Sunderland

Date Collected: July 18, 2019

Borehole: Su_Ha1

Sample Number: N6

Depth (ft-ft): 12.8 13.3 Average Depth (ft): 13.05

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	2.1	1.6	0.5	31.3	21	1	8.2	6.5	1.7	26.2
2	4.9	3.5	1.4	40.0	8	2	7.9	6.3	1.6	25.4
3	3.0	2.3	0.7	30.4	216					
4	3.5	2.6	0.9	34.6	39					

Liquid Limit: 35
Plastic Limit: 26
Plasticity Index: 9

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected:	August 5, 2019
Borehole:	Su_Ex_N	Sample Number:	N1	Depth (ft-ft):	6.5 8.0 Average Depth (ft): 7.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	14.0	9.6	4.4	45.8	2	1	6.2	5.0	1.2	24.0
2	11.0	7.7	3.3	42.9	11	2	5.9	4.7	1.2	25.5
3	13.2	9.8	3.4	34.7	35					
4	15.5	11.4	4.1	36.0	75					

Liquid Limit: 38
 Plastic Limit: 25
 Plasticity Index: 13

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: CL

Procedure Done By: Melissa P.

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_N	Sample Number:	N2	Depth (ft-ft):	16.5 18.0 Average Depth (ft): 17.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	14.3	9.1	5.2	57.1	17	1	6.2	4.9	1.3	26.5
2	6.5	4.3	2.2	51.2	23	2	6.6	5.1	1.5	29.4
3	8.3	5.6	2.7	48.2	31					
4	9.5	6.4	3.1	48.4	46					
5	2.6	1.8	0.8	44.4	85					

Liquid Limit: 52
Plastic Limit: 28
Plasticity Index: 24

Total amount of materials passing sieve
No. 40: 100 %

Fines
Classification: CH

Procedure Done By: Rawan

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland				Date Collected: August 6, 2019
Borehole:	Su_Ex_E	Sample Number:	N1	Depth (ft-ft):	7.5 9.0 Average Depth (ft): 8.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	2.4	1.8	0.6	33.3	2	1	6.1	5.4	0.7	13.0
2	2.1	1.7	0.4	23.5	65	2	6.7	5.4	1.3	24.1
3	3.0	2.3	0.7	30.4	59	3	7.6	6.2	1.4	22.6
4	2.1	1.6	0.5	31.3	47					
5	1.9	1.5	0.4	26.7	16					

Liquid Limit: 29
 Plastic Limit: 23
 Plasticity Index: 5

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 6, 2019	
Borehole:	Su_Ex_E	Sample Number:	N2	Depth (ft-ft):	12.5 14.0 Average Depth (ft): 13.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	4.0	2.7	1.3	48.1	22	1	6.2	4.8	1.4	29.2
2	3.9	2.8	1.1	39.3	68	2	6.8	5.3	1.5	28.3
3	5.0	3.5	1.5	42.9	46					
4	3.1	2.1	1.0	47.6	20					
5	6	4	2.0	50.0	11					

Liquid Limit: 46
Plastic Limit: 29
Plasticity Index: 18

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Ariadna

Project: NSF - Microbial Induced Desaturation			
Location: Sunderland		Date Collected: August 6, 2019	
Borehole: Su_Ex_E	Sample Number: N3	Depth (ft-ft): 17.5 19.0	Average Depth (ft): 18.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	2.1	1.5	0.6	40.0	18	1	6.1	4.9	1.2	24.5
2	3.0	2.1	0.9	42.9	5	2	6.8	5.5	1.3	23.6
3	1.7	1.3	0.4	30.8	48					
4	4.3	3.2	1.1	34.4	34					

Liquid Limit: 36
 Plastic Limit: 24
 Plasticity Index: 12

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: CL

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 6, 2019	
Borehole:	Su_Ex_E	Sample Number:	N4	Depth (ft-ft):	22.5 24.0 Average Depth (ft): 23.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	6.2	4.3	1.9	44.2	7	1	6.3	5.0	1.3	26.0
2	6.7	4.7	2.0	42.6	16	2	8.7	6.7	2.0	29.9
3	7.8	5.7	2.1	36.8	34	3	8.1	6.4	1.7	26.6
4	9.0	6.6	2.4	36.4	44					

Liquid Limit: 39
Plastic Limit: 26
Plasticity Index: 13

Total amount of materials passing sieve
No. 40: 100 %

Fines
Classification: ML

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_S	Sample Number:	N1	Depth (ft-ft):	6.5 8.0 Average Depth (ft): 7.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	7.1	4.9	2.2	44.9	9	1	6.7	5.8	0.9	15.5
2	4.1	3.0	1.1	36.7	36	2	8.8	7.2	1.6	22.2
3	4.1	3.1	1.0	32.3	65	3	9.6	7.8	1.8	23.1
4	4.8	3.5	1.3	37.1	36					
5	2.3	1.7	0.6	35.3	40					

Liquid Limit: 39
 Plastic Limit: 23
 Plasticity Index: 16

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: CL

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_S	Sample Number:	N2	Depth (ft-ft):	11.5 13.0 Average Depth (ft): 12.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	7.3	5.3	2	37.7	29	1	8.5	6.7	1.8	26.9
2	14.1	9.8	4.3	43.9	14	2	6.8	5.4	1.4	25.9
3	13.4	9.9	3.5	35.4	37					
4	16.9	11.9	5.0	42.0	12					
5	2.5	1.9	0.6	31.6	166					
6	3.3	2.5	0.8	32.0	80					

Liquid Limit: 39
Plastic Limit: 26
Plasticity Index: 13

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Rawan

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_S	Sample Number:	N3	Depth (ft-ft):	16.5 18.0 Average Depth (ft): 17.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	3.5	2.4	1.1	45.8	18	1	6.2	5	1.2	24.0
2	4.5	3.1	1.4	45.2	8	2	6.7	5.2	1.5	28.8
3	3.6	2.6	1.0	38.5	140	3	5.9	4.7	1.2	25.5
4	3.7	2.6	1.1	42.3	75					

Liquid Limit: 44
 Plastic Limit: 25
 Plasticity Index: 19

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: CL

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_S	Sample Number:	N4	Depth (ft-ft):	21.5 23.0 Average Depth (ft): 22.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	1.6	1.2	0.4	33.3	20	1	8.2	6.2	2.0	32.3
2	2.7	1.9	0.8	42.1	10	2	6.6	5.1	1.5	29.4
3	3.5	2.7	0.8	29.6	38	3	7.6	5.8	1.8	31.0
4	2.0	1.5	0.5	33.3	28					

Liquid Limit: 33
 Plastic Limit: 32
 Plasticity Index: 1

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation

Location: Sunderland

Date Collected: August 6, 2019

Borehole: Su_Ex_W

Sample Number: N1

Depth (ft-ft): 7.5 9.0

Average Depth (ft): 8.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	4.8	3.3	1.5	45.5	7	1	6.8	5.4	1.4	25.9
2	5.9	4.2	1.7	40.5	96	2	7.0	5.5	1.5	27.3
3	3.7	2.6	1.1	42.3	54					
4	6.9	4.8	2.1	43.8	16					

Liquid Limit: 43
Plastic Limit: 27
Plasticity Index: 17

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 6, 2019	
Borehole:	Su_Ex_W	Sample Number:	N2	Depth (ft-ft):	17.5 19.0 Average Depth (ft): 18.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	14.2	9.1	5.1	56.0	6	1	6.5	5.2	1.3	25.0
2	10.8	7.3	3.5	47.9	22	2	6.3	5.0	1.3	26.0
3	10.2	7.0	3.2	45.7	16					
4	8.0	5.6	2.4	42.9	90					

Liquid Limit: 47
 Plastic Limit: 26
 Plasticity Index: 22

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: CL

Procedure Done By: Rawan

Project: NSF - Microbial Induced Desaturation			
Location: Sunderland		Date Collected: August 5, 2019	
Borehole: Su_Inj	Sample Number: N1a	Depth (ft-ft): 6.5 7.25	Average Depth (ft): 6.88

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	2.9	2.1	0.8	38.1	2	1	10.7	8.7	2.0	23.0
2	3.0	2.4	0.6	25.0	90	2	7.0	5.7	1.3	22.8
3	5.0	3.8	1.2	31.6	22					
4	5.5	4.3	1.2	27.9	39					

Liquid Limit: 30
 Plastic Limit: 23
 Plasticity Index: 7

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Inj	Sample Number:	N1b	Depth (ft-ft):	7.25 8.0 Average Depth (ft): 7.63

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	3.9	2.8	1.1	39.3	4	1	9	7.3	1.7	23.3
2	3.6	2.7	0.9	33.3	82	2	11.3	9.1	2.2	24.2
3	4.8	3.5	1.3	37.1	36					
4	7.1	5.1	2.0	39.2	16					

Liquid Limit: 37
Plastic Limit: 24
Plasticity Index: 13

Total amount of materials passing sieve
No. 40: 100 %

Fines
Classification: CL

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland				Date Collected: August 5, 2019
Borehole:	Su_Inj	Sample Number:	N2	Depth (ft-ft):	11.500 13.0 Average Depth (ft): 12.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	8.1	5.6	2.5	44.6	23	1	6.5	5.3	1.2	22.6
2	6.1	4.2	1.9	45.2	35	2	8.1	6.6	1.5	22.7
3	6.2	4.3	1.9	44.2	22					
4	3.5	2.6	0.9	34.6	235					
5	7.7	5.5	2.2	40.0	152					

Liquid Limit: 45
Plastic Limit: 23
Plasticity Index: 22

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: CL

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Inj	Sample Number:	N3	Depth (ft-ft):	16.5 18.0 Average Depth (ft): 17.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	7.6	5.0	2.6	52.0	13	1	8	6.3	1.7	27.0
2	6.8	4.4	2.4	54.5	5	2	7	5.5	1.5	27.3
3	6.2	4.4	1.8	40.9	135					
4	5.8	4.1	1.7	41.5	60					

Liquid Limit: 47
 Plastic Limit: 27
 Plasticity Index: 20

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: CL

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation
 Location: Sunderland
 Date Collected: August 5, 2019
 Borehole: Su_Inj Sample Number: N4 Depth (ft-ft): 21.5 23.0 Average Depth (ft): 22.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	16.7	11.0	5.7	51.8	25	1	8.0	6.1	1.9	31.1
2	14.2	9.3	4.9	52.7	20	2	8.2	6.0	2.2	36.7
3	17.2	11.2	6.0	53.6	15	3	8.0	5.8	2.2	37.9
4	6.5	4.3	2.2	51.2	27					

Liquid Limit: 52
 Plastic Limit: 37
 Plasticity Index: 14

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: MH

Procedure Done By: Nathan/Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected:	August 5, 2019
Borehole:	Su_Ex_N_U2	Sample Number:	G1	Depth (ft-ft):	14.75 15.0
				Average Depth (ft):	14.88

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	4.6	3.0	1.6	53.3		1	9.8	7.2	2.6	36.1
2	7.9	5.2	2.7	51.9	100	2	10.0	7.3	2.7	37.0
3	7.8	5.1	2.7	52.9	68					
4	9.3	6.0	3.3	55.0	28					
5	9.7	6.2	3.5	56.5	21					
6	15.6	9.7	5.9	60.8	11					

Liquid Limit: 57
 Plastic Limit: 36
 Plasticity Index: 20

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: MH

Procedure Done By: Kayla
 Date Performed: July 29, 2020

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_N_U2	Sample Number:	G2	Depth (ft-ft):	15.00 15.25 Average Depth (ft): 15.13

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	12.9	8.8	4.1	46.6	58	1	7.8	6	1.8	30.0
2	15.7	10.6	5.1	48.1	17	2	8.0	6.2	1.8	29.0
3	12.6	8.3	4.3	51.8	12					
4	16.4	11.4	5.0	43.9	30					
5	17.8	12.5	5.3	42.4	43					

Liquid Limit: 47
 Plastic Limit: 30
 Plasticity Index: 17

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Max/Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_N_U2	Sample Number:	G3	Depth (ft-ft):	15.25 15.50 Average Depth (ft): 15.38

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	6.7	4.6	2.1	45.7	10	1	7.8	6.2	1.6	25.8
2	11.2	7.8	3.4	43.6	28	2	9.3	7.3	2	27.4
3	10.8	7.4	3.4	45.9	10					
4	10.5	7.8	2.7	34.6	98					
5	19.9	14.2	5.7	40.1	24					

Liquid Limit: 42
Plastic Limit: 27
Plasticity Index: 15

Total amount of materials passing sieve
No. 40: 100 %

Fines
Classification: ML

Procedure Done By: Max

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_N_U2	Sample Number:	G4	Depth (ft-ft):	15.50 15.75 Average Depth (ft): 15.63

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	16.4	10.3	6.1	59.2	6	1	6.2	4.7	1.5	31.9
2	15.0	9.5	5.5	57.9	9	2	13.2	9.8	3.4	34.7
3	13.6	9.2	4.4	47.8	36					
4	11.3	8.1	3.2	39.5	110					

Liquid Limit: 50
Plastic Limit: 33
Plasticity Index: 17

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Max

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_N_U2	Sample Number:	G5	Depth (ft-ft):	15.75 16.00 Average Depth (ft): 15.88

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	9.3	6.2	3.1	50.0	18	1	9.5	7.3	2.2	30.1
2	12.2	8.3	3.9	47.0	29	2	6.8	5.3	1.5	28.3
3	9.5	6.9	2.6	37.7	93					
4	11.6	8.0	3.6	45.0	11					
5	10.9	7.2	3.7	51.4	32					
6	10.4	7.3	3.1	42.5	39					

Liquid Limit: 46
Plastic Limit: 29
Plasticity Index: 17

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Max

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_N_U2	Sample Number:	G6	Depth (ft-ft):	16.00 16.25 Average Depth (ft): 16.13

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	15.6	10.2	5.4	52.9		1	6.7	5.1	1.6	31.4
2	11.3	7.4	3.9	52.7	8	2	6.1	4.7	1.4	29.8
3	13.7	9.1	4.6	50.5	11					
4	13.4	9.2	4.2	45.7	24					
5	12.7	9.0	3.7	41.1	92					

Liquid Limit: 47
Plastic Limit: 31
Plasticity Index: 16

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Max

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_N_U2	Sample Number:	G7	Depth (ft-ft):	16.25 16.50 Average Depth (ft): 16.38

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	12.9	8.3	4.6	55.4	7	1	7	5.4	1.6	29.6
2	14.6	9.7	4.9	50.5	16	2	7.4	5.7	1.7	29.8
3	13.2	9.0	4.2	46.7	28					
4	12.3	8.5	3.8	44.7	57					

Liquid Limit: 48
Plastic Limit: 30
Plasticity Index: 18

Total amount of materials passing sieve
No. 40: 100 %

Fines
Classification: ML

Procedure Done By: Max

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_S_U3	Sample Number:	M1	Depth (ft-ft):	14.50 14.75 Average Depth (ft): 14.63

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	22.8	15.6	7.2	46.2		1	10.9	8.2	2.7	32.9
2	13.4	8.8	4.6	52.3	17	2	10.1	7.6	2.5	32.9
3	11.0	7.3	3.7	50.7	18					
4	10.3	6.9	3.4	49.3	61					
5	10.8	7.4	3.4	45.9	90					

Liquid Limit: 51
 Plastic Limit: 33
 Plasticity Index: 18

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: MH

Procedure Done By: Max

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_S_U3	Sample Number:	M2	Depth (ft-ft):	14.75 15.00 Average Depth (ft): 14.88

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	8.0	5.7	2.3	40.4		1	7.8	6	1.8	30.0
2	10.1	7.0	3.1	44.3	96	2	7.8	6	1.8	30.0
3	14.5	9.8	4.7	48.0	27					
4	9.9	6.8	3.1	45.6	70					
5	12.7	8.5	4.2	49.4	22					

Liquid Limit: 49
Plastic Limit: 30
Plasticity Index: 19

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Max

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_S_U3	Sample Number:	M3	Depth (ft-ft):	15.00 15.25 Average Depth (ft): 15.13

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	13.7	9.6	4.1	42.7		1	6	4.8	1.2	25.0
2	14	9.7	4.3	44.3	20	2	8.7	6.9	1.8	26.1
3	10.6	7.3	3.3	45.2	12					
4	12.7	9.0	3.7	41.1	34					
5	13.6	9.8	3.8	38.8	70					

Liquid Limit: 43
Plastic Limit: 26
Plasticity Index: 17

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: CL

Procedure Done By: Max

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_S_U3	Sample Number:	M4	Depth (ft-ft):	15.25 15.50 Average Depth (ft): 15.38

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	10.2	7.0	3.2	45.7		1	10.9	8.5	2.4	28.2
2	12.9	8.8	4.1	46.6	14	2	12.2	9.4	2.8	29.8
3	13.5	9.4	4.1	43.6	18					
4	13.0	9.3	3.7	39.8	48					
5	14.3	10.5	3.8	36.2	121					

Liquid Limit: 43
Plastic Limit: 29
Plasticity Index: 14

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Max

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_S_U3	Sample Number:	M5	Depth (ft-ft):	15.50 15.75 Average Depth (ft): 15.63

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	13.5	9.3	4.2	45.2		1	8.7	6.7	2	29.9
2	12.9	8.6	4.3	50.0	3	2	6.1	4.7	1.4	29.8
3	9.9	7.0	2.9	41.4	11					
4	12.3	9.1	3.2	35.2	36					
5	11	8.2	2.8	34.1	58					

Liquid Limit: 38
Plastic Limit: 30
Plasticity Index: 8

Total amount of materials passing sieve
No. 40: 100 %

Fines
Classification: ML

Procedure Done By: Max

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_S_U3	Sample Number:	M6	Depth (ft-ft):	15.75 16.00 Average Depth (ft): 15.88

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	10.1	6.6	3.5	53.0		1	9.3	7.2	2.1	29.2
2	13.1	8.9	4.2	47.2	34	2	9.2	7.1	2.1	29.6
3	12.8	8.6	4.2	48.8	17					
4	16.5	11.5	5.0	43.5	41					
5	18.3	12.5	5.8	46.4	15					

Liquid Limit: 46
Plastic Limit: 29
Plasticity Index: 17

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla
Date Tested: July 21, 2020

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_S_U3	Sample Number:	M7	Depth (ft-ft):	16.00 16.25 Average Depth (ft): 16.13

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	27.0	18.1	8.9	49.2		1	10.9	8.2	2.7	32.9
2	16.6	11.3	5.3	46.9	23	2	10.7	8.1	2.6	32.1
3	14.9	10.4	4.5	43.3	29					
4	18.6	12.9	5.7	44.2	16					

Liquid Limit: 45
 Plastic Limit: 33
 Plasticity Index: 12

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla
 Date Tested: July 22, 2020

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_S_U3	Sample Number:	M8	Depth (ft-ft):	16.25 16.50 Average Depth (ft): 16.38

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	9.9	6.5	3.4	52.3		1	10.2	7.7	2.5	32.5
2	18.7	12.3	6.4	52.0	8	2	9.8	7.4	2.4	32.4
3	13.0	9.4	3.6	38.3	75					
4	11.7	8.3	3.4	41.0	29					
5	13.5	9.4	4.1	43.6	19					

Liquid Limit: 43
Plastic Limit: 32
Plasticity Index: 11

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla
Date Tested: July 22, 2020

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_E_U3	Sample Number:	T1	Depth (ft-ft):	15.75 16.00 Average Depth (ft): 15.88

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	15.7	10.5	5.2	49.5		1	10.2	7.5	2.7	36.0
2	13.3	8.8	4.5	51.1	42	2	10.4	7.7	2.7	35.1
3	14.7	9.6	5.1	53.1	25					
4	20.5	13.5	7.0	51.9	18					
5	13.2	8.5	4.7	55.3	11					

Liquid Limit: 52
Plastic Limit: 36
Plasticity Index: 17

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: MH

Procedure Done By: Kayla
Date Tested: July 22, 2020

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_E_U3	Sample Number:	T2	Depth (ft-ft):	16.00 16.25 Average Depth (ft): 16.13

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	11.6	7.8	3.8	48.7		1	7.3	5.4	1.9	35.2
2	6	4.1	1.9	46.3	14	2	7.8	5.8	2	34.5
6	8.3	5.8	2.5	43.1	50					
4	9.0	6.3	2.7	42.9	20					
5	11.5	8.2	3.3	40.2	62					
6	6.8	4.8	2.0	41.7	35					

Liquid Limit: 43
Plastic Limit: 35
Plasticity Index: 9

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla
Date Tested: August 18/20, 2020

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_E_U3	Sample Number:	T3	Depth (ft-ft):	16.25 16.50 Average Depth (ft): 16.38

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	7.1	5.0	2.1	42.0		1	7.6	6	1.6	26.7
2	9.9	6.8	3.1	45.6	68	2	7.9	6.2	1.7	27.4
3	7.5	5.3	2.2	41.5	54					
4	7.4	5.1	2.3	45.1	18					
5	9.9	6.7	3.2	47.8	10					

Liquid Limit: 45
Plastic Limit: 27
Plasticity Index: 18

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML/CL

Procedure Done By: Kayla
Date Tested: August 20, 2020

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_E_U3	Sample Number:	T4	Depth (ft-ft):	16.50 16.75 Average Depth (ft): 16.63

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	15.7	10.9	4.8	44.0		1	6.6	5	1.6	32.0
2	6.4	4.4	2	45.5	17	2	6.6	5	1.6	32.0
3	7.1	5.1	2	39.2	70					
4	9.4	6.7	2.7	40.3	43					
5	10.9	7.6	3.3	43.4	20					

Liquid Limit: 43
Plastic Limit: 32
Plasticity Index: 11

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla
Date Tested: October 1, 2020

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected:	August 5, 2019
Borehole:	Su_Ex_E_U3	Sample Number:	T5	Depth (ft-ft):	16.75 17.00
				Average Depth (ft):	16.88

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	8.6	5.5	3.1	56.4		1	8.1	6.1	2	32.8
2	14.5	9.5	5	52.6	54	2	8.0	6	2	33.3
3	12.3	7.9	4.4	55.7	35					
4	10.4	6.7	3.7	55.2	20					
5	15.4	9.8	5.6	57.1	15					

Liquid Limit: 55
 Plastic Limit: 33
 Plasticity Index: 22

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: MH

Procedure Done By: Kayla
 Date Tested: October 18, 2020

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_E_U3	Sample Number:	T6	Depth (ft-ft):	17.00 17.25 Average Depth (ft): 17.13

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	12.6	7.8	4.8	61.5		1	9.1	6.5	2.6	40.0
2	11	7.4	3.6	48.6	106	2	9.2	6.6	2.6	39.4
3	12.5	8.0	4.5	56.3	45					
4	13.5	8.5	5.0	58.8	28					
5	12.2	7.6	4.6	60.5	17					
6	12.6	7.8	4.8	61.5	9					

Liquid Limit: 57
Plastic Limit: 40
Plasticity Index: 18

Total amount of materials passing sieve
No. 40: 100 %

Fines
Classification: MH

Procedure Done By: Kayla
Date Tested: October 18, 2020

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 5, 2019	
Borehole:	Su_Ex_E_U3	Sample Number:	T7	Depth (ft-ft):	17.25 17.50 Average Depth (ft): 17.38

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	10.8	6.6	4.2	63.6		1	8.9	6.4	2.5	39.1
2	7.8	4.9	2.9	59.2	45	2	8.9	6.4	2.5	39.1
3	12.8	7.8	5	64.1	27					
4	8.2	4.9	3.3	67.3	17					
5	10.4	6.1	4.3	70.5	13					

Liquid Limit: 64
Plastic Limit: 39
Plasticity Index: 25

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: MH

Procedure Done By: Kayla
Date Tested: October 21, 2020

Project: NSF - Microbial Induced Desaturation
 Location: Sunderland
 Date Collected: August 6, 2019
 Borehole: Su Ex W U2 Sample Number: G1 Depth (ft-ft): 15.80 16.10 Average Depth (ft): 15.95

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	18.2	12.3	5.9	48.0		1	8.9	6.6	2.3	34.8
2	10.8	7.1	3.7	52.1	53	2	9.0	6.7	2.3	34.3
3	10.8	7.0	3.8	54.3	25					
4	12.9	8.2	4.7	57.3	21					
5			0.0	####						
6			0.0	####						

Liquid Limit: 56
 Plastic Limit: 35
 Plasticity Index: 21

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: MH

Procedure Done By: Kayla
 Date Tested: October 21, 2020

Project: NSF - Microbial Induced Desaturation
 Location: Sunderland
 Date Collected: August 6, 2019
 Borehole: Su_Ex_W_U2 Sample Number: G2 Depth (ft-ft): 16.10 16.40 Average Depth (ft): 16.25

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	15.7	10.7	5	46.7		1	7.5	5.6	1.9	33.9
2	11.4	7.6	3.8	50.0	145	2	7.6	5.7	1.9	33.3
3	11.5	7.5	4	53.3	39					
4	12.3	7.9	4.4	55.7	28					
5	12	7.6	4.4	57.9	22					
6			0.0	####						

Liquid Limit: 56
 Plastic Limit: 34
 Plasticity Index: 23

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: MH

Procedure Done By: Kayla
 Date Tested: April 2, 2021

Project:	NSF - Microbial Induced Desaturation				
Location:	Sunderland			Date Collected: August 6, 2019	
Borehole:	Su_Ex_W_U2	Sample Number:	G3	Depth (ft-ft):	16.40 16.75 Average Depth (ft): 16.58

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	12.3	8.3	4	48.2		1	6.4	4.8	1.6	33.3
2	14.8	9.6	5.2	54.2	5	2	6.6	4.9	1.7	34.7
3	19.7	13.0	6.7	51.5	11					
4	16.8	11.6	5.2	44.8	41					
5			0.0	####						
6			0.0	####						

Liquid Limit: 47
Plastic Limit: 34
Plasticity Index: 13

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla
Date Tested: April 2, 2021

Appendix D: Hydrometer and P200 Washes – Sunderland

Hydrometer Test

Boring:	Su_Ha1	Sample:	N1	Depth (ft-ft):	1.45 1.7	Start Time:	10:26:00 AM
				Ave. Depth (ft):	1.58		

Constants	
M _s (g)	53.74
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.032	1.004	19.6	0.013718	1.028	7.8	0.054181759	84
1	1.031	1.004	19.6	0.013718	1.027	8.1	0.039042112	81
2	1.029	1.004	19.6	0.013718	1.025	8.6	0.02844625	75
4	1.026	1.004	19.6	0.013718	1.022	9.4	0.021029296	66
8	1.023	1.004	19.6	0.013718	1.019	10.2	0.015489803	57
18	1.020	1.004	19.5	0.013735	1.016	11.0	0.010737143	48
34	1.017	1.004	19.4	0.013752	1.013	11.8	0.008101537	39
68	1.015	1.004	19.1	0.013803	1.011	12.3	0.005870453	33
163	1.013	1.004	17.0	0.014170	1.009	12.9	0.003986308	27
300	1.012	1.004	17.0	0.014170	1.008	13.1	0.002961044	24
1447	1.010	1.004	16.0	0.014350	1.006	13.7	0.001396297	18
1616	1.010	1.004	16.0	0.014350	1.006	13.9	0.001330879	18

P200 Wash

Container ID:	I1	Soil Breakdown		
Before - M _d :	29.3 g	Coarse:	2.73 %	
After - M _d :	0.8 g	Silts:	76.27 %	
Fines Fraction:	97.27 %	From Hydrometer	Clays:	21.00 %
Coarse Fraction:	2.73 %			

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ha1	Sample:	N2	Depth (ft-ft):	3.6 4.6	Start Time:	10:28:00 AM
				Ave. Depth (ft):	4.1		

Constants	
M _s (g)	54.21
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.031	1.004	19.6	0.013718	1.027	7.8	0.054181759	80
1	1.030	1.004	19.6	0.013718	1.026	8.1	0.039042112	77
2	1.029	1.004	19.6	0.013718	1.025	8.6	0.02844625	74
4	1.028	1.004	19.6	0.013718	1.024	9.4	0.021029296	71
8	1.026	1.004	19.6	0.013718	1.022	10.2	0.015489803	65
16	1.025	1.004	19.5	0.013735	1.021	11.0	0.01138846	62
32	1.023	1.004	19.4	0.013752	1.019	11.8	0.008350873	56
66	1.020	1.004	19.1	0.013803	1.016	12.3	0.005958735	47
161	1.018	1.004	17.0	0.014170	1.014	12.9	0.004010992	41
298	1.015	1.004	17.0	0.014170	1.011	13.1	0.002970964	33
1445	1.012	1.004	16.0	0.014350	1.008	13.7	0.001397263	24
1614	1.012	1.004	16.0	0.014350	1.008	13.9	0.001331703	24

P200 Wash

Container ID:	E1	Soil Breakdown	
Before - M _d :	24.9 g	Coarse:	0.80 %
After - M _d :	0.2 g	Silts:	71.20 %
Fines Fraction:	99.20 %	From Hydrometer Clays:	28.00 %
Coarse Fraction:	0.80 %		

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ha1	Sample:	N3	Depth (ft-ft):	4.9 5.8	Start Time:	10:30:00 AM
				Ave. Depth (ft):	5.4		

Constants	
M _s (g)	64.73
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.037	1.004	19.5	0.013735	1.033	6.5	0.049522247	82
1	1.034	1.004	19.5	0.013735	1.030	7.3	0.037109926	74
2	1.030	1.004	19.5	0.013735	1.026	8.4	0.028148374	65
4	1.028	1.004	19.5	0.013735	1.024	8.9	0.020487722	60
8	1.024	1.004	19.5	0.013735	1.020	10.0	0.015356197	50
14	1.021	1.004	19.4	0.013752	1.017	10.7	0.012022471	42
30	1.018	1.004	19.3	0.013769	1.014	11.5	0.008524927	35
64	1.016	1.004	19.0	0.013820	1.012	12.1	0.006009118	30
159	1.014	1.004	17.0	0.014170	1.010	12.6	0.003988931	25
296	1.013	1.004	17.0	0.014170	1.009	12.9	0.002958141	22
1443	1.011	1.004	16.0	0.014350	1.007	13.4	0.001382837	17
1612	1.011	1.004	16.0	0.014350	1.007	13.4	0.001308344	17

P200 Wash

Container ID:	K1	Soil Breakdown	
Before - M _d :	29.2 g	Coarse:	5.82 %
After - M _d :	1.7 g	Silts:	74.18 %
Fines Fraction:	94.18 %	From Hydrometer Clays:	20.00 %
Coarse Fraction:	5.82 %		

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ha1	Sample:	N4	Depth (ft-ft):	7.4 8	Start Time:	1:50:00 PM
				Ave. Depth (ft):	7.7		

Constants	
M _s (g)	57.81
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.033	1.004	19.8	0.013684	1.029	7.6	0.053350054	81
1	1.031	1.004	19.8	0.013684	1.027	8.1	0.038945347	75
2	1.029	1.004	19.7	0.013701	1.025	8.6	0.028410998	69
4	1.027	1.004	19.7	0.013701	1.023	9.2	0.020778595	64
8	1.023	1.004	19.7	0.013701	1.019	10.2	0.015470607	53
18	1.020	1.004	19.6	0.013718	1.016	11.0	0.010723854	44
34	1.018	1.004	19.6	0.013718	1.014	11.5	0.007978114	39
66	1.016	1.004	19.4	0.013752	1.012	12.1	0.005888255	33
130	1.013	1.004	19.1	0.013803	1.009	12.9	0.004348071	25
1128	1.009	1.004	16.5	0.014260	1.005	13.9	0.001582969	14
1277	1.009	1.004	16.0	0.014350	1.005	13.9	0.001497145	14

P200 Wash

Container ID:	K1	Soil Breakdown	
Before - M _d :	29.2 g	Coarse:	5.82 %
After - M _d :	1.7 g	Silts:	77.68 %
Fines Fraction:	94.18 %	From Hydrometer Clays:	16.50 %
Coarse Fraction:	5.82 %		

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ha1	Sample:	N5	Depth (ft-ft):	9.3	9.6	Start Time:	1:52:00 PM
				Ave. Depth (ft):	9.45			

Constants	
M _s (g)	57.38
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.035	1.004	19.9	0.013667	1.031	7.0	0.051137232	87
1	1.033	1.004	19.9	0.013667	1.029	7.6	0.037677319	81
2	1.032	1.004	19.9	0.013667	1.028	7.8	0.026990162	78
4	1.030	1.004	19.9	0.013667	1.026	8.4	0.019805365	73
8	1.027	1.004	19.9	0.013667	1.023	9.2	0.014656225	64
16	1.024	1.004	19.7	0.013701	1.020	10.0	0.010831592	56
32	1.022	1.004	19.6	0.013718	1.018	10.5	0.007857972	50
64	1.019	1.004	19.4	0.013752	1.015	11.3	0.0057785	42
128	1.016	1.004	19.2	0.013786	1.012	12.1	0.004238635	34
1126	1.011	1.004	17.0	0.014170	1.007	13.4	0.001545799	20
1275	1.011	1.004	16.0	0.014350	1.007	13.4	0.001471124	20

P200 Wash

Container ID:	L1	Soil Breakdown	
Before - M _d :	27 g	Coarse:	1.11 %
After - M _d :	0.3 g	Silts:	75.89 %
Fines Fraction:	98.89 %	From Hydrometer Clays:	23.00 %
Coarse Fraction:	1.11 %		

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ha1	Sample:	N6	Depth (ft-ft):	12.8	13.3	Start Time:	1:54:00 PM
				Ave. Depth (ft):	13.05			

Constants

M_s (g)	54.45
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.032	1.004	20.2	0.013616	1.028	7.8	0.053778891	83
1	1.031	1.004	20.2	0.013616	1.027	8.1	0.038751815	80
2	1.026	1.004	20.2	0.013616	1.022	9.4	0.029518785	65
4	1.024	1.004	20.2	0.013616	1.020	10.0	0.021528786	59
8	1.020	1.004	20.1	0.013633	1.016	11.0	0.01598611	47
14	1.017	1.004	20.0	0.013650	1.013	11.8	0.01253169	38
30	1.015	1.004	19.9	0.013667	1.011	12.3	0.00875115	32
62	1.013	1.004	19.6	0.013718	1.009	12.9	0.006257341	27
126	1.011	1.004	19.2	0.013786	1.007	13.4	0.004495784	21
1124	1.008	1.004	16.0	0.014350	1.004	14.2	0.00161292	12
1273	1.008	1.004	16.0	0.014350	1.004	14.2	0.00151559	12

P200 Wash

Container ID:	F1	Soil Breakdown	
Before - M_d :	27.5 g	Coarse:	2.55 %
After - M_d :	0.7 g	Silts:	83.45 %
Fines Fraction:	97.45 %	Clays:	14.00 %
Coarse Fraction:	2.55 %	From Hydrometer	

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ex_N	Sample:	N1	Depth (ft-ft):	6.5 8.0	Start Time:	10:06:00 AM
				Ave. Depth (ft):	7.25		

Constants	
M _s (g)	55.41
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.028	1.003	23.9	0.013026	1.025	8.9	0.054956754	72
1	1.026	1.003	23.9	0.013026	1.023	9.4	0.03993696	67
2	1.022	1.003	23.9	0.013026	1.019	10.5	0.029846316	55
4	1.019	1.003	23.9	0.013026	1.016	11.3	0.021893757	46
8	1.017	1.003	23.9	0.013026	1.014	11.8	0.015820022	41
16	1.015	1.003	23.9	0.013026	1.012	12.3	0.011420987	35
32	1.013	1.003	23.4	0.013106	1.010	12.9	0.008321278	29
64	1.011	1.003	22.4	0.013260	1.008	13.4	0.006067446	23
124	1.011	1.003	21.5	0.013400	1.008	13.4	0.004405004	23
164	1.01	1.003	21.1	0.013464	1.007	13.7	0.003891459	20
1502	1.008	1.003	19.3	0.013769	1.005	14.2	0.001338787	14
1852	1.008	1.003	19.9	0.013667	1.005	14.2	0.001196732	14

P200 Wash

Container ID: S1
 Before - M_d: 35.5 g
 After - M_d: 3.3 g
 Fines Fraction: 90.70 %
 Coarse Fraction: 9.30 %

Soil Breakdown	
Coarse:	9.30 %
Silts:	73.70 %
Clays:	17.00 %

From Hydrometer

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ex_N	Sample:	N2	Depth (ft-ft):	16.5	18.0	Start Time:	10:09:00 AM
				Ave. Depth (ft):	17.25			

Constants

M_s (g)	52.16
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.029	1.003	23.0	0.013170	1.026	8.6	0.054619787	80
1	1.027	1.003	23.0	0.013170	1.024	9.2	0.039946588	74
2	1.025	1.003	23.0	0.013170	1.022	9.7	0.029003916	68
4	1.023	1.003	23.0	0.013170	1.020	10.2	0.021030803	62
8	1.022	1.003	23.0	0.013170	1.019	10.5	0.01508813	59
16	1.019	1.003	23.0	0.013170	1.016	11.3	0.011067894	49
32	1.016	1.003	22.6	0.013230	1.013	12.1	0.008135374	40
64	1.014	1.003	21.9	0.013336	1.011	12.6	0.005917263	34
119	1.012	1.003	21.2	0.013448	1.009	13.1	0.0044619	28
164	1.012	1.003	21.0	0.013480	1.009	13.1	0.003809813	28
1502	1.008	1.003	19.3	0.013769	1.005	14.2	0.001338787	15
1852	1.008	1.003	19.3	0.013769	1.005	14.2	0.001205663	15

P200 Wash

Container ID:	T1
Before - M_d :	29.2 g
After - M_d :	0.7 g
Fines Fraction:	97.60 %
Coarse Fraction:	2.40 %

Soil Breakdown	
Coarse:	2.40 %
Silts:	77.60 %
Clays:	20.00 %

From Hydrometer

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ex_E	Sample:	N1	Depth (ft-ft):	7.5 9.0	Start Time:	9:58:00 AM
				Ave. Depth (ft):	8.25		

Constants	
M _s (g)	52.80
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.027	1.003	20.2	0.013616	1.024	9.2	0.058406133	73
1	1.023	1.003	20.2	0.013616	1.020	10.2	0.043486017	61
2	1.020	1.003	20.2	0.013616	1.017	11.0	0.03193235	52
4	1.019	1.003	20.2	0.013616	1.016	11.3	0.02885414	49
8	1.016	1.003	20.2	0.013616	1.013	12.1	0.016745466	40
14	1.015	1.003	20.1	0.013633	1.012	12.3	0.012778503	36
30	1.013	1.003	20.1	0.013633	1.010	12.9	0.008939756	30
62	1.011	1.003	19.9	0.013667	1.008	13.4	0.006353745	24
124	1.010	1.003	19.8	0.013684	1.007	13.7	0.00454844	21
247	1.009	1.003	19.6	0.013718	1.006	13.9	0.003254241	18
1498	1.009	1.003	19.0	0.013820	1.006	13.9	0.00133125	18

P200 Wash

Container ID:	D1	Soil Breakdown	
Before - M _d :	36.1 g	Coarse:	6.37 %
After - M _d :	2.3 g	Silts:	75.63 %
Fines Fraction:	93.63 %	From Hydrometer Clays:	18.00 %
Coarse Fraction:	6.37 %		

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring: Su_Ex_E Sample: N2 Depth (ft-ft): 12.5 14.0 Start Time: 10:03:00 AM
Ave. Depth (ft): 13.25

Constants

M_s (g) 52.80
 G_s 2.65
 G_w 1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.030	1.003	19.8	0.013684	1.027	8.4	0.05608771	82
1	1.029	1.003	19.8	0.013684	1.026	8.6	0.040129365	79
2	1.028	1.003	19.8	0.013684	1.025	8.9	0.02886643	76
4	1.025	1.003	19.8	0.013684	1.022	9.7	0.021309288	67
8	1.023	1.003	19.8	0.013684	1.020	10.2	0.015451411	61
16	1.020	1.003	19.7	0.013701	1.017	11.0	0.011360269	52
34	1.018	1.003	19.7	0.013701	1.015	11.5	0.007968228	46
70	1.015	1.003	19.5	0.013735	1.012	12.3	0.005757477	36
130	1.012	1.003	19.5	0.013735	1.009	13.1	0.004360062	27
247	1.011	1.003	19.5	0.013735	1.008	13.4	0.003199135	24
347	1.010	1.003	19.4	0.013752	1.007	13.7	0.002732508	21
5787	1.007	1.003	16.5	0.014260	1.004	14.4	0.000711335	12

P200 Wash

Container ID: C1
Before - M_d : 28.5 g
After - M_d : 0.2 g
Fines Fraction: 99.30 %
Coarse Fraction: 0.70 %

Soil Breakdown
Coarse: 0.70 %
Silts: 80.30 %
Clays: 19.00 %
From Hydrometer

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring: Su_Ex_E Sample: N3 Depth (ft-ft): 17.5 19.0 Start Time: 10:05:00 AM
Ave. Depth (ft): 18.25

Constants

M_s (g) 55.43
 G_s 2.65
 G_w 1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.033	1.003	19.9	0.013667	1.030	7.6	0.053283775	87
1	1.032	1.003	19.9	0.013667	1.029	7.8	0.038169854	84
2	1.029	1.003	19.9	0.013667	1.026	8.6	0.028340494	75
4	1.026	1.003	19.9	0.013667	1.023	9.4	0.020951114	67
8	1.023	1.003	19.9	0.013667	1.020	10.2	0.015432216	58
16	1.019	1.003	19.8	0.013684	1.016	11.3	0.011499853	46
32	1.017	1.003	19.7	0.013701	1.014	11.8	0.008319903	41
68	1.014	1.003	19.6	0.013718	1.011	12.6	0.005905023	32
128	1.013	1.003	19.6	0.013718	1.010	12.9	0.004354925	29
245	1.011	1.003	19.5	0.013735	1.008	13.4	0.003212166	23
345	1.011	1.003	19.4	0.013752	1.008	13.4	0.002710246	23
5785	1.008	1.003	16.5	0.014260	1.005	14.2	0.0007065	14

P200 Wash

Container ID: B1
Before - M_d : 31.2 g
After - M_d : 0.3 g
Fines Fraction: 99.04 %
Coarse Fraction: 0.96 %

Soil Breakdown
Coarse: 0.96 %
Silts: 78.04 %
Clays: 21.00 %
From Hydrometer

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ex_E	Sample:	N4	Depth (ft-ft):	22.5 24.0	Start Time:	10:07:00 AM
				Ave. Depth (ft):	23.25		

Constants	
M_s (g)	53.40
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.026	1.003	20.0	0.013650	1.023	9.4	0.05918499	69
1	1.023	1.003	20.0	0.013650	1.020	10.2	0.043594604	60
2	1.022	1.003	20.0	0.013650	1.019	10.5	0.031276079	57
4	1.018	1.003	20.0	0.013650	1.015	11.5	0.023144701	45
8	1.015	1.003	20.0	0.013650	1.012	12.3	0.01692545	36
16	1.013	1.003	19.9	0.013667	1.010	12.9	0.012271794	30
30	1.011	1.003	19.7	0.013701	1.008	13.4	0.009156807	24
66	1.010	1.003	19.6	0.013718	1.007	13.7	0.006249987	21
126	1.009	1.003	19.5	0.013735	1.006	13.9	0.004561953	18
243	1.008	1.003	19.5	0.013735	1.005	14.2	0.003320242	15
343	1.008	1.003	19.4	0.013752	1.005	14.2	0.002798098	15
5783	1.006	1.003	16.0	0.014350	1.003	14.7	0.000723492	9

P200 Wash

Container ID: A1
 Before - M_d : 23.2 g
 After - M_d : 2.3 g
 Fines Fraction: 90.09 %
 Coarse Fraction: 9.91 %

Soil Breakdown	
Coarse:	9.91 %
Silts:	76.59 %
Clays:	13.50 %

From Hydrometer

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ex_S	Sample:	N1	Depth (ft-ft):	6.5 8.0	Start Time:	9:52:00 AM
				Ave. Depth (ft):	7.25		

Constants	
M _s (g)	50.10
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.028	1.003	20.8	0.013514	1.025	9.2	0.057968602	80
1	1.027	1.003	20.8	0.013514	1.024	9.2	0.040989992	77
2	1.024	1.003	20.8	0.013514	1.021	10.0	0.030218223	67
4	1.022	1.003	20.8	0.013514	1.019	10.5	0.021895182	61
8	1.020	1.003	20.4	0.013582	1.017	11.0	0.015926307	54
16	1.018	1.003	20.1	0.013633	1.015	11.5	0.011557938	48
32	1.016	1.003	19.9	0.013667	1.013	12.1	0.008404094	42
64	1.013	1.003	19.9	0.013667	1.010	12.9	0.006135897	32
128	1.012	1.003	19.8	0.013684	1.009	13.1	0.004377677	29
290	1.011	1.003	19.8	0.013684	1.008	13.4	0.002941484	26
1528	1.009	1.003	18.9	0.013837	1.006	13.9	0.001319738	19
5830	1.008	1.003	19.1	0.013803	1.005	14.2	0.000681214	16

P200 Wash

Container ID:	W1	Soil Breakdown	
Before - M _d :	31.3 g	Coarse:	4.47 %
After - M _d :	1.4 g	Silts:	73.03 %
Fines Fraction:	95.53 %	Clays:	22.50 %
Coarse Fraction:	4.47 %	From Hydrometer	

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ex_S	Sample:	N2	Depth (ft-ft):	11.5	13.0	Start Time:	10:13:00 AM
				Ave. Depth (ft):	12.25			

Constants

M_s (g)	51.12
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.029	1.003	20.4	0.013582	1.026	8.6	0.056328469	82
1	1.028	1.003	20.4	0.013582	1.025	8.9	0.040519001	79
2	1.026	1.003	20.4	0.013582	1.023	9.4	0.029445074	72
4	1.023	1.003	19.9	0.013667	1.020	10.2	0.021824449	63
8	1.021	1.003	19.9	0.013667	1.018	10.7	0.015805931	57
16	1.018	1.003	19.8	0.013684	1.015	11.5	0.011601175	47
32	1.016	1.003	19.9	0.013667	1.013	12.1	0.008404094	41
64	1.014	1.003	19.9	0.013667	1.011	12.6	0.00606413	35
128	1.013	1.003	19.8	0.013684	1.010	12.9	0.004344131	31
269	1.011	1.003	19.8	0.013684	1.008	13.4	0.003054143	25
1507	1.009	1.003	18.9	0.013837	1.006	13.9	0.001328901	19
5809	1.008	1.003	19.1	0.013803	1.005	14.2	0.000682444	16

P200 Wash

Container ID:	O1	Soil Breakdown	
Before - M_d :	34.8 g	Coarse:	0.57 %
After - M_d :	0.2 g	Silts:	77.43 %
Fines Fraction:	99.43 %	Clays:	22.00 %
Coarse Fraction:	0.57 %	From Hydrometer	

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ex_S	Sample:	N3	Depth (ft-ft):	16.5	18.0	Start Time:	10:13:00 AM
				Ave. Depth (ft):	17.25			

Constants

M_s (g)	50.98
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.026	1.003	19.8	0.013684	1.023	8.6	0.056751493	72
1	1.025	1.003	19.8	0.013684	1.022	8.9	0.040823296	69
2	1.023	1.003	19.8	0.013684	1.020	9.4	0.029666205	63
4	1.021	1.003	19.8	0.013684	1.018	10.2	0.021851596	57
8	1.019	1.003	19.9	0.013667	1.016	10.7	0.015805931	50
16	1.017	1.003	19.8	0.013684	1.014	11.5	0.011601175	44
32	1.014	1.003	19.9	0.013667	1.011	12.1	0.008404094	35
64	1.013	1.003	19.9	0.013667	1.010	12.6	0.00606413	32
128	1.011	1.003	19.8	0.013684	1.008	12.9	0.004344131	25
253	1.01	1.003	19.8	0.013684	1.007	13.4	0.003149236	22
1491	1.007	1.003	18.9	0.013837	1.004	13.9	0.001336012	13
5793	1.006	1.003	19.1	0.013803	1.003	14.2	0.000683386	9

P200 Wash

Container ID:	P1																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																	
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Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring: Su_Ex_S Sample: N4 Depth (ft-ft): 22.5 24.0 Start Time: 10:30:00 AM
Ave. Depth (ft): 23.25

Constants

M_s (g) 53.99
 G_s 2.65
 G_w 1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.023	1.003	20.5	0.013565	1.020	10.2	0.061268166	59
1	1.021	1.003	20.5	0.013565	1.018	10.7	0.044372274	54
2	1.018	1.003	20.5	0.013565	1.015	11.5	0.032527727	45
4	1.015	1.003	20.5	0.013565	1.012	12.3	0.023787147	36
8	1.013	1.003	20.5	0.013565	1.010	12.9	0.017225414	30
16	1.011	1.003	20.5	0.013565	1.008	13.4	0.012414013	24
32	1.010	1.003	20.5	0.013565	1.007	13.7	0.008875751	21
64	1.009	1.003	20.5	0.013565	1.006	13.9	0.006321748	18
140	1.007	1.003	20.4	0.013582	1.004	14.4	0.004355931	12
256	1.007	1.003	20.5	0.013565	1.004	14.4	0.003217222	12
1266	1.006	1.003	20.1	0.013633	1.003	14.7	0.001469039	9
5738	1.005	1.003	19.9	0.013667	1.002	15.0	0.000698777	6

P200 Wash

Container ID: M1
Before - M_d : 34.2 g
After - M_d : 7.9 g
Fines Fraction: 76.90 %
Coarse Fraction: 23.10 %

Soil Breakdown
Coarse: 23.10 %
Silts: 66.90 %
Clays: 10.00 %
From Hydrometer

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ex_W	Sample:	N1	Depth (ft-ft):	7.5 9.0	Start Time:	9:54:00 AM
				Ave. Depth (ft):	8.25		

Constants	
M _s (g)	52.07
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.028	1.003	20.1	0.013633	1.025	8.9	0.05751769	77
1	1.026	1.003	20.1	0.013633	1.023	9.4	0.041797987	71
2	1.024	1.003	20.1	0.013633	1.021	10.0	0.030484315	65
4	1.021	1.003	20.1	0.013633	1.018	10.7	0.022297354	56
8	1.019	1.003	20.1	0.013633	1.016	11.3	0.016202636	49
18	1.017	1.003	20.1	0.013633	1.014	11.8	0.011038147	43
34	1.015	1.003	19.9	0.013667	1.012	12.3	0.008220274	37
66	1.013	1.003	19.8	0.013684	1.010	12.9	0.006049729	31
126	1.011	1.003	19.7	0.013701	1.008	13.4	0.004468064	25
251	1.01	1.003	19.5	0.013735	1.007	13.7	0.00320887	22
1494	1.010	1.003	19.0	0.013820	1.007	13.7	0.001323406	22

P200 Wash

Container ID:	J1	Soil Breakdown	
Before - M _d :	26.4 g	Coarse:	7.58 %
After - M _d :	2.0 g	Silts:	70.42 %
Fines Fraction:	92.42 %	From Hydrometer Clays:	22.00 %
Coarse Fraction:	7.58 %		

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Ex_W	Sample:	N2	Depth (ft-ft):	16.5	18.0	Start Time:	9:56:00 AM
				Ave. Depth (ft):	17.25			

Constants

M_s (g)	50.86
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.026	1.003	20.2	0.013616	1.023	9.4	0.059037569	73
1	1.024	1.003	20.2	0.013616	1.021	10.0	0.043057573	66
2	1.022	1.003	20.2	0.013616	1.019	10.5	0.031198175	60
4	1.021	1.003	20.2	0.013616	1.018	10.7	0.02226955	57
8	1.018	1.003	20.2	0.013616	1.015	11.5	0.016325011	47
16	1.016	1.003	20.1	0.013633	1.013	12.1	0.011855616	41
32	1.014	1.003	20.1	0.013633	1.011	12.6	0.00855464	35
64	1.012	1.003	20.0	0.013650	1.009	13.1	0.006175588	28
124	1.011	1.003	19.8	0.013684	1.008	13.4	0.004498364	25
249	1.009	1.003	19.6	0.013718	1.006	13.9	0.003241145	19
1496	1.008	1.003	19.0	0.013820	1.005	14.2	0.001346438	16

P200 Wash

Container ID:	H1
Before - M_d :	23.5 g
After - M_d :	0.4 g
Fines Fraction:	98.30 %
Coarse Fraction:	1.70 %

Soil Breakdown	
Coarse:	1.70 %
Silts:	80.80 %
Clays:	17.50 %

From Hydrometer

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Inj	Sample:	N1a	Depth (ft-ft):	6.5 7.25	Start Time:	10:39:00 AM
				Ave. Depth (ft):	6.88		

Constants	
M _s (g)	50.90
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.025	1.003	20.4	0.013582	1.022	9.7	0.059822505	69
1	1.023	1.003	20.4	0.013582	1.020	10.2	0.043377429	63
2	1.019	1.003	20.4	0.013582	1.016	11.3	0.032284045	50
4	1.017	1.003	20.4	0.013582	1.014	11.8	0.023327851	44
8	1.014	1.003	20.4	0.013582	1.011	12.6	0.017045275	35
16	1.013	1.003	20.4	0.013582	1.010	12.9	0.012195471	32
32	1.011	1.003	20.4	0.013582	1.008	13.4	0.008789034	25
64	1.010	1.003	20.4	0.013582	1.007	13.7	0.006283969	22
131	1.008	1.003	20.4	0.013582	1.005	14.2	0.004471696	16
247	1.008	1.003	20.4	0.013582	1.005	14.2	0.003256563	16
1257	1.008	1.003	20.1	0.013633	1.005	14.2	0.001448999	16
5729	1.007	1.003	19.9	0.013667	1.004	14.4	0.000685196	13

P200 Wash

Container ID: U1
 Before - M_d: 24.7 g
 After - M_d: 3.2 g
 Fines Fraction: 87.04 %
 Coarse Fraction: 12.96 %

Soil Breakdown
 Coarse: 12.96 %
 Silts: 71.54 %
 Clays: 15.50 %

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Inj	Sample:	N1b	Depth (ft-ft):	7.25 8.00	Start Time:	10:50:00 AM
				Ave. Depth (ft):	7.63		

Constants	
M _s (g)	52.48
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.028	1.003	20.3	0.013599	1.025	8.9	0.057374244	77
1	1.025	1.003	20.3	0.013599	1.022	9.7	0.042353845	67
2	1.023	1.003	20.3	0.013599	1.020	10.2	0.030710866	61
4	1.019	1.003	20.3	0.013599	1.016	11.3	0.022856841	49
8	1.017	1.003	20.3	0.013599	1.014	11.8	0.016515928	43
16	1.014	1.003	20.3	0.013599	1.011	12.6	0.012067915	34
32	1.013	1.003	20.3	0.013599	1.010	12.9	0.008634294	31
64	1.011	1.003	20.0	0.013650	1.008	13.4	0.006245901	24
120	1.010	1.003	20.4	0.013582	1.007	13.7	0.004589162	21
236	1.009	1.003	20.5	0.013565	1.006	13.9	0.003292086	18
1246	1.008	1.003	20.1	0.013633	1.005	14.2	0.001455381	15
5718	1.006	1.003	19.9	0.013667	1.003	14.7	0.000692963	9

P200 Wash

Container ID:	V1
Before - M _d :	31.6 g
After - M _d :	1.7 g
Fines Fraction:	94.62 %
Coarse Fraction:	5.38 %

Soil Breakdown	
Coarse:	5.38 %
Silts:	77.87 %
Clays:	16.75 %

From Hydrometer

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Inj	Sample:	N2	Depth (ft-ft):	11.5 13.00	Start Time:	10:14:00 AM
				Ave. Depth (ft):	12.25		

Constants

M_s (g)	55.54
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.030	1.003	16.0	0.014350	1.027	8.4	0.058817497	78
1	1.029	1.003	16.0	0.014350	1.026	8.6	0.042082461	75
2	1.027	1.003	16.0	0.014350	1.024	9.2	0.030777321	69
4	1.025	1.003	16.0	0.014350	1.022	9.7	0.022346411	64
8	1.023	1.003	16.0	0.014350	1.020	10.2	0.016203431	58
16	1.021	1.003	16.0	0.014350	1.018	10.2	0.011457556	52
32	1.018	1.003	16.0	0.014350	1.015	10.7	0.008297912	43
64	1.016	1.003	17.0	0.014170	1.013	11.5	0.006006601	38
137	1.014	1.003	17.5	0.014080	1.011	12.6	0.004269998	32
261	1.012	1.003	18.0	0.013990	1.009	13.1	0.003134246	26
350	1.011	1.003	18.5	0.013905	1.008	13.4	0.002720755	23
1508	1.009	1.003	18.5	0.013905	1.006	13.9	0.001334989	17

P200 Wash

Container ID:	Q1
Before - M_d :	27.4 g
After - M_d :	1.2 g
Fines Fraction:	95.62 %
Coarse Fraction:	4.38 %

Soil Breakdown	
Coarse:	4.38 %
Silts:	75.37 %
Clays:	20.25 %

From Hydrometer

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Inj	Sample:	N3	Depth (ft-ft):	16.5 18.00	Start Time:	10:24:00 AM
				Ave. Depth (ft):	17.25		

Constants

M_s (g)	54.88
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.032	1.003	16.0	0.014350	1.029	7.8	0.056677959	85
1	1.031	1.003	16.0	0.014350	1.028	8.1	0.040840816	82
2	1.030	1.003	16.0	0.014350	1.027	8.4	0.029408749	79
4	1.028	1.003	16.0	0.014350	1.025	8.9	0.021405083	73
8	1.024	1.003	16.0	0.014350	1.021	10.0	0.016043788	61
16	1.022	1.003	16.0	0.014350	1.019	10.5	0.011624829	56
32	1.019	1.003	16.0	0.014350	1.016	11.3	0.00852739	47
64	1.016	1.003	17.0	0.014170	1.013	12.1	0.006161303	38
127	1.014	1.003	17.5	0.014080	1.011	12.6	0.004434923	32
249	1.012	1.003	18.0	0.013990	1.009	13.1	0.003208882	26
340	1.011	1.003	18.5	0.013905	1.008	13.4	0.002760476	23
1498	1.009	1.003	18.5	0.013905	1.006	13.9	0.001339438	18

P200 Wash

Container ID:	N1	Soil Breakdown	
Before - M_d :	30.3 g	Coarse:	1.65 %
After - M_d :	0.5 g	Silts:	77.85 %
Fines Fraction:	98.35 %	Clays:	20.50 %
Coarse Fraction:	1.65 %	From Hydrometer	

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	Su_Inj	Sample:	N4	Depth (ft-ft):	21.5	23.00	Start Time:	10:03:00 AM
				Ave. Depth (ft):	22.25			

Constants

M_s (g)	55.41
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.029	1.003	23.4	0.013106	1.026	8.6	0.05435436	75
1	1.026	1.003	23.4	0.013106	1.023	9.4	0.040182235	67
2	1.023	1.003	23.4	0.013106	1.020	10.2	0.029597515	58
4	1.022	1.003	23.4	0.013106	1.019	10.5	0.021234147	55
8	1.017	1.003	23.4	0.013106	1.014	11.8	0.015917182	41
16	1.014	1.003	23.4	0.013106	1.011	12.6	0.011630421	32
32	1.013	1.003	22.7	0.013215	1.010	12.9	0.008390484	29
64	1.011	1.003	22.1	0.013305	1.008	13.4	0.006088037	23
127	1.010	1.003	21.3	0.013432	1.007	13.7	0.00441163	20
167	1.009	1.003	21.0	0.013480	1.006	13.9	0.00388901	17
1505	1.007	1.003	19.3	0.013769	1.004	14.4	0.001346838	12
1855	1.007	1.003	19.9	0.013667	1.004	14.4	0.001204155	12

P200 Wash

Container ID: R1

Before - M_d : 25.7 g

After - M_d : 2.4 g

Fines Fraction: 90.66 %

Coarse Fraction: 9.34 %

Soil Breakdown

Coarse: 9.34 %

Silts: 76.66 %

Clays: 14.00 %

From Hydrometer

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring: Su_Ex_N_U2 Sample: G1 Depth (ft-ft): 14.25 14.50 Start Time: 12:18:00 PM
Ave. Depth (ft): 14.38

Constants

M_s (g) 50.55
 G_s 2.65
 G_w 1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.031	1.004	18.5	0.013905	1.027	8.1	0.055966545	86
1	1.030	1.004	18.5	0.013905	1.026	8.4	0.040300519	83
2	1.029	1.004	18.5	0.013905	1.025	8.6	0.028834022	79
4	1.028	1.004	18.5	0.013905	1.024	8.9	0.020741301	76
10	1.025	1.004	18.5	0.013905	1.021	9.7	0.013694837	67
16	1.023	1.004	18.5	0.013905	1.019	10.2	0.011102252	60
31	1.021	1.004	18.5	0.013905	1.017	10.7	0.008169247	54
60	1.019	1.004	18.0	0.013990	1.015	11.3	0.006071295	48
117	1.016	1.004	18.0	0.013990	1.012	12.1	0.004499015	38
215	1.015	1.004	17.5	0.014080	1.011	12.3	0.00336772	35
490	1.013	1.004	18.0	0.013990	1.009	12.9	0.002269941	29
1316	1.012	1.004	16.5	0.014260	1.008	13.1	0.001422746	25

P200 Wash

Container ID: F1
Before - M_d : 6.8 g
After - M_d : 0.1 g
Fines Fraction: 98.53 %
Coarse Fraction: 1.47 %

Soil Breakdown
Coarse: 1.47 %
Silt: 71.53 %
Clays: 27.00 %
From Hydrometer

Procedures Done By: Melissa B.

Hydrometer Test

Boring: Su_Ex_N_U2	Sample: G2	Depth (ft-ft): 14.50 14.75	Start Time: 12:21:00 PM
		Ave. Depth (ft): 14.63	

Constants	
M _s (g)	50.50
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.033	1.004	18.5	0.013905	1.029	7.6	0.05421167	92
1	1.031	1.004	18.5	0.013905	1.027	8.1	0.039574324	86
2	1.030	1.004	18.5	0.013905	1.026	8.4	0.02849677	83
3	1.027	1.004	18.5	0.013905	1.023	9.2	0.024350298	73
7	1.024	1.004	18.5	0.013905	1.020	10.0	0.016619654	64
13	1.021	1.004	18.5	0.013905	1.017	10.7	0.012615115	54
28	1.018	1.004	18.5	0.013905	1.014	11.5	0.008911297	45
57	1.016	1.004	18.0	0.013990	1.012	12.1	0.006445743	38
114	1.015	1.004	18.0	0.013990	1.011	12.3	0.004595342	35
212	1.013	1.004	18.0	0.014080	1.009	12.9	0.003473198	29
487	1.012	1.004	18.0	0.013990	1.008	13.1	0.002294504	25
1313	1.011	1.004	16.5	0.014260	1.007	13.4	0.001440587	22

P200 Wash

Container ID: K1	Soil Breakdown	
Before - M _d : 15.9 g	Coarse:	0.00 %
After - M _d : 0 g	Silts:	75.50 %
Fines Fraction: 100.00 %	Clays:	24.50 %
Coarse Fraction: 0.00 %	From Hydrometer	
Procedures Done By: Melissa B.		

Hydrometer Test

Boring: Su_Ex_N_U2 Sample: G3 Depth (ft-ft): 14.75 15.00 Start Time: 10:32:00 AM
Ave. Depth (ft): 14.88

Constants

M_s (g) 50.09
 G_s 2.65
 G_w 1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.031	1.004	18.0	0.013990	1.027	9.2	0.060010414	87
1	1.029	1.004	18.0	0.013990	1.025	9.7	0.043571607	80
2	1.026	1.004	18.0	0.013990	1.022	10.5	0.032055117	71
4	1.023	1.004	18.0	0.013990	1.019	11.3	0.023514023	61
8	1.020	1.004	18.0	0.013990	1.016	12.1	0.017205425	51
16	1.018	1.004	17.5	0.014080	1.014	12.6	0.012494761	45
32	1.015	1.004	17.5	0.014080	1.011	13.4	0.009111294	35
60	1.013	1.004	17.5	0.014080	1.009	13.9	0.006776952	29
120	1.012	1.004	17.0	0.014170	1.008	14.2	0.004874425	26
215	1.011	1.004	17.0	0.014170	1.007	14.4	0.003667177	22
435	1.010	1.004	17.5	0.014080	1.006	14.7	0.002588312	19
1415	1.009	1.004	17.0	0.014170	1.005	15.0	0.001458939	16

P200 Wash

Container ID: V1
Before - M_d : 9.0 g
After - M_d : 0.1 g
Fines Fraction: 98.89 %
Coarse Fraction: 1.11 %

Soil Breakdown
Coarse: 1.11 %
Silt: 80.89 %
Clay: 18.00 %

From Hydrometer

Procedures Done By: Melissa B.

Hydrometer Test

Boring: Su_Ex_N_U2	Sample: G4	Depth (ft-ft): 15.00 15.25	Start Time: 10:36:00 AM
		Ave. Depth (ft): 15.13	

Constants

M_s (g)	49.99
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.032	1.004	17.5	0.013990	1.028	7.8	0.055256073	90
1	1.031	1.004	17.5	0.013990	1.027	8.1	0.039816238	87
2	1.028	1.004	17.5	0.013990	1.024	8.9	0.029511937	77
4	1.025	1.004	17.5	0.013990	1.021	9.7	0.021785804	67
8	1.022	1.004	17.5	0.013990	1.018	10.5	0.016027558	58
16	1.019	1.004	17.5	0.014080	1.015	11.3	0.011832646	48
32	1.017	1.004	17.5	0.014080	1.013	11.8	0.00855005	42
60	1.015	1.004	17.0	0.014080	1.011	12.3	0.006374991	35
120	1.013	1.004	17.0	0.014170	1.009	12.9	0.004645945	29
211	1.011	1.004	17.0	0.014170	1.007	13.4	0.003570927	22
431	1.010	1.004	17.5	0.014080	1.006	13.7	0.002510292	19
1411	1.009	1.004	17.0	0.014170	1.005	13.9	0.001406416	16

P200 Wash

Container ID: D1	Soil Breakdown	
Before - M_d : 12.2 g	Coarse:	0.82 %
After - M_d : 0.1 g	Silts:	81.68 %
Fines Fraction: 99.18 %	Clays:	17.50 %
Coarse Fraction: 0.82 %	From Hydrometer	
Procedures Done By: Melissa B.		

Hydrometer Test

Boring: Su_Ex_N_U2 Sample: G5 Depth (ft-ft): 15.25 15.50 Start Time: 10:12:00 AM
Ave. Depth (ft): 15.38

Constants

M_s (g) 50.00
 G_s 2.65
 G_w 1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.031	1.005	17.0	0.014170	1.026	8.1	0.05703315	84
1	1.029	1.005	17.0	0.014170	1.024	8.6	0.041554597	77
2	1.025	1.005	17.0	0.014170	1.020	9.7	0.031206188	64
4	1.022	1.005	17.0	0.014170	1.017	10.5	0.022958024	55
8	1.019	1.005	17.0	0.014170	1.014	11.3	0.016840853	45
16	1.017	1.004	17.0	0.014170	1.013	11.8	0.012168887	42
36	1.015	1.004	17.0	0.014170	1.011	12.3	0.008282685	35
84	1.013	1.004	17.0	0.014170	1.009	12.9	0.005552967	29
120	1.012	1.004	17.0	0.014170	1.008	13.1	0.004681822	26
240	1.011	1.004	17.0	0.014170	1.007	13.4	0.00334824	22
491	1.010	1.004	17.0	0.014170	1.006	13.7	0.002366952	19
1556	1.008	1.004	17.0	0.014170	1.004	14.2	0.001353659	13

P200 Wash

Container ID:	N1	Soil Breakdown		
Before - M_d :	7.4 g	Coarse:	4.05 %	
After - M_d :	0.3 g	Silts:	78.45 %	
Fines Fraction:	95.95 %	From Hydrometer	Clays:	17.50 %
Coarse Fraction:	4.05 %			

Procedures Done By: Melissa B.

Hydrometer Test

Boring: Su_Ex_N_U2	Sample: G6	Depth (ft-ft): 15.50 15.75	Start Time: 9:02:00 AM
		Ave. Depth (ft): 15.63	

Constants

M_s (g)	49.98
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.029	1.004	18.5	0.013905	1.025	8.6	0.057668043	80
1	1.027	1.004	18.5	0.013905	1.023	9.2	0.042175953	74
2	1.025	1.004	18.5	0.013905	1.021	9.7	0.030622586	67
4	1.022	1.004	18.5	0.013905	1.018	10.5	0.022528675	58
8	1.019	1.004	18.5	0.013905	1.015	11.3	0.016525904	48
16	1.016	1.004	18.5	0.013905	1.012	12.1	0.012092154	39
32	1.014	1.004	18.5	0.013905	1.010	12.6	0.008725318	32
60	1.012	1.004	18.0	0.013990	1.008	13.1	0.006536989	26
120	1.012	1.004	18.0	0.013990	1.008	13.1	0.004622349	26
211	1.01	1.004	18.0	0.013990	1.006	13.7	0.003564813	19
431	1.009	1.004	18.0	0.013990	1.005	13.9	0.002512387	16
1411	1.008	1.004	18.0	0.013990	1.004	14.2	0.001403455	13

P200 Wash

Container ID: J1		Soil Breakdown
Before - M_d : 7.4 g		Coarse: 2.70 %
After - M_d : 0.2 g		Silts: 82.30 %
Fines Fraction: 97.30 %	From Hydrometer	Clays: 15.00 %
Coarse Fraction: 2.70 %		

Procedures Done By: Melissa B.

Hydrometer Test

Boring: Su_Ex_N_U2	Sample: G7	Depth (ft-ft): 15.75 16.00	Start Time: 11:18:00 AM
		Ave. Depth (ft): 15.88	

Constants

M _s (g)	49.97
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.028	1.004	18.5	0.013905	1.024	8.9	0.058665259	77
1	1.027	1.004	18.5	0.013905	1.023	9.2	0.042175953	74
2	1.025	1.004	18.5	0.013905	1.021	9.7	0.030622586	67
4	1.021	1.004	18.5	0.013905	1.017	10.7	0.022742222	55
8	1.018	1.004	18.5	0.013905	1.014	11.5	0.016671509	45
16	1.016	1.004	18.5	0.013905	1.012	12.1	0.012092154	39
32	1.013	1.004	18.5	0.013905	1.009	12.9	0.00882858	29
60	1.011	1.004	18.5	0.013905	1.007	13.4	0.006571247	22
120	1.010	1.003	18.5	0.013905	1.007	13.7	0.004698299	22
237	1.009	1.003	18.5	0.013905	1.006	13.9	0.003367474	19
515	1.008	1.004	18.5	0.013905	1.005	14.2	0.002308934	14
1440	1.007	1.004	18.5	0.013905	1.003	14.4	0.0013905	10

P200 Wash

Container ID: X1	Soil Breakdown	
Before - M _d : 6.8 g	Coarse:	2.94 %
After - M _d : 0.2 g	Silts:	84.06 %
Fines Fraction: 97.06 %	From Hydrometer Clays:	13.00 %
Coarse Fraction: 2.94 %		
Procedures Done By: Melissa B.		

Hydrometer Test

Boring: Su_Ex_S_U3	Sample: M1	Depth (ft-ft): 14.50 14.75	Start Time: 9:22:00 AM
		Ave. Depth (ft): 14.63	

Constants	
M _s (g)	50.04
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.032	1.004	18.0	0.013990	1.028	8.1	0.056308664	90
1	1.031	1.004	18.0	0.013990	1.027	8.1	0.039816238	87
2	1.030	1.004	18.0	0.013990	1.026	8.4	0.028670968	83
4	1.028	1.004	18.0	0.013990	1.024	8.9	0.020868091	77
8	1.027	1.004	18.0	0.013990	1.023	9.2	0.015002604	74
16	1.025	1.004	18.0	0.013990	1.021	9.7	0.010892902	67
32	1.021	1.004	18.0	0.013990	1.017	10.7	0.008089741	55
61	1.020	1.004	18.0	0.013990	1.016	11.0	0.005940858	51
120	1.018	1.004	17.5	0.014080	1.014	11.5	0.00435874	45
240	1.016	1.004	17.5	0.014080	1.012	12.1	0.003161475	39
517	1.013	1.004	17.5	0.014080	1.009	12.9	0.002224089	29
1444	1.011	1.004	17.0	0.014170	1.007	13.4	0.001365019	22

P200 Wash

Container ID: D1	Soil Breakdown	
Before - M _d : 4.5 g	Coarse:	0.00 %
After - M _d : 0 g	Silts:	72.50 %
Fines Fraction: 100.00 %	Clays:	27.50 %
Coarse Fraction: 0.00 %	From Hydrometer	
Procedures Done By: Melissa B.		

Hydrometer Test

Boring: Su_Ex_S_U3	Sample: M2	Depth (ft-ft): 14.75 15.00	Start Time: 9:24:00 AM
		Ave. Depth (ft): 14.88	

Constants

M_s (g)	47.13
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.032	1.004	19.0	0.013820	1.029	7.8	0.054584626	97
1	1.031	1.004	19.0	0.013820	1.028	8.1	0.03933241	94
2	1.030	1.004	19.0	0.013820	1.027	8.4	0.028322572	90
4	1.027	1.004	19.0	0.013820	1.024	9.2	0.020959068	80
8	1.025	1.004	19.0	0.013820	1.022	9.7	0.015217696	73
16	1.022	1.004	19.0	0.013820	1.019	10.5	0.01119548	63
32	1.020	1.004	18.5	0.013905	1.017	11.0	0.008152529	56
60	1.017	1.004	18.5	0.013905	1.014	11.8	0.006166466	46
120	1.016	1.004	18.5	0.013905	1.013	12.1	0.004415431	43
240	1.013	1.004	18.5	0.013905	1.010	12.9	0.003223742	32
503	1.012	1.004	18.5	0.013905	1.009	13.1	0.002243999	29
1452	1.010	1.004	18.0	0.013990	1.007	13.7	0.001358923	22

P200 Wash

Container ID: Q1	Soil Breakdown	
Before - M_d : 16.3 g	Coarse:	0.00 %
After - M_d : 0 g	Silts:	73.00 %
Fines Fraction: 100.00 %	Clays:	27.00 %
Coarse Fraction: 0.00 %	From Hydrometer	

Procedures Done By: Melissa B.

Hydrometer Test

Boring: Su_Ex_S_U3	Sample: M3	Depth (ft-ft): 15.00 15.25	Start Time: 12:57:00 PM
		Ave. Depth (ft): 15.13	

Constants

M _s (g)	49.55
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.031	1.004	17.5	0.014080	1.028	8.1	0.056670907	89
1	1.029	1.004	17.5	0.014080	1.026	8.6	0.041290665	83
2	1.025	1.004	17.5	0.014080	1.022	9.7	0.031007983	70
4	1.023	1.004	17.5	0.014080	1.020	10.2	0.022483957	63
8	1.020	1.004	17.0	0.014170	1.017	11.0	0.016615798	53
16	1.018	1.004	17.0	0.014170	1.015	11.5	0.012013202	47
32	1.016	1.004	17.0	0.014170	1.013	12.1	0.008713398	41
48	1.015	1.004	17.0	0.014170	1.012	12.3	0.007173016	37
198	1.011	1.004	17.0	0.014170	1.008	13.4	0.003686291	24
362	1.011	1.004	17.0	0.014170	1.008	13.4	0.002726264	24
500	1.010	1.004	17.0	0.014170	1.007	13.7	0.002345552	21
1450	1.009	1.004	17.0	0.014170	1.005	13.9	0.001387373	16

P200 Wash

Container ID: A1	Soil Breakdown	
Before - M _d : 20.5 g	Coarse:	1.95 %
After - M _d : 0.4 g	Silts:	78.55 %
Fines Fraction: 98.05 %	Clays:	19.50 %
Coarse Fraction: 1.95 %	From Hydrometer	
Procedures Done By: Melissa B.		

Hydrometer Test

Boring: Su_Ex_S_U3 Sample: M4 Depth (ft-ft): 15.25 15.50 Start Time: 12:59:00 PM
Ave. Depth (ft): 15.38

Constants

M_s (g) 49.56
 G_s 2.65
 G_w 1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.029	1.004	17.5	0.014080	1.026	8.6	0.058393819	83
1	1.027	1.004	17.5	0.014080	1.024	9.2	0.042706755	76
2	1.024	1.004	17.5	0.014080	1.021	10.0	0.031483837	66
4	1.021	1.004	17.5	0.014080	1.018	10.7	0.023028442	57
8	1.019	1.004	17.5	0.014080	1.016	11.3	0.016733889	50
16	1.016	1.004	17.5	0.014080	1.013	12.1	0.012244339	41
32	1.015	1.004	17.5	0.014080	1.012	12.3	0.008729316	37
48	1.013	1.004	17.0	0.014170	1.010	12.9	0.007345884	31
198	1.010	1.004	17.0	0.014170	1.007	13.7	0.003727327	21
362	1.01	1.004	17.5	0.014080	1.007	13.7	0.002739105	21
500	1.008	1.004	17.0	0.014170	1.005	14.2	0.002387971	15
1450	1.008	1.004	17.0	0.014170	1.004	14.2	0.001402265	13

P200 Wash

Container ID: C1
Before - M_d : 17.2 g
After - M_d : 0.9 g
Fines Fraction: 94.77 %
Coarse Fraction: 5.23 %

Soil Breakdown
Coarse: 5.23 %
Silt: 80.77 %
Clays: 14.00 %
From Hydrometer

Procedures Done By: Melissa B.

Hydrometer Test

Boring: Su_Ex_S_U3	Sample: M5	Depth (ft-ft): 15.50 15.75	Start Time: 10:26:00 AM
		Ave. Depth (ft): 15.63	

Constants

M_s (g)	51.36
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.027	1.004	18.0	0.013990	1.024	9.2	0.060010414	73
1	1.022	1.004	18.0	0.013990	1.019	10.5	0.045332781	58
2	1.019	1.004	18.0	0.013990	1.016	11.3	0.03325385	48
4	1.016	1.004	17.5	0.014080	1.013	12.1	0.024488678	39
8	1.015	1.004	17.5	0.014080	1.012	12.3	0.017458632	36
16	1.013	1.004	17.5	0.014080	1.010	12.9	0.012642633	30
32	1.010	1.004	17.5	0.014080	1.007	13.7	0.009212722	20
61	1.009	1.004	17.0	0.014170	1.006	13.9	0.006764136	17
125	1.008	1.004	17.0	0.014170	1.005	14.2	0.004775942	14
224	1.008	1.004	17.0	0.014170	1.005	14.2	0.003567714	14
1370	1.007	1.004	17.0	0.014170	1.004	14.4	0.00145275	11

P200 Wash

Container ID: P1	Soil Breakdown	
Before - M_d : 15.4 g	Coarse:	24.68 %
After - M_d : 3.8 g	Silts:	63.32 %
Fines Fraction: 75.32 %	Clays:	12.00 %
Coarse Fraction: 24.68 %	From Hydrometer	

Procedures Done By: Melissa B.

Appendix E: Field Logs of Well Installation – Harborton

Maseeh College of Engineering
and Computer Science

GEOTECHNICAL SOIL EXPLORATION
LOG

PAGE 1 of 1

Project NSF- RAPID				Hole No. RGE-EX-N			
Purpose EXTRACTION							
Site Name HARBORTON				Driller CASCADE/ARTURO			
Hole Location				Recorder V. SORENSON			
PSU Site Personnel V. SORENSON							
Start Date 8/8			End Date				
Total Depth		Equipment 6" HSA		Ground Elevation			
Sample Type				Hole completion			
"U" - Undisturbed Shelby tube "N" - Standard Penetration (SPT)							
Depth ()	Sample Type, No.	Measured Rec. ()	SPT Driving Resistance	Graphic Log	Soil Material Description Soil name, USCS, color, plasticity, moisture, consistency, relative density, texture, cementation, structure, origin. Other comments.	Drilling methods, size, and remarks	Water level / date
5'					8" RECOVERY, 5"	NO CATCHER USED	
6.5'	N1		112		5" GRAY SILTY SAND w/ BROWN MOTTLE / LAMINATION; DRY TO DAMP, MICA PRESENT, SOFT TO MED STIFF		
				11.5"	8" GRAY SILTY SAND, MED STIFF, LOW DRY -> DAMP		
10'					1.3" GRAY SILTY CLAY, MED PLASTICITY, SOFT, DAMP		
12.5'	U1				SHELBY TUBE -> DOWNED 24"	CATCHER USED	
14'	N2		111		RECOVERY 26"		
					FULL RECOVERY SILTY SAND TOP HALF IS GRAY SAND LOOSE / SOFT, DILATIVE, WET		
15'					BOTTOM HALF IS GRAY SILTY SAND, MED STIFF, LOW PLASTICITY		
16.5'	N3		223		~ HALF RECOVERY TOP 6" LOOSE GRAY SAND, WET, HIGHLY DILATIVE, MED TO COARSE BOTTOM 4" BROWN SILTY SAND, WET DILATIVE, MEDIUM PLASTICITY		

WELL INSTALLATION LOG

Project <u>NSF RAPID</u>		Hole No. <u>PGE-EX-N</u>
Purpose <u>EXTRACTION</u>		
Site Name <u>HARPORTON</u>	Driller <u>CASCADE / ARTURO</u>	
Hole Location	Installation Date <u>8/8</u>	
PSU Site Personnel <u>K. SOLENSON</u>		
Depth to Water		
Surface Completion

BAGS SAND (6)
 # BAGS BENTONITE (4)

1.5'
 8'
 9'
 13.5'
 14'

Cement monument
 Backfill grout
 Bentonite seal
 Filter Pack Material:
 PVC Slot Size:
 PVC Diameter:
 Hole Diameter:

Project NSF RAPID				Hole No. PGE-Ex-E			
Purpose EXTRACTION WELL							
Site Name PGE HARBORTON			Driller ARTURO MADRIGAL - CASCADE				
Hole Location			Recorder M. PRECIADO				
PSU Site Personnel M. PRECIADO, K. SORENSON, D. MOUG							
Start Date 08/07/19		End Date 08/07/19					
Total Depth		Equipment		Ground Elevation			
Sample Type				Hole completion			
"U" - Undisturbed Shelby tube "N" - Standard Penetration (SPT)							
Depth (FEET)	Sample Type, No.	Measured Rec. (INCHES)	SPT Driving Resistance	Graphic Log	Soil Material Description Soil name, USCS, color, plasticity, moisture, consistency, relative density, texture, cementation, structure, origin. Other comments.	Drilling methods, size, and remarks	Water level / date
5.0'- 6.5'	N ₁	0"	0-0-0		NO RECOVERY (USED CATCHER)		
10'- 12.5'	U ₁	12"	—		MEASURED RECOVERY: 12"		
12.5'- 14'	N ₂		2-3-3		(NO CATCHER) TOP → BOTTOM DESCRIPTION: TOP 12" LIQUEFIED SAND, FINE, SOME ORGANICS, MICA MATERIAL V. LOOSE SPT: GREY BOTTOM 12": MEDIUM STIFF FINE SAND W/ SILT (ML W/ SAND) SOME MICA		
15'- 16.5'	N ₃	0"	1-1-2		NO RECOVERY (NO CATCHER)		

WELL INSTALLATION LOG

Project <u>NSF RAPID</u>		Hole No. <u>PGE-Ex-E</u>	
Purpose <u>Extraction</u>			
Site Name <u>HARBORION</u>		Driller <u>CASCADE / ARTURO</u>	
Hole Location		Installation Date <u>8/7</u>	
PSU Site Personnel <u>MELISSA P. DIANE M. ARASH K. KAYLA J.</u>			
Depth to Water			
Surface Completion

BAGS SAND
 (7)

BAGS BENTONITE
 (4)

1'
 8'
 9'
 13.5'
 14'

Cement monument
 Backfill grout
 Bentonite seal
 Filter Pack Material:
 PVC Slot Size:
 PVC Diameter:
 Hole Diameter:

Project NSF RAPID				Hole No. PGE-Ex-S			
Purpose EXTRACTION							
Site Name PGE HARBOR TON			Driller ARTURO MADRIGAL - CASCADE				
Hole Location			Recorder M. PRECIADO				
PSU Site Personnel D. MOUA, K. SORENSON, M. PRECIADO							
Start Date 08/07/19			End Date				
Total Depth		Equipment CHE 75		Ground Elevation			
Sample Type				Hole completion			
"U" - Undisturbed Shelby tube "N" - Standard Penetration (SPT)							
Depth ()	Sample Type, No.	Measured Rec. ()	SPT Driving Resistance	Graphic Log	Soil Material Description Soil name, USCS, color, plasticity, moisture, consistency, relative density, texture, cementation, structure, origin. Other comments.	Drilling methods, size, and remarks	Water level / date
5'-6.5'	N1	1"	0-0-0		BROWN AND GREY SILTY SAND LOW PLASTICITY DRY-MOIST. MICACEOUS PARTICLES.		
10'-12.5'	U1	0"	—		MEASURED RECOVERY FROM TOP OF TUBE : NO RECOVERY		
12.5'-14.0'	N2	17"	1-1-1		TOP TO BOTTOM: SILT W/ SAND, WET GRAY (SM?) LOW PLASTICITY, SOFT. 13-14' : MOIST GREY SILT, LOW PLASTICITY (ML) WITH TRACE ORG MEDIUM SOFT, LOW DILATANCY MICACEOUS MINERALS OBSERVED THROUGHOUT SPT.		
15.0'-16.5'	N3		1-1-2		(BROWN : LIGHT GREY) VERY SOFT, WET, THIN LAYERS OF SAND : SILT INTERBEDDED IN GREY SILTY SAND. VERY DILATIVE MICACEOUS MINERALS THROUGHOUT SOME ORGANICS		

WELL INSTALLATION LOG

Project <u>NSF RAPID</u>		Hole No. <u>PGE-Ex-S</u>
Purpose <u>EXTRACTION WELL</u>		
Site Name <u>PGE HARBOR TOWN</u>	Driller <u>ARTURO MADRIGAL</u>	
Hole Location	Installation Date <u>08/07/19</u>	
PSU Site Personnel <u>M. PRECIADO, K. GRENSON, D. MOUG</u>		
Depth to Water		
Surface Completion		

SAND
14.5'

BENTONITE
9'

1.25'

15'

Cement monument

Backfill grout

Bentonite seal

Filter Pack Material:
SILICA SAND

PVC Slot Size:
SCHEDULE 40

PVC Diameter: 2"

Hole Diameter: 10"

Project NSF RAPID				Hole No. PGE-EX-W3		
Purpose EXTRACTION						
Site Name HARBORTON			Driller CASCADE/ARTURO			
Hole Location			Recorder K. SORENSON			
PSU Site Personnel K. SORENSON						
Start Date 8/8			End Date 8/8			
Total Depth		Equipment 6" HSA		Ground Elevation		
Sample Type "U" - Undisturbed Shelby tube "N" - Standard Penetration (SPT)				Hole completion		
Depth ()	Sample Type, No.	Measured Rec. ()	SPT Driving Resistance	Graphic Log	Soil Material Description Soil name, USCS, color, plasticity, moisture, consistency, relative density, texture, cementation, structure, origin. Other comments.	Drilling methods, size, and remarks Water level / date
5' 6.5'	2'		000		24" RECOVERY GRAY SANDY SILT W/ BROWN LAMINATIONS, MEDIUM, LOW PT, SOFT, DRY TO DAMP	NO CATCHER USED
10' 12.5'	4'				SHELBY -> DRIVEN 24" FULL RECOVERY	
12.5' 14'	7'		112		NO FULL RECOVERY TOP HALF WET SAND, GRAY GRAY SAND, MED STIFF, DILATIVE, WET BOTTOM HALF SANDY SILT, SOFT, DAMP TO WET, MED PLASTICITY	CATCHER USED
15' 16.5'	7.5'		110		FULL RECOVERY BOTTOM 1/3 GRAY CLAYEY SILT, SOFT, WET, MED PLASTICITY TOP 2/3 MED SAND, GRAY W/ MICK, WET, DILATIVE	

WELL INSTALLATION LOG

Project <u>NSF RAPID</u>		Hole No. <u>PGE-EX-W</u>	
Purpose <u>EXTRACTION</u>			
Site Name <u>HARBERTON</u>		Driller <u>CASCADE / ARTURO</u>	
Hole Location		Installation Date <u>8/8</u>	
PSU Site Personnel <u>K SORENSON, D MONG, A HUEFMAN</u>			
Depth to Water			
Surface Completion			

11 BAGS SAND (7)

18 BAGS CHIPS (5)

11'

8'

9'

14'

15'

Cement monument

Backfill grout

Bentonite seal

Filter Pack Material:

PVC Slot Size:

PVC Diameter:

Hole Diameter:

Project NSF RAPID				Hole No. PGE-IN-		
Purpose INJECTION						
Site Name PGE - HARBORTON			Driller ARTURO MADRIGAL - CASCADE			
Hole Location			Recorder M. PRECIADO			
PSU Site Personnel A. KHOSRAVIFAR, D. MOUA, K. SORENSEN, M. PRECIADO						
Start Date 08/07/19			End Date			
Total Depth		Equipment		Ground Elevation		
Sample Type				Hole completion		
"U" - Undisturbed Shelby tube "N" - Standard Penetration (SPT)						
Depth (FEET)	Sample Type, No.	Measured Rec. (1/4 GHER)	SPT Driving Resistance	Graphic Log	Soil Material Description Soil name, USCS, color, plasticity, moisture, consistency, relative density, texture, cementation, structure, origin. Other comments.	Drilling methods, size, and remarks Water level / date
5.0'- 6.5'	N ₁	9"	C-1-1		BROWN W/ GREY, LOW PLASTICITY SILTY SAND (SM) DAMP. W/ OR FLAKES. LAMINATIONS MICA MINERALS BOTTOM 2" : GREY SILT W/ SOME SAND. MOIST	HSA 10"
10'- 12.5'	U ₁	0"	—		NO RECOVERY	
10'- 11.5'	N ₂	13"	1-2-2		TOP → BOTTOM (SM) TOP 4" EMPTY ⇒ 4" OF GREY SILTY SAND W/ MICA MINERALS, LOW PLASTICITY BOTTOM 9" SANDY SILT (ML) MEDIUM STIFF GREY W/ BROWN LAMINAE	
15'- 16.5'	N ₃		1-2-2		TOP 2" → MEDIUM POORLY GRADED SAND NOT PLASTIC, GREY BOTTOM 8" → MEDIUM PLASTICITY GREY SILT STIFF (ML). SOME LAMINATIONS	

WELL INSTALLATION LOG

Project <u>NSF RAPID</u>		Hole No. <u>PGE-1A1</u>
Purpose <u>INJECTION</u>		
Site Name <u>PGE - HARBORTON</u>		Driller <u>ARTURO - CASADE</u>
Hole Location		Installation Date <u>03/07/19</u>
PSU Site Personnel <u>PRECIADO, SOREMON, MOUG</u>		
Depth to Water		
Surface Completion

Cement monument
 Backfill grout
 Bentonite seal
 8'
 9'
 14.5'
 15'
 Filter Pack Material:
 PVC Slot Size:
 PVC Diameter:
 Hole Diameter:

Project		NSF RAPID		Hole No. PGE-MON	
Purpose		MONITORING			
Site Name		LABRETTON		Driller CASADE / ARLO	
Hole Location				Recorder K. SORENSON	
PSU Site Personnel					
Start Date		8/16		End Date 8/16	
Total Depth		Equipment		Ground Elevation	
Sample Type				Hole completion	
"U" - Undisturbed Shelby tube				"N" - Standard Penetration (SPT)	
Depth ()	Sample Type, No.	Measured Rec. ()	SPT Driving Resistance	Graphic Log	Soil Material Description Soil name, USCS, color, plasticity, moisture, consistency, relative density, texture, cementation, structure, origin. Other comments.
10'- 12.5'	u ₁				Drilling methods, size, and remarks
13 15.5	u ₂				Water level / date
SHELBY TUBE → DRIVEN 24" RECOVERY 8" SHELBY TUBE → DRIVEN 24" FULL RECOVERY					

Appendix F: Finished Boring Logs – Harborton

Portland State UNIVERSITY		PROJECT: NSF - Microbial Induced Desaturation				BORING ID: PGE_Ex_E					
		LOCATION: 12500 NE Marina Way, Portland Oregon				WELL ID: PGE_Ex_E					
		DRILLING CONTRACTOR: Cascade Drilling/Arturo				NORTHING: 45.615082		EASTING: -122.799927			
		DRILLING EQUIPMENT: CME 75 Tracker				GROUND SURFACE ELEV.: 19.69'		TOC ELEVATION:			
		DRILLING METHOD: 10" Hollow Stem Auger (6" ID)				TOTAL DEPTH: 16.5'		DEPTH TO WATER: 7.5'			
LOGGED BY: AMP				SAMPLING METHOD: Shelby tube and split-spoon sampler				DATE STARTED: 8/7/2019		DATE COMPLETED: 8/7/2019	
Depth (feet)	Sample Type	% REC	# Blows	USCS	Graphic Log	Description	LL PL PI	Water Content (%)	Coarse Silt Clay (%)	Well Diagram	Well Construction
0						Low plasticity brown SILT (ML) interbedded with non-plastic SILT (NP)					Flush mounted 12" cover
2											
4											
6	N1	0	0 0 0			No recovery	---	---	---		9 ft of 2 in dia., Sch. 40 PVC solid riser
8											
10						Low plasticity gray SILT (ML) interbedded with non-plastic sandy SILT (NP)					
12	U1	12"/24"									5 ft of 2 in dia., Sch. 40 PVC slotted screen
	N2a					Liquified gray SAND, trace organics, very soft	NP	46	26 72 2		
	N2b	100	2 3 3			Fine gray SAND, medium stiff, some mica	NP	42	15 82 3		
14											Bottom of well at 14 ft bgs
16	N3	0	1 1 2			No recovery	---	---	---		End of exploration at 16.5 ft bgs
18											
NOTES:							<div><div>Solid riser</div><div>Grout</div><div>Bentonite seal</div><div>Screen</div><div>Filter pack</div><div>end cap</div><div>Soil</div></div>

Portland State UNIVERSITY						PROJECT: NSF - Microbial Induced Desaturation		BORING ID: PGE_Ex_W			
						LOCATION: 12500 NE Marina Way, Portland Oregon		WELL ID: PGE_Ex_W			
						DRILLING CONTRACTOR: Cascade Drilling/Arturo		NORTHING: 45.615082	EASTING: -122.799927		
						DRILLING EQUIPMENT: CME 75 Tracker		GROUND SURFACE ELEV.: 19.69'	TOC ELEVATION:		
						DRILLING METHOD: 10" Hollow Stem Auger (6" ID)		TOTAL DEPTH: 16.5'	DEPTH TO WATER: 7.5'		
LOGGED BY: KRS		SAMPLING METHOD: Shelby tube and split-spoon sampler		DATE STARTED: 8/8/2019	DATE COMPLETED: 8/8/2019						
Depth (feet)	Sample Type	% REC	# Blows	USCS	Graphic Log	Description	LL PL PI	Water Content (%)	Coarse Silt Clay (%)	Well Diagram	Well Construction
0						Low plasticity brown SILT (ML) interbedded with non-plastic SILT (NP)					Flush mounted 12" cover
2											
4				ML							9 ft of 2 in dia., Sch. 40 PVC solid riser
6	N1	20	0 0 0			Gray SAND seam with brown laminations, soft, dry to damp	NP	28	6 -- 94		
8
10						Low plasticity gray SILT (ML) interbedded with non-plastic sandy SILT (NP)					
12	U1	24"/24"									5 ft of 2 in dia., Sch. 40 PVC slotted screen
	N2a					Gray silty SAND seam, medium stiff, dilative, wet	NP	44	4 93 3		
	N2b	100	1 1 2	ML		Gray sandy SILT, soft, damp to wet	47 39 8	48	0 94 6		
14											Bottom of well at 14 ft bgs
	N3a					Medium-grained gray SAND seam, dilative, wet	NP	44	21 73 6		
16	N3b	100	1 1 0			Gray clayey SILT, soft, wet	57 30 27	65	6 84 10		End of exploration at 16.5 ft bgs
18											
NOTES:						Solid riser Bentonite seal Filter pack Soil Grout Screen end cap

Portland State UNIVERSITY				PROJECT: NSF - Microbial Induced Desaturation		BORING ID: PGE_Ha1		
				LOCATION: 12500 NE Marina Drive, Portland Oregon		WELL ID: PGE_Ha1		
				DRILLING CONTRACTOR: Portland State (AK, DMM, AMP, KRS)		NORTHING:	EASTING:	
				DRILLING EQUIPMENT: N/A		GROUND SURFACE ELEV.: 14'	TOC ELEVATION:	
				DRILLING METHOD: Hand Auger		TOTAL DEPTH: 12.5	DEPTH TO WATER: 11	
LOGGED BY: AMP		SAMPLING METHOD: Bagged Samples		DATE STARTED: 7/18/2019		DATE COMPLETED: 7/18/2019		
Depth (feet)	Sample Type	USCS	Graphic Log	Description	Water Table	LL PL PI	Water Content (%)	Coarse Silt Clay (%)
0				Low plasticity brown SILT (ML) interbedded with non-plastic SILT (NP)				
2								
4								
	N1	ML		Soft, blue-gray sandy CLAY		37 36 1	36	5 89 9
6								
	N2			Soft, blue-gray sandy SILT		38 37 1	36	2 89 9
8								
	N3			Soft, blue-gray CLAY, trace organics		60 36 24	59	9 77 14
				Low plasticity gray SILT (ML) interbedded with non-plastic sandy SILT (NP)				
10								
	N4			Sandy CLAY with trace organics		NP	38	1 93 6
	N5			Dark gray laminations		56 40 16	44	1 80 19
	N6			SAND		48 34 12	41	14 86 0
12								
	N7	ML		Sandy SILT		NP	44	4 93 3
	N8			Sandy SILT		NP	48	8 89 3
14								
NOTES:								

Appendix G: Atterberg Limits – Harborton

Project: NSF - Microbial Induced Desaturation					
Location: Harborton			Date Collected: July 18, 2019		
Borehole: PGE_Ha1	Sample Number: N1	Depth (ft-ft): 4.5	5.2	Average Depth (ft): 4.85	

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	3.4	2.5	0.9	36.0	39	1	7.6	5.6	2	35.7
2	1.5	1.1	0.4	36.4	31	2	9.8	7.2	2.6	36.1
3	2.2	1.6	0.6	37.5	18					
4	3.1	2.1	1	47.6	6					

Liquid Limit: 37
 Plastic Limit: 36
 Plasticity Index: 1

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation

Location: Harborton

Date Collected: July 18, 2019

Borehole: PGE_Ha1

Sample Number: N2

Depth (ft-ft): 6.0 6.8

Average Depth (ft): 6.40

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	1.9	1.4	0.5	35.7	34	1	10.9	8.0	2.9	36.3
2	2.5	1.8	0.7	38.9	22	2	11.1	8.1	3	37.0
3	2.1	1.5	0.6	40.0	13					

Liquid Limit: 38
Plastic Limit: 37
Plasticity Index: 1

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation

Location: Harborton

Date Collected: July 18, 2019

Borehole: PGE_Ha1

Sample Number: N3

Depth (ft-ft): 8.3 9.2 Average Depth (ft): 8.75

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	3.5	2.2	1.3	59.1	37	1	9.3	6.8	2.5	36.8
2	2.9	1.8	1.1	61.1	21	2	10.0	7.4	2.6	35.1
3	4.7	2.9	1.8	62.1	12					

Liquid Limit: 60
Plastic Limit: 36
Plasticity Index: 24

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: MH

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: July 18, 2019	
Borehole:	PGE_Ha1	Sample Number:	N4	Depth (ft-ft):	10.2 10.6 Average Depth (ft): 10.40

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	8.0	5.8	2.2	37.9	14					
2	6.3	4.7	1.6	34.0	1					
3	9.8	6.8	3	44.1	18					
4	11.2	7.4	3.8	51.4	4					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: NP

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation

Location: Harborton

Date Collected: July 18, 2019

Borehole: PGE_Ha1

Sample Number: N5

Depth (ft-ft): 10.6 10.8 Average Depth (ft): 10.70

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	14.3	9.9	4.4	44.4	166	1	6.7	4.8	1.9	39.6
2	11.0	7.0	4	57.1	33	2	7.0	5.0	2	40.0
3	10.8	6.6	4.2	63.6	7					
4	15.5	9.7	5.8	59.8	14					

Liquid Limit: 57
Plastic Limit: 40
Plasticity Index: 17

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: MH

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation

Location: Harborton

Date Collected: July 18, 2019

Borehole: PGE_Ha1

Sample Number: N6

Depth (ft-ft): 10.8 11.4 Average Depth (ft): 11.10

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	7.9	5.6	2.3	41.1	44	1	8.5	6.3	2.2	34.9
2	7.2	4.9	2.3	46.9	27	2	8.4	6.3	2.1	33.3
3	6.3	4.2	2.1	50.0	11					
4	9.3	6.0	3.3	55.0	6					

Liquid Limit: 46
Plastic Limit: 34
Plasticity Index: 12

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Ariadna

Project: NSF - Microbial Induced Desaturation
 Location: Harborton Date Collected: July 18, 2019
 Borehole: PGE_Ha1 Sample Number: N7 Depth (ft-ft): 11.4 12.1 Average Depth (ft): 11.75

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	43.8	30.5	13.3	43.6	1					
2	7.1	5.1	2	39.2	4					
3	11.5	8.4	3.1	36.9	10					
4	19.7	15.1	4.6	30.5	1					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: NP

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: July 18, 2019	
Borehole:	PGE_Ha1	Sample Number:	N8	Depth (ft-ft):	12.1 12.5 Average Depth (ft): 12.30

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	47.2	31.9	15.3	48.0	1					
2	12.5	9.0	3.5	38.9	9					
3	11.0	8.1	2.9	35.8	15					
4	19.2	14.7	4.5	30.6	1					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: NP

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation
 Location: Harborton
 Date Collected: August 8, 2019
 Borehole: PGE_Ex_N Sample Number: N1a Depth (ft-ft): 5.0 5.6 Average Depth (ft): 5.30

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	5.3	4.3	1	23.3	1					
2	12.5	9.8	2.7	27.6	1					
3	9.8	7.4	2.4	32.4	18					
4	14.4	10.7	3.7	34.6	7					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: NP

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation				
Location: Harborton			Date Collected: August 8, 2019	
Borehole: PGE_Ex_N	Sample Number: N1b	Depth (ft-ft): 5.6 5.8	Average Depth (ft): 5.70	

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	5.7	4.3	1.4	32.6	1					
2	4.9	3.4	1.5	44.1	5					
3	6.9	4.4	2.5	56.8	1					

Liquid Limit: _____
Plastic Limit: 0
Plasticity Index: 0

Total amount of materials passing sieve
No. 40: 100 %

Fines
Classification: NP

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: July 18, 2019	
Borehole:	PGE_Ex_N	Sample Number:	N1c	Depth (ft-ft):	5.8 6.0 Average Depth (ft): 5.90

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	3.4	2.4	1.0	41.7		1	6.5	4.8	1.7	35.4
2	3.0	2.1	0.95	46.3	18	2	6.3	4.6	1.7	37.0
3	4.1	2.9	1.2	41.4	47					
4	5.4	3.6	1.8	50.0	28					
5	4.6	3.1	1.5	48.4	6					

Liquid Limit: 46
 Plastic Limit: 36
 Plasticity Index: 10

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: ML

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 8, 2019	
Borehole:	PGE_Ex_N	Sample Number:	N2a	Depth (ft-ft):	12.5 13.25 Average Depth (ft): 12.88

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	3.1	2.2	0.9	40.9	3					
2	4.3	3.4	0.9	26.5	1					
3	3.8	2.8	1.0	35.7	3					
4	5.9	4.0	1.9	47.5	1					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: NP

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 8, 2019	
Borehole:	PGE_Ex_N	Sample Number:	N2b	Depth (ft-ft):	13.3 14.00 Average Depth (ft): 13.63

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	4.0	2.7	1.3	48.1	45	1	9.2	6.7	2.5	37.3
2	4.3	2.8	1.5	53.6	14	2	7.8	5.7	2.1	36.8
3	3.1	2.1	1.0	47.6	85					
4	4.9	3.3	1.6	48.5	40					
5	3.9	2.5	1.4	56.0	16					

Liquid Limit: 52
 Plastic Limit: 37
 Plasticity Index: 15

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: MH

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 8, 2019	
Borehole:	PGE_Ex_N	Sample Number:	N3a	Depth (ft-ft):	15.5 16.1 Average Depth (ft): 15.80

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	14.6	10.3	4.3	41.7	1					
2	11.7	9.0	2.7	30.0	4					
3	9.6	7.9	1.7	21.5	1					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: NP

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 8, 2019	
Borehole:	PGE_Ex_N	Sample Number:	N3b	Depth (ft-ft):	16.1 16.5 Average Depth (ft): 16.30

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	8.6	6.4	2.2	34.4	6					
2	5.5	4.0	1.5	37.5	3					
3	6.4	4.8	1.6	33.3	15					
4	5.2	3.7	1.5	40.5	3					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: NP

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation			
Location: Harborton		Date Collected: August 7, 2019	
Borehole: PGE_Ex_E	Sample Number: N2a	Depth (ft-ft): 12.5 13.25	Average Depth (ft): 12.88

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	12.4	8.5	3.9	45.9	2					
2	12.0	8.8	3.2	36.4	5					
3	8.3	6.3	2	31.7	3					
4	10.0	8.5	1.5	17.6	1					

Liquid Limit: _____
Plastic Limit: 0
Plasticity Index: 0

Total amount of materials passing sieve
No. 40: 100 %

Fines
Classification: NP

Procedure Done By: Melissa P.

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 7, 2019	
Borehole:	PGE_Ex_E	Sample Number:	N2b	Depth (ft-ft):	13.25 14.0 Average Depth (ft): 13.63

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	10.2	7.2	3	41.7	1					
2	7.7	5.4	2.3	42.6	4					
3	7.5	5.2	2.3	44.2	3					
4	5.4	3.6	1.8	50.0	1					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: NP

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation			
Location: Harborton		Date Collected: August 7, 2019	
Borehole: PGE_Ex_S	Sample Number: N1	Depth (ft-ft): 5.0 6.5	Average Depth (ft): 5.75

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	12.1	9.4	2.7	28.7	1					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve No. 40: 100 %

Fines NP by
 Classification: observation

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation
 Location: Harborton
 Date Collected: August 7, 2019
 Borehole: PGE_Ex_S Sample Number: N2a Depth (ft-ft): 12.5 13.0 Average Depth (ft): 12.75

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	4.3	3.3	1.0	30.3	10					
2	4.2	2.9	1.3	44.8	2					
3	3.4	2.5	0.9	36.0	1					
4	4.5	3.2	1.3	40.6	6					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: NP

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 7, 2019	
Borehole:	PGE_Ex_S	Sample Number:	N2b	Depth (ft-ft):	13.0 14.0 Average Depth (ft): 13.50

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	3.2	2.3	0.9	39.1		1	9.0	6.7	2.3	34.3
2	4.0	2.7	1.3	48.1	23	2	8.7	6.5	2.2	33.8
3	6.8	4.5	2.3	51.1	21					
4	4.0	2.8	1.2	42.9	31					
5	3.8	2.7	1.1	40.7	69					

Liquid Limit: 48
Plastic Limit: 34
Plasticity Index: 14

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Rawan

Project: NSF - Microbial Induced Desaturation

Location: Harborton

Date Collected: August 7, 2019

Borehole: PGE_Ex_S

Sample Number: N3

Depth (ft-ft): 15.0 16.5 Average Depth (ft): 15.75

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	26.9	17.1	9.8	57.3	1					
2	15.7	11.2	4.5	40.2	22					
3	12.5	8.7	3.8	43.7	14					
4	15.7	10.7	5.0	46.7	7					

Liquid Limit: _____

Plastic Limit: 0

Plasticity Index: 0

Total amount of materials passing sieve

No. 40: 100 %

Fines

Classification: NP

Procedure Done By: Kayla

Project: NSF - Microbial Induced Desaturation
 Location: Harborton
 Date Collected: August 8, 2019
 Borehole: PGE_Ex_W Sample Number: N1 Depth (ft-ft): 5.0 6.5 Average Depth (ft): 5.75

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	5.1	4	1.1	27.5	1					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve No. 40: 100 %

Fines NP by
 Classification: observation

Procedure Done By: Nathan

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 8, 2019	
Borehole:	PGE_Ex_W	Sample Number:	N2a	Depth (ft-ft):	12.5 13.25 Average Depth (ft): 12.88

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	8.2	5.7	2.5	43.9	1					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve
 No. 40: 100 %

Fines _____ NP by
 Classification: observation

Procedure Done By: Nathan

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 8, 2019	
Borehole:	PGE_Ex_W	Sample Number:	N2b	Depth (ft-ft):	13.25 14.0 Average Depth (ft): 13.63

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	8.3	5.6	2.7	48.2		1	8.3	6.0	2.3	38.3
2	14.1	9.8	4.3	43.9	30	2	8.7	6.2	2.5	40.3
3	13.4	9.1	4.3	47.3	24					
4	13.6	8.8	4.8	54.5	17					

Liquid Limit: 47
 Plastic Limit: 39
 Plasticity Index: 8

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Nathan

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 8, 2019	
Borehole:	PGE_Ex_W	Sample Number:	N3a	Depth (ft-ft):	15.00 15.75 Average Depth (ft): 15.38

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	16.1	11.2	4.9	43.8	1					

Liquid Limit: _____
Plastic Limit: 0
Plasticity Index: 0

Total amount of materials passing sieve
No. 40: 80 %

Fines _____ NP by
Classification: observation

Procedure Done By: Nathan

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 8, 2019	
Borehole:	PGE_Ex_W	Sample Number:	N3b	Depth (ft-ft):	15.75 16.0 Average Depth (ft): 15.88

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	12.4	7.5	4.9	65.3		1	6.5	5.0	1.5	30.0
2	14.5	9.2	5.3	57.6	20	2	7.1	5.3	1.8	34.0
3	17.1	10.8	6.3	58.3	15					
4	14.4	9.0	5.4	60.0	11					

Liquid Limit: 57
Plastic Limit: 32
Plasticity Index: 25

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: MH

Procedure Done By: Nathan

Project: NSF - Microbial Induced Desaturation			
Location: Harborton		Date Collected: August 7, 2019	
Borehole: PGE_Inj	Sample Number: N1a	Depth (ft-ft): 5.0 6.3	Average Depth (ft): 5.65

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	8	6.2	1.8	29.0	1					
2	5.5	4.1	1.4	34.1	8					
3	4.9	3.5	1.4	40.0	2					
4	7.4	5.3	2.1	39.6	1					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: NP

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 7, 2019	
Borehole:	PGE_Inj	Sample Number:	N1b	Depth (ft-ft):	6.3 6.5 Average Depth (ft): 6.40

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	8.1	5.5	2.6	47.3	20	1	9.5	7.0	2.5	35.7
2	7.1	4.9	2.2	44.9	49	2	9.4	7.0	2.4	34.3
3	14.0	9.7	4.3	44.3	63					
4	13.5	8.9	4.6	51.7	5					

Liquid Limit: 47
 Plastic Limit: 35
 Plasticity Index: 12

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: ML

Procedure Done By: Melissa P./Kayla

Project: NSF - Microbial Induced Desaturation			
Location: Harborton		Date Collected: August 7, 2019	
Borehole: PGE_Inj	Sample Number: N2a	Depth (ft-ft): 10.0 10.25	Average Depth (ft): 10.13

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	8.7	6.6	2.1	31.8	1					
2	8.9	6.7	2.2	32.8	2					
3	12.4	8.3	4.1	49.4	1					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: NP

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 7, 2019	
Borehole:	PGE_Inj	Sample Number:	N2b	Depth (ft-ft):	10.25 11.5 Average Depth (ft): 10.88

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	11.4	6.9	4.5	65.2	12	1	5.5	4.0	1.5	37.5
2	12.1	7.8	4.3	55.1	20	2	6.0	4.4	1.6	36.4
3	11.1	7.2	3.9	54.2	25					
4	7.4	5.2	2.2	42.3	36					

Liquid Limit: 51
 Plastic Limit: 37
 Plasticity Index: 14

Total amount of materials passing sieve
 No. 40: 100 %

Fines
 Classification: MH

Procedure Done By: Melissa P./Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 7, 2019	
Borehole:	PGE_Inj	Sample Number:	N3a	Depth (ft-ft):	15.0 15.75 Average Depth (ft): 15.38

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	9.4	7.1	2.3	32.4	1					

Liquid Limit: _____
 Plastic Limit: 0
 Plasticity Index: 0

Total amount of materials passing sieve No. 40: 100 %

Fines _____ NP by
 Classification: observation

Procedure Done By: Kayla

Project:	NSF - Microbial Induced Desaturation				
Location:	Harborton			Date Collected: August 7, 2019	
Borehole:	PGE_Inj	Sample Number:	N3b	Depth (ft-ft):	15.75 16.50 Average Depth (ft): 16.13

Liquid Limit						Plastic Limit				
Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)	No. of Blows	Sample Number	Weight of Wet Soil (g)	Weight of Dry Soil (g)	Weight of Water (g)	Water Content (%)
1	8.8	5.9	2.9	49.2	85	1	6.8	4.9	1.9	38.8
2	6.8	4.4	2.4	54.5	26	2	7.1	5.1	2.0	39.2
3	9.0	5.6	3.4	60.7	7					
4	8.6	5.2	3.4	65.4	4					

Liquid Limit: 55
 Plastic Limit: 39
 Plasticity Index: 16

Total amount of materials passing sieve No. 40: 100 %

Fines Classification: MH

Procedure Done By: Kayla

Appendix H: Hydrometer and P200 Washes – Harborton

Hydrometer Test

Boring:	PGE_Ha1	Sample:	N1	Depth (ft-ft):	4.5 5.2	Start Time:	10:37:00 AM
				Ave. Depth (ft):	4.85		

Constants	
M _s (g)	55.21
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.031	1.004	16.0	0.014350	1.027	8.1	0.057757636	79
1	1.029	1.004	16.0	0.014350	1.025	8.6	0.042082461	73
2	1.026	1.004	16.0	0.014350	1.022	10.5	0.032879981	64
4	1.023	1.004	16.0	0.014350	1.019	10.2	0.022915112	55
8	1.019	1.004	16.0	0.014350	1.015	11.3	0.01705478	44
18	1.015	1.004	16.0	0.014350	1.011	12.3	0.011862281	32
34	1.012	1.004	16.0	0.014350	1.008	13.1	0.008907341	23
66	1.010	1.004	16.0	0.014350	1.006	13.7	0.006537929	17
145	1.009	1.004	15.5	0.014435	1.005	13.9	0.004469307	15
274	1.008	1.004	15.5	0.014435	1.004	14.2	0.003286137	12
366	1.007	1.004	15.5	0.014435	1.003	14.4	0.002863238	9
1421	1.007	1.004	15.5	0.014435	1.003	14.4	0.001453118	9

P200 Wash

Container ID:	R1	Soil Breakdown	
Before - M _d :	20.6 g	Coarse:	4.85 %
After - M _d :	1 g	Silts:	86.15 %
Fines Fraction:	95.15 %	Clays:	9.00 %
Coarse Fraction:	4.85 %	<i>From Hydrometer</i>	

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	PGE_Ha1	Sample:	N2	Depth (ft-ft):	6.0	6.8	Start Time:	10:39:00 AM
				Ave. Depth (ft):	6.4			

Constants

M_s (g)	54.33
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.033	1.004	16.5	0.014260	1.029	7.6	0.055595715	86
1	1.031	1.004	16.5	0.014260	1.027	8.1	0.040584671	80
2	1.027	1.004	16.5	0.014260	1.023	9.2	0.030584293	68
4	1.024	1.004	16.5	0.014260	1.020	10.0	0.02254704	59
8	1.020	1.004	16.5	0.014260	1.016	11.0	0.016721332	47
16	1.016	1.004	16.5	0.014260	1.012	12.1	0.012400872	35
32	1.013	1.004	16.5	0.014260	1.009	12.9	0.009053977	27
64	1.011	1.004	16.0	0.014350	1.007	13.4	0.006566203	21
143	1.009	1.004	16.0	0.014350	1.005	13.9	0.004473952	15
272	1.008	1.004	15.5	0.014435	1.004	14.2	0.003298196	12
364	1.007	1.004	15.5	0.014435	1.003	14.4	0.002871094	9
1419	1.007	1.004	15.0	0.014435	1.003	14.4	0.001454142	9

P200 Wash

Container ID:	M1
Before - M_d :	23 g
After - M_d :	0.4 g
Fines Fraction:	98.26 %
Coarse Fraction:	1.74 %

From Hydrometer

Soil Breakdown	
Coarse:	1.74 %
Silts:	89.26 %
Clays:	9.00 %

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	PGE_Ha1	Sample:	N3	Depth (ft-ft):	8.3 9.2	Start Time:	10:41:00 AM
				Ave. Depth (ft):	8.75		

Constants

M_s (g)	57.27
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.033	1.004	16.0	0.014350	1.029	7.6	0.0559466	81
1	1.032	1.004	16.0	0.014350	1.028	7.8	0.040077369	79
2	1.029	1.004	16.0	0.014350	1.025	8.6	0.029756793	70
4	1.027	1.004	16.0	0.014350	1.023	9.2	0.021762853	64
8	1.024	1.004	16.0	0.014260	1.020	10.0	0.015943165	56
14	1.022	1.004	16.0	0.014350	1.018	10.5	0.012427465	50
30	1.019	1.004	16.0	0.014350	1.015	11.3	0.008807051	42
62	1.016	1.004	16.0	0.014350	1.012	12.1	0.006339409	34
141	1.012	1.004	16.0	0.014350	1.008	13.1	0.004373992	22
270	1.011	1.004	15.5	0.014435	1.007	13.4	0.003215787	20
362	1.010	1.004	15.5	0.014435	1.006	13.7	0.002808166	17
1417	1.008	1.004	15.0	0.014520	1.004	14.2	0.001453536	11

P200 Wash

Container ID:	U1
Before - M_d :	20.9 g
After - M_d :	1.8 g
Fines Fraction:	91.39 %
Coarse Fraction:	8.61 %

From Hydrometer

Soil Breakdown	
Coarse:	8.61 %
Silts:	77.39 %
Clays:	14.00 %

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	PGE_Ha1	Sample:	N4	Depth (ft-ft):	10.2 10.6	Start Time:	12:18:00 PM
				Ave. Depth (ft):	10.4		

Constants

M_s (g)	51.79
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.031	1.004	18.0	0.013990	1.027	8.1	0.056308664	84
1	1.029	1.004	18.0	0.013990	1.025	8.6	0.041026733	78
2	1.025	1.004	18.0	0.013990	1.021	9.7	0.030809779	65
4	1.020	1.004	18.0	0.013990	1.016	11.0	0.02319979	50
8	1.014	1.004	18.0	0.013990	1.010	12.6	0.017557311	31
18	1.010	1.004	17.5	0.014080	1.006	13.7	0.012283629	19
34	1.008	1.004	17.5	0.014080	1.004	14.2	0.009099287	12
66	1.007	1.004	17.0	0.014170	1.003	14.4	0.006618798	9
115	1.006	1.004	17.0	0.014170	1.002	14.7	0.005066168	6
211	1.006	1.004	16.5	0.014260	1.002	14.7	0.00376389	6
393	1.006	1.004	16.0	0.014350	1.002	14.7	0.002775328	6
1386	1.006	1.004	15.0	0.014435	1.002	14.7	0.001486599	6

P200 Wash

Container ID:	P1
Before - M_d :	22.7 g
After - M_d :	0.3 g
Fines Fraction:	98.68 %
Coarse Fraction:	1.32 %

From Hydrometer

Soil Breakdown	
Coarse:	1.32 %
Silts:	92.68 %
Clays:	6.00 %

Procedures Done By: Kayla/Melissa B.

Hydrometer Test

Boring:	PGE_Ha1	Sample:	N5	Depth (ft-ft):	10.6 10.8	Start Time:	12:20:00 PM
				Ave. Depth (ft):	10.7		

Constants

M_s (g)	54.40
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.036	1.004	17.0	0.014170	1.032	6.8	0.052256378	94
1	1.035	1.004	17.0	0.014170	1.031	7.0	0.037490296	92
2	1.034	1.004	17.0	0.014170	1.030	7.3	0.027071747	89
4	1.030	1.004	17.0	0.014170	1.026	8.4	0.020534281	77
8	1.028	1.004	17.0	0.014170	1.024	8.9	0.014945824	71
16	1.024	1.004	16.5	0.014260	1.020	10.0	0.01127352	59
32	1.019	1.004	16.5	0.014260	1.015	11.3	0.008473908	44
64	1.016	1.004	16.5	0.014260	1.012	12.1	0.006200436	35
113	1.014	1.004	16.5	0.014260	1.010	12.6	0.004761739	30
209	1.012	1.004	16.0	0.014350	1.008	13.1	0.003592646	24
391	1.011	1.004	16.0	0.014350	1.007	13.4	0.002656537	21
1384	1.010	1.004	15.5	0.014435	1.006	13.7	0.001436181	18

P200 Wash

Container ID:	F1
Before - M_d :	15.2 g
After - M_d :	0.2 g
Fines Fraction:	98.68 %
Coarse Fraction:	1.32 %

From Hydrometer

Soil Breakdown	
Coarse:	1.32 %
Silts:	79.68 %
Clays:	19.00 %

Procedures Done By: Kayla/Melissa B.

Hydrometer Test

Boring:	PGE_Ha1	Sample:	N6	Depth (ft-ft):	10.8 11.4	Start Time:	8:14:00 AM
				Ave. Depth (ft):	11.1		

Constants

M_s (g)	49.82
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.028	1.004	17.5	0.014080	1.024	8.9	0.059403585	77
1	1.027	1.004	17.5	0.014080	1.023	9.2	0.042706755	74
2	1.025	1.004	17.5	0.014080	1.021	9.7	0.031007983	68
4	1.022	1.004	18.0	0.013990	1.018	10.5	0.022666391	58
8	1.018	1.004	18.0	0.013990	1.014	11.5	0.016773421	45
16	1.015	1.004	18.0	0.013990	1.011	12.3	0.012266207	35
30	1.013	1.004	17.5	0.014080	1.009	12.9	0.009232873	29
69	1.010	1.004	17.5	0.014080	1.006	13.7	0.006273912	19
108	1.009	1.004	17.5	0.014080	1.005	13.9	0.005051242	16
213	1.008	1.004	17.5	0.014080	1.004	14.2	0.00363544	13
545	1.007	1.004	17.5	0.014080	1.003	14.4	0.002288683	10
1535	1.007	1.004	17.5	0.014080	1.003	14.4	0.001363734	10

P200 Wash

Container ID:	P1	Soil Breakdown	
Before - M_d :	27.5 g	Coarse:	14.18 %
After - M_d :	3.9 g	Silts:	75.82 %
Fines Fraction:	85.82 %	Clays:	10.00 %
Coarse Fraction:	14.18 %	From Hydrometer	

Procedures Done By: Kayla/Melissa B.

Hydrometer Test

Boring:	PGE_Ha1	Sample:	N7	Depth (ft-ft):	11.4 12.1	Start Time:	12:22:00 PM
				Ave. Depth (ft):	11.75		

Constants

M_s (g)	57.24
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.030	1.004	17.0	0.014170	1.026	8.4	0.058079717	73
1	1.023	1.004	17.0	0.014170	1.019	10.2	0.045255351	53
2	1.019	1.004	17.0	0.014170	1.015	11.3	0.033681705	42
4	1.014	1.004	17.0	0.014170	1.010	12.6	0.025149255	28
8	1.009	1.004	17.0	0.014170	1.005	13.9	0.018678081	14
14	1.007	1.004	17.5	0.014080	1.003	14.4	0.014279726	8
30	1.006	1.004	17.5	0.014080	1.002	14.7	0.009856	6
62	1.006	1.004	17.0	0.014170	1.002	14.7	0.006899739	6
111	1.005	1.004	17.0	0.014170	1.001	15.0	0.005208996	3
207	1.005	1.004	16.5	0.014260	1.001	15.0	0.003838663	3
389	1.005	1.004	16.0	0.014350	1.001	15.0	0.002817882	3
1382	1.005	1.004	15.5	0.014435	1.001	15.0	0.001503863	3

P200 Wash

Container ID:	H1
Before - M_d :	26.2 g
After - M_d :	1.1 g
Fines Fraction:	95.80 %
Coarse Fraction:	4.20 %

From Hydrometer

Soil Breakdown	
Coarse:	4.20 %
Silts:	92.80 %
Clays:	3.00 %

Procedures Done By: Kayla/Melissa B.

Hydrometer Test

Boring:	PGE_Ha1	Sample:	N8	Depth (ft-ft):	12.1 12.5	Start Time:	12:17:00 PM
				Ave. Depth (ft):	12.3		

Constants	
M_s (g)	50.99
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.023	1.004	16.5	0.014260	1.019	10.2	0.064407228	60
1	1.021	1.004	16.5	0.014260	1.017	10.7	0.046645678	54
2	1.017	1.004	16.5	0.014260	1.013	11.8	0.03463742	41
4	1.014	1.004	16.5	0.014260	1.010	12.6	0.025308989	31
8	1.010	1.004	16.5	0.014260	1.006	13.7	0.018660996	19
16	1.007	1.004	16.5	0.014260	1.003	14.4	0.013528224	9
32	1.006	1.004	16.5	0.014260	1.002	14.7	0.00966503	6
60	1.006	1.004	16.5	0.014260	1.002	14.7	0.00705834	6
120	1.006	1.004	16.5	0.014260	1.002	14.7	0.004991	6
227	1.005	1.004	16.5	0.014260	1.001	15.0	0.00366566	3
422	1.005	1.004	16.5	0.014260	1.001	15.0	0.002688493	3
1384	1.005	1.004	16.5	0.014260	1.001	15.0	0.001484558	3

P200 Wash

Container ID:	Q1	Soil Breakdown	
Before - M_d :	25.4 g	Coarse:	7.87 %
After - M_d :	2.0 g	Silts:	89.13 %
Fines Fraction:	92.13 %	Clays:	3.00 %
Coarse Fraction:	7.87 %	From Hydrometer	
Procedures Done By:		Kayla/Melissa B.	

Hydrometer Test

Boring:	PGE_Ex_N	Sample:	N1a	Depth (ft-ft):	5.0	5.6	Start Time:	11:49:00 AM
				Ave. Depth (ft):	5.3			

Constants

M_s (g)	49.94
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.018	1.004	18.0	0.013990	1.014	11.5	0.067093683	45
1	1.015	1.004	18.0	0.013990	1.011	12.3	0.049064827	35
2	1.013	1.004	18.0	0.013990	1.009	12.9	0.035530193	29
4	1.010	1.004	17.5	0.014080	1.006	13.7	0.026057512	19
8	1.009	1.004	17.5	0.014080	1.005	13.9	0.018559448	16
16	1.007	1.004	17.5	0.014080	1.003	14.4	0.013357461	10
32	1.006	1.004	17.5	0.014080	1.002	14.7	0.009543031	6
64	1.006	1.004	17.5	0.014080	1.002	14.7	0.006747942	6
124	1.005	1.004	17.5	0.014080	1.001	15.0	0.004897083	3
164	1.005	1.004	17.0	0.014170	1.001	15.0	0.004285422	3
1502	1.005	1.004	17.0	0.014170	1.001	15.0	0.001416056	3
1852	1.005	1.004	16.5	0.014260	1.001	15.0	0.001283349	3

P200 Wash

Container ID:	W1
Before - M_d :	24.3 g
After - M_d :	2.2 g
Fines Fraction:	90.95 %
Coarse Fraction:	9.05 %

Soil Breakdown	
Coarse:	9.05 %
Silts:	87.95 %
Clays:	3.00 %

From Hydrometer

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring: PGE_Ex_N Sample: N1b Depth (ft-ft): 5.6 5.8 Start Time: _____
Ave. Depth (ft): 5.7

Constants
M_s (g) #DIV/0!
G_s 2.65
G_w 1

There was not enough soil to perform a hydrometer test.

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)

P200 Wash

Container ID: G1, L1
Before - M_d: 25.7 g
After - M_d: 3.9 g
Fines Fraction: 84.82 %
Coarse Fraction: 15.18 %

Procedures Done By: Kayla/Melissa P.

Boring: PGE_Ex_N	Sample: N1c	Depth (ft-ft): 5.8 6.0	Start Time:
		Ave. Depth (ft): 5.9	

There was not enough soil to perform a hydrometer test.

The graph is a semi-logarithmic plot with the following characteristics:

- Y-axis:** Labeled "Percent Passing (%)", ranging from 0 to 100 in increments of 10.
- X-axis:** Labeled "Grain Size (mm)", ranging from 0.0001 to 1 on a logarithmic scale.
- Grid:** A grid with major lines every 10% on the y-axis and major lines every 0.001 mm on the x-axis.
- Vertical Lines:** Two vertical dashed lines are present at grain sizes of 0.075 mm and 0.425 mm.

Container ID:	S1
Before - M _d :	30.3 g
After - M _d :	2.4 g
Fines Fraction:	92.08 %
Coarse Fraction:	7.92 %
Procedures Done By:	Kayla/Melissa P.

Hydrometer Test

Boring: PGE_Ex_N	Sample: N2a	Depth (ft-ft): 12.5 13.3	Start Time: 8:16:00 AM
		Ave. Depth (ft): 12.9	

Constants

M_s (g)	49.76
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.027	1.004	18.0	0.013990	1.023	9.2	0.060010414	74
1	1.023	1.004	18.0	0.013990	1.019	10.2	0.044680477	61
2	1.015	1.004	18.0	0.013990	1.011	12.3	0.034694072	36
4	1.012	1.004	18.0	0.013990	1.008	13.1	0.025317649	26
8	1.009	1.004	18.0	0.013990	1.005	13.9	0.018440815	16
16	1.007	1.004	18.0	0.013990	1.003	14.4	0.013272079	10
30	1.006	1.004	18.0	0.013990	1.002	14.7	0.009793	6
67	1.005	1.004	18.0	0.013990	1.001	15.0	0.006619512	3
106	1.005	1.004	17.5	0.014080	1.001	15.0	0.005296578	3
211	1.005	1.004	17.5	0.014080	1.001	15.0	0.003754111	3
543	1.004	1.004	17.5	0.014080	1.000	15.2	0.002355725	0
1533	1.004	1.004	17.5	0.014080	1.000	15.2	0.001402017	0

P200 Wash

Container ID:	W1
Before - M_d :	24.3 g
After - M_d :	2.2 g
Fines Fraction:	90.95 %
Coarse Fraction:	9.05 %

From Hydrometer

Soil Breakdown	
Coarse:	9.05 %
Silts:	90.95 %
Clays:	0.00 %

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	PGE_Ex_N	Sample:	N2b	Depth (ft-ft):	13.25 14.0	Start Time:	8:42:00 AM
				Ave. Depth (ft):	13.63		

Constants	
M _s (g)	50.05
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.032	1.004	18.5	0.013990	1.028	7.8	0.055256073	90
1	1.030	1.004	18.5	0.013990	1.026	8.4	0.040546872	83
2	1.026	1.004	18.0	0.013990	1.022	9.4	0.030329597	71
4	1.024	1.004	18.5	0.013990	1.020	10.0	0.022120132	64
8	1.019	1.004	18.5	0.013990	1.015	11.3	0.016626925	48
16	1.015	1.004	18.0	0.013990	1.011	12.3	0.012266207	35
41	1.011	1.004	18.0	0.013990	1.007	13.4	0.007997941	22
77	1.010	1.004	18.0	0.013990	1.006	13.7	0.005901095	19
134	1.009	1.004	17.5	0.014080	1.005	13.9	0.004534795	16
242	1.008	1.004	17.5	0.014080	1.004	14.2	0.003410666	13
1036	1.006	1.004	18.0	0.014080	1.002	14.7	0.001677187	6

P200 Wash

Container ID:	E1	Soil Breakdown	
Before - M _d :	31 g	Coarse:	0.65 %
After - M _d :	0.2 g	Silts:	91.35 %
Fines Fraction:	99.35 %	Clays:	8.00 %
Coarse Fraction:	0.65 %	From Hydrometer	

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring: PGE_Ex_N Sample: N3a Depth (ft-ft): 15.5 16.1 Start Time: 11:20:00 AM

Ave. Depth (ft): 15.8

Constants

M_s (g)	26.71
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G_s	2.65
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$$G_W \quad 1$$
[illegible]

P200 Wash

Container ID:

Before - M_d : g

After - M_d : g

Fines Fraction: 31.98 %

Coarse Fraction: 68.02 %

Soil Breakdown

Coarse:	68.02 %
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Silts: 26.98 %

Clays: 5.00 %

From Hydrometer

Procedures Done By: Kayla/Melissa B.

Hydrometer Test

Boring:	PGE_Ex_N	Sample:	N3b	Depth (ft-ft):	16.1 16.5	Start Time:	8:42:00 AM
				Ave. Depth (ft):	16.3		

Constants	
M_s (g)	49.66
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.019	1.004	18.5	0.013905	1.015	11.3	0.066103615	49
1	1.016	1.004	18.5	0.013905	1.012	12.1	0.048368618	39
2	1.013	1.004	18.0	0.013990	1.009	12.9	0.035530193	29
4	1.011	1.004	18.5	0.013905	1.007	13.4	0.025450329	23
8	1.008	1.004	18.5	0.013905	1.004	14.2	0.01852551	13
16	1.007	1.004	18.0	0.013990	1.003	14.4	0.013272079	10
43	1.006	1.004	18.0	0.013990	1.002	14.7	0.00817979	6
79	1.006	1.004	18.0	0.013990	1.002	14.7	0.006034799	6
136	1.006	1.004	17.5	0.014080	1.002	14.7	0.00462905	6
244	1.005	1.004	17.5	0.014080	1.001	15.0	0.003491028	3
1038	1.005	1.004	18.0	0.013990	1.001	15.0	0.001681763	3

P200 Wash

Container ID:	F1	Soil Breakdown		
Before - M_d :	38.4 g	Coarse:	36.20 %	
After - M_d :	13.9 g	Silts:	60.80 %	
Fines Fraction:	63.80 %	From Hydrometer	Clays:	3.00 %
Coarse Fraction:	36.20 %			
Procedures Done By:	Kayla/Melissa B.			

Hydrometer Test

Boring:	PGE_Ex_E	Sample:	N2a	Depth (ft-ft):	12.5 13.3	Start Time:	11:32:00 AM
				Ave. Depth (ft):	12.9		

Constants	
M_s (g)	50.20
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.022	1.004	19.0	0.013820	1.018	10.5	0.063331196	58
1	1.020	1.004	19.0	0.013820	1.016	11.0	0.045835755	51
2	1.015	1.004	19.0	0.013820	1.011	12.3	0.034272485	35
4	1.011	1.004	19.0	0.013820	1.007	13.4	0.025294753	22
8	1.008	1.004	18.5	0.013905	1.004	14.2	0.01852551	13
16	1.006	1.004	19.0	0.013820	1.002	14.7	0.01324667	6
32	1.005	1.004	19.0	0.013820	1.001	15.0	0.009461907	3
62	1.005	1.004	19.0	0.013820	1.001	15.0	0.006797635	3
115	1.005	1.004	19.0	0.013820	1.001	15.0	0.004991197	3
159	1.005	1.004	18.5	0.013905	1.001	15.0	0.004270887	3
732	1.005	1.004	16.5	0.014260	1.001	15.0	0.002041313	3

P200 Wash

Container ID:	K1	Soil Breakdown	
Before - M_d :	24.5 g	Coarse:	25.71 %
After - M_d :	6.3 g	Silts:	71.29 %
Fines Fraction:	74.29 %	Clays:	3.00 %
Coarse Fraction:	25.71 %	From Hydrometer	
Procedures Done By:		Kayla/Melissa B.	

Hydrometer Test

Boring:	PGE_Ex_E	Sample:	N2b	Depth (ft-ft):	13.3 14.0	Start Time:	5:42:00 PM
				Ave. Depth (ft):	13.65		

Constants	
M_s (g)	50.82
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.024	1.004	19.5	0.013735	1.020	10.0	0.061424787	63
1	1.019	1.004	19.5	0.013735	1.015	11.3	0.046170852	47
2	1.014	1.004	19.5	0.013735	1.010	12.6	0.034474576	32
4	1.010	1.004	19.0	0.013820	1.006	13.7	0.025576336	19
8	1.007	1.004	19.0	0.013820	1.003	14.4	0.018541476	9
15	1.006	1.004	19.0	0.013820	1.002	14.7	0.013681102	6
30	1.005	1.004	19.0	0.013820	1.001	15.0	0.009772216	3
60	1.005	1.004	19.0	0.013820	1.001	15.0	0.00691	3
120	1.005	1.004	19.0	0.013820	1.001	15.0	0.004886108	3
234	1.005	1.004	18.5	0.013905	1.001	15.0	0.003520535	3
1429	1.005	1.004	18.0	0.013990	1.001	15.0	0.001433333	3

P200 Wash

Container ID:	I1	Soil Breakdown		
Before - M_d :	26.2 g	Coarse:	15.27 %	
After - M_d :	4 g	Silts:	81.73 %	
Fines Fraction:	84.73 %	From Hydrometer	Clays:	3.00 %
Coarse Fraction:	15.27 %			
Procedures Done By:	Kayla/Melissa P.

Boring: PGE_Ex_S	Sample: N1	Depth (ft-ft): 5.0 5.25	Start Time:
		Ave. Depth (ft): 5.125	

There was not enough soil to perform a hydrometer test.

The graph is a semi-logarithmic plot with the following characteristics:

- Y-axis:** Labeled "Percent Passing (%)", ranging from 0 to 100 in increments of 10.
- X-axis:** Labeled "Grain Size (mm)", ranging from 0.0001 to 1 on a logarithmic scale.
- Grid:** A grid with major lines every 10% on the y-axis and major lines every 0.001 mm on the x-axis.
- Vertical Lines:** Two vertical dashed lines are present at grain sizes of 0.002 mm and 0.075 mm.

Container ID:	K1
Before - M _d :	33.4 g
After - M _d :	3.2 g
Fines Fraction:	90.42 %
Coarse Fraction:	9.58 %
Procedures Done By:	Melissa B.

Hydrometer Test

Boring:	PGE_Ex_S	Sample:	N2a	Depth (ft-ft):	12.5 13.0	Start Time:	12:00:00 PM
				Ave. Depth (ft):	12.75		

Constants	
M _s (g)	50.00
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.027	1.004	17.0	0.014170	1.023	9.2	0.060782528	74
1	1.023	1.004	17.0	0.014170	1.019	10.2	0.045255351	61
2	1.018	1.004	17.0	0.014170	1.014	11.5	0.033978466	45
4	1.014	1.004	17.0	0.014170	1.010	12.8	0.025348067	32
8	1.010	1.004	17.0	0.014170	1.006	13.7	0.01854322	19
16	1.007	1.004	17.0	0.014170	1.003	14.4	0.013442842	10
32	1.006	1.004	17.0	0.014170	1.002	14.7	0.00960403	6
60	1.005	1.004	17.0	0.014170	1.001	15.0	0.007085	3
120	1.005	1.004	17.0	0.014170	1.001	15.0	0.005009852	3
251	1.005	1.004	17.0	0.014170	1.001	15.0	0.003464006	3
1212	1.005	1.004	16.0	0.014350	1.001	15.0	0.001596417	3

P200 Wash

Container ID:	E1	Soil Breakdown	
Before - M _d :	22.2 g	Coarse:	2.70 %
After - M _d :	0.6 g	Silts:	94.30 %
Fines Fraction:	97.30 %	Clays:	3.00 %
Coarse Fraction:	2.70 %	From Hydrometer	

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	PGE_Ex_S	Sample:	N2b	Depth (ft-ft):	13.0 14.0	Start Time:	10:32:00 AM
				Ave. Depth (ft):	13.5		

Constants

M_s (g)	49.97
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.033	1.004	17.0	0.014170	1.029	7.6	0.05524483	93
1	1.030	1.004	17.0	0.014170	1.026	8.4	0.041068562	84
2	1.027	1.004	17.0	0.014170	1.023	9.2	0.030391264	74
4	1.023	1.004	17.0	0.014170	1.019	10.2	0.022627675	61
8	1.020	1.004	17.0	0.014170	1.016	11.0	0.016615798	51
16	1.017	1.004	17.0	0.014170	1.013	11.8	0.012168887	42
32	1.013	1.004	17.0	0.014170	1.009	12.9	0.008996834	29
65	1.011	1.004	16.5	0.014260	1.007	13.4	0.006474634	22
135	1.009	1.004	16.5	0.014260	1.005	13.9	0.004575726	16
242	1.008	1.004	16.5	0.014260	1.004	14.2	0.003454268	13
1469	1.007	1.004	16.0	0.014260	1.003	14.4	0.001411854	10

P200 Wash

Container ID:	I1
Before - M_d :	30.6 g
After - M_d :	0.1 g
Fines Fraction:	99.67 %
Coarse Fraction:	0.33 %

From Hydrometer

Soil Breakdown	
Coarse:	0.33 %
Silts:	88.67 %
Clays:	11.00 %

Procedures Done By: Kayla/Melissa B.

Hydrometer Test

Boring:	PGE_Ex_S	Sample:	N3	Depth (ft-ft):	15.0 16.5	Start Time:	8:26:00 AM
				Ave. Depth (ft):	15.75		

Constants

M_s (g)	52.18
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.028	1.004	17.0	0.014170	1.024	8.9	0.059783295	74
1	1.024	1.004	17.0	0.014170	1.020	10.0	0.044809474	62
2	1.020	1.004	17.0	0.014170	1.016	11.0	0.033231596	49
4	1.016	1.004	17.0	0.014170	1.012	12.1	0.024645211	37
8	1.012	1.004	17.0	0.014170	1.008	13.1	0.018132618	25
16	1.009	1.004	17.0	0.014170	1.005	13.9	0.013207398	15
32	1.008	1.004	17.0	0.014170	1.004	14.2	0.009439284	12
63	1.007	1.004	16.5	0.014260	1.003	14.4	0.006817584	9
134	1.006	1.004	16.5	0.014260	1.002	14.7	0.004723085	6
241	1.006	1.004	16.5	0.014260	1.002	14.7	0.00352184	6
1468	1.005	1.004	16.0	0.014350	1.001	15.0	0.001450556	3

P200 Wash

Container ID:	M1	Soil Breakdown	
Before - M_d :	17.9 g	Coarse:	10.06 %
After - M_d :	1.8 g	Silts:	85.94 %
Fines Fraction:	89.94 %	Clays:	4.00 %
Coarse Fraction:	10.06 %	From Hydrometer	

Procedures Done By: Kayla/Melissa B.

Hydrometer Test

Boring: PGE_Ex_W Sample: N1 Depth (ft-ft): 5.0 5.5 Start Time: _____
Ave. Depth (ft): 5.25

Constants
M_s (g) #DIV/0!
G_s 2.65
G_w 1

There was not enough soil to
perform a hydrometer test.

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)

P200 Wash

Container ID: U1
Before - M_d: 19.3 g
After - M_d: 1.1 g
Fines Fraction: 94.30 %
Coarse Fraction: 5.70 %

Procedures Done By: Melissa P.

Hydrometer Test

Boring:	PGE_Ex_W	Sample:	N2a	Depth (ft-ft):	12.5	13.25	Start Time:	12:03:00 PM
				Ave. Depth (ft):	12.875			

Constants

M_s (g)	50.25
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.026	1.004	17.0	0.014170	1.022	9.4	0.061439656	70
1	1.023	1.004	17.0	0.014170	1.019	10.2	0.045255351	61
2	1.018	1.004	17.5	0.014080	1.014	11.5	0.033762654	45
4	1.014	1.004	17.0	0.014170	1.010	12.6	0.025149255	32
8	1.011	1.004	17.5	0.014080	1.007	13.4	0.018222588	22
16	1.009	1.004	17.0	0.014170	1.005	13.9	0.013207398	16
32	1.007	1.004	17.0	0.014170	1.003	14.4	0.009505525	10
60	1.007	1.004	17.0	0.014170	1.003	14.4	0.006941854	10
120	1.006	1.004	17.0	0.014170	1.002	14.7	0.0049595	6
251	1.005	1.004	17.0	0.014170	1.001	15.0	0.003464006	3
1212	1.005	1.004	16.0	0.014350	1.001	15.0	0.001596417	3

P200 Wash

Container ID:	S1	Soil Breakdown	
Before - M_d :	23.7 g	Coarse:	4.22 %
After - M_d :	1 g	Silts:	92.78 %
Fines Fraction:	95.78 %	Clays:	3.00 %
Coarse Fraction:	4.22 %	From Hydrometer	

Procedures Done By: Melissa B.

Hydrometer Test

Boring:	PGE_Ex_W	Sample:	N2b	Depth (ft-ft):	13.25 14.0	Start Time:	11:30:00 AM
				Ave. Depth (ft):	13.63		

Constants	
M _s (g)	50.13
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.031	1.004	19.0	0.013820	1.027	8.1	0.055624427	87
1	1.030	1.004	19.0	0.013820	1.026	8.4	0.040054165	83
2	1.028	1.004	19.0	0.013820	1.024	8.9	0.029153322	77
4	1.024	1.004	19.0	0.013820	1.020	10.0	0.021851339	64
8	1.019	1.004	19.0	0.013820	1.015	11.3	0.016424882	48
16	1.014	1.004	19.0	0.013820	1.010	12.6	0.012264033	32
32	1.011	1.004	19.0	0.013820	1.007	13.4	0.008943046	22
60	1.010	1.004	18.5	0.013905	1.006	13.7	0.006644398	19
113	1.008	1.004	18.5	0.013905	1.004	14.2	0.004929194	13
157	1.007	1.004	19.0	0.013820	1.003	14.4	0.004185424	10
730	1.006	1.004	16.5	0.014260	1.002	14.7	0.002023563	6

P200 Wash

Container ID: J1
 Before - M_d: 13.6 g
 After - M_d: 0.0 g
 Fines Fraction: 100.00 %
 Coarse Fraction: 0.00 %

From Hydrometer

Soil Breakdown	
Coarse:	0.00 %
Silts:	94.00 %
Clays:	6.00 %

Procedures Done By: Melissa B.

Hydrometer Test

Boring:	PGE_Ex_W	Sample:	N3a	Depth (ft-ft):	15.00 15.8	Start Time:	4:53:00 AM
				Ave. Depth (ft):	15.38		

Constants	
M _s (g)	49.87
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.016	1.004	19.5	0.013735	1.012	12.1	0.067567266	39
1	1.013	1.004	19.5	0.013735	1.009	12.9	0.049331409	29
2	1.012	1.004	19.5	0.013735	1.008	13.1	0.035151941	26
4	1.011	1.004	19.5	0.013735	1.007	13.4	0.025139178	23
8	1.010	1.004	19.0	0.013820	1.006	13.7	0.018085201	19
16	1.008	1.004	19.5	0.013735	1.004	14.2	0.012939361	13
32	1.007	1.004	19.0	0.013820	1.003	14.4	0.009270738	10
62	1.006	1.004	19.0	0.013820	1.002	14.7	0.006729315	6
313	1.006	1.004	19.0	0.013820	1.002	14.7	0.002994984	6
278	1.006	1.004	19.0	0.013820	1.002	14.7	0.00317793	6
1101	1.006	1.004	18.0	0.013990	1.002	14.7	0.001616526	6

P200 Wash

Container ID:	W1	Soil Breakdown	
Before - M _d :	25.9 g	Coarse:	20.85 %
After - M _d :	5.4 g	Silts:	73.15 %
Fines Fraction:	79.15 %	Clays:	6.00 %
Coarse Fraction:	20.85 %	From Hydrometer	

Procedures Done By: Melissa B.

Hydrometer Test

Boring: PGE_Ex_W	Sample: N3b	Depth (ft-ft): 15.75 16.50	Start Time: 4:51:00 AM
		Ave. Depth (ft): 16.125	

Constants	
M _s (g)	50.28
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.027	1.004	19.5	0.013735	1.023	9.2	0.058916586	73
1	1.026	1.004	19.0	0.013820	1.022	9.4	0.042371318	70
2	1.023	1.004	19.0	0.013820	1.019	10.2	0.031209954	61
4	1.020	1.004	19.0	0.013820	1.016	11.0	0.022917877	51
8	1.016	1.004	19.0	0.013820	1.012	12.1	0.016996353	38
16	1.013	1.004	19.0	0.013820	1.009	12.9	0.012409175	29
32	1.011	1.004	19.5	0.013735	1.007	13.4	0.008888042	22
60	1.009	1.004	19.0	0.013820	1.005	13.9	0.00665181	16
131	1.008	1.004	19.0	0.013820	1.004	14.2	0.004550054	13
276	1.007	1.004	19.0	0.013820	1.003	14.4	0.00315671	10
1099	1.007	1.004	18.0	0.013990	1.003	14.4	0.001601401	10

P200 Wash

Container ID: R1		Soil Breakdown	
Before - M _d : 10.7 g		Coarse:	5.61 %
After - M _d : 0.6 g		Silts:	84.39 %
Fines Fraction: 94.39 %	From Hydrometer	Clays:	10.00 %
Coarse Fraction: 5.61 %			

Procedures Done By: Melissa B.

Hydrometer Test

Boring:	PGE_Inj	Sample:	N1a	Depth (ft-ft):	5.00 6.25	Start Time:	10:49:00 AM
				Ave. Depth (ft):	5.625		

Constants

M_s (g)	52.24
G_s	2.65
G_w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.021	1.003	17.0	0.014170	1.018	10.7	0.06555061	55
1	1.017	1.003	17.0	0.014170	1.014	11.8	0.048675548	43
2	1.013	1.003	17.0	0.014170	1.010	12.9	0.035987337	31
4	1.009	1.003	17.0	0.014170	1.006	13.9	0.026414796	18
8	1.007	1.003	17.0	0.014170	1.004	14.4	0.01901105	12
16	1.006	1.003	17.0	0.014170	1.003	14.7	0.01358215	9
36	1.005	1.003	17.0	0.014170	1.002	15.0	0.009146696	6
68	1.004	1.003	17.0	0.014170	1.001	15.2	0.00669942	3
127	1.004	1.003	17.0	0.014170	1.001	15.2	0.004902186	3
236	1.004	1.003	17.0	0.014170	1.001	15.2	0.003596132	3
1449	1.004	1.003	16.0	0.014350	1.001	15.2	0.001469737	3

P200 Wash

Container ID:	Z1	Soil Breakdown		
Before - M_d :	55.5 g	Coarse:	20.36 %	
After - M_d :	11.3 g	Silts:	76.64 %	
Fines Fraction:	79.64 %	From Hydrometer	Clays:	3.00 %
Coarse Fraction:	20.36 %			
Procedures Done By:	Kayla/Melissa P.			

Hydrometer Test

Boring: PGE_Inj Sample: N1b Depth (ft-ft): 6.3 6.5 Start Time: _____
Ave. Depth (ft): 6.4

Constants
M_s (g) #DIV/0!
G_s 2.65
G_w 1

There was not enough soil to perform a hydrometer test.

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)

P200 Wash

Container ID: X1
Before - M_d: 30.7 g
After - M_d: 1.1 g
Fines Fraction: 96.42 %
Coarse Fraction: 3.58 %

Procedures Done By: Melissa P.

Hydrometer Test

Boring:	PGE_Inj	Sample:	N2a	Depth (ft-ft):	10.00 10.25	Start Time:	10:51:00 AM
				Ave. Depth (ft):	10.125		

Constants	
M _s (g)	50.59
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.022	1.003	17.5	0.014080	1.019	10.5	0.064522666	60
1	1.021	1.003	17.5	0.014080	1.018	10.7	0.046056883	57
2	1.015	1.003	17.5	0.014080	1.012	12.3	0.034917264	38
4	1.010	1.003	17.5	0.014080	1.007	13.7	0.026057512	22
8	1.008	1.003	17.5	0.014080	1.005	14.2	0.018758661	16
16	1.005	1.003	17.5	0.014080	1.002	15.0	0.013632901	6
34	1.004	1.003	17.5	0.014080	1.001	15.2	0.009414234	3
66	1.004	1.003	17.5	0.014080	1.001	15.2	0.006756978	3
125	1.004	1.003	17.5	0.014080	1.001	15.2	0.004909864	3
234	1.004	1.003	17.0	0.014170	1.001	15.2	0.003611468	3
1447	1.004	1.003	16.0	0.014350	1.001	15.2	0.001470752	3

P200 Wash

Container ID:	D1	Soil Breakdown	
Before - M _d :	27.6 g	Coarse:	7.97 %
After - M _d :	2.2 g	Silts:	89.03 %
Fines Fraction:	92.03 %	Clays:	3.00 %
Coarse Fraction:	7.97 %	<i>From Hydrometer</i>	

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	PGE_Inj	Sample:	N2b	Depth (ft-ft):	10.25 11.50	Start Time:	10:53:00 AM
				Ave. Depth (ft):	10.875		

Constants	
M _s (g)	52.00
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.027	1.003	17.5	0.014080	1.024	9.2	0.060396471	74
1	1.026	1.003	17.5	0.014080	1.023	9.4	0.043168463	71
2	1.023	1.003	17.5	0.014080	1.020	10.2	0.031797117	62
4	1.022	1.003	17.5	0.014080	1.019	10.5	0.022812207	59
8	1.018	1.003	17.5	0.014080	1.015	11.5	0.016881327	46
16	1.014	1.003	17.5	0.014080	1.011	12.6	0.012494761	34
32	1.011	1.003	17.5	0.014080	1.008	13.4	0.009111294	25
64	1.009	1.003	17.5	0.014080	1.006	13.9	0.006561756	19
125	1.007	1.003	17.5	0.014080	1.004	14.4	0.00477891	12
247	1.007	1.003	17.0	0.014170	1.004	14.4	0.00342139	12
1445	1.006	1.003	16.0	0.014350	1.003	14.7	0.00144736	9

P200 Wash

Container ID:	A1
Before - M _d :	37.6 g
After - M _d :	0.3 g
Fines Fraction:	99.20 %
Coarse Fraction:	0.80 %

Soil Breakdown	
Coarse:	0.80 %
Silts:	88.20 %
Clays:	11.00 %

From Hydrometer

Procedures Done By: Kayla/Melissa P.

Hydrometer Test

Boring:	PGE_Inj	Sample:	N3a	Depth (ft-ft):	15.5	15.75	Start Time:
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Ave. Depth (ft): 15.625

Constants

M_s (g) #DIV/0!

G_s 2.65

 G_w 1

There was not enough soil to perform a hydrometer test.

[illegible]

P200 Wash

Container ID:

Before - M_d : g

After - M_d : g

Fines Fraction: 21.22 %

Coarse Fraction: 78.78 %

Procedures Done By: Melissa B.

Hydrometer Test

Boring:	PGE_Inj	Sample:	N3b	Depth (ft-ft):	15.75 16.50	Start Time:	10:55:00 AM
				Ave. Depth (ft):	16.125		

Constants	
M _s (g)	59.35
G _s	2.65
G _w	1

Time (min)	Soil (slurry)	Control	Temp (°C)	Temp Correction (K)	Hydrometer Correction (R)	Effective Depth, L (cm)	Diameter (mm)	Percent Passing (%)
0.5	1.030	1.003	17.5	0.014080	1.027	8.4	0.057710827	73
1	1.029	1.003	17.5	0.014080	1.026	8.6	0.041290665	70
2	1.027	1.003	17.5	0.014080	1.024	9.2	0.030198236	65
4	1.026	1.003	17.5	0.014080	1.023	9.4	0.021584231	62
8	1.022	1.003	17.5	0.014080	1.019	10.5	0.016130666	51
16	1.017	1.003	17.5	0.014080	1.014	11.8	0.012091597	38
30	1.013	1.003	17.5	0.014080	1.010	12.0	0.008904974	27
62	1.010	1.003	17.5	0.014080	1.007	13.7	0.006618615	19
123	1.007	1.003	17.5	0.014080	1.004	14.4	0.004817607	11
245	1.006	1.003	17.0	0.014170	1.003	14.7	0.003470927	8
1443	1.005	1.003	16.0	0.014350	1.002	15.0	0.001463068	5

P200 Wash

Container ID:	C1
Before - M _d :	27.5 g
After - M _d :	0.6 g
Fines Fraction:	97.82 %
Coarse Fraction:	2.18 %

Soil Breakdown	
Coarse:	2.18 %
Silts:	90.82 %
Clays:	7.00 %

From Hydrometer

Procedures Done By: Kayla/Melissa P.

Appendix I: V_s/V_p Acquisition Software Installation Instructions

1. Download the file 'TREX_Software' onto your personal computer.
2. Open the 'Driver_CD' folder.
3. Open the application 'setup', date modified 10/12/2010.

Allow the program access to make changes to your computer.

4. Click 'Driver Installation'.
5. Choose 'USBDAQ'.
6. Click 'Driver Installation'.

Go through the Setup Wizard.

7. Exit the Setup Wizard. The software is now installed.

Appendix J: V_s/V_p Field Instrumentation Schematic

Appendix K: V_s/V_p Data Collection Instructions

1. Setup the equipment.

2. Open the 'VB_ADLink' application, located within the TREX_Software folder.

NOTE: This will only open if the Data Logger is connected to the laptop with the software already installed.

3. Click the 'Open Excel' button. There are 5 sheets in this workbook.

- The first sheet is Setup. We use this sheet to change the name of the files for the data acquired.

- The second sheet is AveragedRecord. We do not use this sheet during data acquisition.

- The third sheet is Sheet1. This sheet displays the data received from the hammer.

NOTE: This is the sheet that is looked at while collecting the data, to make sure the average is representative of the set of 10 hammer hits.

It also displays the maximum values of Sheet2 and Sheet3 to make sure that the data gathered is good quality (these values should be in the 10^{-4} to 10^{-2} magnitude range, and both values should have close to the same order or magnitude).

- The fourth sheet is Sheet2. This sheet displays the data captured from the nearest geophone.

- The fifth sheet is Sheet3. This sheet displays the data captured from the furthest geophone.

3. Go back to the AD_Link software window. Click on the Start button to start collecting data.

4. Look at the excel sheet Sheet1 while gently tap the hammer 10 times on the designated rod. Check the quality of the hammer hits and the maximum values recorded for the geophones.

NOTE: If the average line on the graph is representative of all 10 hammer hits, and the maximums for Sheet2 and Sheet3 are acceptable, go to the Setup sheet and save the file.

IMPORTANT: Save the data in the same format to keep the file names consistent. First is the hitting direction, then the set of geophones, then the direction data is being collected from, e.g., Up 1&2 X or Down 5&6 Z.

5. Repeat step 4 until you have a set a data for both up hits and down hits for each direction (X and Z) for each set of geophones. You should have a total of 16 folders when done with the data collection.

Appendix L: V_s/V_p Data Filtering Instructions

1. Go to the 'Crosshole Data' folder on the stash. Create a folder and name it with the date that the data was collected in the format year_month_day (i.e. 2019_11_07).
2. Upload the collected data to the stash. If there are 2 data sets, name the folders 'Data_Set_1' and 'Data_Set_2'.
3. Open the Anaconda prompt (part of Python) and type 'Jupyter Notebook' in the command screen. This will open up your default browser.
4. Navigate through the files displayed until you find the filtering code, then double-click. This will open a new webpage with the code displayed.
5. Change the file paths for where the data is located that you want to filter (Step 2), and where you want the filtered data to be saved to (this can be the same folder if desired). These paths are displayed in red text within the code.
6. Run the code.

Appendix M: V_s/V_p Data Formatting Instructions

1. Go to the 'Crosshole Data' folder on the stash and choose the date of the data that needs to be filtered.

2.

3. Open a folder from a previous date, and transfer the excel workbook

(YYYY_MM_DD_Filtered) into the new folder with the new data. Rename the workbook with the date of the new data.

NOTE: This workbook has 8 sheets. The sheets are named with the source rod name and the data set, i.e. Rod 3_2 is the data for source rod 3, from the second data set. The headers describe which geophone the data is from, as well as the type of hammer hit and the type of wave captured. I.e. Sheet3UZ is data from the furthest geophone, up hits, and the shear wave is what was captured. The workbook tab indicates which rod the data is from.

4. Open the folder 'Data_Set_1'. Open the folder 'Down 1&2 X'. Open the workbook 'AveragedRecord_Filtered'. This is the data source rod 1, hitting downwards, and capturing the X-directional wave (pressure wave). Ch 0 is the average of the hammer hits, Ch 1 is the average of the nearest geophone recordings, and CH 2 is the average of the furthest geophone recordings.

5. Copy the data from columns labeled 'Ch 1' and 'Ch 2' and paste the data into the workbook with 8 tabs, named with the collection date. Paste the data in the sheet label 'Rod 1_1' under the headings 'Sheet2DX' and 'Sheet3DX'. This is the averaged data from downhits on source rod 1 for both the nearest and furthest geophones in the X direction.

6. Close the 'AveragedRecord_Filtered' workbook. Go back into the 'Data_Set_1' folder and open the folder 'Down 1&2 Z'. Repeat step 5, but place the copied data into the columns labeled 'Sheet2DZ' and 'Sheet3DZ'. This is the averaged data from downhits on source rod 1 for both the nearest and furthest geophone in the Z direction.
7. Close the 'AveragedRecord_Filtered' workbook. Go back into the 'Data_Set_1' folder and open the folder 'Up 1&2 X'. Repeat step 5, placing the copied data into the columns labeled 'Sheet2UX' and 'Sheet3UX'.
8. Close the 'AveragedRecord_Filtered' workbook. Go back into the 'Data_Set_1' folder and open the folder 'Up 1&2 Z'. Repeat step 5, placing the copied data into the columns labeled 'Sheet2UZ' and 'Sheet3UZ'.
9. All the data from source rod 1 for the first data set is now in the workbook. Move to the tab labeled 'Rod 2_1' and repeat steps 5-8 for the folders labeled 'Down 3&4 X', 'Down 3&4 Z', 'Up 3&4 X', and 'Up 3&4 Z'.
10. All the data from source rod 2 for the first data set is now in the workbook. Move to the tab labeled 'Rod 3_1' and repeat steps 5-8 for the folders labeled 'Down 5&6 X', 'Down 5&6 Z', 'Up 5&6 X', and 'Up 5&6 Z'.
11. All the data from source rod 3 for the first data set is now in the workbook. Move to the tab labeled 'Rod 4_1' and repeat steps 5-8 for the folders labeled 'Down 7&8 X', 'Down 7&8 Z', 'Up 7&8 X', and 'Up 7&8 Z'.
12. All the data from the first data set is now in the workbook. Repeat steps 4-11 for the data in the folder 'Data_Set_2'.
13. All data from both data sets are now in the workbook. Make sure this workbook is saved on the stash.

Appendix N: Analyzing the V_s/V_p Data with Matlab

1. Open Matlab
2. Run the script 'Pick_Arrivals.m'. This script is located on the stash in the 'Matlab' folder.
3. Make sure the excel named with date the data was taken is copied into the 'Matlab' folder on the stash. Make sure that Matlab is reading from this folder.
4. Click on the 'Import Data' button within Matlab.
5. Choose the workbook with the data you want to analyze. Click Open.
6. A pop-up window will open. Change the output type to 'Numeric Matrix'.
7. Click 'Import Selection'. Repeat this step for each of the 8 tabs.
8. Close the pop-up window.
9. In the workspace window of Matlab, you will now have 8 files. The order they were imported were 'Untitled', 'S1', 'S2', etc. In the order they were imported, rename the matrices as the next set of run numbers (i.e. Run00124, Run00125, etc.).

NOTE: The files were imported in the order of: (Rod 1, data set 1), (Rod 1, data set 2), (Rod 2, data set 1), (Rod 2, data set 2), etc.
10. Right click on each of these newly-renamed matrices. Save each one as the same run number. This will save the .mat file with the run number. This is what is called within the script.
11. Within the 'Pick_Arrivals.m' script, change the inputs on lines 5,6,7,8,9,10,12,13,14,15,16, and 17 to the run that you want to analyze. All inputs are the same run number.
12. Click 'Run' on the top ribbon under the 'Editor' tab.

13. A pop-up window appears with 4 plots. Go to Edit --> copy figure.
 14. Open the powerpoint file named 'Graphs_After_Treatment'. Paste this figure onto a new slide with the data set number, the date the data was collected, the run number, the rod the data was collected from, and whether it is from 'Data_Set_1' or 'Data_Set_2'.
 15. In Matlab, under Tools, choose 'Data Tips'. Pick the arrival times for each graph. The top two graphs are the p-wave, the bottom two are the s-wave.
- NOTE: You may need to use the 'Zoom In' function under Tools to accurately choose the arrival point. You can hold the 'Shift' key to choose multiple data points at once.
16. Once all data points are chosen, copy the graph. Paste the graph in the 'Graphs_After_Treatment' powerpoint on a new slide immediately following the slide with the information listen in step 14.
 17. Open the excel file 'Summary_Velocity'. Create a new tab and name it with the date the data was taken and the data set number.
 18. Insert the X coordinate values from the Matlab graphs into their respective cells. The velocity will auto-populate.
 19. Repeat steps 11-18 for each run. There should be 8 runs for 2 data sets, 4 runs for 1 data set.
 20. On the 'Data Summary' tab of the 'Summary_Velocity' excel, copy/paste the velocity values for the average p-wave, p-wave from data set 1, p-wave from data set 2, and the average s-wave. The graphs up top should auto-populate. If not, include the new cells in the data being called for the graph.

Appendix O: Before treatment: Crosshole geophone voltage time series for V_s and V_p arrival selection.

Data Set 2 (8.9.2019)

Run00001f

R1_1

Data Set 2 (8.9.2019)

Run00002f

R1_2

Data Set 2 (8.9.2019)

Run00003f

R2_1

Data Set 2 (8.9.2019)

Run00004f

R2_2

Data Set 2 (8.9.2019)

Run00005f

R3_1

Data Set 2 (8.9.2019)

Run00006f

R3_2

Data Set 2 (8.9.2019)

Run00007f

R4_1

Data Set 3 (8.12.2019)

Run00009f

R1_1

Data Set 3 (8.12.2019)

Run000010f

R1_2

Data Set 3 (8.12.2019)

Run00011f

R2_1

Data Set 3 (8.12.2019)

Run00012f

R2_2

Data Set 3 (8.12.2019)

Run00013f

R3_1

Data Set 3 (8.12.2019)

Run00014f

R3_2

Data Set 3 (8.12.2019)

Run00015f

R4_1

Data Set 3 (8.12.2019)

Run00016f

R4_2

Data Set 4 (8.14.2019)

Run00017f

R1_1

Data Set 4 (8.14.2019)

Run00019f

R2_1

Data Set 4 (8.14.2019)

Run00020f

R2_2

Data Set 4 (8.14.2019)

Run00021f

R3_1

Data Set 4 (8.14.2019)

Run00022f

R3_2

Data Set 4 (8.14.2019)

Run00023f

R4_1

Data Set 4 (8.14.2019)

Run00024f

R4_2

Appendix P: During treatment: Crosshole geophone voltage time series for V_s and V_p arrival selection.

Data Set 5 (8.15.2019)

Run00025f

R1_1

Data Set 5 (8.15.2019)

Run00026f

R1_2

Data Set 5 (8.15.2019)

Run00027f

R2_1

Data Set 5 (8.15.2019)

Run00028f

R2_2

Data Set 5 (8.15.2019)

Run00029f

R3_1

Data Set 5 (8.15.2019)

Run00030f

R3_2

Data Set 5 (8.15.2019)

Run00031f

R4_1

Data Set 5 (8.15.2019)

Run00032f

R4_2

Data Set 6 (8.16.2019)

Run00033f

R1_1

Data Set 6 (8.16.2019)

Run00034f

R1_2

Data Set 6 (8.16.2019)

Run00035f

R2_1

Data Set 6 (8.16.2019)

Run00036f

R2_2

Data Set 6 (8.16.2019)

Run00037f

R3_1

Data Set 6 (8.16.2019)

Run00038f

R3_2

Data Set 6 (8.16.2019)

Run00039f

R4_1

Data Set 6 (8.16.2019)

Run00040f

R4_2

Data Set 7 (8.19.2019)

Run00041f

R1_1

Data Set 7 (8.19.2019)

Run00042f

R1_2

Data Set 7 (8.19.2019)

Run00043f

R2_1

Data Set 7 (8.19.2019)

Run00044f

R2_2

Data Set 7 (8.19.2019)

Run00045f

R3_1

Data Set 7 (8.19.2019)

Run00046f

R3_2

Data Set 7 (8.19.2019)

Run00047f

R4_1

Data Set 7 (8.19.2019)

Run00048f

R4_2

Data Set 8 (8.20.2019)

Run00049f

R1_1

Data Set 8 (8.20.2019)

Run00050f

R1_2

Data Set 8 (8.20.2019)

Run00051f

R2_1

Data Set 8 (8.20.2019)

Run00052f

R2_2

Data Set 8 (8.20.2019)

Run00053f

R3_1

Data Set 8 (8.20.2019)

Run00054f

R3_2

Data Set 8 (8.20.2019)

Run00055f

R4_1

Data Set 8 (8.20.2019)

Run00056f

R4_2

Data Set 9 (8.21.2019)

Run00057f

R1_1

Data Set 9 (8.21.2019)

Run00058f

R1_2

Data Set 9 (8.21.2019)

Run00059f

R2_1

Data Set 9 (8.21.2019)

Run00060f

R2_2

Data Set 9 (8.21.2019)

Run00061f

R3_1

Data Set 9 (8.21.2019)

Run00062f

R3_2

Data Set 9 (8.21.2019)

Run00063f

R4_1

Data Set 9 (8.21.2019)

Run00064f

R4_2

Data Set 10 (8.22.2019)

Run00065f

R1_1

Data Set 10 (8.22.2019)

Run00066f

R1_2

Data Set 10 (8.22.2019)

Run00067f

R2_1

Data Set 10 (8.22.2019)

Run00068f

R2_2

Cannot determine clear arrival times.

Data Set 10 (8.22.2019)

Run00069f

R3_1

Data Set 10 (8.22.2019)

Run00070f

R3_2

Data Set 10 (8.22.2019)

Run00071f

R4_1

Data Set 10 (8.22.2019)

Run00072f

R4_2

Data Set 11 (8.23.2019)

Run00073f

R1_1

Data Set 11 (8.23.2019)

Run00074f

R1_2

Data Set 11 (8.23.2019)

Run00075f

R2_1

Data Set 11 (8.23.2019)

Run00076f

R2_2

Data Set 11 (8.23.2019)

Run00077f

R3_1

Data Set 11 (8.23.2019)

Run00078f

R3_2

Data Set 11 (8.23.2019)

Run00079f

R4_1

Data Set 11 (8.23.2019)

Run00080f

R4_2

Data Set 12 (8.26.2019)

Run00081f

R1_1

Data Set 12 (8.26.2019)

Run00082f

R1_2

Data Set 12 (8.26.2019)

Run00083f

R2_1

Data Set 12 (8.26.2019)

Run00084f

R2_2

Data Set 12 (8.26.2019)

Run00085f

R3_1

Data Set 12 (8.26.2019)

Run00086f

R3_2

Data Set 12 (8.26.2019)

Run00087f

R4_1

Data Set 12 (8.26.2019)

Run00088f

R4_2

Data Set 13 (8.27.2019)

Run00089f

R1_1

Data Set 13 (8.27.2019)

Run00090f

R1_2

Data Set 13 (8.27.2019)

Run00091f

R2_1

Data Set 13 (8.27.2019)

Run00092f

R2_2

Data Set 13 (8.27.2019)

Run00093f

R3_1

Data Set 13 (8.27.2019)

Run00094f

R3_2

Data Set 13 (8.27.2019)

Run00095f

R4_1

Data Set 13 (8.27.2019)

Run00096f

R4_2

Data Set 14 (8.28.2019)

Run00097f

R1_1

Data Set 14 (8.28.2019)

Run00098f

R1_2

Data Set 14 (8.28.2019)

Run00090f

R2_1

Data Set 14 (8.28.2019)

Run00100f

R2_2

Data Set 14 (8.28.2019)

Run00101f

R3_1

Data Set 14 (8.28.2019)

Run00102f

R3_2

Data Set 14 (8.28.2019)

Run00103f

R4_1

Data Set 14 (8.28.2019)

Run00104f

R4_2

Data Set 15 (8.29.2019)

Run00105f

R1_1

Data Set 15 (8.29.2019)

Run00106f

R1_2

Data Set 15 (8.29.2019)

Run00107f

R2_1

Data Set 15 (8.29.2019)

Run00108f

R2_2

Data Set 15 (8.29.2019)

Run00109f

R3_1

Data Set 15 (8.29.2019)

Run00110f

R3_2

Data Set 15 (8.29.2019)

Run00111f

R4_1

Data Set 15 (8.29.2019)

Run00112f

R4_2

Data Set 16 (8.30.2019)

Run00113f

R1_1

Data Set 16 (8.30.2019)

Run00114f

R1_2

Data Set 16 (8.30.2019)

Run00115f

R2_1

Data Set 16 (8.30.2019)

Run00116f

R2_2

Data Set 16 (8.30.2019)

Run00117f

R3_1

Data Set 16 (8.30.2019)

Run00118f

R3_2

Data Set 16 (8.30.2019)

Run00119f

R4_1

Data Set 16 (8.30.2019)

Run00120f

R4_2

Data Set 17 (9.2.2019)

Run00121f

R1_1

Data Set 17 (9.2.2019)

Run00122f

R1_2

Data Set 17 (9.2.2019)

Run00123f

R2_1

Data Set 17 (9.2.2019)

Run00124f

R2_2

Data Set 17 (9.2.2019)

Run00125f

R3_1

Data Set 17 (9.2.2019)

Run00126f

R3_2

Data Set 17 (9.2.2019)

Run00127f

R4_1

Data Set 17 (9.2.2019)

Run00128f

R4_2

Data Set 18 (9.3.2019)

Run00129f

R1_1

Data Set 18 (9.3.2019)

Run00130f

R1_2

Data Set 18 (9.3.2019)

Run00131f

R2_1

Data Set 18 (9.3.2019)

Run00132f

R2_2

Data Set 18 (9.3.2019)

Run00133f

R3_1

Data Set 18 (9.3.2019)

Run00134f

R3_2

Data Set 18 (9.3.2019)

Run00135f

R4_1

Data Set 18 (9.3.2019)

Run00136f

R4_2

Data Set 19 (9.4.2019)

Run00137f

R1_1

Data Set 19 (9.4.2019)

Run00138f

R1_2

Data Set 19 (9.4.2019)

Run00139f

R2_1

Data Set 19 (9.4.2019)

Run00140f

R2_2

Data Set 19 (9.4.2019)

Run00141f

R3_1

Data Set 19 (9.4.2019)

Run00142f

R3_2

Data Set 19 (9.4.2019)

Run00143f

R4_1

Data Set 19 (9.4.2019)

Run00144f

R4_2

Data Set 20 (9.5.2019)

Run00145f

R1_1

Data Set 20 (9.5.2019)

Run00146f

R1_2

Data Set 20 (9.5.2019)

Run00147f

R2_1

Data Set 20 (9.5.2019)

Run00148f

R2_2

Data Set 20 (9.5.2019)

Run00149f

R3_1

Data Set 20 (9.5.2019)

Run00150f

R3_2

Data Set 20 (9.5.2019)

Run00151f

R4_1

Data Set 20 (9.5.2019)

Run00152f

R4_2

Data Set 21 (9.6.2019)

Run00153f

R1_1

Data Set 21 (9.6.2019)

Run00154f

R1_2

Data Set 21 (9.6.2019)

Run00155f

R2_1

Data Set 21 (9.6.2019)

Run00156f

R2_2

Data Set 21 (9.6.2019)

Run00157f

R3_1

Data Set 21 (9.6.2019)

Run00158f

R3_2

Data Set 21 (9.6.2019)

Run00159f

R4_1

Data Set 21 (9.6.2019)

Run00160f

R4_2

Data Set 22 (9.7.2019)

Run00161f

R1_1

Data Set 22 (9.7.2019)

Run00162f

R1_2

Data Set 22 (9.7.2019)

Run00163f

R2_1

Data Set 22 (9.7.2019)

Run00164f

R2_2

Data Set 22 (9.7.2019)

Run00165f

R3_1

Data Set 22 (9.7.2019)

Run00166f

R3_2

Data Set 22 (9.7.2019)

Run00167f

R4_1

Data Set 22 (9.7.2019)

Run00168f

R4_2

Data Set 23 (9.9.2019)

Run00169f

R1_1

Data Set 23 (9.9.2019)

Run00170f

R1_2

Data Set 23 (9.9.2019)

Run00171f

R2_1

Data Set 23 (9.9.2019)

Run00172f

R2_2

Data Set 23 (9.9.2019)

Run00173f

R3_1

Data Set 23 (9.9.2019)

Run00174f

R3_2

Data Set 23 (9.9.2019)

Run00175f

R4_1

Data Set 23 (9.9.2019)

Run00176f

R4_2

Data Set 24 (9.10.2019)

Run00177f

R1_1

Data Set 24 (9.10.2019)

Run00178f

R1_2

Data Set 24 (9.10.2019)

Run00179f

R2_1

Data Set 24 (9.10.2019)

Run00180f

R2_2

Data Set 24 (9.10.2019)

Run00181f

R3_1

Data Set 24 (9.10.2019)

Run00182f

R3_2

Data Set 24 (9.10.2019)

Run00183f

R4_1

Data Set 24 (9.10.2019)

Run00184f

R4_2

Appendix Q: After treatment: Crosshole geophone voltage time series for V_s and V_p arrival selection.

Data Set 25 (9.16.2019)

Run00185f

R1_1

Data Set 25 (9.16.2019)

Run00186f

R1_2

Data Set 25 (9.16.2019)

Run00187f

R2_1

Data Set 25 (9.16.2019)

Run00188f

R2_2

Data Set 25 (9.16.2019)

Run00189f

R3_1

Data Set 25 (9.16.2019)

Run00190f

R3_2

Data Set 25 (9.16.2019)

Run00191f

R4_1

Data Set 25 (9.16.2019)

Run00192f

R4_2

Data Set 26 (9.26.2019)

Run00193f

R1_1

Data Set 26 (9.26.2019)

Run00194f

R1_2

Data Set 26 (9.26.2019)

Run00195f

R2_1

Data Set 26 (9.26.2019)

Run00196f

R2_2

Data Set 26 (9.26.2019)

Run00197f

R3_1

Data Set 26 (9.26.2019)

Run00198f

R3_2

Data Set 26 (9.26.2019)

Run00199f

R4_1

Data Set 26 (9.26.2019)

Run00200f

R4_2

Data Set 27 (10.7.2019)

Run00201f

R1_1

Data Set 27 (10.7.2019)

Run00202f

R1_2

Data Set 27 (10.7.2019)

Run00203f

R2_1

Data Set 27 (10.7.2019)

Run00204f

R2_2

Data Set 27 (10.7.2019)

Run00205f

R3_1

Data Set 27 (10.7.2019)

Run00206f

R3_2

Data Set 27 (10.7.2019)

Run00207f

R4_1

Data Set 27 (10.7.2019)

Run00208f

R4_2

Data Set 28 (10.18.2019)

Run00209f

R1_1

Data Set 28 (10.18.2019)

Run00210f

R1_2

Data Set 28 (10.18.2019)

Run00211f

R2_1

Data Set 28 (10.18.2019)

Run00212f

R2_2

Data Set 28 (10.18.2019)

Run00213f

R3_1

Data Set 28 (10.18.2019)

Run00214f

R3_2

Data Set 28 (10.18.2019)

Run00215f

R4_1

Data Set 28 (10.18.2019)

Run00216f

R4_2

Cannot determine clear arrival times.

Data Set 29 (11.1.2019)

Run00217f

R1_1

Cannot determine clear arrival times.

Data Set 29 (11.1.2019)

Run00218f

R1_2

Cannot determine clear arrival times.

Data Set 29 (11.1.2019)

Run00219f

R2_1

Cannot determine clear arrival times.

Data Set 29 (11.1.2019)

Run00220f

R2_2

Cannot determine clear arrival times.

Data Set 29 (11.1.2019)

Run00221f

R3_1

Data Set 29 (11.1.2019)

Run00222f

R3_2

Data Set 29 (11.1.2019.2019)

Run00223f

R4_1

Cannot determine clear arrival times.

Data Set 29 (11.1.2019)

Run00224f

R4_2

Data Set 30 (11.2.2019)

Run00225f

R1_1

Run00226f

R1_2

Data Set 30 (11.2.2019)

Run00227f

R2_1

Data Set 30 (11.2.2019)

Run00228f

R2_2

Data Set 30 (11.2.2019)

Run00229f

R3_1

Data Set 30 (11.2.2019)

Run00230f

R3_2

Data Set 30 (11.2.2019)

Run00231f

R4_1

Data Set 30 (11.2.2019)

Run00232f

R4_2

Data Set 31 (11.7.2019)

Run00233f

R1_1

Data Set 31 (11.7.2019)

Run00234f

R1_2

Data Set 31 (11.7.2019)

Run00235f

R2_1

Cannot determine clear arrival times.

Data Set 31 (11.7.2019)

Run00236f

R2_2

Data Set 31 (11.7.2019)

Run00237f

R3_1

Data Set 31 (11.7.2019)

Run00238f

R3_2

Data Set 31 (11.7.2019)

Run00239f

R4_1

Data Set 31 (11.7.2019)

Run00240f

R4_2

Data Set 32 (11.22.2019)

Run00241f

R1_1

Data Set 32 (11.22.2019)

Run00242f

R1_2

Data Set 32 (11.22.2019)

Run00245f

R3_1

Data Set 32 (11.22.2019)

Run00246f

R3_2

Data Set 32 (11.22.2019)

Run00247f

R4_1

Data Set 32 (11.22.2019)

Run00248f

R4_2

Data Set 33 (12.8.2019)

Run00249f

R1_1

Data Set 33 (12.8.2019)

Run00250f

R1_2

Data Set 33 (12.8.2019)

Run00251f

R2_1

Data Set 33 (12.8.2019)

Run00253f

R3_1

Data Set 33 (12.8.2019)

Run00254f

R3_2

Data Set 33 (12.8.2019)

Run00255f

R4_1

Data Set 33 (12.8.2019)

Run00256f

R4_2

Data Set 34 (12.18.2019)

Run00257f

R1_1

Data Set 34 (12.18.2019)

Run00258f

R1_2

Data Set 34 (12.18.2019)

Run00259f

R2_1

Data Set 34 (12.18.2019)

Run00260f

R2_2

Data Set 34 (12.18.2019)

Run00261f

R3_1

Cannot determine clear arrival times.

Data Set 34 (12.18.2019)

Run00262f

R3_2

Data Set 34 (12.18.2019)

Run00263f

R4_1

Data Set 34 (12.18.2019)

Run00264f

R4_2

Cannot determine clear arrival times

Data Set 35 (1.17.2020)

Run00265f

R1_1

Data Set 35 (1.17.2020)

Run00266f

R1_2

Cannot determine clear arrival times

Data Set 35 (1.17.2020)

Run00267f

R2_1

Cannot determine clear arrival times

Data Set 35 (1.17.2020)

Run00268f

R2_2

Data Set 35 (1.17.2020)

Run00269f

R3_1

Data Set 35 (1.17.2020)

Run00270f

R3_2

Data Set 35 (1.17.2020)

Run00271f

R4_1

Data Set 35 (1.17.2020)

Run00272f

R4_2

Data Set 36 (2.21.2020)

Run00273f

R1_1

Data Set 36 (2.21.2020)

Run00275f

R2_1

Cannot determine clear arrival times

Data Set 36

(2.21.2020)

Run00276f

R2_2

Data Set 36 (2.21.2020)

Run00277f

R3_1

Data Set 36 (2.21.2020)

Run00278f

R3_2

Data Set 36 (2.21.2020)

Run00279f

R4_1

Data Set 36 (2.21.2020)

Run00280f

R4_2

Data Set 37 (2.28.2020)

Run00281f

R1_1

Data Set 37 (2.28.2020)

Run00282f

R1_2

Data Set 37 (2.28.2020)

Run00283f

R2_1

Data Set 37 (2.28.2020)

Run00284f

R2_2

Data Set 37 (2.28.2020)

Run00285f

R3_1

Data Set 37 (2.28.2020)

Run00286f

R3_2

Data Set 37 (2.28.2020)

Run00287f

R4_1

Data Set 37 (2.28.2020)

Run00288f

R4_2

Data Set 38 (4.3.2020)

Run00289f

R1_1

Data Set 38 (4.3.2020)

Run00290f

R1_2

Data Set 38 (4.3.2020)

Run00291f

R2_1

Data Set 38 (4.3.2020)

Run00292f

R2_2

Data Set 38 (4.3.2020)

Run00293f

R3_1

Data Set 38 (4.3.2020)

Run00294f

R3_2

Data Set 38 (4.3.2020)

Run00295f

R4_1

Data Set 38 (4.3.2020)

Run00296f

R4_2

Data Set 39 (4.28.2020)

Run00297f

R1_1

Data Set 39 (4.28.2020)

Run00298f

R1_2

Data Set 39 (4.28.2020)

Run00299f

R2_1

Data Set 39 (4.28.2020)

Run00300f

R2_2

Data Set 39 (4.28.2020)

Run00301f

R3_1

Data Set 39 (4.28.2020)

Run00302f

R3_2

Data Set 39 (4.28.2020)

Run00303f

R4_1

Data Set 39 (4.28.2020)

Run00304f

R4_2

Data Set 40 (5.29.2020)

Run00305f

R1_1

Data Set 40 (5.29.2020)

Run00306f

R1_2

Data Set 40 (5.29.2020)

Run00307f

R2_1

Data Set 40 (5.29.2020)

Run00308f

R2_2

Data Set 40 (5.29.2020)

Run00309f

R3_1

Data Set 40 (5.29.2020)

Run00310f

R3_2

Data Set 40 (5.29.2020)

Run00311f

R4_1

Data Set 40 (5.29.2020)

Run00312f

R4_2

Data Set 41 (6.21.2020)

Run00313f

R1_1

Data Set 41 (6.21.2020)

Run00314f

R1_2

Data Set 41 (6.21.2020)

Run00315f

R2_1

Data Set 41 (6.21.2020)

Run00316f

R2_2

Data Set 41 (6.21.2020)

Run00317f

R3_1

Data Set 41 (6.21.2020)

Run00318f

R3_2

Data Set 41 (6.21.2020)

Run00319f

R4_1

Data Set 41 (6.21.2020)

Run00320f

R4_2

Data Set 42 (7.9.2020)

Run00321f

R1_1

Data Set 42 (7.9.2020)

Run00322f

R1_2

Data Set 42 (7.9.2020)

Run00323f

R2_1

Data Set 42 (7.9.2020)

Run00324f

R2_2

Data Set 42 (7.9.2020)

Run00326f

R3_2

Data Set 42 (7.9.2020)

Run00327f

R4_1

Data Set 42 (7.9.2020)

Run00328f

R4_2

Data Set 43 (8.11.2020)

Run00329f

R1_1

Data Set 43 (8.11.2020)

Run00330f

R1_2

Data Set 43 (8.11.2020)

Run00331f

R2_1

Data Set 43 (8.11.2020)

Run00332f

R2_2

Data Set 43 (8.11.2020)

Run00333f

R3_1

Data Set 43 (8.11.2020)

Run00334f

R3_2

Data Set 43 (8.11.2020)

Run00335f

R4_1

Data Set 43 (8.11.2020)

Run00336f

R4_2

Data Set 44 (9.3.2020)

Run00337f

R1_1

Data Set 44 (9.3.2020)

Run00338f

R1_2

Data Set 44 (9.3.2020)

Run00339f

R2_1

Data Set 44 (9.3.2020)

Run00340f

R2_2

Data Set 44 (9.3.2020)

Run00341f

R3_1

Data Set 44 (9.3.2020)

Run00342f

R3_2

Data Set 44 (9.3.2020)

Run00343f

R4_1

Data Set 44 (9.3.2020)

Run00344f

R4_2

Data Set 45 (10.2.2020)

Run00345f

R1_1

Data Set 45 (10.2.2020)

Run00346f

R1_2

Data Set 45 (10.2.2020)

Run00347f

R2_1

Data Set 45 (10.2.2020)

Run00348f

R2_2

Data Set 45 (10.2.2020)

Run00349f

R3_1

Data Set 45 (10.2.2020)

Run00350f

R3_2

Data Set 45 (10.2.2020)

Run00351f

R4_1

Data Set 45 (10.2.2020)

Run00352f

R4_2

Data Set 46 (11.21.2020)

Run00353f

R1_1

Data Set 46 (11.21.2020)

Run00354f

R1_2

Data Set 46 (11.21.2020)

Run00355f

R2_1

Data Set 46 (11.21.2020)

Run00356f

R2_2

Data Set 46 (11.21.2020)

Run00357f

R3_1

Data Set 46 (11.21.2020)

Run00358f

R3_2

Data Set 46 (11.21.2020)

Run00359f

R4_1

Data Set 46 (11.21.2020)

Run00360f

R4_2

Data Set 47 (12.12.2020)

Run00361f

R1_1

Data Set 47 (12.12.2020)

Run00362f

R1_2

Data Set 47 (12.12.2020)

Run00363f

R2_1

Data Set 47 (12.12.2020)

Run00364f

R2_2

Data Set 47 (12.12.2020)

Run00365f

R3_1

Data Set 47 (12.12.2020)

Run00366f

R3_2

Data Set 47 (12.12.2020)

Run00367f

R4_1

Data Set 47 (12.12.2020)

Run00368f

R4_2

Data Set 48 (3.16.2021)

Run00369f

R1_1

Data Set 48 (3.16.2021)

Run00370f

R1_2

Data Set 48 (3.16.2021)

Run00371f

R2_1

Data Set 48 (3.16.2021)

Run00372f

R2_2

Data Set 48 (3.16.2021)

Run00373f

R3_1

Data Set 48 (3.16.2021)

Run00374f

R3_2

Data Set 48 (3.16.2021)

Run00375f

R4_1

Data Set 48 (3.16.2021)

Run00376f

R4_2