Summer 6-2022

Draft Final Blacktail Creek Remediation and Contaminated Groundwater Hydraulic Control Site Piezometer Installation and Monitoring Well Repair Plan

Pioneer Technical Services, Inc.

Atlantic Richfield Company

317 Anaconda Road
Butte MT 59701

Josh Bryson
Liability Manager

Direct (406) 782-9964
Fax (406) 782-9980

June 10, 2022

Nikia Greene
Remedial Project Manager
US EPA – Montana Office
Baucus Federal Building
10 West 15th Street, Suite 3200
Helena, Montana 59626

Erin Agee
Senior Assistant Regional Counsel
US EPA Region 8 Office of Regional Counsel
CERCLA Enforcement Section
1595 Wynkoop Street
Denver, CO 80202
Mail Code: 8ORC-C

Daryl Reed
DEQ Project Officer
P.O. Box 200901
Helena, Montana 59620-0901

Jonathan Morgan, Esq.
DEQ, Legal Counsel
P.O. Box 200901
Helena, Montana 59620-0901

RE: Blacktail Creek Piezometer Installation and Monitoring Well Repair Plan

Agency Representatives:

I am writing you on behalf of Atlantic Richfield Company (Atlantic Richfield) to submit the Draft Final *Blacktail Creek (BTC) Remediation and Contaminated Groundwater Hydraulic Control Site Piezometer Installation and Monitoring Well Repair Plan* (Installation and Repair Plan) for your review and approval.

Fieldwork is anticipated to begin as soon as approval is received to allow for the BTC pumping test to occur in 2022.

The report may be downloaded at the following link:

https://pioneertechnicalservices.sharepoint.com/:f:/s/submitted/EvrYZ9SZgAtHkvFmMjSP24wBgKYI7yHGHU2Q-i88dPJh7g.

If you have any questions or comments, please call me at (406) 723-1834.

Sincerely,

Josh Bryson, PE, PMP
Liability Manager
Remediation Management Services Company
An affiliate of **Atlantic Richfield Company**

Atlantic Richfield Company

317 Anaconda Road
Butte MT 59701

Josh Bryson
Liability Manager

Direct (406) 782-9964
Fax (406) 782-9980

Cc: Patricia Gallery / Atlantic Richfield - email
Chris Greco / Atlantic Richfield - email
Mike Mc Anulty / Atlantic Richfield - email
Loren Burmeister / Atlantic Richfield - email
Dave Griffis / Atlantic Richfield - email
Jean Martin / Atlantic Richfield - email
Irene Montero / Atlantic Richfield - email
David A. Gratson / Environmental Standards - email
Mave Gasaway / DGS - email
Brianne McClafferty / Holland & Hart - email
Joe Vranka / EPA - email
David Shanight / CDM - email
Curt Coover / CDM - email
James Freeman / DOJ - email
John Sither / DOJ - email
Dave Bowers / DEQ - email
Carolina Balliew / DEQ - email
Matthew Dorrington / DEQ – email
Wil George / DEQ - email
Jim Ford / NRDP - email
Pat Cunneen / NRDP - email
Harley Harris / NRDP - email
Katherine Hausrath / NRDP - email
Meranda Flugge / NRDP - email
Ted Duaime / MBMG - email
Gary Icopini / MBMG - email
Becky Summerville / MR - email
Kristen Stevens / UP - email
Robert Bylsma / UP - email
John Gilmour / Kelley Drye - email
Leo Berry / BNSF - email
Robert Lowry / BNSF - email
Brooke Kuhl / BNSF - email
Mark Engdahl / BNSF - email
Jeremie Maehr / Kennedy Jenks - email
Annika Silverman / Kennedy Jenks - email
Matthew Mavrinac / RARUS - email
Harrison Roughton / RARUS - email
Brad Gordon / RARUS - email
Mark Neary / BSB - email
Eric Hassler / BSB - email
Julia Crain / BSB - email

Chad Anderson / BSB - email
Brandon Warner / BSB - email
Abigail Peltomaa / BSB - email
Eileen Joyce / BSB - email
Sean Peterson/BSB - email
Gordon Hart / BSB - email
Jeremy Grotbo / BSB - email
Karen Maloughney / BSB - email
Josh Vincent / WET - email
Craig Deeney / TREC - email
Scott Bradshaw / TREC – email
Joel Thompson / Stantec - email
Brent Lucyk / Stantec - email
Tom Madsen / Stantec - email
Brad Archibald / Pioneer - email
Pat Sampson / Pioneer – email
Adam Logar / Pioneer - email
Joe McElroy / Pioneer - email
Andy Dare / Pioneer - email
Karen Helfrich / Pioneer - email
Leesla Jonart / Pioneer - email
Randa Colling / Pioneer - email
Ian Magruder / CTEC- email
CTEC of Butte / email
Scott Juskiewicz / Montana Tech - email

File: MiningSharePoint@bp.com - email
BPSOU SharePoint - upload

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

Draft Final

Blacktail Creek Remediation and Contaminated Groundwater Hydraulic Control Site

Piezometer Installation and Monitoring Well Repair Plan

Atlantic Richfield Company

June 2022

SILVER BOW CREEK/BUTTE AREA NPL SITE
BUTTE PRIORITY SOILS OPERABLE UNIT

Draft Final

Blacktail Creek Remediation and Contaminated Groundwater Hydraulic Control Site

Piezometer Installation and Monitoring Well Repair Plan

Prepared for:

Atlantic Richfield Company
317 Anaconda Road
Butte, Montana 59701

Prepared by:

Pioneer Technical Services, Inc.
1101 South Montana Street
Butte, Montana 59701

June 2022

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REVISION SUMMARY

Revision No.	Author	Version	Description	Date
Rev 0	J. Janosko	Draft Final	Issued for Agency Review	06/10/2022

ACRONYMS

Acronym	Definition
ARM	Administrative Rules of Montana
Atlantic Richfield	Atlantic Richfield Company
bgs	Below ground surface
BPSOU	Butte Priority Soils Operable Unit
BSB	Butte-Silver Bow
BTL	Butte Treatment Lagoons
BTC	Blacktail Creek
CAR	Corrective Action Report
CD	Consent Decree
CPM	Contractor Project Manager
DE	Diggings East
EPA	Environmental Protection Agency
GWIC	Groundwater Information Center
GWR PM	Groundwater Remedy Project Manager
MBMG	Montana Bureau of Mines and Geology
PDI ER	Pre-Design Investigation Evaluation Report
Pioneer	Pioneer Technical Services, Inc.
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
RM	Remediation Management
SOP	Standard Operating Procedure
SSHASP	Site-Specific Health and Safety Plan

1.0 INTRODUCTION

This Blacktail Creek (BTC) Remediation and Contaminated Groundwater Hydraulic Control Site Piezometer Installation and Monitoring Well Repair Plan (Installation and Repair Plan) provides the procedures and protocols necessary to install new piezometers and repair an existing monitoring well.

2.0 ADDITIONAL BLACKTAIL CREEK PIEZOMETERS

This section provides procedures and protocols necessary to install 13 additional piezometers to support the BTC Pumping Test. Twelve piezometers are proposed in locations that are radial to the pumping well location (BTC-PW-01), and these piezometers will be paired when installed (i.e., with both a 'shallow' and 'deep' screened interval): BTC-PZ01-S/D, BTC-PZ02-S/D, BTC-PZ03-S/D, BTC-PZ04-S/D, BTC-PZ05-S/D, and BTC-06-S/D (Figure 1). An additional piezometer (BTC-PZ07) will be installed adjacent to the pumping well to obtain water level measurements near the pumping well. Shallow piezometer screen intervals will be completed in the unpumped aquifer, just below the water table. Deep piezometer screen intervals will be completed in the pumped aquifer at approximately the same interval as the pumping well, BTC-PW-01, as field conditions allow. BTC-PW-01 is screened from 42.5 to 52.5 feet below ground surface (bgs) or approximately 28.5 to 38.5 feet below the water table. With approval from the Contractor Project Manager (CPM), in consultation with the Quality Assurance Officer (QAO), piezometer final locations and installation measurements may be altered by the Field Team Leader.

2.1 Property Access

Butte-Silver Bow (BSB) owns the property where the new piezometers will be installed. Atlantic Richfield Company (Atlantic Richfield) representatives will coordinate access to the property with the BSB Department of Reclamation and Environmental Services prior to commencing work. During field activities, any work related to monitoring wells that are located on private property will use existing access agreements or the Atlantic Richfield Liability Manager (or designated representative) will acquire updated or new access agreements, as necessary. Copies of the access agreement(s) will be placed in the field binder to have on hand during field activities.

2.2 Utility Locates

Utility locates will be performed prior to any ground disturbance activities and will follow Remediation Management (RM) supplier's procedures for ground disturbance in addition to applicable control measures addressed in the internal Site-Specific Health and Safety Plan (SSHASP). Final utility locates for the work area will be completed by the performing authority prior to any ground disturbance activities.

2.3 Installation

The field team will use a Geoprobe® unit to drill and log boreholes for the purpose of installing the proposed paired piezometers to provide sufficient data at strategic locations surrounding the pumping test well. Pioneer Technical Services, Inc. (Pioneer) anticipates using a 7822DT Geoprobe® rig to drill and install 12 paired shallow/deep piezometers and 1 additional deep piezometer (Figure 1). The equipment used may change based on field conditions and equipment availability. Pioneer will follow the Geoprobe® Standard Operating Procedures (SOPs; Attachment A) to install these piezometers. Additionally, Figure 2 shows the typical piezometer construction details.

2.3.1 Borehole Drilling Procedures

The Geoprobe unit will provide continuous core samples using the dual tube soil sampling system. These core samples are anticipated to be 5 feet in length by approximately 1.5 inches in diameter. To temporarily store the sediment core from the Geoprobe, plastic liners will be used within the inner core barrel to collect the core samples. Each 5-foot length will be properly labeled for storage within appropriately labeled and oriented core storage containers (described further in the next section).

The final depth of each borehole will depend on field conditions, determined by the Field Team Leader, CPM, and QAO based on the observed lithology in the boreholes. Piezometers will be located and completed in aquifer materials inferred to be conductive and hydraulically connected to the targeted pumping zone, where possible. If the depth of a piezometer borehole is installed deeper than the screen depth of the piezometer, a second borehole may be drilled to install the piezometer.

The following general procedures will be performed at each borehole location (at the required depth intervals). Note that this list is not intended to be complete. Detailed drilling procedures are outlined in the Geoprobe SOPs in Attachment A.

- Prepare Geoprobe unit for operation: decontaminate drilling tools and sampling equipment, level rig, prepare the down-hole tool, and establish the drill location.
- Begin advancing the core barrel. Advance the core barrel to collect the core sample, then retrieve the inner core barrel to recover the core sample. Continue adding core barrel segments and collecting core samples until desired depth is reached.
- Decontaminate the drill rig core barrel(s) between samples by rinsing with tap water and/or using a high-pressure washer.

2.3.2 Lithology Logging

The continuous core samples will be examined to produce a detailed lithologic characterization log of the subsurface materials at each borehole location. For paired piezometers, classification and lithology of the core from the deeper boreholes will be logged and photographed following the general procedures presented in SOP-Geoprobe-06 Geoprobe Dual Tube Sampling System and SOP-S-12 or SOP-S-13. The core for the single piezometer, BTC-PZ07, will also be logged

and photographed following the same procedures. The soil classification and lithology of the core from the deeper piezometers will be used to select the screen depth for the deep and shallow piezometers.

The core will be placed in properly labeled sample core boxes for transport (the labels will include location, depth interval, and core orientation). It is imperative that the core sample is marked clearly and is carefully transported horizontally, as it may be used for further observation. Sediment cores from every borehole drilled during this project will be stored in their entirety (in increments) at the Pioneer field office at 244 Anaconda Road in Butte, Montana, or an alternate suitable location. When it has been determined that enough sample is present for design-related purposes, additional samples will be shared with other parties, transferred off the Site, or disposed of appropriately. Refer to SOP-DE-03 Investigation Derived Waste Handling (Attachment A) for further information on handling investigation derived waste.

Equipment used to collect core samples will include, but not be limited to, the following:

- Field logbook and pens.
- Field data sheets and forms (Attachment B).
- Measuring tape.
- Unified Soil Classification System chart (ASTM D-2488; Attachment B).
- Sieve.
- Sample containers and labels.
- Core boxes.
- Decontamination equipment (pressure washer, tap water, dilute nitric acid, Liquinox soap, decontamination containers, paper towels, scrub brushes, and spray bottles; refer to SOP-DE-02 and SOP-DE-02A in Attachment A).
- Digital camera and/or digital video camera.
- Appropriate safety personal protective equipment.

2.3.3 Installing Piezometers

Final piezometer locations will be adjusted in the field, as necessary, to allow for safe installation and monitoring as well as property access. Installation will be completed according to the requirements of Administrative Rules of Montana (ARM) 36.21.8 and SOP-GW-11 Groundwater Monitoring Well Design and Construction, included in Attachment A. The primary Contaminants of Concern will be metals in groundwater; therefore, polyvinyl chloride (PVC) material will be appropriate for piezometer casing. Piezometers will be constructed using pre-pack well screens and details for piezometer construction are provided on Figure 2. The procedures below assume that a Geoprobe unit will be used to install the piezometers. These procedures may change based on field conditions and equipment availability.

The target depth for the piezometer screen will be determined by the Field Team Leader, CPM, and QAO. Equipment, materials, and supplies used to install the piezometer are outlined in Geoprobe SOPs (Attachment A).

Pioneer will prepare a piezometer completion log for the location, and, at a minimum, it will contain the following.

- Time and date installed.
- Borehole, casing, and screen diameters.
- Bottom cap length.
- Boring depth (plus or minus 0.1 foot) in relation to the ground surface.
- Well depth (plus or minus 0.1 foot) in relation to the ground and final measuring point.
- Lithology logs (lithology collected at deeper piezometer locations will be used for paired piezometer lithology logs).
- Casing materials.
- Screen size, slot size, length, and depth to top and bottom of screen from ground surface.
- Filter pack material, size, and thickness in relation to the ground surface.
- Seal thickness and depth below ground in relation to the ground surface.
- Depth to groundwater at time of completion, in relation to the ground and final measuring point.
- Survey-grade X and Y coordinates and elevations for the measuring point (marked on the north side of the PVC casing), top of protective casing, and ground surface (SOP-G-01 and SOP-SURVEY-01 in Attachment A).

Drilling equipment and accessories will be decontaminated at the completion of the piezometer installation.

If any boreholes or piezometers need to be abandoned in place, the field team will follow the procedures in Pioneer SOP-GW-18 Groundwater Monitoring Well Abandonment (Attachment A). Details of borehole and/or well abandonment may be modified by the Field Team Leader, CPM, and QAO if necessary.

3.0 EXISTING MONITORING WELL BPS11-10A

This section provides the procedures and protocols necessary for Atlantic Richfield to assess damage and preferentially repair or, if repair is not possible, abandon and replace monitoring well BPS11-10A. Monitoring well BPS11-10A was installed in 2011 and has served as a long-term monitoring well until it was struck by a vehicle in August 2020, and the casing was bent, rendering the monitoring well unusable (Atlantic Richfield Company, 2011 and Atlantic Richfield Company, 2022).

3.1 Property Access

Monitoring well repair or abandonment and replacement activities will take place on Atlantic Richfield property within the Diggings East (DE) Site.

3.2 Utility Locates

Utility locates will be performed prior to ground disturbance activities and will follow RM supplier's procedure for ground disturbance in addition to applicable control measures addressed in the internal SSHASP. Final utility locates for the work area will be completed by the performing authority prior to ground disturbance activities, including repair of BPS11-10A.

3.3 Repair

Repair of the monitoring well is the preferred alternative to maintain groundwater monitoring continuity and reduce disturbance to the subsurface. The location of the existing monitoring well is shown on Figure 1. The monitoring well will be repaired or replaced, as feasible, to match the existing configuration of the well prior to being damaged as closely as possible (see Figure 3 and Figure 4). The following alternatives are proposed for monitoring well BPS11-10A:

- If the monitoring well is salvageable, it will be repaired by removing the external casing, either replacing at the closest, accessible threaded joint (if possible) or cutting the internal casing below the damaged section, and gluing on a new section of 2-inch Schedule 40 PVC pipe using a PVC coupling. The external casing will be reinstalled, the well will be redeveloped to remove accumulated sediment, and a new measuring point surveyed as outlined below (Section 6.0).
- If the damaged section cannot be accessed or repaired, the monitoring well will be replaced and the existing well will be abandoned. A replacement well will be installed to match the configuration of the well prior to being damaged as closely as possible (see Figure 3) as outlined in the next section.

3.4 Abandonment and Replacement

If repair is not feasible, the replacement well (BPS11-10AR) will be installed a minimum of 10 feet away from the original structure to avoid subsurface disturbance and will be installed using either a vibratory roto-sonic drilling rig or Geoprobe unit. The exact location of the well will be adjusted in the field, as necessary, to allow for safe installation and monitoring as well as property access. Installation will be completed according to the requirements of Administrative Rules of Montana (ARM) 36.21.8, monitoring well construction standards. The replacement well will be constructed of 2-inch diameter, schedule 40 PVC well casing with a 10-foot section of screen (set as close as possible to the original screen interval of 10.67 to 21.67 feet bgs), and a solid riser section from 3 feet above ground to 11 feet bgs. The well will include surface casing and will be secured with a 4-inch to 6-inch diameter steel protective casing with concrete collar. The well will have a factory pre-pack screen, and additional sand completion to about 10 feet bgs, where a bentonite seal will be added to the annulus to the depth of about 1 foot bgs.

The borehole for the replacement monitoring well (BPS11-10AR), if necessary, will extend to match the depth (21.67 feet bgs) of the existing BPS11-10A well. Lithology will be logged to confirm subsurface conditions at the new location and compared to the existing, damaged well. The target depth for the well screen is 10.67 to 21.67 feet bgs, which may be modified based on

field conditions. Well installation procedures and generation of a new monitoring well log will be performed, if necessary, according to SOP-GW-18 (Attachment A).

Monitoring well abandonment, if necessary, will be completed according to the requirements of ARM 36.21.810, permanent abandonment of wells, and according to Pioneer's SOP-GW-18 Groundwater Monitoring Well Abandonment (Attachment A). The surface casing and concrete collar will be removed and disposed of, and the well casing will be cut or driven so that the top of the casing is a minimum of 3 feet bgs. The well casing will be sealed from bottom to top with bentonite grout. If the monitoring well is abandoned, a licensed monitoring well constructor will submit a Montana Well Abandonment Report (Attachment C) to the Montana Bureau of Mines and Geology (MBMG) within 60 days of abandonment so the Groundwater Information Center (GWIC) database can be updated.

4.0 DEVELOPMENT

Newly installed piezometers and BPS11-10A (or BPS11-10AR) will be developed following the general procedures detailed in SOP-GW-12 Well Development Using a Modified Over Pumping Technique (Attachment A). The piezometers and well will be considered developed when 3 consecutive readings for turbidity are below 5 Nephelometric Turbidity Units or are within 10% of each other and the water quality parameters are stable, or the well has been developed for 4 hours. The water quality parameters are considered stable when 3 consecutive readings are as follows:

- Temperature range is no more than plus or minus 1 degree Celsius.
- pH varies by no more than 0.1 pH units.
- Specific conductance readings are within 3% of the average.

Development water will be transported to a holding tank and then taken to the Butte Treatment Lagoons (BTL) drying beds for disposal. Refer to SOP-DE-03 Investigation Derived Waste Handling (Attachment A) for further information on handling investigation derived waste.

5.0 DECONTAMINATION

All drilling, well development, and related equipment required to complete the work will be decontaminated before and after use by the contractor using procedures outlined in SOP-GEOPROBE-10 Equipment Decontamination for Inorganic Contaminants, SOP-DE-01 Personal Decontamination, and SOP-DE-02 Equipment Decontamination. Decontamination water will be transported via a holding tank to the drying beds at BTL following procedures outlined in SOP-DE-03 Investigation Derived Waste Handling (Attachment A).

6.0 WELL SURVEY AND DOCUMENTATION

After development is completed, top of newly installed PVC casings will be cut level and measuring points will be clearly marked on the north side of the PVC casing. Newly installed piezometers and the repaired or replaced well will be surveyed at ground surface elevation and

measuring point (within plus or minus 0.01 feet) per SOP-SURVEY-01 Staking and Surveying (Attachment A). A licensed monitoring well constructor will submit a Montana Well Log Report (Attachment D) to the MBMG within 60 days of installation so the GWIC database can be updated. Once the installation is completed, the revised or new monitoring well log will be provided to all contractors using the monitoring well, so it may be updated in appropriate sampling plans and/or QAPPs.

7.0 ASSESSMENT AND OVERSIGHT

7.1 Field Activities Oversight

Atlantic Richfield will provide oversight personnel to oversee all field activities for installation of additional piezometers and repair or abandonment/replacement of BPS11-10A. Assessment and oversight of installation activities are designed to verify that infrastructure installation is performed in accordance with the procedures established in this Installation and Repair Plan. The audits of field and laboratory activities include two independent parts: internal and external audits. Internal audits will be performed by Atlantic Richfield, or their contractor. External audits will be performed by the Environmental Protection Agency (EPA), or designated representative, as necessary.

Agency oversight personnel will have the ability to inspect each piezometer completion interval and verify that the appropriate installation and documentation are performed. Copies of field logbook pages and completed soil logs may be made available to Agency oversight personnel during installation activities.

Any deviations from this plan will be brought to the attention of Agency oversight personnel. If the deviation is first determined by Agency oversight personnel, Atlantic Richfield and/or field representatives will be immediately notified. Reasons for such deviations will be recorded in the field logbook along with corrective actions to be implemented, if required. If Agency oversight personnel request a deviation from the plan, the deviation and the reasons for the deviation will be noted and then signed by the Agency personnel.

7.2 Corrective Action Procedures

Corrective action is the process of identifying, recommending, approving, and implementing measures to counter unacceptable procedures. Corrective actions implemented by field personnel will follow appropriate field SOPs (Attachment A), as necessary.

Corrective actions to address unsatisfactory conditions will be taken in consultation with the Project Manager/QAO and reported on a Corrective Action Report (CAR) form (Attachment B). If corrective action requests are not in complete accordance with approved project planning documents, EPA will be consulted, and concurrence will be obtained before the change is implemented. All corrective action records will be included with the plan records.

8.0 HEALTH AND SAFETY

All work completed by Pioneer and its subcontractor(s) during the execution of the Installation and Repair Plan will be performed in accordance with all procedures outlined in the BTC Pumping Test SSHASP. Potential hazards associated with this work include the following:

- Drilling activities.
- Late or long hours associated with infrastructure installation.
- Working around heavy equipment hazards.
- Exposure to heavy metals from impacted soil and groundwater.

Site-specific hazards and applicable control measures will be addressed in the SSHASP. All tasks will be risk assessed prior to starting work. All field personnel will have a current certification for the 40-hour Occupational Safety and Health Administration Hazardous Waste Site and Emergency Response Training. Current certification records will be maintained at Pioneer's headquarters at 1101 S. Montana Street in Butte, Montana.

In a project meeting held prior to fieldwork, all field personnel will review this BTC Installation and Repair Plan and receive any specified training. Field personnel will review procedures and requirements prior to field activities and will be trained in how to properly use field equipment and complete activities according to field data collection SOPs in Attachment A.

The Field Team Leader will review the internal SSHASP with all field personnel prior to fieldwork to assess the Site's specific hazards and the control measurements put in place to mitigate these hazards. The SSHASP review will cover all other safety aspects related to the Site including personnel responsibilities and contact information, additional safety requirements and procedures, and the emergency response plan. The Field Team Leader will be responsible for training field personnel on how to calibrate field measurement instruments. The Field Team Leader will be experienced in the use and calibration of the equipment that will be used and responsible for training and overseeing the support staff. One hard copy of the current approved version of the BTC Installation and Repair Plan will be maintained for reference purposes in the field vehicle and/or field office. All field team personnel will have access to electronic PDF files of all documents pertaining to fieldwork.

9.0 PROJECT ORGANIZATION

9.1 Roles, Duties and Responsibilities

The roles, duties, and responsibilities of personnel assigned to the Installation and Repair Plan are provided below. An organizational chart showing the overall organization of the project team is shown on Figure 5.

Atlantic Richfield Liability Manager – Josh Bryson

The Atlantic Richfield Liability Manager communicates directly to the Agencies on project matters, monitors the performance of the contractor(s), consults with the Groundwater Remedy

Project Manager (GWR PM), CPM and QAO on deficiencies, and helps finalize resolution actions.

Atlantic Richfield Quality Assurance Manager (QAM) – David Gratson (Environmental Standards)

The Atlantic Richfield QAM interfaces with the Atlantic Richfield Liability Manager on company policies regarding quality and has the authority and responsibility to approve specific quality assurance (QA) documents including the BTC Pumping Test QAPP.

Groundwater Remedy Project Manager (GWR PM) – Brent Lucyk (Stantec)

The GWR PM maintains consistency in the direction of work performed across the groundwater remedy program as part of the Butte Priority Soils Operable Unit (BPSOU) Consent Decree (CD). The GWR PM is responsible for verifying that the work meets the requirements set forth in the BPSOU CD and is consistent with the overall project schedules and goals of the groundwater remedy optimization efforts. The GWR PM will serve in an advisory role to the CPM and QAO with respect to meeting project goals, evaluating the significance of any changes or field decisions as they fit into BPSOU CD work progression, and maintaining consistency between interrelated projects.

Contractor

Pioneer is the Contractor responsible for conducting the elements of the piezometer installation and monitoring well repair or abandonment and replacement under the direction of Atlantic Richfield and Stantec.

Contractor Quality Assurance Officer (QAO) – Adam Logar

The QAO is responsible for verifying effective implementation of QAPP requirements and procedures, including reviewing field and laboratory data, and evaluating data quality. The QAO may conduct on-site reviews and prepare site review reports for the QAM. The QAO will have a direct line of communication to the QAM to resolve issues related to project QA.

The QAO is also authorized to stop work if, in the judgment of that individual, the work is performed contrary to or in the absence of prescribed quality controls or approved methods and further work would make it difficult or impossible to obtain acceptable results.

Pioneer Contractor Project Manager (CPM) – Jackie Janosko

The CPM is responsible for scheduling work to be completed and ensuring that the work is performed in accordance with the requirements contained herein. The CPM, or designated alternate, is also responsible for consulting with the specific project QA personnel regarding any deficiencies and finalizing resolution actions and verifying effective implementation of plan requirements and procedures. This includes reviewing data collected in the field.

Pioneer Field Team Leader – Drew Conrady

The Field Team Leader verifies that this Plan and any associated requests for changes have been reviewed by all members of the field team and procedures herein are properly followed during field activities. The Field Team Leader will conduct daily safety meetings, assist in field

activities, and document activities in the field logbook. The Field Team Leader is responsible for facilitating field activities, managing equipment, and coordinating with the CPM and QAO regarding problem solving and decision making in the field. The Field Team Leader is responsible for technical aspects of the project and providing on-the-ground overviews of project implementation by observing work activities to maintain compliance with technical project requirements and the SSHASP. The Field Team Leader is responsible for identifying potential Integrity Management issues during field activities and reporting any issues to the QAO.

Safety and Health Manager – Tara Schleeman

The Safety and Health Manager is responsible for reviewing the SSHASP with all members of the field team and updating it if necessary. The Safety and Health Manager will lead applicable Task Risk Assessments and conduct the initial safety meeting prior to starting fieldwork. The Safety and Health Manager will monitor work crews' compliance with all site safety and health requirements.

Subcontractor – Hunter Brothers Construction

Hunter Brothers Construction, or equivalent, will subcontract to Pioneer and follow all health and safety protocols established by Pioneer to work on the Site. Hunter Brothers Construction will assist with repair and redevelopment of BPS11-10A and hydro excavate select new piezometer locations, as determined necessary by the Field Team Leader, in consultation with the CPM and QAO.

9.2 Authority to Stop Work

All personnel, including third parties, have the authority, obligation, and responsibility to stop work for situations involving imminent danger to health and safety of personnel and/or environment. Safety takes precedence over schedule. Personnel have stop-work authority in circumstances where, if in the judgment of that individual, work is performed contrary to controls, safety requirements, or approved methods described in the SSHASP or herein. Upon notice of stop work, the initiator will immediately notify the affected workforce and the immediate supervisor. Communication from the immediate supervisor to additional affected parties will follow the line of communication shown on Figure 5. Problems and associated corrective actions will be documented on a CAR (Attachment B).

10.0 SCHEDULE

Fieldwork will begin once Agency approval has been received. Infrastructure installation described in this plan is anticipated to take approximately four weeks. Work will be performed as weather conditions permit. Potential constraints that could delay fieldwork include adverse weather conditions, contractor availability, coordination with land managers/users, challenges with drilling caused by Site conditions, or other unforeseen issues. Major project delays resulting from these constraints will be recorded in the field logbooks and reported to the Agencies.

11.0 REPORTING

Montana Well Log Reports will be submitted to MBMG to update the GWIC for all newly installed piezometers and the repaired or replaced monitoring well as described in Section 6.0. All additional reporting, such as the summary of all infrastructure installed, as well as new and/or revised well logs generated by activities described herein, will be included in the BTC Pumping Test PDI ER as described in BTC Pumping Test Investigation QAPP (Atlantic Richfield Company, 2021).

12.0 REFERENCES

Atlantic Richfield Company, 2022. 2021 Butte Priority Soils Operable Unit (BPSOU) Draft Groundwater Monitoring Data Summary Report January 2021 – December 2021. Atlantic Richfield Company. April 2022.

Atlantic Richfield Company, 2011. Butte Priority Soils Operable Unit Silver Bow Creek/Butte Area Superfund Site Draft Ground Water Monitoring Well Installation Plan. November 2011.

FIGURES

LEGEND

- Pumping Well
- Proposed Piezometers
- BPSOU Monitoring Well Repair or Replacement Location
- Radius in Feet
- Shallow Groundwater Contours March 2012 (ft)

N

DISPLAYED AS:
PROJECTION/ZONE: MSP
DATUM: NAD 83
UNITS: INTL FT
SOURCE: PIONEER/QSI 2020

0 125 250
Feet

FIGURE 1

BTC PIEZOMETER AND MONITORING WELL REPAIR LOCATIONS

PIONEER TECHNICAL SERVICES, INC.

DATE: 5/20/2022

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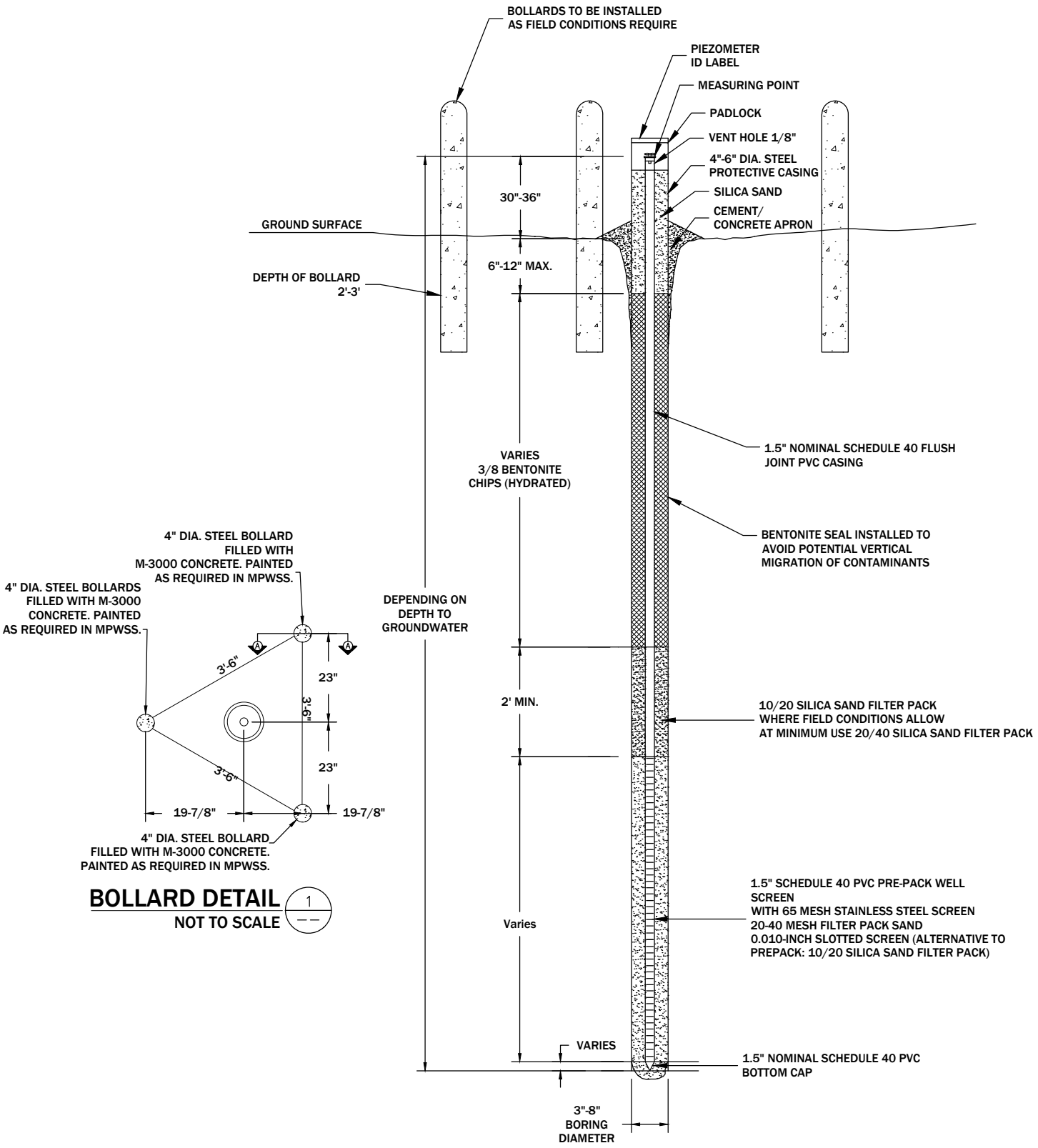

BOLLARD DETAIL (1)
NOT TO SCALE

DISPLAYED AS:
COORD SYS/ZONE: N/A
DATUM: N/A
UNITS: N/A
SOURCE: PIONEER

SCALE IN FEET
0 NTS

FIGURE 2

PIONEER TECHNICAL SERVICES, INC.

BTC PIEZOMETER CONSTRUCTION DETAILS

DATE: 5/2022

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PIONEER TECHNICAL SERVICES, INC.

Well Log

Well Name: BPS11-10A

Project: 2011 BPSOU MWIP | Location: Butte, Montana

Well Owner : Atlantic Richfield Co. | Depth to Water: 12.84 ft Date: 2/15/2012 Time: 11:19

Drilled by: Environmental West	Silica Sand Size: 10-20	Casing Type/Dia: PVC/2.0"	Screen Slot Size: 0.020"
Drilling Method: Roto-Sonic	Bentonite Seal: 3/8" chips	Screen Type/Length: PVC Machine Slot/10'	Borehole Dia: 6.0"

Well Construction

TOC Elevation: 5451.74 ft (NGVD 29)
5456.1 ft (NAVD 88)

Logged by: W. Goldberg

Stickup: -2.92 ft

Ground Level

Surface Completion: Stickup

Depth (ft)	Elevation (NGVD 29)	Lithology Description
0	5,450	TOPSOIL
		FILL, CONCRETE, BRICK, SILTY SAND
5	5,445	NO RECOVERY
	5,440	SAND, FINE ANGULAR QUARTZ GRAINS, TRACE MICA
		CLAY, COHESIVE, OLIVE
10		ORGANIC SILT, BLACK, PLANT FRAGMENTS
		CLAY, COHESIVE
	5,435	SILTY SAND WITH TRACE SUBROUNDED GRAVEL
15		NO RECOVERY
	5,430	SAND, FINE TO MEDIUM, OXIDIZED, MAGNETIC. PIECE OF SHEETMETAL AT 18'.
20		

6" Steel Protective Casing
Cement Grout
2" PVC Flush Coupled Riser
10-20 Colorado Silica Sand
2" PVC Machine-Slot 0.020" Screen, 10 ft
TD: 21'

XRF Data From Collected Core

Cd, Ni, Mn, Cu, Zn, Ca, K, Fe

Concentration (mg/kg)
Log Scale
1 | 10 | 100 | 1000 | 10000 | 100000

Particle Size Distribution

1"=30%

Gravel, Coarse | Sand, Coarse | Sand, Fine | Clay
Gravel, Fine | Sand, Medium | Silt

Percent (%)
0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100

Concrete Collar Elevation: 5448.82 ft. (NGVD 29)
5453.18 ft. (NAVD 88)
Well Completion Date: 12/17/2011
Screen Interval: 10.67-20.67 ft. Filter Pack Interval: 10-21 ft.

Driller: J.R. Cantrell Monitoring Well License: #451
Signature _____

Well Construction Key

Bentonite | Riser | Cement Grout | Slough | Steel Casing | Filter Pack | Screen

Lithology

Ash | Asphalt | Clay | Clayey gravel | Clayey sand | Clayey Sand, some gravel
Clayey silt | Fill | Granite | No Recovery | Organic silt | Residual weathered granite
Sand | Sand, oxidized | Sand and gravel | Sand and gravel, oxidized | Sand, some gravel
Sand, some gravel oxidized | Sandy clay | Sandy silt | Sandy silt, some gravel | Silt
Silt, oxidized | Silty Clay | Silty Clay, oxidized | Silty Clay, some gravel | Silty sand
Silty Sand some gravel | Slag | Tailings | Topsoil | Weathered granite

Pg. 1 of 1

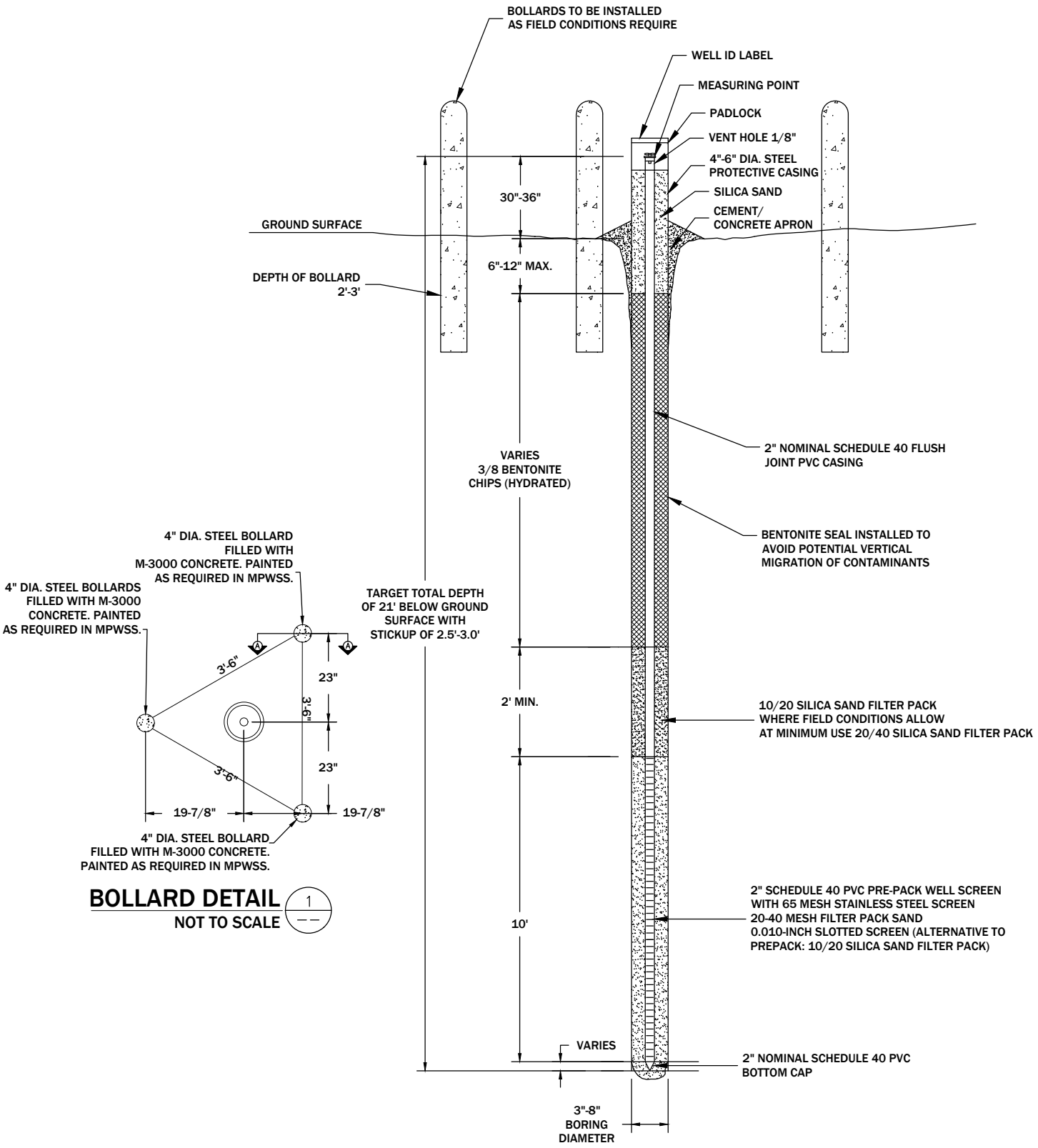
Latitude (NAD83):45.99490361 (Dec. Degrees)
Longitude (NAD83):-112.53031392 (Dec. Degrees)
Northing (SP-N83):651084.16 ft. (IF)
Easting (SP-N83):1198834.6 ft. (IF)
T3N R8W S24

GWIC ID # 264087

FIGURE 3 BPS11-10A
MONITORING WELL LOG

PIONEER TECHNICAL SERVICES, INC.

DATE: 5/9/2022



BOLLARD DETAIL (1)

NOT TO SCALE

DISPLAYED AS:

COORD SYS/ZONE: N/A

DATUM: N/A

UNITS: N/A

SOURCE: PIONEER

SCALE IN FEET

0 NTS

FIGURE 4

BPS11-10A WELL REPLACEMENT CONSTRUCTION DETAILS

PIONEER TECHNICAL SERVICES, INC.

DATE: 5/2022

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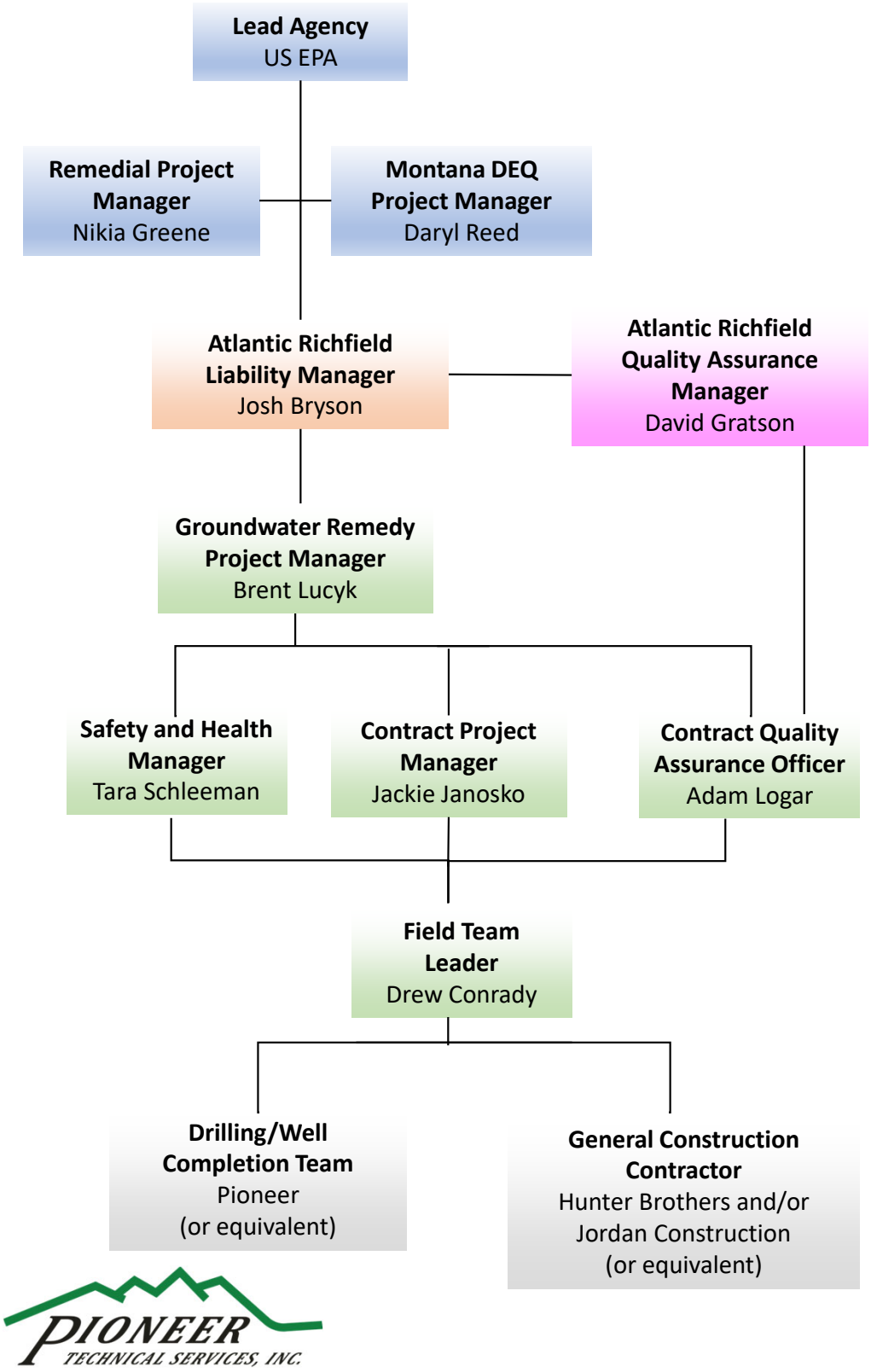

PIONEER TECHNICAL SERVICES, INC.

Figure 5: Project Organizational Chart

Attachment A
Standard Operating Procedures

SOP Number	Title	Version
SOP-GEOPROBE-01	Mobilization and Loading/Unloading the Geoprobe	11/16/2020
SOP-GEOPROBE-02	Pre and Post Job inspection	11/16/2020
SOP-GEOPROBE-03	Starting and Stopping the Kubota Engine	11/16/2020
SOP-GEOPROBE-04	Driving and Positioning the Geoprobe Model 7822DT	11/16/2020
SOP-GEOPROBE-05	Geoprobe® DT-22 Dual Tube Sampling System	11/16/2020
SOP-GEOPROBE-06	Geoprobe® DT-325/375 Dual Tube Sampling System	11/16/2020
SOP-GEOPROBE-07	Operating the Geoprobe® During Probing Operations	11/16/2020
SOP-GEOPROBE-09	DH133 Automatic Drop Hammer	11/16/2020
SOP-GEOPROBE-10	Equipment Decontamination – Inorganic Contaminants	03/30/2022
SOP-DE-01	Personal Decontamination	09/08/2020
SOP-DE-02	Equipment Decontamination	06/05/2015
SOP-DE-03	Investigation Derived Waste Handling	12/03/2014
SOP-GW-11	Groundwater Monitoring Well Design and Construction	04/23/2018
SOP-GW-12	Well Development Using a Modified Over-Pumping Technique	04/10/2018
SOP-GW-18	Groundwater Monitoring Well Abandonment	03/17/2017
SOP-S-12	Sampling Soil from a Geoprobe Liner	11/18/2020
SOP-S-13	Sampling Core from Sonic Drill	11/16/2020
SOP-SA-05	Project Documentation	04/14/2022
SOP-SURVEY-01	Staking and Surveying	10/24/2016

PURPOSE	To provide standard instructions for mobilizing and loading/unloading the Geoprobe® Model 7822DT.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Trailer hook-up	1. Turn on the diesel work truck to allow the glow plugs to warm up. To warm the glow plugs, turn the ignition switch to the first setting on the truck and there will be a light on the dashboard that looks like a pig tail. When this light goes off, the glow plugs are warmed, and the truck can be started. 2. Before backing up the truck, ensure that the gooseneck is high enough that it won't hit the truck when backing up. Using a spotter, back the truck up so the ball on the truck's hitch is right below the coupler on the trailer hitch. 3. When the ball of the truck's hitch is located under the coupler on the trailer, ensure that the coupler is unlatched. To do this, make sure the pin, which is normally locked in the down position is raised up and flipped over into the catch and you will see it has locked in the up position. 4. Turn the front trailer jack's crank counterclockwise to lower trailer onto the truck's hitch . 5. To make sure coupler is latched securely to ball, swing pin out of the catch and let it drop straight down through the hole in the plate and then swing it to the side. 6. When the trailer is locked to the truck's hitch, pull the clip and safety pin from the front jack's foot plate and move the spring-loaded foot plate up into the jack and replace the safety pin and clip. 7. Attach the trailer's safety chains and break away system to the truck's hitch system. 8. Inspect and attach the trailer's brake and trailer's lights cord to the power output connection on the truck. Verify that the trailer's lighting and braking system are

	working. 9. Ensure that the trailer's doors are all locked during transport. 10. Verify that all jacks (two on the front of the trailer) are up off the ground and secured. Also verify that the safety chains, pins, and power cord are attached and secured. 11. Remove the chocks out from under the trailer's tires and place them in the back of the truck. The Geoprobe® trailer is now ready for mobilization to and from job sites.
Unloading the Geoprobe®	1. Park the trailer on level ground. Set the parking brake on the truck and place tire chocks under the front and rear of one set of trailer's tires. Verify that the trailer's hitch is securely fastened to the truck. 2. Remove the safety pin and then pull down the spring assisted ramps. 3. Take the front and back ratchet straps off of the Geoprobe®. 4. Start the Geoprobe® and allow its fluids sufficient time to warmup to prevent unnecessary wear on the engine and hydraulic systems. While the Geoprobe® is going through the warmup, the system will lock out the Geoprobe® so that it can't be moved until the warmup is completed. 5. Prior to backing out of the trailer, ensure the blade and/or toolbox are raised so that they do not drag or get caught on anything during the unloading process. Slowly back the Geoprobe® out of the trailer using the remote control. For proper alignment, split the middle of the two tracks when unloading the Geoprobe®. Use the slow speed on the remote control when unloading the Geoprobe® from the trailer. **Note:** when the Geoprobe's center of gravity is at the end of the trailer, the front portion of the tracks will lift off the trailer's floor and the back portion of the tracks will lower onto the ramps, however the operator is controlling the Geoprobe® from the remote control and is not operating the Geoprobe® from a driver's seat on the machine. 6. Back the Geoprobe® 4 to 5 feet off the ramp and perform the pre-job inspection. Refer to SOP-GEOPROBE-02 Pre-Job and Post-Job Inspection for this procedure.
Loading the Geoprobe®	1. Perform the post-job inspection per SOP-GEOPROBE-02 Pre-job and Post-job Inspection as necessary. 2. Connect the truck to the trailer and park the trailer on level ground. Set the truck's parking brake and place tire chocks under the front and rear of one set of trailer's tires.

	3. Remove the safety pin and then pull down the spring assisted ramps. 4. Cool down of the Geoprobe® may be necessary before loading into the trailer. There are two fans that are used to cool the machine and will be visible on the control panel if they are turned on. If either fan is operating, do not turn off the Geoprobe®. The fans will turn off automatically when the Geoprobe® reaches the necessary cool down temperature. 5. Slowly move the Geoprobe® forward into the trailer using the remote control. For proper alignment, split the middle of the two tracks when loading the Geoprobe®. Ensure the Geoprobe® blade is up as high as it can go so the job box does not drag or get caught during the loading process. Use the slow speed on the remote control when loading the Geoprobe® into the trailer. 6. Flip the spring assisted Ramps back up and put the safety pin back in place. Loading the Geoprobe® is complete.
Securing the Geoprobe® in the trailer	1. Ensure the Geoprobe® is centered in the trailer. Refer to SOP-GEOPROBE-04 Driving the Geoprobe® Model 7822DT for driving procedures. 2. Make sure the Geoprobe® tracks are 3-4 inches in front of where the black strips start on the trailer floor. This will put the Geoprobe® in an optimal position for weight distribution on the trailer axles and tongue. 3. Attach the two front ratchet straps to the front strap connection on the Geoprobe® and the front strap rings located on the floor towards the front of the trailer. Tighten the ratchet strap so there is no slack in the strap. 4. Attach the two ratchet straps to the back-strap rings located at the rear of the trailer. Tighten the strap so there is no slack in the strap.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Hydraulic fluid and diesel.	Geoprobe®.	Employees could be exposed to hydraulic fluid and/or diesel via inhalation, ingestion and skin/eye contact, when operating the Geoprobe®, or if equipment malfunctions resulting in adverse health effects.	Employees will wear work gloves and safety glasses, if contact with hydraulic fluid/diesel is possible. In the event of a spill/leak, personnel will contain the fluid using the spill cleanup material available in the Geoprobe's trailer. Cleanup materials will be disposed of according to state's regulations. All components of the Geoprobe® will be inspected prior to and at the completion of the task. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.
NOISE	Elevated noise levels.	Geoprobe®.	Employees could be exposed to elevated noise levels when driving the Geoprobe® resulting in irritability, decreased concentration, and noise-induced hearing loss.	Personnel within a 20-foot buffer of the Geoprobe® will wear single hearing protection (e.g., ear muffs). Non-essential personnel will maintain a 20-foot buffer zone around the Geoprobe®.
ELECTRICAL	Defective electrical lines.	Geoprobe®.	Contact with defective electrical lines could result in personal injury.	Inspect electrical lines of the Geoprobe® prior to and at the completion of the task.
BODY MECHANICS	Not Applicable			

GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces and steep slopes.	Walking on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Workers will wear work boots with good traction and ankle support. Employees will plan their path and walk cautiously. Keep work area free of tools/rods. If conditions are wet/muddy, muck boots may be worn.
	Geoprobe® falling off of ramps.	Geoprobe®.	The Geoprobe® could fall off of the ramps when loading/ unloading it resulting in personal injuries and/or property damage.	Use a spotter when loading/unloading the Geoprobe®. Workers will use special caution when loading the Geoprobe® onto a trailer with wet ramps. It is significantly easier for the tracks to slip under such conditions.
WEATHER	Cold/heat stress.	Outdoors.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers). Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Lightning.	Sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Employees will follow the 30/30 rule during lightning storms. When the Geoprobe® is running, the Geoprobe's helper will watch for thunder/lightning.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during	Employees will wear safety glasses with tinted lenses, long-sleeve work shirts, and long

			summer months causing sun burns, skin damage, and eye damage.	pants. Employees should wear sunscreen, if necessary.
BIOLOGICAL	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Employees with allergies should notify their supervisor.
MECHANICAL	Backing up the work truck.	Sites.	Incidents could occur when backing up the work truck to connect the trailer to the truck resulting in personal injury and/or property damage.	Use a spotter when backing up the work truck. If a spotter is not available, walk around the truck to check distances and look for obstacles that may be in your blind spots. The spotter will wear high visibility clothing.
	Unloading the Geoprobe®.	Sites.	Incidents could occur when backing up the Geoprobe® to unload it from the trailer resulting in personal injury and/or property damage.	As a precaution, the operator should be ready to move the track control levers forward to stop the reverse motion. The operator will use the slow speed on the remote control when backing up the Geoprobe®.
	Towing the Geoprobe's trailer.	Road.	Incidents could occur when towing the Geoprobe's trailer to and from the job site resulting in personal injury and/or property damage.	Driver will follow defensive driving techniques and will be trained on how to tow a trailer. Driver will verify that the trailer's safety chains are attached to the truck's hitch system.

	Pinch points.	Loading/unloading the Geoprobe®.	Employees could be exposed to hand injuries, such as lacerations, punctures, cuts, and pinched fingers, when connecting the trailer to the work truck and when setting up the trailer's ramps.	Personnel will wear work gloves and will watch for hand placement when performing these tasks.
	Struck by/caught between the work truck, trailer, and/or Geoprobe®.	Loading/ unloading the Geoprobe®.	Personnel could be struck by/caught between the work truck, trailer, and/or Geoprobe® resulting in injury and/or property damage.	Set the truck's parking brake and place the tire chalks under the tires of the trailer before unloading and loading the Geoprobe®. When unloading the Geoprobe®, the helper will maintain a 20-foot buffer zone from the Geoprobe®. All employees will wear high visibility clothing. Non-essential personnel will maintain a 20-foot buffer zone around the rig. Use traffic cones to delineate the space needed to load/unload the Geoprobe®.
PRESSURE	Pressurized hydraulic lines.	Geoprobe®.	Faulty pressurized hydraulic lines could burst resulting in personal injury/exposure and hydraulic fluid release.	All components of the Geoprobe® will be inspected prior to and at the completion of the task. In the event of a spill/leak, personnel will contain the fluid using the spill cleanup material available in the Geoprobe's trailer. Cleanup materials will be disposed of according to state's regulations. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.
THERMAL	Not applicable.			

HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperience workers and improper training could cause incidents resulting in personal injuries and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. When loading/unloading for the first time, an experienced operator should be on site to help coach the loading/unloading process. All employees operating the Geoprobe® will be familiar with the basic controls of the machine including the Emergency Kill switch button. Employees will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D PPE (hard hat, safety glasses, high-visibility work shirt or vest, long pants, steel-toed boots), work gloves, and single hearing protection (e.g., ear muffs).
APPLICABLE SDS	SDSs will be maintained based on-site characterization and contaminants. Hydraulic Fluid and diesel.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	SOP-GEOPROBE-02 Pre-Job and Post-Job Inspection SOP-GEOPROBE-03 Starting and Stopping the Kubota Engine SOP-GEOPROBE-04 Driving the Geoprobe® Model 7822DT
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**

Revisions:

Revision	Description	Date
1	Updates to SOP to reflect Geoprobe ® Model 7822DT	11/16/2020

PURPOSE	To provide standard instructions for conducting a pre-job and post-job Geoprobe® inspection.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Pre-job Geoprobe® setup.	Note: this procedure assumes that the Geoprobe® is out of the trailer. Refer to SOP-GEOPROBE-01 Mobilization and Loading/Unloading the Geoprobe® for instructions on how to back the Geoprobe® out of the trailer. The pre- and post-job inspections cannot be fully performed while the Geoprobe® is in the trailer due to the mast being folded over and preventing the removal of the engine cover lid. 1. Place the Geoprobe® on flat ground. 2. Unfold the derrick by pushing the fold lever downward. Unfold the derrick until the foot of the Geoprobe® is parallel to the ground. 3. Lower the foot of the Geoprobe® until it touches the ground by pushing the foot lever downward. 4. Turn off the Geoprobe®.
Pre-job engine hours.	1. Locate the run time odometer on the control panel and write down the machine's current hours on the Geoprobe's pre-operation inspection sheet. A Geoprobe's pre-operation inspection form is attached to this SOP as an example.
Pre-job engine compartment inspection.	1. Open the engine compartment by removing the rear upper engine cover. 2. Check the engine oil level using the oil dip stick. The oil level should be between the marks on the dip stick. If the oil level is below the lowest mark, additional engine oil is required for engine protection. 3. Check the engine's coolant fluid level inside the radiator by checking where the fluid is in relation to the "Full" and "Low" line on the reservoir.

	4. Check the hydraulic fluid level by reading the sight glass located On the control panel. Maintain the hydraulic fluid at or within 0.5 inches below the upper solid black line on the glass. If the hydraulic fluid level is below, new hydraulic oil must be added to the hydraulic oil tank until the fluid rises to the upper mark on the site glass. 5. Check diesel fuel level by removing the fuel cap and visually inspecting fuel level or by turning ignition switch to energize fuel gage on the control panel. 6. Ensure the hydraulic fluid cap, fuel cap, and radiator cap are all in place. 7. Check the radiator for leaks, cracks, and cleanliness. Inspect radiator's hoses and radiator's body for coolant leaks and inspect the engine's compartment for signs of coolant leakage. 8. Inspect the engine belts for cracking and glazing, indicators that the belts are worn and will need replacement. Also, check the belts for tension by pushing on the longest length of belt to determine the amount deflection. If the deflection is greater than 0.5 inches, the belt tension will require adjustment. 9. Document fluid levels and other notable conditions on the pre-operation inspection sheet. 10. Close the engine compartment.
Pre-job machine chassis inspection.	1. Inspect the rubber tracks for cracks and nicks, indicating that the tracks will need to be replaced soon. Also, check for proper tension by raising the tracks off the ground. The tracks should have 3 inches of slack in them at the midpoint of the track. 2. Grease three Zirk fittings on Geoprobe® as required. A single Zirk fitting is located under the rig in the rotation bearing. The bearing requires 5 pumps of multipurpose grease every 100 hours of operation. To gain access to the grease fitting, first make sure the engine is off and the ignition key is removed. Slide in between the tracks from under the front of the vehicle. Two additional Zirk fittings are located on the fold bracket pivot points. These fittings require 3 pumps of grease every 50 hours of operation. 3. Visually check the hydraulic cylinders for leaks. The hydraulic cylinders will require little to no maintenance. Under normal use, hydraulic cylinder rods will have some fluid accumulation. Excessive leaks between the cylinder rod and cylinder rod seal indicates that service is necessary by Geoprobe® Systems or a qualified hydraulic cylinder

	service. 4. Locate the battery and fuse/relay box by opening the side door behind the pipe rack. Check the battery and fuse/relay box. Ensure they are clean and free of corrosion. 5. Visually check the hydraulic hoses and fittings for leaks. Operator should look for hydraulic hoses that are leaking, cut, collapsed, or bulged. **Note:** if hydraulic fittings are loose, tighten them. If hoses are leaking or fittings cannot be tightened, immediately stop work, and have the given fittings and/or hoses replaced. 6. Check the Geoprobe's frame for cracks or damage. 7. Ensure the rear-tool basket (if used) is attached to rear blade of the Geoprobe®. 8. Ensure the fire extinguisher is inspected and located in the basket or with the Geoprobe® at all times during Geoprobing activities. 9. Ensure the five emergency stop buttons are functioning properly. Test each button individually by starting the Geoprobe® and pushing that individual emergency stop button. If the engine quits, that emergency stop button is working. If the emergency stop buttons are not working, field work will be halted until the stop buttons are repaired and functioning properly. 10. Inspect Geoprobe's assembly bolts and look for loose screws and nuts. The hammering operations tend to loosen fasteners over time making it important to visually check chassis screws, nuts, and bolts. Tighten any loose fasteners that are identified. 11. Check the hose carriers/housings for breaks in brackets.
Pre-job control panel and accessories inspection.	1. Ensure all gauges are operating properly by examining each gauge to see if the measurement is normal or the dial indicator is moving. 2. Ensure all control levers are in the neutral position and are secure. 3. Ensure all control switches are operating properly by testing each switch to determine if function control is maintained. 4. Visually inspect the winch line and winch safety hook for any damage or fraying. 5. If the drop hammer is being used make sure it is secured. Check the

	hoses coming from the drop hammer to ensure there are no leaks and also make sure the auxiliary hydraulic line and fittings are free of leaks. Refer to SOP-GEOPROBE-09 DH133 Drop Hammer to see the drop hammer securing procedures.
Post-job Geoprobe® inspection.	1. Move Geoprobe to a flat, safe location. 2. With the engine running and cooling down, perform a visual inspection of the Geoprobe®, looking for leaking oil, coolant, or hydraulic fluid. Additionally, look for loose bolts, nuts, and screws that may have come loose during the day's operation. This inspection will identify any new issues with the Geoprobe® that could be repaired or replaced before the next work day. **Note:** a thorough inspection is not usually performed at the end of the day when the Geoprobe® components are hot. Checking fluid levels in a hot engine is hazardous, especially coolant levels.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Diesel, Oil, hydraulic fluid, coolant, and fitting grease.	Geoprobe®.	Employees could be exposed to diesel, hydraulic fluid, coolant, and/or fitting grease via inhalation, ingestion, and skin/eye contact, when inspecting the Geoprobe®, or if equipment malfunctions resulting in adverse health effects.	Employees will wear work gloves and safety glasses, if contact with diesel, oil, hydraulic fluid, coolant or fitting grease is possible. In the event of a spill/leak, personnel will contain the fluid using the spill cleanup material available in the Geoprobe's trailer. Cleanup materials will be disposed of according to state's regulations. All components of the Geoprobe® will be inspected prior to and at the completion of the task. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.
NOISE	Elevated noise levels.	Geoprobe®.	Employees could be exposed to elevated noise levels when the Geoprobe® is running resulting in irritability, decreased concentration, and noise-induced hearing loss.	Personnel within a 20-foot buffer of the Geoprobe® will wear single hearing protection (e.g., earmuffs). Non-essential personnel will maintain a 20-foot buffer zone around the Geoprobe®.
ELECTRICAL	Defective electrical lines.	Geoprobe®.	Contact with defective electrical lines could result in personal injury.	Inspect electrical lines of the Geoprobe® prior to and at the completion of the task. Do not operate the Geoprobe® if defective electrical lines are found during the pre/post job inspection.
BODY MECHANICS	Not applicable.			
GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet	Walking on slick/muddy/wet	Workers will wear work boots with good traction and ankle

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
		surfaces and steep slopes.	and uneven terrain could cause slips and trips resulting in falls and injuries.	support. Employees will plan their path and walk cautiously. Keep work area free of tools/rods. If conditions are wet/muddy, muck boots may be worn.
WEATHER	Cold/heat stress.	Outdoors.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke. Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g. layers). Employees will remain hydrated and will have sufficient caloric intake during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP. Employees will follow the 30/30 rule during lighting storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Employees should wear sunscreen, if necessary.
BIOLOGICAL	Plants, animals, and insects.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available in work trucks. Employees with allergies should notify their supervisor.
MECHANICAL	Pinch Points from folding and	Geoprobe®	Employees could be exposed to	Personnel will wear work gloves and will watch for hand

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
	unfolding the Geoprobe.		hand injuries, such as lacerations, punctures, cuts, and pinched fingers, when folding and unfolding the Geoprobe® during pre/post job inspection.	placement when performing these tasks. All non-essential personnel will maintain a 20-foot buffer zone around the Geoprobe®.
PRESSURE	Pressurized hydraulic lines.	Geoprobe®.	Faulty pressurized hydraulic lines could burst resulting in injury/ exposure and hydraulic fluid release.	All components of the Geoprobe® will be inspected prior to and at the completion of the task. In the event of a spill/leak, personnel will contain the fluid using the spill cleanup material available in the Geoprobe's trailer. Cleanup materials will be disposed of according to state's regulations. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.
THERMAL	Hot fluids in the engine compartment.	Geoprobe®.	Employees could be exposed to hot fluids in the engine compartment that if contact occurs could result in injury/exposure or fluid release.	All components of the Geoprobe® will be inspected prior to and at the completion of the task. Allow time for the engine and fluids to cool prior to performing the pre/post job inspection. In the event of a spill/leak, personnel will contain the fluid using the spill cleanup material available in the Geoprobe's trailer. Cleanup materials will be disposed of according to state's regulations. Employees will use Level D PPE and proper gloves when preforming pre/post job inspections. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in personal injuries and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. When performing the pre/post job inspection for the first time, an experienced operator should be on site to help coach the pre/post job inspection process. All employees operating the Geoprobe® will be familiar with the basic controls of the machine including the Emergency kill switch button. Employees will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D PPE (hard hat, safety glasses, high-visibility work shirt or vest, long pants, steel-toed boots), work gloves, and single hearing protection (e.g., earmuffs).
APPLICABLE SDS	SDSs will be maintained based on-site characterization and contaminants.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/	SOP-GEOPROBE-01 Mobilization and Loading/Unloading the Geoprobe® SOP-GEOPROBE-09 DH133 Drop Hammer

WORK PLANS	
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**

Revisions:

Revision	Description	Date
1	Updates to SOP to reflect Geoprobe ® Model 7822 DT	11/16/2020

PURPOSE	To provide standard instructions for starting and stopping the Kubota Diesel Engine on the Geoprobe®.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Preparing the Engine for Start Up	1. Make sure the Geoprobe® is in an open area for ventilation. When starting the Geoprobe® in the trailer completely open the front and back doors to provide ventilation. 2. Ensure as the operator you are familiar with all five kill switches on the Geoprobe®. There is a kill switch located on the remote control, on the control panel, one on each side of the Geoprobe®, and the last kill switch is a pull latch cable located next to the control panel.
Starting the Kubota Engine.	1. Warm the glow plugs before starting. To warm the glow plugs, turn the key counterclockwise. A message will appear on the control panel when the machine is ready. **Note:** In cold weather conditions, it is good practice to warm the glow plugs twice. Also, if the machine has been warmed up and been running, then there is no need to warm the glow plugs again before start up. 2. Turn ignition key clockwise to activate the starter motor. Release the ignition key when the engine starts and runs on its own power. **IMPORTANT: Do not run the starter motor for longer than 10 seconds. If the engine does not start running, then allow 30 seconds to pass and repeat the starting procedure.** 3. Verify the oil pressure gauge is reading in the white on the pressure gauge and the battery gauge is also reading in the white. **(Refer to the Kubota Manual for troubleshooting procedures).**

	4. Allow the engine to run approximately 5 to 10 minutes, or through a complete warm up cycle, to bring the coolant and hydraulic fluid up to running temperature. The machine will be locked out until the warm up cycle is completed and fluids are at correct operating temperatures. The control panel has gauges that show hydraulic fluid temperature, hydraulic tank temperature, and coolant temperature.
Running the Kubota Engine	1. When the engine is running between pushing and/or sampling procedures, the machine is equipped with an automatic throttle and will lower the throttle. This will help to conserve fuel, prolong the engine life, and reduce noise levels.
Stopping the Kubota Engine	1. Check the control panel to see if the two fans are running. If either fan is on, the Geoprobe® needs to stay on to allow the fan(s) to cool the engine and fluids. Once both fans are turned off, the Geoprobe® is cool and can be turned off. 2. Turn the ignition key to the "OFF" position. **IMPORTANT: Familiarize yourself with the engine kill switches so in case of an emergency these switches can be easily used!!!**

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
CHEMICAL	Carbon Monoxide	Geoprobe®.	Employees could be exposed to carbon monoxide via inhalation when operating the Geoprobe®, resulting in adverse health effects.	Employees will make sure the Geoprobe® is started in an open area to provide good ventilation. If the Geoprobe® is started in the trailer, make sure both doors are open. Do Not work around the exhaust area (back of the rig) while the Geoprobe® is running. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.
	Hydraulic fluid and diesel.	Geoprobe®.	Employees could be exposed to	Employees will wear work gloves and safety glasses, if contact with hydraulic

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
			hydraulic fluid and or diesel via inhalation, ingestion and skin/eye contact, when operating the Geoprobe®, or if equipment malfunctions resulting in adverse health effects.	fluid/diesel is possible. In the event of a spill/leak, personnel will contain the fluid using the spill cleanup material available in the Geoprobe's trailer. Cleanup materials will be disposed of according to state's regulations. All components of the Geoprobe® will be inspected prior to and at the completion of the task. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.
NOISE	Elevated noise levels.	Geoprobe®	Employees could be exposed to elevated noise levels when driving the Geoprobe® resulting in irritability, decreased concentration, and noise-induced hearing loss.	Personnel within a 20-foot buffer zone of the Geoprobe® will wear single hearing protection (e.g. earmuffs). Non-essential personnel will maintain a 20-foot buffer zone around the Geoprobe®.
ELECTRICAL	Defective electrical lines.	Geoprobe®	Contact with defective electrical lines could result in personal injury.	Inspect electrical lines of the Geoprobe® prior to and at the completion of the task.
BODY MECHANICS	Not applicable.			
GRAVITY	Falls from slips and trips.	Uneven terrain, slick, muddy/wet surfaces and steep slopes.	Walking on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Workers will wear work boots with good traction and ankle support. Employees will plan their path and walk cautiously. If conditions are wet/muddy, muck boots may be worn Keep work area free of tools/rods.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
WEATHER	Cold/heat stress	Outdoors.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g. layers). Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Lightning.	Sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Employees will follow the 30/30 rule during lightning storms. When the Geoprobe® is running, the Geoprobe helper will watch/listen for lightning and thunder.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Employees should wear sunscreen, if necessary.
BIOLOGICAL	Plants, Animals, Insects and Humans	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First aid kits will be available in the work truck. Employees with allergies should notify their supervisor.
MECHANICAL	Not applicable.			
PRESSURE	Pressurized hydraulic lines.	Geoprobe®	Faulty pressurized hydraulic lines could burst	All components of the Geoprobe® will be inspected prior to and at the completion of the task. In the event of a

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
			resulting in injury/exposure and hydraulic fluid release.	spill/leak, personnel will contain the fluid using the spill cleanup material available in the Geoprobe's trailer. Cleanup materials will be disposed of according to state's regulations. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperience and improperly trained worker.	Sites.	Inexperience workers and improper training could cause incidents resulting in personal injuries and/or property damage.	Employees will be properly trained int his procedure and other applicable procedures. When starting/stopping for the first time, an experienced operator should be on site to help coach the process. All employees operating the Geoprobe® will be familiar with the basic controls of the machine including the Emergency kill switch button. Employees will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D PPE (hard hat, safety glasses, high-visibility work shirt or vest, long pants, steel toed boots), work gloves, and single hearing protection (e.g. earmuffs).
APPLICABLE SDS	SDSs will be maintained based on-site characterization and contaminants.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**

Revisions:

Revision	Description	Date
1	Updates to SOP to reflect Geoprobe ® Model 7822DT	11/16/2020

PURPOSE	To provide standard instructions for driving and positioning the Geoprobe® for probing.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Driving and Braking Controls on the Advance 7822DT	***Brakes*** The Geoprobe® Model 7822DT is equipped with automatic track brakes. When the engine is not running the track brakes are automatically engaged. ***Hydraulic Steering Controls*** The Model 7822DT has two steering control levers on the remote control. There are two additional steering control levers on the control panel but to use these levers the safety enable button must also be engaged. The two steering controls levers control two independently controlled tracks. The left lever controls the left track and the right lever controls the right track. To move forward move both control levers forward. To move in reverse move both control levers towards the back of the machine. There are three types of turns the Model 7822DT can accomplish. These turns are listed and described below. **1. Gradual Turn** This turn is used when the Geoprobe® is in motion. By moving the control levers in the same direction but to different degrees will produce a gradual turn. This turn is possible in both forward and reverse directions. **2. Pivot Turn** This turn is used when the Geoprobe® is stationary. By moving one control lever and leaving the other control lever in neutral position will produce a pivot turn. The turn will center around the track that is stationary. This turn is used a lot when positioning the Geoprobe® over probe-hole locations. This turn is possible in both forward and reverse directions. **3. Counter-Rotation Turn** This turn is used when the Geoprobe® is stationary. By moving both controls

	but in opposite directions will produce a Counter-Rotation Turn. This turn will center around the center of the Geoprobe®. This turn is used widely in congested areas with limited room to turn.
Driving the Geoprobe® Model 7822DT	**CAUTION: When driving the Geoprobe®, check job site for obstacles if not readily visible.** 1. Start the Geoprobe® Model 7822DTas stated in the Starting and Stopping the Kubota Engine SOP (SOP-GEOPROBE-03). 2. Make sure to do a complete walk around to make sure the blade is in the upright position and that all other rig extremities are free of debris/obstacles. 3. Make sure the Geoprobe® is in transport position. Transport position is when the rig is completely folded up. • The probe cylinder must be lowered all the way to the foot. To lower the foot, place the probe lever in the downward position until motion has halted. • The foot must be completely raised up to the folding bracket. To raise the foot, place the foot lever in the upward position until motion has halted. • The mast must be completely lowered to the folding bracket. To lower the mast, place the mast lever (in the downward position until motion has halted. • In order to raise the mast, the winch must be lowered. Once the mast is raised, the slack can be taken out of the winch. The opposite happens when lowering the mast, and there will be slack in the winch line. **NOTE:** Do Not pull all the winch line in. Allow a couple inches of slack in the winch line so the line or winch does not get damaged. • The Geoprobe® should now be completely folded up. To fold up the Geoprobe®, place the fold lever in the upward position until motion has halted. 4. Move the Geoprobe® to the specified location using the Track Control Levers and turns as necessary. Use best judgement on type of terrain for travel speed, generally when moving to specific location medium speed is sufficient.

	5. Use a spotter when necessary to obtain the best and safest route to the probe-hole locations. **IMPORTANT: DO NOT SIDE HILL WITH THE RIG!! When traversing through mountainous and hilly areas drive straight up or down the terrain.**
Positioning the Geoprobe® Model 7822DT	1. After the Geoprobe® has been driven close to the new probe hole location (no farther than five feet away), unfold the derrick of the machine. To unfold the derrick, place the fold lever in the downward position until the foot of the machine is parallel to the existing ground. 2. Raise the mast completely up. To raise the mast, place the mast lever in the upward position until motion is halted. 3. Lower the foot until there is roughly six to twelve inches between the bottom of the foot and the existing ground. To lower the foot, place the foot lever in the downward position until the desired position is reached. 4. Raise the probe cylinder three to four feet off of the foot. To raise the probe cylinder, place the probe lever in the upward position until the desired position is reached. 5. Make sure the machine is extended in about half-way (six to seven and a half inches). To extend the machine in and out, place the extend lever in the upward position to move the machine in and place the extend lever in the downward position to extend out. 6. Level the machine using the oscillating head and moving the foot. Use the magnetic level. **CAUTION: When driving the Geoprobe®, check job site for obstacles if not readily visible.**

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Hydraulic fluid and diesel.	Geoprobe®.	Employees could be exposed to hydraulic fluid and/or diesel via inhalation, ingestion, and skin/eye contact, when operating the Geoprobe®, or if equipment malfunctions resulting in adverse health effects.	Employees will wear work gloves and safety glasses, if contact with hydraulic fluid/diesel is possible. In the event of a spill/leak, personnel will contain the fluid using the spill cleanup material available in the Geoprobe® trailer. Cleanup materials will be disposed of according to state regulations. All components of the Geoprobe® will be inspected prior to and at the completion of the task. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.
NOISE	Elevated noise levels.	Geoprobe®.	Employees could be exposed to elevated noise levels when driving the Geoprobe® resulting in irritability, decreased concentration, and noise-induced hearing loss.	Personnel within a 20-foot buffer zone of the Geoprobe® will wear single hearing protection (e.g. earmuffs). Non-essential personnel will maintain a 20-foot buffer zone around the Geoprobe®.
ELECTRICAL	Defective electrical lines. Overhead Power Lines	Geoprobe®. Sites.	Contact with defective electrical lines could result in personal injury. Contact with overhead power lines could result in serious injury or property	Inspect electrical lines of the Geoprobe® prior to and at the completion of the task. Employees will maintain sufficient distance from any overhead power lines on the site. Employees will also not drive the Geoprobe® with the

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
			damage.	mast raised.
BODY MECHANICS	Not applicable.			
GRAVITY	Not applicable.			
WEATHER	Cold/heat stress.	Outdoors.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on the signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g. layers). Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlines in applicable SSHASP and/or Pioneer corporate HASP.
	Lightning.	Sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Employees will follow the 30/30 rule during lightning storms. When the Geoprobe® is running, the Geoprobe helper will watch/listen for lightning and thunder.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Employees should wear sunscreen, if necessary.
BIOLOGICAL	Plants, animals, insects and humans.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available in the work trucks. Employees with allergies should notify their supervisor.
MECHANICAL	Driving on unstable ground	Sites.	Incidents could occur when	Employees will avoid side hilling in the Geoprobe® to

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
	or sloped surfaces.		driving on unstable ground or sloped surfaces which could result in personal injury and/or property damage.	prevent tipping the machine. Employees will do a site walk around before mobilizing to the probing location to determine the best route to drive the Geoprobe®. Employees will use the remote control to move the Geoprobe®.
PRESSURE	Pressurized hydraulic lines.	Geoprobe®.	Faulty pressurized hydraulic lines could burst resulting in personal injury/exposure and hydraulic fluid release.	All components of the Geoprobe® will be inspected prior to and at the completion of the task. In the event of a spill/leak, personnel will contain the fluid using the spill cleanup material available in the Geoprobe's trailer. Cleanup materials will be disposed of according to state's regulations. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperience workers and improper training could cause incidents resulting in personal injuries and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. When driving the Geoprobe® for the first time, an experienced operator should be on site to help coach the driving process. All employees operating the Geoprobe® will be familiar with the basic controls of the machine including the Emergency Kill switch button. Employees will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			
ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D PPE (hard hat, safety glasses, high-visibility work shirt or vest, long pants, steel-toed boots), work gloves, and single hearing protection (e.g. earmuffs).
APPLICABLE SDS	SDSs will be maintained based on-site characterization and contaminants.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	SOP-GEOPROBE-03 Starting and Stopping the Kubota Engine
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

Revisions:

Revision	Description	Date
1	Updates to SOP to reflect Geoprobe ® Model 7822DT	11/16/2020

PURPOSE	To provide standard instructions for constructing tool strings and sampling procedures using the Geoprobe® Model DT-22 Dual Sampling System.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
DT-22 Expendable Cutting Shoe Tool String Set Up	The procedure for operating the Geoprobe® can be reviewed in SOP-GEOPROBE-07 (Operating the Geoprobe® During Probing Operations). Figure 1 depicts the DT-22 tool string diagram. The expendable cutting shoes are used to collect soil samples. When sampling is complete, tooling or materials (e.g., monitoring wells) can be placed or constructed inside the probe rod string. The following instructions describe how to set up the expendable cutting shoe tool string. 1. The expendable cutting shoe has two spaces on the neck portion of the tool. Lubricate a single O-ring with Liquinox soap solution. Place the lubricated O-ring on the top most groove. 2. Take the expendable cutting shoe, with the O-ring inserted, and place the cutting shoe into the expendable cutting shoe holder. 3. Thread the expendable cutting shoe holder onto the female end of the 2.25-inch probe rod. 4. Attach the 1.125-inch clear plastic core liner to the liner driver head. • Take a small piece of light weight inner rod and secure it in the pipe tri-stand. • Thread the liner driver head into the piece of lightweight inner rod. • Push the core liner onto the liner driver head and line up the hole on the top part of the core liner with the set screw hole on the liner drive head. • Place a set screw in the hole and tighten it down with a 3/32 allen wrench.

	5. Unscrew the liner drive head with the sample core liner attached and place it inside the probe rod. **NOTE:** if the bore hole is deeper than four feet, then additional light weight center rods need to be attached to the liner drive head so that four feet of lightweight center rod protrudes out of the outer probe rod in the ground. 6. Place an extra four feet of light weight center rod onto the center rods or sample drive head. 7. Place another outer probe rod over the light weight center rod and thread it onto the lower probe rod until the joint is tight. Tighten joint with a pipe wrench. 8. Place the rubber bumper onto the top light weight center rod or the liner drive head. 9. Place the drive cap over the threads of the probe rods. The tool string is now complete and ready for probing.
DT-22 Attached Cutting Shoe Tool String Set Up	The attached cutting shoes are used to collect soil samples. 1. Thread the attached cutting shoe onto the female end of the DT-22 probe rod. 2. Attach the 1.125-inch clear plastic core liner to the liner driver head. • Take a small piece of light weight inner rod and secure it in the pipe tri-stand. • Thread the liner driver head into the piece of lightweight inner rod. • Push the core liner onto the liner driver head and line up the hole on the top part of the core liner with the set screw hole on the liner drive head. • Place a set screw in the hole and tighten it down with a 3/32 allen wrench. 3. Unscrew the liner drive head with the sample core liner attached and place it inside the probe rod. **NOTE:** if the bore hole is deeper than four feet, then additional light weight center rods need to be attached to the liner drive head so that four feet of lightweight center rod protrude out of the probe rod in the ground. 4. Place an extra four feet of light weight center rod onto the center rods or sample drive head. 5. Place another outer probe rod over the light weight center rod and thread it onto the lower probe rod until the joint is tight. Use pipe wrench to

	tighten the joint. 6. Place the rubber bumper onto the top light weight center rod or the liner drive head. 7. Place the drive cap over the threads of the probe rods. The tool string is now complete and ready for probing.
DT-22 Expendable Point Tool String Set Up	The expendable points are used when collection of soil samples is not needed, but tooling or materials (e.g., monitoring wells) are to be placed or constructed inside the hole. 1. The expendable point has two grooves on the neck portion of the tip. Lubricate a single O-ring with Liquinox soap solution. Place the lubricated O-ring in the upper groove. 2. Take the expendable point, with the O-ring inserted, and place the cutting shoe into the expendable point holder. 3. Thread the expendable point holder onto the female end of the 2.25-inch probe rod. 4. Place the drive cap over the threads of the probe rods. The tool string is now complete and ready for probing.
Threaded Point Tool String Set Up	The threaded point is used when collecting samples is not needed and tooling or equipment (e.g., monitoring wells) will not be placed or constructed inside the hole. 1. Thread the attached point holder onto the female end of the 2.25-inch probe rod. 2. Place the drive cap over the threads of the probe rods. The tool string is now complete and ready for probing.
Cutting the DT-22 Sample Liners	1. Unfold and setup the sample table. 2. Place the aluminum sample core liner holder on the table and fasten the holder to the table with hand clamps. 3. Place the core liner that needs to be sampled in the aluminum holder tray. Place the liner so that the core catcher end of the liner slides over the sample tray retaining pin. 4. Place the DT-22 core liner cutter at the top of the core liner and pulled the length of the core liner. This operation will cut the core liner and make it possible to acquire the soil samples inside the core liner.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Contact with impacted soils and water.	Impacted sites, during sample collection and handling.	Adverse health effects could result from ingesting, inhaling, and/or skin/eye contact with impacted soils and water.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Employees will wear nitrile gloves when collecting and handling samples. Employees will wear work gloves when handling probe rods. Work will be suspended during high wind conditions that produce large amounts of visible impacted dust.
	Hydraulic fluid and diesel.	Geoprobe®.	Employees could be exposed to hydraulic fluid and/or diesel via inhalation, ingestion, and skin/eye contact, when operating the Geoprobe®, or if equipment malfunctions resulting in adverse health effects.	Employees will wear work gloves and eye protection, if contact with hydraulic fluid/diesel is possible. In the event of a spill/leak, personnel will contain the fluid using the spill cleanup material available in the Geoprobe® trailer. Cleanup materials will be disposed of according to the appropriate regulations. All components of the rig will be inspected prior to and at the completion of the task. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.
	Lubricating grease.	Probing location.	Employees could be exposed to lubricating grease via ingestion and skin/eye contact when assembling probe rods resulting in adverse health effects.	Employees will wear work gloves and eye protection when assembling probe rods.

	Liquinox	Probing location.	Employees could be exposed to Liquinox via ingestion and skin/eye contact when assembling probe rods resulting in adverse health effects.	Employees will wear work gloves and eye protection when assembling probe rods.
NOISE	Elevated noise levels.	Geoprobe®.	Employees could be exposed to elevated noise levels when operating the Geoprobe® resulting in irritability, decreased concentration, and noise-induced hearing loss.	Personnel within a 20-foot buffer zone of the Geoprobe® will wear single hearing protection (e.g. earmuffs or earplugs). Non-essential personnel will maintain a 20-foot buffer zone around the Geoprobe®.
ELECTRICAL	Defective electrical lines.	Geoprobe®.	Contact with defective electrical lines could result in personal injury.	Inspect electrical lines of the Geoprobe® prior to and at the completion of the task. Do not operate the Geoprobe® if defective electrical lines are found.
BODY MECHANICS	Lifting and moving rods.	Probing location.	Employees could be exposed to back or muscle strains or sprains when lifting or connecting the Geoprobe® rods.	Employees will follow good lifting techniques including lifting with the legs and not the back, get a good grip, and keep the load close to your body. Two employees will lift the rods if necessary.

GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces and steep slopes.	Walking on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Workers will wear work boots with good traction and ankle support. Employees will plan their path and walk cautiously. Keep work area free of tools/rods. If conditions are wet/muddy, muck boots may be worn. Site can be cleared of snow, if applicable.
	Falling rods.	Probing location.	Heavy rods could slip off of worker's hands while carrying and assembling tool strings causing personal injury.	Employees will use work gloves when assembling and handling rods. Two workers will carry rods, if necessary. All personnel will wear steel-toe boots.
WEATHER	Cold/heat stress	Outdoors.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g. layers). Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Lightning.	Sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Employees will follow the 30/30 rule during lightning storms. When the Geoprobe® is running, the Geoprobe helper will watch/listen for lightning and thunder.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun	Employees will wear sunscreen, long-sleeve work shirts and long pants. Employees will also use safety glasses with tinted lenses.

			burns, skin damage, and eye damage.	
BIOLOGICAL	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. All employees operating the Geoprobe® will be familiar with the basic controls of the machine including the Emergency Kill switch button.
	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Employees with allergies should notify their supervisor.
MECHANICAL	Improper body mechanics.	Assembling and handling rods/sample tubes.	Improper lifting, bending, squatting, and kneeling could result in muscle/back strains or other injuries.	Personnel will use proper lifting techniques – get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder height. Two people will lift, if necessary. Employees should stretch prior to starting work and they will take breaks when necessary.
	Pinch points.	During equipment assembly and when cutting sample liners.	Employees could be exposed to hand injuries such as lacerations, punctures, cuts, and pinched	Employees will wear work gloves when assembling probe rods and sample casings, using the liner cutter, and handling plastic core liners after they have been cut open.

			fingers when assembling probe rods and sample casings, and when using the liner cutter.	Workers will be trained on how to properly use the liner cutter.
	Flying debris.	Probing location.	Eye injuries could result from flying debris when assembling probe rods and sample casings.	Employees will wear safety glasses at all times during Geoprobe® operations.
PRESSURE	Pressurized hydraulic lines.	Geoprobe®.	Faulty pressurized hydraulic lines could burst resulting in personal injury/exposure and hydraulic fluid release.	All components of the rig will be inspected prior to and at the completion of the task.
THERMAL	Cold/heat stress.	Outdoors.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress. Personnel will wear appropriate clothing when working outdoors. Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
HUMAN FACTORS	Inexperience and improperly trained worker.	Sites.	Inexperience workers and improper training could cause incidents resulting in personal injuries and/or property damage.	Employees will be properly trained int his procedure and other applicable procedures. When starting/stopping for the first time, an experienced operator should be on site to help coach the process. All employees operating the Geoprobe® will be familiar with the basic

				controls of the machine including the Emergency kill switch button. Employees will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D PPE.
APPLICABLE SDS	SDSs will be maintained based on site characterization and contaminants. Hydraulic fluid, diesel, Liquinox, and lubricating grease.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	SOP-GEOPROBE-07 Operating the Geoprobe® During Probing Operations
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	

Revisions:

Revision	Description	Date
1	Updates to SOP to reflect Geoprobe ® Model 7822DT	11/16/2020

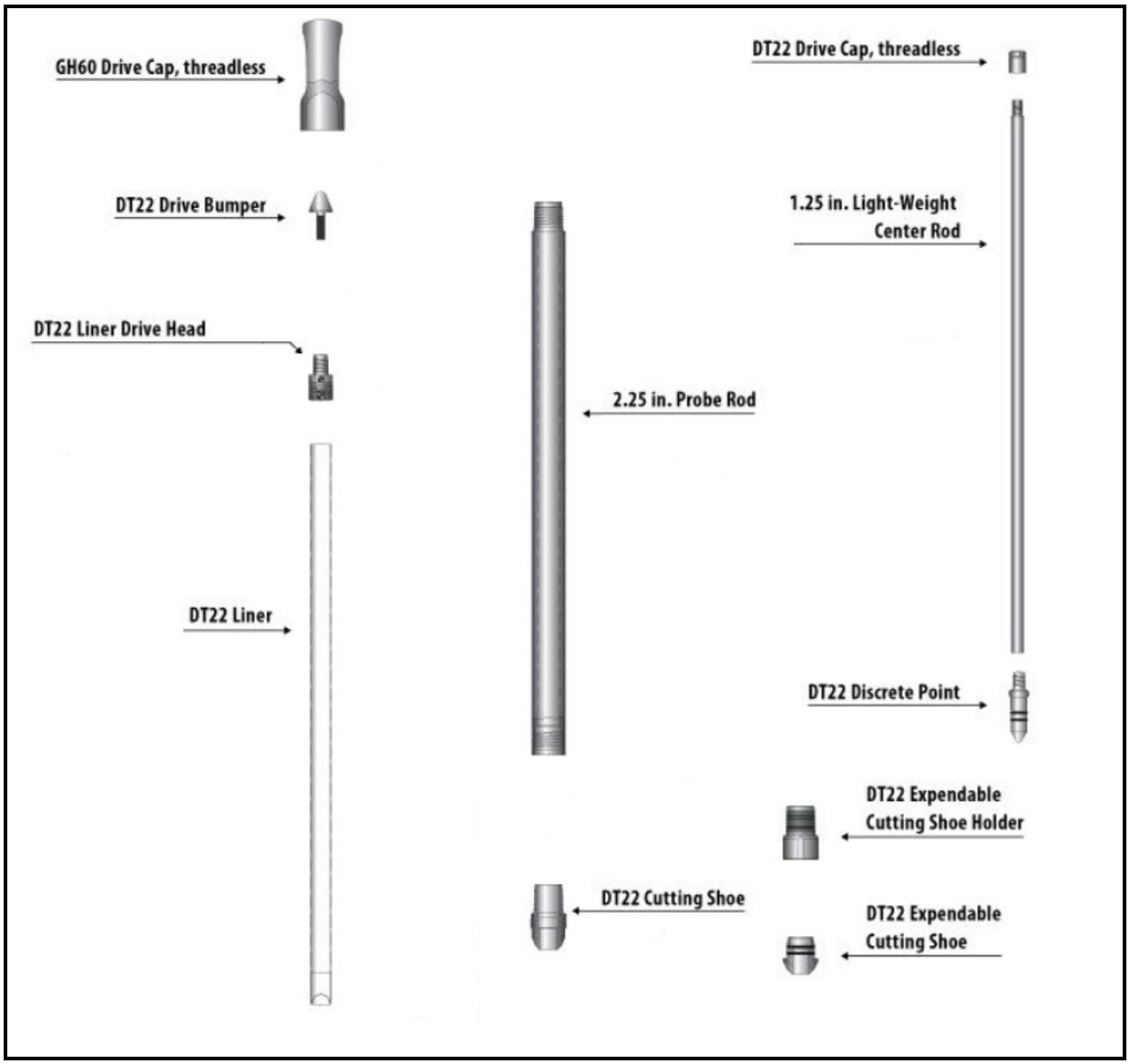

Figure 1 - The DT-22 Tool String Diagram

PURPOSE	To provide standard instructions for constructing tool strings and sampling procedures using the Geoprobe® DT-325/375 Dual Tube Sampling System and the 3.25 and 3.75-inch probe rod. Both the 3.25- and 3.75-inch rods follow the same procedure for set up and operation. Each system has unique cutting shoes, expandable points, etc. specific to the size probe rods being used, but set up and operations are identical. When using expendable points and shoes, wells may also be set.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
DT-325/375 Expendable Cutting Shoe Tool String Set Up	The procedure for operating the Geoprobe® can be reviewed in SOP-GEOPROBE-07 (Operating the Geoprobe® During Probing Operations). Figure 1 depicts the DT-325/375 tool string diagram. The expendable cutting shoes are used to collect soil samples during probe string advancement. When soil sampling is complete, tooling or materials (e.g., monitoring wells) can be placed or constructed inside the probe rod string, leaving the expendable cutting shoe at the bottom of the probe hole as the probe rod is removed from the hole. The following instructions describe how to assemble the expendable cutting shoe tool string. 1. The expendable cutting shoe has two grooves on the neck portion of the cutting shoe. Lubricate a single O-ring with Liquinox soap solution. Place the lubricated O-ring on the top-most groove. 2. Take the expendable cutting shoe, with the O-ring installed, and push the cutting shoe into the expendable cutting shoe holder. Thread the expendable cutting shoe holder onto the female end of the 3.25/3.75-inch probe rod. 3. Prepare the soil sample sheath assembly using the following steps: • Press a DT-325/375 ring retainer onto the bottom end of the 2.1-inch diameter clear plastic core liner. • Slide the sample tube assembly into the sample sheath and thread the ring retainer into the sample sheath. If a core catcher is used, ensure it is on the end with the ring retainer. • Thread sheath drive head on top portion of the sample

	sheath. • Place the sample sheath assembly into the lead probe rod with the expendable cutting shoe. • Place the centering drive cap on the sheath drive head. • Place 3.25/3.75-inch drive cap on the outer probe string. • The tool string is now ready to drive and samples the first interval. 4. Drive the tool string to depth. 5. Remove outer drive cap and then the inner centering drive cap. 6. Thread the 1.25-inch Tee-handle on to the sheath drive head and pull the sample sheath from the outer rod. 7. Unthread the ring retainer to remove the plastic liner containing the soil core. Decontaminate the sample sheath and components as required and reassemble using a new plastic liner as described in step 3 above. 8. Place a four (or five) foot light weight center rod onto the sample drive head and lower the sampler back into the outer probe rod remaining in the ground until it seats into the outer rod assembly. This will leave a lightweight center rod sticking 4 (or 5) feet above the top of the outer rod. 9. Place another outer probe rod over the lightweight center rod and thread it onto the lower probe rod until the joint is tight. Tighten joint with a pipe wrench if necessary. 10. Place the inner drive cap onto the top of the lightweight center rod followed by the placement of the outer drive cap over the threads of the probe rods. The tool string is now complete and ready to probe and sample the next interval. The process is repeated by adding a lightweight center rod and outer probe rod each interval until final depth is achieved. Installation of a well or other equipment can now proceed.
DT-325/375 Threaded Cutting Shoe Tool String Set Up	The threaded cutting shoes are used to collect soil samples. The fixed cutting shoe limits the size and placement of well materials, and therefore is typically used only for collecting soil cores. However, small diameter wells or piezometers can be placed through the center of the cutting shoe. 1. Thread the cutting shoe onto the female end of the DT-325/375 probe rod. 2. Prepare the sample sheath assembly using the following steps:

	• Press a DT-325/375 ring retainer onto the bottom end of the 2.1-inch diameter clear plastic core liner. • Slide the sample tube assembly into the sample sheath and thread the ring retainer into the sample sheath. If a core catcher is used, ensure it is on the end with the ring retainer. • Thread sheath drive head on top portion of the sample sheath. • Place the sample sheath assembly into the lead probe rod with the threaded cutting shoe. • Place the centering drive cap on the sheath drive head. • Place 3.25/3.75-inch drive cap on the outer probe string. • The tool string is now ready to drive and samples the first interval. 3. Drive the tool string to depth. 4. Remove outer drive cap and then the inner centering drive cap. 5. Thread the 1.25-inch Tee-handle on to the sheath drive head and pull the sample sheath from the outer rod. 6. Unthread the ring retainer to remove the plastic liner containing the soil core. Decontaminate the sample sheath and components as required and reassemble using a new plastic liner as described in step 2 above. 7. Place a four (or five) foot light weight center rod onto the center rods or sample drive head and lower the sampler back into the outer probe rod remaining in the ground until it seats into the outer rod assembly. This will leave a lightweight center rod sticking 4 (or 5) feet above the top of the outer rod. 8. Place another outer probe rod over the lightweight center rod and thread it onto the lower probe rod until the joint is tight. Tighten joint with a pipe wrench if necessary. 9. Place the inner drive cap onto the top light weight center rod followed by the placement of the outer drive cap over the threads of the probe rods.
DT-325/375 Expendable Point Tool String Set Up	The expendable points are used when collection of soil samples is not needed, but tooling or materials (e.g., monitoring wells) are to be placed or constructed through the outer rods. 1. The expendable point has two grooves on the neck portion of the tip. Lubricate a single O-ring with Liquinox soap solution. Place the lubricated O-ring in the upper groove.

	2. Take the expendable point, with the O-ring inserted, and place the point into the expendable point holder 3. Thread the expendable point holder onto the female end of the 3.25/3.75-inch probe rod. 4. Place the outer drive cap over the threads of the probe rods. The tool string is now ready for probing. 5. Drive the probe rod the full interval. 6. Continue to add a new 3.25/3.75-inch probe rod as the probe string is advanced each interval. 7. Continue driving the 3.25/3.75-inch rods until the desired depth is reached.
Threaded Point Tool String Set Up	The threaded point is used when collecting samples is not needed and tooling or equipment (e.g., monitoring wells) will not be placed or constructed inside the hole. 1. Thread the solid point onto the female end of the 3.25/3.75-inch probe rod. 2. Place the outer drive cap over the threads of the probe rods. The tool string is now complete and ready for probing.
Cutting the DT-325/375 Sample Liners	1. Unfold and setup the sample table. 2. Place the aluminum sample core liner holder on the table and fasten the holder to the table with hand clamps. 3. Place the core liner that needs to be sampled in the aluminum holder tray. Place the liner so that the core catcher end of the liner slides over the sample tray retaining pin. 4. Place the DT-325/375 core liner cutter at the top of the core liner and pull the length of the core liner. This operation will cut the core liner and make it possible to acquire the soil samples inside the core liner.

Pulling 3.25/3.75-inch rods from the ground using threaded pull cap	1. Thread pull cap on top of the rod string to be extracted from the ground. 2. Move Geoprobe head with rod puller into position to pull the rod. 3. Begin pulling rod out of ground until the pull cap is at full height. 4. Place rod clamp around rods at ground level and clamp tightly. 5. Relax the pull on the rods by moving the Geoprobe head down slightly, allowing the pull bar to be moved away from the pull cap. 6. Remove pull cap. 7. Remove upper rod from the rod string. 8. Replace threaded pull cap on remaining rod string and repeat the process until all the rods have been removed from the ground.
Pulling 3.25/3.75-inch rods from the ground using external rod grip system with well installation.	1. Well installation. If doing 1.5" well both 3.75" and 3.25" rods can be used. If doing 2" wells they need to be slim pre-pack and can only be used with the 3.75" system. Start with the well screen, and thread on a bottom cap. 2. With one person holding the screen down the well the next person will attach the next section of well casing typically a riser. Tighten riser hand tight and make sure it is flush and not cross threaded. Then one person will lower this piece down as the other person screws on another piece. This process is repeated until desired length is added to meet well construction specs. 3. Once you have your desired length an extra piece of riser will be added so you don't drop the well and can lower it slowly to the bottom. Once this is reached the very last piece should not be threaded on tightly. This piece will be left loose so when you start the removal process of the outer casing you can separate this piece and pull it out. This makes it so you do not have to lift the outer casing above the well stickup. 4. Move Geoprobe head into position to where the leaf pull plates line up on rod. If the rod was originally driven to ground level, thread a 2-foot rod on the string to extend the string, allowing the rod grip system to grab the rod string. 5. Install rod grip tool by aligning the pull pins on the head with the tool. 6. Begin pulling rods from the ground. During this process one person should hold the well casing installed earlier down to make sure it does not begin coming up. If the well casing does begin to come up stop the process. Grab a hammer and begin tapping on the well casing as the other person pulls up to prevent the well casing from coming up. Do not hit the well casing to hard as it

can break the plastic well and pieces may come off.

7. Once you have almost reached the top of pulling out the first 5' rod, un-thread the last piece of casing and remove it. Then continue to pull the outer rods out all the way to the top. Install the rod clamp at ground level to secure the rod string.

8. Relax the pull of the Geoprobe head and remove the rod grip tool. You can relax the pull of the Geoprobe by lowering the head a little once the rods are clamped and secured.

9. Move the Geoprobe head back away from the rod and remove the upper rod.

10. Repeat the procedure starting from step 4 above until all rods have been removed from the ground. Once you have removed enough casing above the screen the well should stay in place. However, putting the extra well casing to make sure the well is staying down in place is good practice and should be done through the whole process until all rods are out of the ground.

11. Once rods have been removed, measure down with a tape measure to see how far down the hole is open to. Sand must be 2' above the screen or natural back fill. If you measure and the hole has collapsed 2' above the screen, one person should poor a little sand down the hole while the other person uses the tape measure moving it up and down. Moving the tape measure up and down will help prevent bridging of the sand. Once a little sand has been added see if the hole has filled up. If the hole has not filled up, keep adding sand until you raise the level by about an inch. This will let you know that voids have been filled and bentonite can now not reach the pre-pack screen and blind it off.

12. Once you have filled the hole with sand, bentonite can be added to ground surface or to spec. Some instances natural back fill must be used the last 3 feet or if a flush mount is to be installed the last foot should be left open for adding the flush mount and concrete.

13. Once well is installed cut to desired length.

14. If placing standup protective casing around well use at least a 5' long protective casing. Cut the well so there is 32" stickup. Mark the protective casing so when you open the lid the well will be flush. Center the protective casing over the well and use the Geoprobe to push the protective casing down make sure the protective casing is level. As you do this process a little bit of hammer may be necessary. Every so often you should check to make sure you are not pushing the well down, and it is still centered. Once the well is level with the open lid of the protective casing, place silica sand between the well

	and the protective casing. 15. If placing a flush mount use shovels to dig out the dirt around the well and place your flush mount. If in asphalt or concrete use a concrete saw to cut a chunk out and dig down to make the flush mount level. Once flush mount is level mix concrete according to the bag and poor around and smooth out the concrete around the well. You want to have a slight slope away from the well to keep running water from going into your well.

HSSE CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
CHEMICAL	Contact with impacted soils and water.	Impacted sites, during sample collection and handling.	Adverse health effects could result from ingesting, inhaling, and/or skin/eye contact with impacted soils and water.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Employees will wear nitrile gloves when collecting and handling samples. Employees will wear work gloves when handling probe rods. Work will be suspended during high wind conditions that produce large amounts of visible impacted dust.
	Hydraulic fluid and diesel.	Geoprobe®.	Employees could be exposed to hydraulic fluid and/or diesel via inhalation, ingestion, and skin/eye contact, when operating the Geoprobe®, or if equipment malfunctions resulting in adverse health effects.	Employees will wear work gloves and eye protection if contact with hydraulic fluid/diesel is possible. In the event of a spill/leak, personnel will contain the fluid using the spill cleanup material available in the Geoprobe® trailer. Cleanup materials will be disposed of according to the appropriate regulations. All components of the rig will be inspected prior to and at the completion of the task. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
	Lubricating grease.	Probing location.	Employees could be exposed to lubricating grease via ingestion and skin/eye contact when assembling probe rods resulting in adverse health effects.	Employees will wear work gloves and eye protection when assembling probe rods.
	Liquinox	Probing location.	Employees could be exposed to Liquinox via ingestion and skin/eye contact when assembling probe rods resulting in adverse health effects.	Employees will wear work gloves and eye protection when assembling probe rods.
NOISE	Elevated noise levels.	Geoprobe®.	Employees could be exposed to elevated noise levels when operating the Geoprobe® resulting in irritability, decreased concentration, and noise-induced hearing loss.	Personnel within a 20-foot buffer zone of the Geoprobe® will wear single hearing protection (e.g. earmuffs or earplugs). Non-essential personnel will maintain a 20-foot buffer zone around the Geoprobe®.
PRESSURE	Pressurized hydraulic lines.	Geoprobe®.	Faulty pressurized hydraulic lines could burst resulting in personal injury/exposure and hydraulic fluid release.	All components of the rig will be inspected prior to and at the completion of the task.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
ELECTRICAL	Defective electrical lines.	Geoprobe®.	Contact with defective electrical lines could result in personal injury.	Inspect electrical lines of the Geoprobe® prior to and at the completion of the task.
BODY MECHANICS	Lifting and moving rods.	Probing location.	Employees could be exposed to back or muscle strains or sprains when lifting or connecting the Geoprobe® rods or installing well casing.	Employees will follow good lifting techniques including lifting with the legs and not the back, get a good grip, and keep the load close to your body. Two employees will lift the rods if necessary.
GRAVITY	Falls from slips and trips. Falling rods.	Uneven terrain, slick/muddy/wet surfaces and steep slopes. Probing location.	Walking on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries. Heavy rods could slip off of worker's hands while carrying and assembling tool strings causing personal injury.	Workers will wear work boots with good traction and ankle support. Employees will plan their path and walk cautiously. Keep work area free of tools/rods. If conditions are wet/muddy, muck boots may be worn. Site can be cleared of snow, if applicable. Employees will use work gloves when assembling and handling rods. Two workers will carry rods, if necessary. All personnel will wear steel-toe boots.
WEATHER	Cold/heat stress Lightning.	Outdoors.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke. Electrocution, injury, death, or	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g. layers). Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP. Employees will follow the 30/30 rule during lightning

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
		Sites.	equipment damage could be caused by lightning strike.	storms. When the Geoprobe® is running, the Geoprobe helper will watch/listen for lightning and thunder.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear sunscreen, long-sleeve work shirts and long pants. Employees will also use safety glasses with tinted lenses.
BIOLOGICAL	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. All employees operating the Geoprobe® will be familiar with the basic controls of the machine including the Emergency Kill switch button.
	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals. Wear Level D PPE and avoid contact with animals. Stop work if animals enter work area. Use insect repellant if necessary. First-aid kits will be available on site. Employees with allergies should notify their supervisor.
MECHANICAL	Improper body mechanics.	Assembling and handling rods/sample tubes.	Improper lifting, bending, squatting, and kneeling could result in muscle/back	Personnel will use proper lifting techniques – get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder height.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
			strains or other injuries.	Two people will lift, if necessary. Employees should stretch prior to starting work and they will take breaks when necessary.
	Pinch points.	During equipment assembly, well installation, and when cutting sample liners.	Employees could be exposed to hand injuries such as lacerations, punctures, cuts, and pinched fingers when assembling probe rods and sample or well casings, and when using the liner cutter.	Employees will wear work gloves when assembling probe rods and sample casings, using the liner cutter, and handling plastic core liners after they have been cut open. Workers will be trained on how to properly use the liner cutter.
	Flying debris.	Probing location.	Eye injuries could result from flying debris when assembling probe rods and sample casings.	Employees will wear safety glasses at all times during Geoprobe® operations.
PRESSURE	Pressurized hydraulic lines.	Geoprobe®.	Faulty pressurized hydraulic lines could burst resulting in personal injury/exposure and hydraulic fluid release.	All components of the rig will be inspected prior to and at the completion of the task.
THERMAL	Grass fire	Outdoors in dry season.	Parking or driving vehicle /Geoprobe on or near dry grass could cause a fire and equipment or environmental damage.	Personnel will avoid parking or driving in areas containing dry shrubs or tall grass during hot/dry weather conditions.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
HUMAN FACTORS	Inexperience and improperly trained worker.	Sites.	Inexperience workers and improper training could cause incidents resulting in personal injuries and/or property damage.	Employees will be properly trained int his procedure and other applicable procedures. When starting/stopping for the first time, an experienced operator should be on site to help coach the process. All employees operating the Geoprobe® will be familiar with the basic controls of the machine including the Emergency kill switch button. Employees will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D PPE.
APPLICABLE SDS	SDSs will be maintained based on site characterization and contaminants. Hydraulic fluid, diesel, Liquinox, and lubricating grease.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	SOP-GEOPROBE-07 Operating the Geoprobe® During Probing Operations
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**

Revisions:

Revision	Description	Date
1	Update to SOP to reflect Geoprobe ® Model 7822DT	11/16/2020

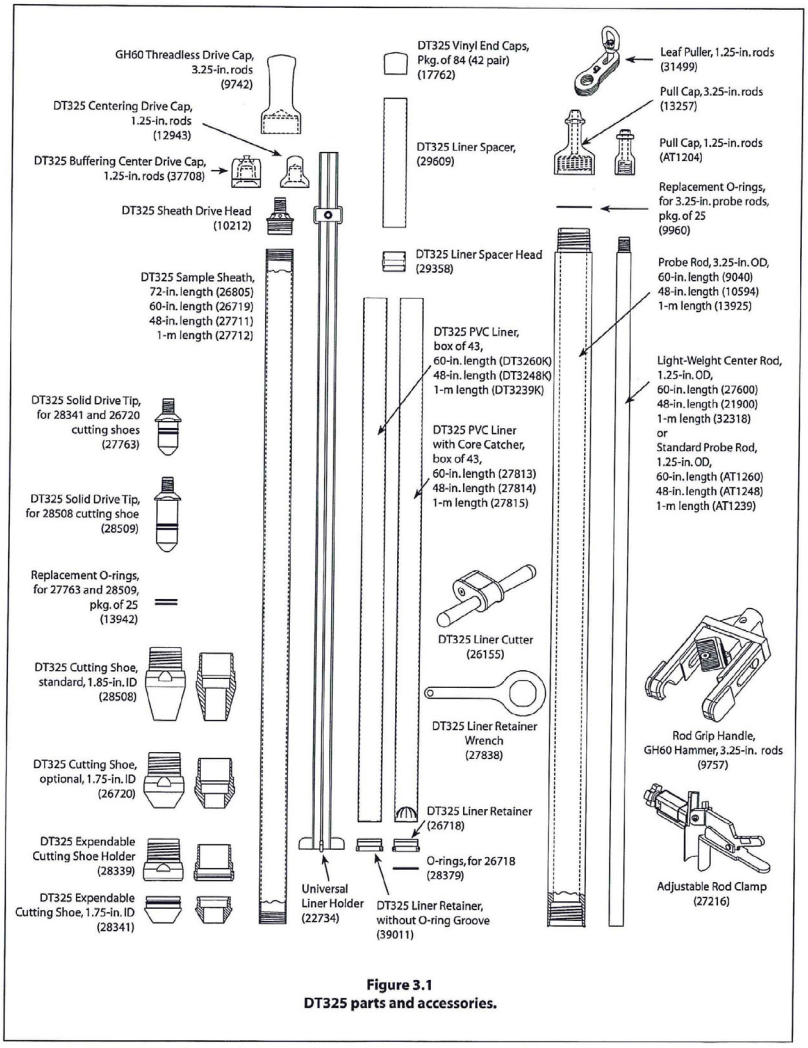

Figure 3.1
DT325 parts and accessories.

Standard Operating Procedure 7 DT325 Sampling System

Figure 1 - The DT-325 Tool String Diagram

PURPOSE	To provide standard instructions for operating the Geoprobe® Model 7822DT during probing operations.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Probe Operating Controls	***Probe*** The Probe Control Lever operates the probe cylinder. The probe control lever will lower and raise the probe cylinder and the hammer assembly. Place the probe control lever in the downward position to lower the probe cylinder and place the probe control lever in the upward position to raise the probe cylinder. The probe cylinder uses the static weight of the machine to push/hammer the rig tooling into the ground to either conduct sampling or install wells. ***Hammer/Rotation*** The Hammer/Rotation Control Lever activates and deactivates the hammer percussion and also will allow rotation when percussion is conducted. The Hammer/Rotation is used when the static weight of the machine is not enough force to push the tooling into the ground. Sometimes the hammer function is helpful when sampling and not getting very good recovery just with the static weight of the rig. The rotation is generally not used during probing operations. The rotation is typically used when using a special concrete bit to drill holes through concrete in a roto-hammer fashion. ***Auger*** The Auger Control Lever controls the speed and direction of the auger head. This tool is not used in Pioneer's probing operations. ***Regen (Two-Speed Pull System)*** The Regen Control Switch activates the regenerating probe cylinder circuit. By activating the circuit, the probe cylinder will move up and down much faster. With the low speed setting (full pulling power), the full pull stroke takes 11 seconds, while on the fast speed setting, the full stroke takes 5 seconds. When using the high-speed setting, the probe cylinder will lose a lot of its pulling force. This switch is mainly used on shallow holes or at the end of the tool string on deeper holes when heavy pulling is not required.

Probing Using Static Weight	When using static weight, the Geoprobe® only uses the weight of the unit to advance probe rods. 1. Drive and position the Model 7822DT at the desired sampling location. Refer to SOP-GEOPROBE-04 Driving and Positioning the Geoprobe® Model 7822DT for instructions. 2. Put a magnetic bullet level on the front of the derrick on the rig. Ensure the derrick is vertical in the fore and aft position. To plumb the derrick vertically, use the Fold Control Lever until the derrick is plumb. 3. Set up the tool string using the desired configuration for the DT-22 or the DT-325/375 dual tube systems. Refer to SOP-GEOPROBE-05 Geoprobe® DT-22 Dual Tube Sampling System and SOP-GEOPROBE-06 Geoprobe® DT-325/375 Dual Tube Sampling System for tool string diagrams and set-up procedures. 4. Position the initial pipe/tool string under the Geoprobe hammer. Lower the hammer onto the drive cap by placing the probe lever into the downward position. ***CAUTION:*** *do not hold onto the drive cap; make sure to hold onto the push rod when lowering the probe hammer onto the drive head. This will make sure that no appendages can be pinched between the metal.* 5. Place the magnetic bullet level on the front of the pipe. Use the extend lever to get the pipe plumb fore and aft. 6. Place the magnetic bullet level on the side of the pipe . Use the swing lever to get the pipe plumb from side to side. ***IMPORTANT:*** *ensure that the first pipe entering the ground is plumb. This will ensure there is no angle to the probe hole and will make for easier extraction when pulling the tool string out of the ground. It is best to initially check the pipe for level and then push the pipe approximately one foot into the ground and check the level again. In some instances, it may be necessary to check the rod plumb every half foot due to difficult probing conditions. Do not try to force the pipe level after the first pipe has entered the ground. This may damage the threads on the pipe and can break the pipe itself.* 7. When the first pipe/tool string is plumb, begin the push by pulling the probe lever down to start pushing the rod into the ground. Stop approximately one foot into the push and check for rod plumbness. Then continue to push the rod into the ground by pulling down on the probe lever. Check for rod plumb as necessary as the first rod is advanced. During static weight probing, the foot of the Geoprobe

	derrick may or may not slightly lift off of the ground. To get a feel for the machine and how hard the soil is, the operator should place their left foot on the front portion of the foot of the rig to provide feedback on how the push is progressing. **NOTE:** if the operator is recovering small soil samples, try to use the hammer lever slightly to try and vibrate the soil into the sample tube. It is very unlikely that just the static weight of the rig will be able to push the rod into the ground past four to eight feet. If the operator is collecting soil caps as per SOP-GEOPROBE-05 Geoprobe® DT-22 Dual Tube Sampling System and/or SOP-GEOPROBE-06 Geoprobe® DT-325/375 Dual Tube Sampling System. The remainder of the push will be completed following the appropriate SOP. If the operator is collecting soil cores, follow SOP-GEOPROBE-05 Geoprobe® DT-22 Dual Tube Sampling System and/or SOP-GEOPROBE-06 Geoprobe® DT-325/375. **NOTE:** as stated before, generally the static weight alone is not enough to reach the total depth of the hole. Do not just use static weight if one believes they have reached refusal. Refusal is when the piping will not go into the ground anymore.
Probing Using Percussion and Static Weight	The tool string cannot be advanced only of the Geoprobe weight in most soil formations. In these situations, hammer percussion must be employed as described in this section. 1. Follow steps in task "Probing using only the static weight of the Geoprobe" prior to starting probing using percussion. 2. Put a magnetic bullet level on the front of the derrick on the rig. Ensure the derrick is vertical in the fore and aft position. To plumb the derrick vertically, use the Fold Control Lever until the derrick is plumb. 3. Place the magnetic bullet level on the side of the derrick to check the verticality side to side. Use lever to rotate derrick until plumb. Position the initial pipe/tool string under the Geoprobe hammer. Lower the hammer onto the drive cap by placing the probe lever into the downward position. NOTE: Ensure that the first pipe entering the ground is plumb. This will ensure there is no angle to the probe hole and will make for easier extraction when pulling the tool string out of the ground. It is best to initially check the pipe for level and then push the pipe approximately one foot into the ground and check the level again. In some instances, it may be necessary to check the rod plumb every half foot due to difficult probing conditions. Do not try to force the pipe level after the first pipe has entered the ground. This may damage the threads on the pipe and can break the pipe itself.

	When the first rod/tool string is plumbed, begin to pull the probe lever and the hammer/rotation lever down simultaneously to start pushing and hammering the rod into the ground. Stop part way through the push of the rod and re-plumb the pipe. Then continue to push the rod into the ground by pulling down on the probe lever and hammer/rotation lever. During percussion probing, the foot of the derrick should be lifted roughly an inch off of the ground. To get a feel for the machine and how hard the soil is, the operator should place their left foot on the front portion of the foot of the rig. 4. ***NOTE:*** *the operator needs to make sure that the foot of the derrick comes off of the ground during percussion probing. If the foot is not coming off of the ground, the rubber bumpers will melt and deteriorate. This is because not enough static weight is being applied to the tool string.* 5. If the operator is collecting soil cores, the next step would be to pull off the drive caps and use the extraction "T" to pull the sample out of the outside casing as per SOP-GEOPROBE-05 Geoprobe® DT-22 Dual Tube Sampling System and/or SOP-GEOPROBE-06 Geoprobe® DT-325/375 Dual Tube Sampling System SOP-Geoprobe. The remainder of the push will be completed following the appropriate SOP. Note: Depending on subsurface conditions, there may be instances where probe refusal is encountered. Continued hammering on a rod that is not advancing can cause damage to the rod string. The Pioneer operator needs to recognize refusal and determine the best course of action. In some instances when the probe rod encounters a small subsurface cobble, hammering on the rod will break the cobble allowing the probe string will advance. Knowing subsurface stratigraphy in advance if possible will assist in making good field decisions when it comes to refusal.
Adding Probe Rods, Inner Rods, and Sample Liners or Sheaths	Probe rods must be added to the tool string to reach the desired depth below ground surface. 1. Using the probe control lever, raise the hammer assembly to its full height. 2. Using the extend lever, extend back as far as the rig will go. This will allow for easy access to the in-ground tool string and will allow for easy addition of probe rods and sampling equipment. 3. Remove the outer drive cap from the probe rod that was driven into the existing ground followed by removing rubber bumper and/or inner rod drive cap.

	4. Thread the extraction "T" to the inner rod string and use "T" to pull up to remove the inner rods and sample liner or sample sheath out of the existing probe rod string. The inner rods simply thread onto each other and to the sample core or sample sheath. Refer to SOP-GEOPROBE-05 to see the procedure and diagrams of how to set up the DT-22 Sample Core. Refer to SOP-GEOPROBE-06 to see the procedure and diagrams of how to set up the DT-325/375 Sample Sheath. 5. If retrieving cores, replace the sample core or sample sheath with a clean set and attach enough inner rod to leave an extra length of inner rod (4 feet) out of the in-ground probe rod. 6. Place a new piece of outer probe rod over the 4-foot length of inner rod sticking out of the existing hole and thread the new probe rod to the existing probe rod in the ground. Tighten the threaded joint with a pipe wrench. 7. Place inner rod drive cap and/or rubber bumper followed by the outer rod drive cap. Use the extend lever to extend the rig outward until the Geoprobe hammer is above the drive cap. 8. Slowly lower the probe cylinder onto the top probe rod with the probe control lever. 9. Advance the tool string into the ground. 10. Repeat steps 1- 9 until the desired sampling depth or refusal is reached. ***IMPORTANT:*** *do not continue probing if the tool string meets refusal. Prolonged hammering at refusal can cause damage to the tool string.*
Pulling Probe Rods with the Pull Cap	A pull cap is used to retract probe rods from an existing bore hole, when monitoring well materials through and the rods do not need to be lifted over the well casing are not being set 1. Raise the hammer assembly just high enough to provide access to the top probe rod. 2. Remove the drive cap from the top probe rod of the tool string. 3. Attach a pull cap to the top probe rod by threading the pull cap securely onto the probe rod. 4. Ensure that the probe foot is in contact with the ground surface. This provides support for the unit. The downward force resulting from pulling the rods may damage the unit if the foot is not supported.

	NOTE: if when pulling the probe rods out of the ground the foot begins to sink into the ground, then lengths of blocking should be placed under the foot to allow for more surface area to support the force on the ground. 5. Hold down on the probe control lever until the drive head is close to the pull cap. 6. Pull the pin upward to release the extraction latch and place it around the pull cap. 7. Retract the probe rod by placing the probe control lever in the upward position until motion has stopped. 8. Once the probe cylinder is all the way up and the first probe rod has been retracted, place the Kwik Klamp-pipe clamp on the lower section of the pipe. A pipe clamp is used to support the weight of the rod string so that when the extraction latch is taken off, the top piece of pipe can be unattached from the tool string without losing the rest of the tool string down the hole. 9. Lower the probe cylinder slightly so the extraction latch is free from the pull cap. Pull the extraction latch and lock it back into its locked position. 10. Place the section of pipe that was taken off of the tool string to the side or in the rod rack out of the way. 11. Repeat steps 3 through 10 until the entire tool string has been extracted from the ground. Note: The last rod out of the ground is relatively unsupported. Special care must be taken to avoid dropping the rod back down the hole. One method to prevent rod loss is to leave the Kwik Klamp tool on the rod until the rod is well away from the probe hole. If the rod slips, the Kwik Klamp prevents the rod from getting loose and falling back into the hole.
Pulling Probe Rods with the Rod Grip Pull System	The rod grip pull system is used when installing monitoring wells and other applications when the inside of the tool string needs to be available during extraction of the probe rods. There are three handle assemblies and jaws to accommodate the various rod sizes: 1.0-inch, 1.25-inch, 2.125-inch, 3.25-inch and 3.75-inch. ***Pulling Probe Rods*** In order to pull with this system, there must be enough exposed probe rod above the ground surface to allow the puller jaws to engage the outside of

the rod. Approximately 18 inches of exposed rod is needed. If the tool string is driven too far and the puller cannot fully engage the top probe rod, simply add another rod to the tool string and reattach the handle assembly.

IMPORTANT: it is very important that the puller jaws never grip over the threaded section of a probe rod. Severe damage to the threads will result. Furthermore, avoid placing the puller near rod joints as gripping is not as effective at this location and rod deformation can occur.

1. Lower the extraction latch so it will not bind up the pipe when extracting with the rod grips.

2. Position the hammer with the jaws directly behind the top probe rod and below the threads. Take the appropriate handle assembly (according to rod diameter) and orientate the jaw cutout toward the probe rod as shown in.

3. Hook the handle over the socket head cap screws on each side of the probe cylinder.

4. To start pulling, lower the end of the handle assembly and raise the probe cylinder. This tightly clamps the jaws of the handle and probe cylinder around the probe rod. If slipping occurs, step on the end of the handle assembly to encourage the gripping action.

5. Once fully raised, place a pipe vice on top of the probe rod string below the retracted rod connection and slightly lower the probe cylinder to release the pressure on the probe rod. Lift the end of the handle to rotate the assembly on the cap screws. This moves the handle jaw away from the probe rod and disengages the puller. The probe cylinder can now be lowered to pull another section of rod. Once the rod grip puller is engaged on the next rod, the rod above is removed. Alternatively, and especially if rod deviation took place during probing operations, the rod grip puller is removed, the Geoprobe is extended inward, and the hammer is lowered into the pulling position. The Geoprobe is then extended out until the rod grips are aligned with the probe rod. The rod grip puller then is installed and used to pull the next section of probe rod. In some cases, the rod grip handle gets very tight and does not want to loosen when ready for removal. In that case, a hammer can be used on the outer end of the handle with an upward motion to loosen the puller. Before extracting the next rod, the pipe clamp is loosened. One at the top of the pull, the pipe clamp is reattached to support the rod string before releasing the rod grip system.

6. Repeat steps 2 through 5 until the in-hole tool string is fully extracted.

Note: The last rod out of the ground is relatively unsupported. Special care must be taken to avoid dropping the rod back down the hole. One method

	to prevent rod loss is to leave the Kwik Klamp tool on the rod until the rod is well away from the probe hole. If the rod slips, the Kwik Klamp prevents the rod from getting loose and falling back into the hole.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Contact with impacted soils and water.	Impacted sites, during sample collection and handling.	Adverse health effects could result from ingesting, inhaling, and/or skin/eye contact with impacted soils and water.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Employees will wear nitrile gloves when collecting and handling samples. Employees will wear work gloves when handling probe rods. Work will be suspended during high wind conditions that produce large amounts of visible impacted dust.
	Hydraulic fluid and diesel.	Geoprobe®.	Employees could be exposed to hydraulic fluid and/or diesel via inhalation, ingestion, and skin/eye contact, when operating the Geoprobe®, or if equipment malfunctions resulting in adverse health effects.	Employees will wear work gloves and eye protection, if contact with hydraulic fluid/diesel is possible. In the event of a spill/leak, personnel will contain the fluid using the spill cleanup material available in the Geoprobe® trailer. Cleanup materials will be disposed of according to the appropriate regulations. All components of the rig will be inspected prior to and at the completion of the task. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.
	Lubricating grease.	Probing location.	Employees could be exposed to lubricating grease via ingestion and skin/eye contact when assembling probe rods resulting in adverse health effects.	Employees will wear work gloves and eye protection when assembling probe rods.

NOISE	Elevated noise levels.	Geoprobe®.	Employees could be exposed to elevated noise levels when operating the Geoprobe® resulting in irritability, decreased concentration, and noise-induced hearing loss.	Personnel within a 20-foot buffer zone of the Geoprobe® will wear single hearing protection (e.g. earmuffs or earplugs). Non-essential personnel will maintain a 20-foot buffer zone around the Geoprobe®.
ELECTRICAL	Defective electrical lines.	Geoprobe®.	Contact with defective electrical lines could result in personal injury.	Inspect electrical lines of the Geoprobe® prior to and at the completion of the task.
	Contact with overhead utilities.	Probing location.	Injury, death, or property damage could occur from contact with overhead utilities when the hammer assembly is raised to its highest position.	If overhead hazards are present, established overhead utility procedures will be followed. Probe locations will be moved to avoid working around overhead utilities. Employees will maintain the required minimal radial clearance distances based on voltage when working around overhead lines.
	Contact with underground utilities.	Probing location.	Injury, death or property damage could occur from contact with underground utilities when geoprobing.	Prior to starting work, employees will call for a utility locate (i.e., call 811). If underground utilities are present, established underground utility procedures will be followed. Probe locations will be moved to avoid working around underground utilities.
BODY MECHANICS	Lifting and moving rods.	Probing location.	Employees could be exposed to back or muscle strains or sprains when lifting or connecting the Geoprobe® rods.	Employees will follow good lifting techniques including lifting with the legs and not the back, get a good grip, and keep the load close to your body. Two employees will lift the rods if necessary.

GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces and steep slopes.	Walking on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Workers will wear work boots with good traction and ankle support. Employees will plan their path and walk cautiously. Keep work area free of tools/rods. If conditions are wet/muddy, muck boots may be worn. Site can be cleared of snow, if applicable.
	Falling rods.	Probing location.	Heavy rods could slip off of worker's hands while carrying and assembling tool strings causing personal injury.	Employees will use work gloves when assembling and handling rods. Two workers will carry rods, if necessary. All personnel will wear steel-toe boots.
WEATHER	Cold/heat stress	Outdoors.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g. layers). Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Lightning.	Sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Employees will follow the 30/30 rule during lightning storms. When the Geoprobe® is running, the Geoprobe helper will watch/listen for lightning and thunder.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage	Employees will wear sunscreen, long-sleeve work shirts and long pants. Employees will also use safety glasses with tinted lenses.

BIOLOGICAL	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. All employees operating the Geoprobe® will be familiar with the basic controls of the machine including the Emergency Kill switch button.
	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Employees with allergies should notify their supervisor.
MECHANICAL	Geoprobe® shifting.	Probing location, when probing with percussion and working on a sloped surface.	Personal injury and equipment damage could occur if the Geoprobe® shifts while probing with percussion and when working on a sloped surface.	When probing with percussion, do not raise the machine foot more than approximately 6 inches off the ground or the vehicle may become unstable and shift. When working on a sloped surface, position the rig so that it is facing upslope. In the event that the probe unit loses stability, it will roll away from the operator without causing injury.
	Struck by the Geoprobe®.	Operating the Geoprobe®.	Personnel could be injured if struck by the Geoprobe®.	Non-essential personnel will maintain a 20-foot buffer zone around the rig.
	Improper body mechanics.	Assembling, handling, and retrieving rods/sample tubes.	Improper lifting, bending, squatting, and kneeling could result in muscle/back strains or other	Personnel will use proper lifting techniques – get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder height. Two people will lift, if

			injuries.	necessary. Employees will also use good body mechanics when retrieving rods/sample tubes: bend knees, lean slightly away from the object, keep back and wrists straight, use legs to move the objects. Employees should stretch prior to starting work and they will take breaks when necessary.
	Contact with rotating and moving parts of the Geoprobe®.	Operating the Geoprobe®.	Fingers/hands could become pinched or caught in moving/rotating parts of the Geoprobe® resulting in cuts, scrapes, and/or broken bones.	Employees will not touch moving/rotating parts of the rig. Personnel will tie back long hair and will not wear loose clothing when operating the machine. Work gloves are required when operating the rig. Operators will stand to the control side of the machine, clear of the probe foot and derrick, while operating the controls. Personnel will never reach across the probe assembly to manipulate the machine controls. All employees on site will be familiar with the basic controls of the machine including the Emergency Kill switch button.
	Pinch points.	During equipment assembly, advancing the Geoprobe®, and extracting probe rods.	Employees could be exposed to hand injuries such as lacerations, punctures, cuts, and pinched fingers when assembling probe rods and sample	Employees will always wear work gloves when operating the Geoprobe® and handling its components. Employees will never place their hands-on top of the tool string while raising or lowering the hammer. Workers will not place thumb or fingers between latch and hammer when raising

			casings, pulling probe rods and sampling devices with the hammer latch and/or the rod grip pull assembly, and when the Geoprobe hammer is in motion.	latch to pull probe rods and sampling devices from the ground. Grind or file sharp burrs that can be developed on the outside of probe rods if the rod grip puller is allowed to slip during tool retrieval.
	Flying debris.	Probing location.	Eye injuries could result from flying debris when driving tool strings into the ground.	Employees will wear safety glasses at all times during Geoprobe® operations.
PRESSURE	Pressurized hydraulic lines.	Geoprobe®.	Faulty pressurized hydraulic lines could burst resulting in personal injury/exposure and hydraulic fluid release.	All components of the rig will be inspected prior to and at the completion of the task.
THERMAL	Contact with hot drive head and caps.	Probing location.	The drive head and caps can become hot during probing operations and direct contact with these components could cause skin injuries.	Employees will let the drive head and caps cool down before removing them from the tool string. Workers will also wear work gloves when handling these components.
HUMAN FACTORS	Inexperience and improperly trained worker.	Sites.	Inexperience workers and improper training could cause incidents resulting in personal injuries and/or property damage.	Employees will be properly trained int his procedure and other applicable procedures. When starting/stopping for the first time, an experienced operator should be on site to help coach the process. All employees operating the Geoprobe® will be familiar with the basic controls of the

				machine including the Emergency kill switch button. Employees will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D PPE, earplugs, and earmuffs.
APPLICABLE SDS	SDSs will be maintained based on site characterization and contaminants. Hydraulic fluid, diesel, and lubricating grease.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	SOP-GEOPROBE-04 Driving and Positioning the Geoprobe® Model 7822DT SOP-GEOPROBE-05 Geoprobe® DT-22 Dual Tube Sampling System SOP-GEOPROBE-06 Geoprobe® DT-325/375 Dual Tube Sampling System
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**

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Revisions:

Revision	Description	Date
1	Updates to SOP to reflect Geoprobe ® Model 7822DT	11/16/2020

PURPOSE	To provide standard instructions for using a DH133 Automatic Drop Hammer to perform Standard Penetration Test (SPT).
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Assembling and Driving the Outer and Inner Rods	An outer casing is first driven through the undisturbed soil with the probe unit hammer assembly to reach the top of the testing intervals. Specific instructions are listed below. 1. Align the probe unit hammer assembly by pulling the hammer pin and swinging the hammer over to the identified/applicable location. 2. Thread the SPT cutting shoe to the leading end of a heavy-weight outer probe rod (3.25-in. ODx60-in. length). 3. Thread the SPT solid drive tip to the leading end of a heavy-weight inner rod (1.25-in ODx60-in length). 4. Insert the heavy-weight inner rod into the outer rod until the solid drive tip partially extends from the bottom of the cutting shoe. 5. Slip a threadless drive cap to the top of the heavy-weight inner rod. 6. Place a threadless drive cap on top of the heavy-weight outer rod. 7. Raise the probe unit hammer assembly to its highest position by fully extending the probe cylinder until it stops. 8. Position the assembled rods directly under the probe unit hammer assembly with the cutting shoe centered between the probe foot. The heavy-weight outer rod should now be parallel to the probe derrick. A magnetic level should be placed on the heavy-weight rod to check rod verticality. 9. Start the probe unit hammer assembly using both down feed and hammer levers to advance the assembled rods into the ground until reaching the desired testing depth below ground surface.

Using the DH133 Automatic Drop Hammer	Once the rod assembly has been driven into the ground to reach the top of the desired testing interval, the operator can start using the DH133 Automatic Drop Hammer (drop hammer). Step by step instructions are listed below. 1. Remove the threadless drive cap on top of the heavy-weight outer rod. 2. Remove the threadless inner rod drive cap. 3. Remove the heavy-weight inner rod and remove the solid drive tip. 4. Assemble split spoon sampler and thread it to the bottom of the heavy-weight inner rod. 5. Insert the heavy-weight inner rod and the split spoon string into the outer rod that was previous driven into the ground. Add inner rod as necessary until the split spoon sampler is resting on bottom. 6. Using a marker, mark the desired testing intervals (typically 6', 12", 18" and 24") on the heavy-weight inner rod. 7. Unlatch and swing the Geoprobe® hammer directly above the heavy-weight inner rod. 8. Activate the drop hammer on by using the axillary hydraulic switch to advance the heavy-weight inner rod and split spoon into the ground until reaching the desired testing depth. The operator will count and record the number of blow counts that is takes to reach each testing interval previously marked on the heavy-weight inner rod. If the blow count reaches 50 and the full 6-inch interval has not been sampled, it will be called refusal and the hammer will be stopped. 9. Reposition the Geoprobe® hammer by the swing function. Adjust Geoprobe ® so the probe unit hammer assembly is directly above the heavy-weight inner rod. Using the probe machine and a threaded pull cap, pull up the heavy-weight inner rod and split spoon. The outer rod remains in the ground. 10. Remove the split spoon from the heavy-weight inner rod. Disassemble the split spoon sampler by removing the cutting shoe and adapter pin from either end of the split spoon. Open the split spoon and collect the soil sample. Then, decontaminate the split spoon components as necessary, assemble the two halves of the sample tube, and thread the cutting shoe

back onto the leading end of the split spoon and the adapter pin onto the opposite end.

11. Thread a solid drive tip onto the leading end of a heavy-weight inner rod and connect an additional heavy-weight inner rod to other end of the rod.

12. Place the threadless drive cap onto the top of the heavy-weight inner rod tool string.

13. Insert the assembled heavy-weight inner rod tool string into the 3.25” outer rod that was previously driven into the ground.

14. Using the overhead winch, raise a heavy-weight outer rod and feed it over the protruding heavy-weight inner rods. Thread the heavy-weight outer rod onto the outer rod that was previously driven into the ground.

15. Place a threadless drive cap on top of the heavy-weight outer rod tool string.

16. Using the probe unit hammer assembly, drive the assembled rods into the ground to the top of the next SPT sample interval.

17. Remove the threadless drive cap from the heavy-weight outer rods and the threaded drive cap from the heavy-weight inner rods.

18. Thread a loop pull cap onto the tool string of heavy-weight inner rods.

19. Connect the overhead winch to the loop pull cap and remove the heavy-weight inner rod tool string.

20. Remove the solid drive tip from the heavy-weight inner rods and thread a split spoon sampler onto the assembled heavy-weight inner rods.

21. Replace the loop pull cap on the heavy-weight inner rods with a threaded drive cap.

22. Insert the assembled heavy-weight inner rod tool string into the 3.25” outer rod that was previously driven into the ground until it rests on bottom. Once on bottom, mark the inner rod string for the proper SPT intervals

23. Reposition the Geoprobe® so the drop hammer is directly above the heavy-weight inner rods.

24. Activate the drop hammer on to drive the tool string of heavy-weight inner rods and split spoon into the ground until reaching the desired testing depth. The operator will count the number of blow counts that is takes to reach each testing interval marked on the heavy-weight inner rod.

Repeat steps 9 to 24 until reaching the end of the testing depth.

	Note: as the assembled rods get longer and heavier, use the probe machine, the overhead winch, and/or the adjustable rod clamp to facilitate the process of placing and retrieving rods.
Outer Casing Retrieval	The outer casing may be retrieved in two ways: 1. Entire casing string removed from the ground and remaining probe hole sealed from ground surface with granular bentonite. The outer casing may be pulled from the ground with the probe machine and a pull cap, if the probe hole is to be sealed with granular bentonite from the ground surface. This method is used for shallow probe holes in stable formations only. Such conditions allow the entire probe hole to be sealed with granular bentonite. 2. Casing pulled with probe hole sealed from bottom-up during retrieval. Bottom-up grouting should be performed during casing retrieval in unstable formations where side slough is probable. Such conditions create void spaces in the probe hole if granular bentonite is installed from the ground surface.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Contact with impacted soils and water.	Impacted sites, during sample collection and handling.	Adverse health effects could result from ingesting, inhaling, and/or skin/eye contact with impacted soils and water.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Employees will wear nitrile gloves when collecting and handling samples. Employees will wear work gloves when handling probe rods. Work will be suspended during high wind conditions that produce large amounts of visible impacted dust.
	Hydraulic fluid and diesel.	Geoprobe®.	Employees could be exposed to hydraulic fluid and/or diesel via inhalation, ingestion, and skin/eye contact, when operating the Geoprobe®, or if equipment malfunctions resulting in adverse health effects.	Employees will wear work gloves and eye protection, if contact with hydraulic fluid/diesel is possible. In the event of a spill/leak, personnel will contain the fluid using the spill cleanup material available in the Geoprobe® trailer. Cleanup materials will be disposed of according to the appropriate regulations. All components of the rig will be inspected prior to and at the completion of the task. Non-essential personnel will maintain a 20-foot buffer zone around the equipment.
	Lubricating grease.	Probing location.	Employees could be exposed to lubricating grease via ingestion and skin/eye contact when assembling probe rods resulting in adverse health effects.	Employees will wear work gloves and eye protection when assembling probe rods.

NOISE	Elevated noise levels.	Geoprobe®.	Employees could be exposed to elevated noise levels when operating the Geoprobe® resulting in irritability, decreased concentration, and noise-induced hearing loss.	Personnel within a 20-foot buffer zone of the Geoprobe® will wear single hearing protection (e.g. earmuffs or earplugs). Non-essential personnel will maintain a 20-foot buffer zone around the Geoprobe®.
ELECTRICAL	Defective electrical lines.	Geoprobe®.	Contact with defective electrical lines could result in personal injury.	Inspect electrical lines of the Geoprobe® prior to and at the completion of the task.
	Contact with overhead utilities.	Probing location.	Injury, death, or property damage could occur from contact with overhead utilities when the hammer assembly is raised to its highest position.	If overhead hazards are present, established overhead utility procedures will be followed. Probe locations will be moved to avoid working around overhead utilities. Employees will maintain the required minimal radial clearance distances based on voltage when working around overhead lines.
	Contact with underground utilities.	Probing location.	Injury, death or property damage could occur from contact with underground utilities when geoprobing.	Prior to starting work, employees will call for a utility locate (i.e., call 811). If underground utilities are present, established underground utility procedures will be followed. Probe locations will be moved to avoid working around underground utilities.
BODY MECHANICS	Lifting and moving rods.	Probing location.	Employees could be exposed to back or muscle strains or sprains when lifting or connecting the Geoprobe® rods.	Employees will follow good lifting techniques including lifting with the legs and not the back, get a good grip, and keep the load close to your body. Two employees will lift the rods if necessary.

GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces and steep slopes.	Walking on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Workers will wear work boots with good traction and ankle support. Employees will plan their path and walk cautiously. Keep work area free of tools/rods. If conditions are wet/muddy, muck boots may be worn. Site can be cleared of snow, if applicable.
	Falling rods.	Probing location.	Heavy rods could slip off of worker's hands while carrying and assembling tool strings causing personal injury.	Employees will use work gloves when assembling and handling rods. Two workers will carry rods, if necessary. All personnel will wear steel-toe boots.
WEATHER	Cold/heat stress	Outdoors.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g. layers). Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Lightning.	Sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Employees will follow the 30/30 rule during lightning storms. When the Geoprobe® is running, the Geoprobe helper will watch/listen for lightning and thunder.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear sunscreen, long-sleeve work shirts and long pants. Employees will also use safety glasses with tinted lenses.

BIOLOGICAL	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. All employees operating the Geoprobe® will be familiar with the basic controls of the machine including the Emergency Kill switch button.
	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Employees with allergies should notify their supervisor.
MECHANICAL	Geoprobe® shifting.	Probing location, when using the drop hammer and working on a sloped surface.	Personal injury and equipment damage could occur if the Geoprobe® shifts while using the drop hammer and when working on a sloped surface.	When using the drop hammer, do not raise the machine foot more than approximately 6 inches off the ground or the vehicle may become unstable and shift. When working on a sloped surface, position the rig so that it is facing upslope. In the event that the probe unit loses stability, it will roll away from the operator without causing injury.
	Struck by the Geoprobe®/drop hammer.	Operating the Geoprobe®/ drop hammer.	Personnel could be injured if struck by the Geoprobe®/drop hammer.	Non-essential personnel will maintain a 20-foot buffer zone around the rig.
	Improper body mechanics.	Assembling, handling, and retrieving	Improper lifting, bending, squatting, and	Personnel will use proper lifting techniques – get a good grip, keep the load close to the

		rods/sample tubes.	kneeling could result in muscle/back strains or other injuries.	body, lift with legs and not with back, and avoid lifting loads above shoulder height. Two people will lift, if necessary. Employees will also use good body mechanics when retrieving rods/sample tubes: bend knees, lean slightly away from the object, keep back and wrists straight, use legs to move the objects. Employees should stretch prior to starting work and they will take breaks when necessary.
	Back injuries.	Moving the drop hammer with hand dolly.	Back injuries and muscle/back strains could result when using the hand dolly to move the drop hammer.	Employees will inspect the hand dolly (including all wheels) before using it. Two employees will load the drop hammer on the hand dolly. Workers will use proper body mechanics when loading the drop hammer. Employees will make sure the weight is evenly distributed on all wheels of the hand dolly. Employees will always push a hand dolly to move the load, instead of pulling the hand dolly. Personnel will use a belt to keep the drop hammer from shifting or slipping.
	Contact with rotating and moving parts of the drop hammer.	When the drop hammer is in motion.	Fingers/hands could become pinched or caught in moving/rotating parts of the drop hammer resulting in cuts, scrapes, and/or broken bones.	Employees will not touch moving/rotating parts of the drop hammer. Work gloves are required when operating the drop hammer. Operators will stand to the control side of the machine, clear of the probe foot and drop hammer, while operating the

				controls. Personnel will never reach across the probe assembly to manipulate the machine controls. All employees on site will be familiar with the basic controls of the machine including the Emergency Kill switch button.
	Pinch points.	When mounting the drop hammer, while the drop hammer is in motion, assembling probe rods, and extracting probe rods.	Employees could be exposed to hand injuries such as lacerations, punctures, cuts, and pinched fingers.	Employees will always wear work gloves. Employees will never place their hands-on top of the tool string while raising or lowering the drop hammer.
	Flying debris.	Probing location.	Eye injuries could result from flying debris when driving tool strings into the ground with the drop hammer.	Employees will wear safety glasses at all times during Geoprobe® operations.
PRESSURE	Pressurized hydraulic lines.	Geoprobe®.	Faulty pressurized hydraulic lines could burst resulting in personal injury/exposure and hydraulic fluid release.	All components of the rig will be inspected prior to and at the completion of the task.
THERMAL	Cold/heat stress.	Outdoors.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in	Training on signs and symptoms of cold/heat stress. Personnel will wear appropriate clothing when working outdoors. Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will

			heat cramps, heat exhaustion, or heat stroke.	follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
HUMAN FACTORS	Inexperience and improperly trained worker.	Sites.	Inexperience workers and improper training could cause incidents resulting in personal injuries and/or property damage.	Employees will be properly trained int his procedure and other applicable procedures. When starting/stopping for the first time, an experienced operator should be on site to help coach the process. All employees operating the Geoprobe® will be familiar with the basic controls of the machine including the Emergency kill switch button. Employees will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Level D PPE, earplugs, and earmuffs.
APPLICABLE SDS	SDSs will be maintained based on-site characterization and contaminants. Hydraulic fluid, diesel, lubricating grease.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	
TOOLS	DH133 automatic drop hammer: hitch mounted basket, counterweights, hand dolly, pipe wrench, safety pin, machine vise, work table, and deionized water.
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**

Revisions:

Revision	Description	Date
1	Updates to SOP to reflect Geoprobe ® Model 7822DT	11/16/2020

PURPOSE	To provide standard instructions for equipment decontamination (inorganic contaminants – heavy metals).
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.
NOTES	All equipment leaving the contaminated area of a site must be decontaminated. Decontamination methods include removal of contaminants through physical, chemical, or a combination of both methods. Decontamination procedures are to be performed in the same level of protection used in the contaminated area of a site. In some cases, decontamination personnel may be sufficiently protected by wearing one level lower protection. The information for site specific equipment decontamination and personnel protection levels, as detailed in the Sampling and Analysis Plan (SAP) or work plan, should be followed. The following decontamination procedures are for typical uncontrolled hazardous waste sites. For a specific or unusual contaminant, such as dioxins, see the Site-Specific Health and Safety Plan (SSHASP) and consult with the Safety and Health Manager. Decontamination procedures should be used in conjunction with methods to prevent contamination of sampling and monitoring equipment. If practical, one-time-use equipment should be used, and disposed of in accordance with the SAP, work plan, and SSHASP.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Remove gross contamination.	Remove gross contamination with a tap water rinse. If available, use pressurized or gravity flow tap water. If not, a 5-gallon bucket of tap water and a stiff brush may be used.
Wash equipment.	Wash equipment in a solution of soap (no phosphate) and tap water with a stiff brush.
Triple rinse equipment.	Triple rinse the equipment with tap water. Then, rinse the equipment with de-ionized or distilled water.
Rinse equipment with nitric acid/distilled water mixture.	If specified in the SAP, work plan, or SSHASP, rinse the equipment with a mixture of 10:1 nitric acid in distilled water (10 parts water to 1-part nitric acid). In many cases, the tap water and de-ionized water rinses will be sufficient. If a nitric rinse is used, rinse the equipment again with distilled water.

Air dry equipment.	Place equipment on plastic sheeting or foil to air dry.
Transport/ store equipment.	Wrap equipment in foil or plastic wrap to transport or store.
Triple rinse decontamination equipment.	Triple rinse equipment (i.e., brushes, buckets, tubs, etc.) used in the decontamination process with water, preferably pressurized.
Wash decontamination equipment.	Agitate the equipment used in the decontamination process in the soap/tap water solution. (The tub which holds the solution will only have the water rinse)
Triple rinse decontamination equipment.	Triple rinse equipment with tap water.
Store and label decontamination equipment.	Place equipment in appropriate areas, so they are used only for decontamination purposes. Label the equipment, if necessary.
Dispose of decontamination solutions.	Use a wastewater container to properly dispose of the soap/tap water solution, the tap water rinse, and the de-ionized water rinse. Use an organic solvent waste container to properly dispose of the solvent rinse. When contaminants have been identified, either in the solutions or elsewhere on the site, solutions should be disposed of appropriately as discussed in the SAP, work plan, or SSHASP. If they are hazardous (e.g., characteristic, listed, etc.), dispose of them as such. **Note:** when using other than the above-mentioned solutions, check with the Safety and Health Manager and the Project Manager. Some solvents must be evaporated.
Measure effectiveness of procedures.	Effectiveness of the decontamination procedures will be measured using field equipment rinsate blanks (see the Site-Specific Quality Assurance Project Plan).

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Potential contact with contaminated items and resulting water from decontamination procedures.	Sites.	Inadvertent exposure to contaminated items and water resulting from decontamination procedures could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Employees will follow decontamination procedures as described above. Employees will wear nitrile gloves when handling contaminated items.
	Nitric acid.	Sites.	Employees could be exposed to nitric acid via ingestion and skin/eye contact when decontaminating equipment. Exposure could cause irritation of skin/eye and dental erosion.	Employees will prevent skin/eye contact with nitric acid and they will wear nitrile gloves and eye protection when handling nitric acid and the nitric acid and distilled water mixture.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Improper lifting.	Sites.	Back injuries and muscle/back strains could result when using improper techniques to lift decontamination equipment.	Personnel will use proper lifting techniques – get a good grip, hold the load close to the body, lift with the legs and not with the back, and avoid lifting above shoulder height. Use two employees to lift equipment when necessary.
GRAVITY	Slips and falls.	Sites.	Slips and falls could occur while performing decontamination procedures due to slippery surfaces resulting in	Workers will wear work boots with good traction and ankle support. Keep work areas as dry as possible. Wear muck boots, as necessary.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
			bruises, scrapes, or broken bones.	
WEATHER	Cold/heat stress.	Outdoors.	Exposure to cold climates may result in cold burns, frostbite, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g. layers). Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Lightning.	Outdoors.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Employees will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear sunscreen, long-sleeve work shirts and long pants. Employees will also use safety glasses with tinted lenses.
BIOLOGICAL	Plants, insects, and animals.	Sites	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Employees with allergies will notify their supervisor.
MECHANICAL	Struck by and/or caught in between heavy equipment or	Sites.	Personnel could be injured if struck by and/or caught in	When applicable, employees will communicate with the contact person of other contractors on the site.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
	vehicles.		between heavy equipment or vehicles while performing decontamination procedures.	Personnel will avoid working near heavy equipment/vehicles, when possible. High visibility clothing will be worn. When possible, personnel will park field vehicles or use traffic cones to prevent third party vehicles from coming into the work area.
PRESSURE	Not applicable.			
THERMAL	Cold/heat stress.	Sites.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress. Personnel will wear appropriate clothing when working outdoors. Employees will remain hydrated and will have sufficient caloric intakes during the day.
	Hypothermia/frostbite.	Sites where air temperature is 35.6°F (2°C) or less.	Workers whose clothing becomes wet during decontamination procedures may be exposed to hypothermia and/or frostbite.	Employees will change clothing if it becomes wet.
HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SIMOPS	Not applicable			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Safety glasses, high-visibility work shirt or vest, long pants, work boots, and nitrile gloves.
APPLICABLE SDS	SDSs will be maintained based on-site characterization and contaminants. Nitric acid.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	
TOOLS	5-gallon bucket of tap water, stiff brush, soap, de-ionized or distilled water, nitric acid (if required), plastic sheeting or foil, tarps, decontamination tubs and buckets, and sprayers.
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
SAFETY AND HEALTH MANAGER	**DATE**

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	

Revisions:

Revision	Description	Date
1	Updates to SOP to reflect Geoprobe ® Model 7822DT	11/16/2020

PURPOSE	To provide standard instructions for decontamination of all personnel leaving a contaminated area.
SCOPE	Pioneer Technical Services, Inc. (Pioneer) prepared this practice for the workforce and this Standard Operating Procedure (SOP) applies to all work performed by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent (as defined by OSHA) in the risk-assessed procedure described below before performing the work.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is inaccurate or unsafe, personnel must notify the Project Manager, Safety Manager, and the SOP Technical Author to initiate appropriate revisions. Personnel will perform all work under this SOP in a manner that is consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plans (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
1. Wash/ remove outer contaminated items.	**If wearing two layers of gloves, remove outer contaminated items. If task requires only one pair of gloves, skip to Step 2:** a. Remove nitrile or latex gloves by grasping the outside of the opposite glove near the wrist. b. Pull and peel the glove away from the hand, turning the glove inside out with the contaminated side now on the inside. c. Hold the removed glove in the opposite gloved hand. d. Slide one or two fingers of the ungloved hand under the wrist of the remaining glove. e. Peel off the glove from the inside, creating a bag for both gloves. **If wearing protective coveralls such as Tyvek suites**: a. Keep inner layer of nitrile or latex gloves on while decontamination process occurs. b. If in a designated decontamination zone*, brush built-up material off the suit. c. Unzip the coverall and begin rolling it outwards, rolling it down over your shoulders. d. Place both hands behind your back and pull down the sleeve of each arm until the arms are completely out of the sleeves. e. Sit down and remove each shoe. f. Roll the coveralls down (ensuring the contaminated side is not touched or does not come into contact with clothing) over your knees until completely removed. g. Place the coveralls into a designated bag for storage/transportation to proper disposal area. h. With soap (non-phosphate) and tap water, wash the outer, more heavily contaminated items, such as boots (if in a designated decontamination zone, there may be a specific place to rinse off boots). i. Rinse the outer items in tap water.

	*If there is not a designated decontamination zone, remove personal protective equipment (PPE) carefully to contain material and place it in the appropriate disposal container. For instructions to remove additional PPE not described in this document, refer to the project's SSHASP.
2. Wash/remove inner contaminated items.	Remove the inner layer of nitrile or latex gloves following the procedure in Step 1. If necessary, wash with soap (non-phosphate) and tap water the inner, less contaminated items. Rinse the items in tap water.
3. Store/ transport items.	Store/transport contaminated items in a separate designated area to prevent cross contamination prior to disposal.
4. Dispose of contaminated items.	Dispose of contaminated clothing and equipment in accordance with site/project and/or federal and state requirements.
5. Contact the Safety and Health Manager.	For contaminants other than those found typically at uncontrolled hazardous waste sites, such as asbestos, polychlorinated biphenyls (PCB), perchloroethylene (PCE), etc., contact the Safety and Health Manager.
Information about Emergency Decontamination	
1. During life-saving process.	If the decontamination procedure is essential to the life-saving process (i.e., the contamination/exposure is the cause of needing medical treatment), decontamination must be performed immediately before medical treatment can be administered.
2. During heat-related illness.	If heat-related illness develops, protective clothing should be removed as soon as possible. Wash, rinse, and/or cut off protective clothing/equipment.
3. When medical treatment is needed.	If medical treatment is required to save a life (i.e., the reason for medical treatment is not related to the contamination/exposure), decontamination should be delayed until the victim is stabilized. Wrap the victim to reduce contamination of others. Alert medical personnel to the emergency and instruct them about potential contamination. Instruct medical personnel about specific decontamination procedures. Once the victim is medically stable, decontamination should be performed as soon as possible for the victim and any affected medical personnel.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	HAZARDS	WHERE	HOW, WHEN, RESULT	CONTROLS
CHEMICAL	Potential contact with contaminated items and resulting water from decontamination procedures.	Sites.	Inadvertent exposure to contaminated items and water resulting from decontamination procedures could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site; follow decontamination procedures as described in the SSHASP; and wear nitrile gloves and safety glasses when handling contaminated items.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Potential awkward, repetitive postures when performing decontamination tasks.	Sites.	Exposure to repeated postures, awkward postures when completing decontamination.	Stretch prior to completing task and break up tasks as necessary to reduce awkward and repetitive postures.
GRAVITY	Slips and falls.	Areas designated for decontamination procedures.	Slips and falls could occur while performing decontamination procedures due to slippery surfaces resulting in bruises, scrapes, or broken bones.	Personnel will wear work boots with good traction and ankle support. Personnel will also be aware of working/walking surfaces and choose a path to avoid hazards, keep work area as dry as possible, and wear muck boots as necessary.
WEATHER	Cold/heat stress.	Sites.	Exposure to cold temperatures may result in cold burns, frostbite, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors, remain hydrated, and have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer Corporate HASP.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	HAZARDS	WHERE	HOW, WHEN, RESULT	CONTROLS
	Hypothermia/ frostbite.	Sites where air temperature is 35.6 °F (2°C) or less.	Personnel whose clothing becomes wet during decontamination procedures may be exposed to hypothermia and/or frostbite.	If it becomes wet, personnel will change clothing.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could result from lightning strike.	Personnel will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Personnel could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.
BIOLOGICAL	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Personnel will avoid contact with plants, insects, and animals. First-aid kits will be available on the site. Personnel with allergies will notify their supervisor.
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Not applicable.			

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	**HAZARDS**	**WHERE**	**HOW, WHEN, RESULT**	**CONTROLS**
HUMAN FACTORS	Inexperienced and improperly trained personnel.	Sites.	Inexperienced personnel and improper training could cause incidents resulting in injuries and/or property damage.	Personnel will be properly trained in this procedure and other applicable procedures. Personnel will implement stop work procedures, if necessary.
SIMOPS (Simultaneous Operations)	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	**Personnel Protection Equipment** (PPE)**:** Safety glasses, high-visibility work shirt or vest, long pants, work boots, and nitrile or latex gloves.
APPLICABLE SDSs	**Safety Data Sheets** (SDSs) are available to Pioneer personnel on the internal website under Safety.
REQUIRED PERMITS/ FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
DRAWINGS	
RELATED SOPs/ PROCEDURES/ WORK PLANS	
TOOLS/ EQUIPMENT	In general, the following items will be needed: soap, tap water, tarps, decontamination tubs, brushes, and sprayers. The Sampling and Analysis Plan (SAP) or Quality Assurance Project Plan (QAPP) will describe additional items needed for decontamination.
FORMS/ CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Kendra Overley **Kendra Overley**	**03/30/2022**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**03/30/2022**

PURPOSE	To provide standard instructions for equipment decontamination.
SCOPE	Pioneer Technical Services, Inc. (Pioneer) prepared this practice for the workforce and this Standard Operating Procedure (SOP) applies to all work performed by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent (as defined by OSHA) in the risk-assessed procedure described below before performing the work.
NOTES	All equipment leaving the contaminated area of a site must be decontaminated. Decontamination methods include removal of contaminants through physical, chemical, or a combination of both methods. Decontamination procedures are to be performed at the same level of protection used in the contaminated area of a site. In some cases, decontamination personnel may be sufficiently protected by wearing one level lower protection. The information for site-specific equipment decontamination and personnel protection levels, as detailed in the Sampling and Analysis Plan (SAP), work plan (WP), and Site-Specific Health and Safety Plan (SSHASP), should be followed. The following decontamination procedures are for typical uncontrolled hazardous waste sites. For a specific or unusual contaminant, such as dioxins, see the SSHASP and consult with the Safety and Health Manager. Decontamination procedures should be used in conjunction with methods to prevent contamination of sampling and monitoring equipment. If practical, particularly with organic contaminants, one-time-use equipment should be used and disposed of in accordance with the SAP, WP, and SSHASP. This SOP covers all equipment decontamination EXCEPT for submersible pumps. Decontamination of pumps is detailed in SOP-DE-02A – Equipment Decontamination - Pumps for Well Sampling.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is inaccurate or unsafe, personnel must notify the Project Manager, Safety Manager, and the SOP Technical Author to initiate appropriate revisions. Personnel will perform all work under this SOP in a manner that is consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plans (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
1. Set up decontamination station.	a. Review the SAP or WP and determine if decontamination fluids need to be contained and the need for special decontamination requirements (i.e., chemical rinse). b. If the fluids require containment, set up the decontamination station so that it is located within a small plastic swimming pool or on plastic sheeting with turned up edges to contain water that may slop over during the decontamination process.

	c. If pressurized or gravity flow water is available, attach a hose or piping to reach the decontamination area. If no water is available, bring 5-gallon containers of tap and deionized water (DI) to the decontamination area to clean the equipment. d. Label empty 5-gallon buckets: *gross wash, soap wash, DI rinse, final rinse, and chemical rinse* (if required). e. Lay out clean plastic or foil to place cleaned equipment on to allow for air drying. f. If a chemical rinse is required, fill a spray bottle with the appropriate chemical and label the spray bottle with the chemical's name. g. Pour approximately 2.5 to 3 gallons of tap water into the buckets labeled: *gross wash* and *soap wash*. h. Add a **few drops** (1-3 drops) of Liquinox© soap to the bucket marked *soap wash*. i. Pour 2.5-3 gallons of DI water into the buckets labeled: *DI rinse* and *final rinse.* If a chemical rinse is required, pour DI water into the bucket labeled: *chemical rinse.*
2. Remove gross contamination.	Remove gross contamination using pressurized or gravity flow tap water, if available. If not, manually scrub the equipment using the 5-gallon bucket of water marked *gross wash* and a stiff brush (dedicated to the gross wash step).
3. Wash equipment.	Move the equipment to the 5-gallon bucket marked *soap wash*. Wash equipment with a stiff brush (dedicated to the soap wash step).
4. Triple rinse equipment.	In the bucket marked *DI rinse*, triple rinse the equipment with DI water to remove any soap residue.
5. Second rinse with deionized water.	Using DI water, triple rinse the equipment again in the bucket marked *final rinse* if a chemical rinse is not required.
6. Rinse equipment with chemicals.	In many cases, the tap water and DI water rinses will be sufficient. However, if specified in the SAP, WP, or SSHASP, chemical rinses of the equipment may be required. For inorganic contaminants, a mixture of 10:1 nitric acid in distilled water (10 parts water to 1 part nitric acid) may be specified. A methanol rinse may be required for some organic contaminants, such as hydrocarbons. Spray bottles, clearly marked with the appropriate chemical name, are an acceptable means of rinsing most equipment. **To perform the chemical rinse:** a. Hold the equipment over a collection container (5-gallon bucket or bowl). b. Make sure that all personnel and vehicles are upwind of the spray. c. Spray the piece of equipment inside and out starting at the top and working down to the bottom. d. Dispose of the contained chemicals as described in the SAP, WP or SSHASP. The Safety and Health Manager and/or Project Manager must approve the disposal method used.

7. Rinse equipment with deionized water.	After a required chemical rinse, rinse the equipment again with the DI water in the bucket marked *chemical rinse.* This DI water will need to be retained (i.e., do not dispose of this water on the site), tested, and disposed of according to federal and state requirements for the chemical used. The Safety and Health Manager and/or Project Manager must approve the disposal method used. After the rinse in the *chemical rinse* bucket, triple rinse the equipment again in the bucket marked *final rinse.*
8. Air dry equipment.	Place equipment on plastic sheeting or foil to air dry.
9. Transport/ store equipment.	Wrap equipment in foil or plastic wrap to transport or store.
10. Clean decontamination equipment.	a. Triple rinse equipment from the *gross wash* and *soap wash* (brushes and buckets) with clean tap water, preferably with pressurized water. Soap can be used on particularly dirty equipment. b. Triple rinse all decontamination equipment with DI water, including *DI rinse* and *final rinse* buckets. c. Store decontamination equipment, labeled and in a clean location so they are used only for decontamination purposes.
11. Dispose of decontamination solutions.	Storage of contained decontamination fluids as required by the SAP, QAPP, or WP or of residue from a chemical rinse should have been arranged on site prior to sampling. Once the sampling and associated decontamination is complete, sampling of the stored fluids for hazardous waste criteria will be required. If the fluids are determined to be hazardous (e.g., meet the characteristics of a hazardous waste [ignitability, corrosivity, reactivity, or toxicity] or contain listed wastes from title 40 of the Code of Federal Regulations [CFR] in part 261.4), dispose of them according to federal and state requirements. The Safety and Health Manager and/or Project Manager must approve the disposal method used. Note: when using other than the above-mentioned solutions, check with the Safety and Health Manager and the Project Manager.
12. Measure effectiveness of procedures.	Measure the effectiveness of the decontamination procedures using field equipment rinsate blanks as discussed in the SAP, QAPP, or WP.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
CHEMICAL	Potential contact with contaminated items and resulting water from decontamination procedures.	Sites.	Inadvertent exposure to contaminated items and water resulting from decontamination procedures could lead to adverse health effects.	Personnel will practice proper personal hygiene (wash hands prior to eating/drinking and when leaving the site); follow decontamination procedures as described above; and wear nitrile gloves and safety glasses when handling contaminated items.
	Chemical rinse (e.g., dilute nitric acid, methanol, and hexane).	Sites.	Personnel could be exposed to chemicals via ingestion and skin/eye contact when decontaminating equipment. Exposure could cause irritation of skin/eye and adverse health effects.	Personnel will check and follow safety procedures as outlined in the chemical-specific Safety Data Sheets. Personnel will prevent skin/eye contact with chemicals and they will wear nitrile gloves and eye protection when handling chemicals. Personnel will practice proper personal hygiene (wash hands prior to eating/drinking, after decontaminating equipment, and when leaving the site). All personnel and vehicles will stand upwind when spraying equipment with chemicals. Refer to the Chemical Flushing Guidelines available inside any Pioneer vehicle's first aid kit for first-aid procedures in case of contact with chemicals.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BODY MECHANICS	Improper lifting.	Sites.	Back injuries and muscle/back strains could result when using improper techniques to lift and carry 5-gallon containers.	Personnel will use proper lifting techniques: get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder's height. Two people will lift awkward/heavy tools and equipment.
GRAVITY	Falls from slips and trips.	Areas designated for decontamin-ation procedures.	Slips and falls could occur while performing decontamination procedures due to slippery surfaces resulting in bruises, scrapes, or broken bones.	Personnel will wear work boots with good traction and ankle support. Personnel will also be aware of working/ walking surfaces and choose a path to avoid hazards, keep work areas as dry as possible, and wear muck boots as necessary.
WEATHER	Cold/heat stress.	Sites.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors, remain hydrated, and have sufficient caloric intakes during the day. Personnel will also follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Hypothermia/ frostbite.	Sites where air temperature is 35.6 °F (2 °C) or less.	Personnel whose clothing becomes wet during decontamination procedures may be exposed to hypothermia and/or frostbite.	Personnel will change clothing if it becomes wet.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Personnel will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Personnel could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.
BIOLOGICAL	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Personnel will avoid contact with plants, insects, and animals. First-aid kits will be available on the site. Personnel with allergies will notify their supervisor.
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Contact with hot surfaces.	Foil and decontamination equipment.	If foil and decontamination equipment are placed directly in the sun, they could get hot. Contact with hot surfaces could result in personal injury.	Personnel will not set decontamination stations directly in the sun.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
HUMAN FACTORS	Inexperienced and improperly trained personnel.	Sites.	Inexperienced personnel and improper training could cause incidents resulting in injuries and/or property damage.	Personnel will be properly trained in this procedure and other applicable procedures. Personnel will implement stop work procedures, if necessary.
SIMOPS (Simultaneous Operations)	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	**Personnel Protection Equipment** (PPE)**:** Safety glasses, high-visibility work shirt or vest, long pants, work boots, and nitrile gloves.
APPLICABLE SDSs	**Safety Data Sheets** (SDSs) for corresponding chemicals used during chemical rinse will be maintained based on the site characterization and contaminants. Safety Data Sheets are available to Pioneer personnel on the internal website under Safety.
REQUIRED PERMITS/ FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
DRAWINGS	
RELATED SOPs/ PROCEDURES/ WORK PLANS	

TOOLS/ EQUIPMENT	Five empty 5-gallon buckets, tap water, stiff brushes, Liquinox soap, four 5-gallon containers of DI (or distilled water if DI water is not available), chemicals for chemical rinse (if required), small plastic swimming pool/plastic sheeting or foil, tarps, and sprayers (if available). If additional items for decontamination are needed, they will be listed on the SAP.
FORMS/ CHECKLIST	

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

SOP TECHNICAL AUTHOR	**DATE**
Julie Flammang **Julie Flammang**	**09/08/2020**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**09/08/2020**

PURPOSE	To provide standard instructions for handling investigation-derived waste in accordance with the US Environmental Protection Agency (EPA) protocols and Department of Environmental Quality (DEQ) guidance. Investigation-derived waste may be generated during a Site Assessment (SA), Site Investigation (SI), or Remedial Investigation (RI).
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work carried under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
1. Collect and dispose of decontaminati on fluids.	Collect and dispose of decontamination fluids by using one of the following methods: - Send fluids to a Treatment, Storage, and Disposal (TSD) facility. - Evaporate fluids. - Tread fluids using an activated carbon or air sparging unit. - Temporarily store fluids until determined if they are contaminated. Dispose of decontamination fluids, generated from cleaning equipment used in background sampling or for sampling in areas where past results indicate that contaminants are below standards, to the ground surface.
2. Discharge groundwater from developing and purging wells.	If past monitoring results and laboratory analysis indicate that all contaminants are below groundwater standards, discharge groundwater generated from developing and purging monitoring wells to the ground surface.
3. Collect/label/ store contaminated groundwater from developing and purging wells.	If past monitoring results indicate that one or more contaminants are above groundwater standards, collect the purged water and potentially contaminated water. There may be instances (e.g., inclement weather) where purge water and/or decontamination water will be temporarily stored in drums or tanks to be treated on site with granulated activated carbon or air sparging. If the water is determined by laboratory analysis to contain contaminants above groundwater standards and cannot be treated on site, store the water on site until shipping/disposal arrangements can be made. If the water is visibly contaminated, drum, label, and store the water on site until

	shipping/disposal arrangements are made. Label all containers stored on site with the following information: date, time, contents, any corresponding analytical data, collection location, contact person, and contact agency, etc.
4. Return soils back to borehole.	Unless it is visibly contaminated, place soil and/or cuttings from monitoring well installation back in the borehole.
5. Collect/label/ store contaminated soils from installing wells.	If the soil is visibly contaminated, drum, label, and store the soil/cuttings on site until shipping/disposal arrangements are made. Drum and label soils from borings/well installations located in previously sampled areas that are known to be contaminated. Leave these soils on site until shipping/disposal arrangements are made.
6. Pack and dispose of one-time use equipment and PPE.	Pack disposable equipment intended for one-time use and personal protective equipment (PPE) materials for appropriate disposal. Double bag the disposable equipment and PPE utilized for sampling and dispose of it as a solid waste in the local landfill. Package, drum, and label disposable equipment and PPE utilized for sampling visibly contaminated sites or sites known to be contaminated from previous monitoring. Leave equipment and PPE on site until shipping/disposal arrangements are made.
7. Dispose of samples not used for analysis.	Laboratories will dispose of the portions of the samples submitted, but not used for analysis. If samples are retained and not sent for analysis, they need to be returned to the site prior to remediation or disposed of according to federal and state regulations.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Potential contact with contaminated soils and resulting water from decontamination procedures.	Sites.	Inadvertent exposure to contaminated soils and water resulting from decontamination procedures could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Employees will follow decontamination procedures as described above. Employees will wear nitrile gloves and safety glasses when handling contaminated items.
	Nitric acid.	Sites.	Employees could be exposed to nitric acid via ingestion and skin/eye contact when decontaminating equipment. Exposure could cause irritation of skin/eye and adverse health effects.	Employees will prevent skin/eye contact with nitric acid and they will wear nitrile gloves and eye protection when handling nitric acid. Employees will practice proper personal hygiene – wash hands prior to eating/drinking, after decontaminating equipment, and when leaving the site. Refer to the Chemical Flushing Guidelines available inside vehicle's first aid kit for first-aid procedures in case of contact with nitric acid.
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Improper shoveling techniques.	Sites.	Personnel could be injured if using improper shoveling techniques to store contaminated soils/cuttings in drums, causing back injuries and muscle/back strains.	Personnel will use proper shoveling techniques: keep feet wide apart, place front foot close to shovel, put weight on front foot, use leg to push shovel, shift weight to rear foot, keep load close to body, and turn feet in direction of throw.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
	Improper lifting.	Sites.	Back injuries and muscle/back strains could result when using improper techniques to lift and carry 5-gallon containers of tap water.	Personnel will use proper lifting techniques – get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder's height.
GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces and steep slopes.	Walking/working on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Workers will wear work boots with good traction and ankle support. Personnel will be aware of working/walking surfaces and choose a path to avoid hazards. Keep work areas as dry as possible. Wear muck boots, as necessary.
WEATHER	Cold/heat stress.	Sites.	Exposure to cold climates may result in cold burns, frostbites, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors. Employees will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Hypothermia/frost bite.	Sites where air temperature is 35.6°F (2°C) or less.	Workers whose clothing becomes wet during decontamination procedures may be exposed to hypothermia and/or frostbite.	Employees will change clothing, if it becomes wet.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be	Employees will follow the 30/30 rule during lightning storms.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
			caused by lightning strike.	
RADIATION	Ultraviolet (UV) radiation.	Outdoors.	Employees could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Employees will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Employees should wear sunscreen, if necessary.
BIOLOGICAL	Plants, insects, and animals.	Sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available on site. Employees with allergies will notify their supervisor.
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperienced workers and improper training could cause incidents resulting in adverse health effects and/or property damage.	Employees will be properly trained in this procedure and other applicable procedures. Employees will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, and nitrile gloves.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
APPLICABLE SDS	Safety Data Sheets (SDSs) will be maintained based on site characterization and contaminants. Nitric acid.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	SOP-DE-02 Equipment Decontamination.
TOOLS	Five 5-gallon buckets, tap water, stiff brushes, soap, de-ionized or distilled water, nitric acid (if required), plastic sheeting or foil, tarps, decontamination tubs and buckets, sprayers, storage containers, labels, and shovels.
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
 **Julie Flammang**	**12/03/2014**
SAFETY AND HEALTH MANAGER	**DATE**
 **Tara Schleeman**	**12/03/2014**

Revisions:

Revision	Description	Date

PURPOSE	To provide standard instructions for groundwater monitoring well design and construction.
SCOPE	This practice is for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed procedure described below.
NOTE	A set procedure for designing and constructing groundwater monitoring wells cannot be presented as a standardized operating procedure. Every location within a site may vary depending on contamination encountered, lithology of the subsurface, and depth to groundwater. A technique that may work at one location may be inappropriate at the next. The following sections discuss general guidelines for well design and construction, but actual well designs will depend on specific site conditions and the associated contaminants of concern. Wells drilled for a Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) investigation will be designed to specifications suggested by the site being investigated, provided such design presents no conflict with investigation sampling objectives. This policy will permit the site to incorporate any new wells into on-going monitoring programs by ensuring that new wells are constructed in the same manner as existing wells. Conflicts may result when existing well construction is not suitable for the proposed sampling. For example, polyvinyl chloride (PVC) casing will not be used, if the site is contaminated with high-concentrations of organic compounds, even though existing wells contain PVC casings. Such conflicts will be resolved on a site-specific, case-by-case basis. The method of well construction and the materials used in the casing and screen affect the quality of the well, and its utility for groundwater monitoring, throughout its lifetime. The elements of proper monitoring well construction presented serve as guides for any wells constructed for the groundwater investigation. In addition, these guidelines can be applied to evaluate the adequacy of existing wells when sampling will be conducted from available wells.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work performed under this Standard Operating Procedure (SOP) will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
1. Coordinate utility locates.	Prior to starting work, the drilling subcontractor will have a utility locate and marking performed.
2. Conduct a site walk.	Verify utility locates have been performed. Walk through the site and determine any site-specific hazards associated with the work area. Discuss these hazards with site personnel and note them in the field logbook. Verify the utility locate information

	by identifying where natural gas pipes or other utilities enter any structures on the property or if yard lights or street lights are present with no overhead lines.
3. Select well diameter.	The diameter of the well casing will be the minimum that allows the sampling and/or monitoring equipment to be lowered to the desired depth. The diameter of the borehole into which the casing is placed must be large enough for the casing to fit and have sufficient annular space for the addition of a filter pack and well seal. The diameter of the borehole should be at least 4 inches larger than the casing to provide a minimum 2-inch annular space. When using direct push methods for well installation, the use of prepacked well screens and foam bridge/prepacked bentonite seals are necessary to install wells in smaller boreholes under saturated conditions.
4. Determine well depth.	Wells will be constructed to be depth discrete and to be sampled from one aquifer zone without interference from other zones. This requires provisions for grouting above, and if necessary, below the well screen on the outside of the casing. The location of the screen will be important for sampling since it has an impact on sampling of immiscible organics. Sampling of less dense or more dense organics, which float or sink, will require the screen to be placed at the appropriate depth.
5. Select well casings and screens.	Well casings and screens will be constructed of materials with the least potential for affecting the water quality parameters of the sample. Guidance/criteria regarding casing and screen material selection is presented in various U.S. Environmental Protection Agency (EPA) guidance documents. Well casings and screens will be cleaned and protected from contamination prior to their installation. Factory cleaned screen and casing stored in plastic protective wrap may be used instead of field decontamination of well materials. Selection of screen and slot style are important factors in screen selection. Saw-slot style screens offer less screen open area than the Vee-wire continuous wrap screens making the saw-slot screens far less efficient in terms of producing water. Pre-packed wells screens available from many vendors offer the alternative to set well screen and filter pack in one operation, guaranteeing accurate filter pack placement.
6. Define well drilling method.	Drilling method selection will be based on minimizing both the disturbance of the geologic materials penetrated, and the introduction of air, fluids, and muds. Additionally, some drilling methods are better at collecting soil samples during drilling operations for subsurface characterization. Rotary sonic is one such method that collects quality soil cores for logging and characterization purposes. The direct push technology has also become increasingly popular for the installation of small diameter wells that significantly decreases the volumes of investigation derived waste. Mud rotary drilling that utilizes either bentonite or a polymer-based drilling muds will be avoided. Advantages and disadvantages of various drilling methods are also discussed in EPA guidance documents.
7. Select monitoring well filter pack and annular sealant.	The materials used to construct the filter pack should be chemically inert (e.g., clean quartz sand, silica, or glass beads), well rounded, and dimensionally stable. Natural gravel packs are acceptable, provided that a sieve analysis is performed to establish the appropriate well screen slot size and determine chemical inertness of the filter

pack materials in anticipated environments. Typically, 10-20 mesh silica sand is used to construct most monitoring wells utilizing screens with slot sizes of 0.010 or 0.020 inches. The prepack well screen option typically uses 0.010-inch slotted screen with 20-40 mesh silica sand contained within an outer layer of 65 mesh stainless steel screen.

The materials used to seal the annular space must prevent the migration of contaminants from the surface or intermediate zones to the sampling zone and prevent cross contamination between strata. The materials should be chemically compatible with the anticipated contaminants to ensure seal integrity during the life of the monitoring well and chemically inert so they do not affect the quality of the groundwater samples. The permeability of the sealants should be one to two orders of magnitude less than the surrounding formation. An example of an appropriate use of annular sealant material is using a minimum of 2 feet of certified sodium bentonite pellets immediately over the filter pack when in a saturated zone. Bentonite pellets are best used in a saturated zone because they will sink in the column of water before hydrating and create an effective seal. Deep water columns may require the use of coated bentonite pellets to allow the bentonite to sink before hydrating. Coarse grit sodium bentonite is likely to hydrate in the water column and bridge before reaching the filter pack and therefore should only be used to install seals above the water table. A cement and bentonite mixture, bentonite chips, or anti-shrink cement mixtures may be used as the annular sealant in the unsaturated zone above the certified-bentonite pellet seal and below the frost line. The addition of bentonite to the cement admixture should generally be in the amount of 2 to 5 percent by weight of cement content. This will aid in reducing shrinkage and control time of setting. However, field experience has demonstrated that pure bentonite installed in the vadose zone forms a better well seal as opposed to the cement-based seals that are prone to fracturing over time. Again, the appropriate clay seal material must be selected on the basis of the environment in which it is to be used. In most cases, sodium bentonite is appropriate. Calcium bentonite may be more appropriate in calcic sediments/soils due to reduced cation exchange potential. Clays based seals should be pure (i.e., free of additives that may affect groundwater quality).

The untreated clay seal should be placed around the casing either by dropping it directly down the borehole or, if a hollow-stem auger is used, putting the bentonite between the casing and the inside of the auger stem. The use of a granular bentonite facilitates the installation of the well seal where the annular space is limited, and the use of bentonite chips presents bridging risks. In shallow monitoring wells, a tamping device or slender rod system should be used to reduce this potential of bridging. Generally, a spacing differential of 3 to 5 inches should exist between the outer diameter of the casing and the inner diameter of the auger, or the surface of the borehole to facilitate emplacement of filter pack and annular sealant. The actual volume of materials used should be recorded during well construction and compared to the calculated volume. Discrepancies between calculated volumes and volumes used require an explanation.

If a cement-bentonite seal mixture is specified, the mix should be prepared using clean water and placed in the borehole using a tremie pipe. The tremie method ensures good sealing of the borehole from the bottom.

	Upon completion of the well, installation of a suitable threaded or flanged cap or compression seal should be placed or locked in properly to prevent either tampering with the well or the entrance of foreign material into it. A ¼-inch vent hole pipe provides an avenue for the escape of gas, if a totally submerged well screen is installed. Placement of concrete or steel bumper guards around the well will prevent external damage by a vehicular collision with the exposed casing.
8. Design well screen.	The intake of the monitor well should be designed and constructed to: 1) allow sufficient groundwater flow into the well for sampling; 2) minimize the passage of formation materials (turbidity) into the well; and 3) ensure sufficient structural integrity to prevent the collapse of the intake structure. For wells completed in unconsolidated materials, the intake of a monitoring well should consist of a screen or slotted casing with openings sized to minimize the amount of formation material from passing through the well during development. Extraneous fine-grained material (e.g., clays and silts) that has been dislodged during drilling may be left on the screen and in the well water. These fines should be removed from the screen and filter pack during development of the well. Commercially-manufactured screens or slotted casings should be used; field slotting of screens is not acceptable.
9. Develop well.	After the installation of the monitoring well, the natural hydraulic conductivity of the formation should be restored, and all foreign sediment removed to ensure turbid-free groundwater samples. A variety of techniques are available for developing a well. To be effective, they require reversals or surges in flow to avoid bridging by particles, which is common when flow is continuous in one direction. These reversals or surges can be created by using surge blocks, bailers, or pumps. Formation water should be used for surging the well. Any contaminated waters produced during development will be containerized for proper disposal. In low-yielding water-bearing formations, an outside source of water may sometimes be introduced into the well to facilitate development. In these cases, this water should be chemically analyzed to evaluate its potential impact on in-situ water quality. The driller should not used air to develop the wells. All developing equipment and materials need to be decontaminated prior to developing the well. Refer to SOP-GW-12 Well Development Using a Modified Over-Pumping Technique for more information.
10. Document well design and construction.	Information on the design and construction of wells will be documented and may include: • Date/time of construction. • Drilling method and drilling fluid used. • Well location (± 0.5 feet). • Borehole diameter and well casing diameter.

	• Well depth (± 0.1 feet). • Drilling and lithologic logs. • Casing materials. • Screen materials and design. • Casing and screen joint type. • Screen slot size/length. • Filter pack material/size, grain analysis (D10). • Filter pack volume calculations. • Filter pack placement method. • Sealant materials (percent bentonite). • Sealant placement method. • Surface seal design/construction. • Well development procedure. • Type of protective well cap. • Ground surface elevation (± 0.01 feet). • Surveyor's pin elevation (± 0.01 feet) on concrete apron. • Top of monitoring well casing elevation (± 0.01 feet). • Top of protective steel casing elevation (± 0.01 feet). • Detailed drawing of well (include dimensions).
Specialized Well Designs	
	There are two cases where special monitoring well design will be used: • Where it has been decided to use dedicated pumps to draw groundwater samples. • Where light and/or dense immiscible phases may be present. If it is elected to use a dedicated system, it should be a fluorocarbon resin or stainless-steel bailer, or a dedicated positive gas displacement bladder pump composed of the same two materials. As other sampling devices that can perform at least equivalently become available, they may be employed as well. The introduction of this pump, however, necessitates certain changes in the well. The principal change is the addition of a 2-inch diameter pump with fluorocarbon resin outlet tubing to the well. A 4-inch interior diameter outer well casing should easily accommodate this additional equipment. However, should a larger pump (e.g., 3 inches in diameter) be required because of greater well depth or yield, a larger outer casing may prove necessary (6-inch inside diameter). The pump should be positioned midway along the screened interval, and the top of its outlet pipe should extend into the well cap. If light or non-aqueous phase liquids (L-NAPLs) or dense non-aqueous phase liquids (D-NAPLs) layers are presumed to be present, discrete samples must be obtained. The well system needs to be designed to allow sampling of light or dense phases by using a well screen that either extends from above the potentiometric surface for the L-NAPL sampling or slightly into the lower confining layer for DNAPL monitoring. Where well clusters are employed, one well in the cluster may

	be screened at horizons where floaters are expected, another at horizons where dense phases are expected, and others within other portions of the uppermost aquifer. A periodic check of the dedicated sampling system should be exercised to prevent damage and maximize efficiency. This inspection should include removal of samples for verification of proper function. The design of the dedicated sampling system should also allow access for regular testing of aquifer characteristics. It is also recommended that the well be periodically resurveyed using the protective casing and apron as points of reference. An option that can be exercised in constructing a monitoring well (e.g., dedicated sampler) is the use of fine sand at the top of the filter pack to reduce or minimize invasion.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Potential contact with contaminated soils and water.	Sites.	Inadvertent exposure to contaminated soils and water could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Personnel will wear nitrile gloves and safety glasses when contact with soils and water is possible.
	Exposure to hydraulic fluids.	Drilling operations.	Exposure to hydraulic fluids could occur while operating and working around the drill due to equipment malfunction/ failure resulting in personal injuries.	The operator will inspect the drill and document inspections daily before starting work. The operator will also replace/repair all faulty equipment before starting work. When inspecting equipment, personnel will wear work gloves to prevent possible exposures to hydraulic fluids. Non-essential personnel will maintain a 20-foot buffer zone around the drill.
	Contact with gasoline/diesel.	Fueling equipment.	Inadvertent exposure via inhalation and/or skin contact can result in adverse health effects and skin irritation.	Personnel will fuel the equipment in a well-ventilated area, stand up wind while fueling, and minimize splash hazards so skin contact does not occur.
	Exposure to annular sealant material (e.g., bentonite and cement).	Sealing the annular space of wells.	Personnel could be exposed to annular sealant material via inhalation of material dust and/or direct skin/eye contact, which could result in personal injuries such as irritation of the	To prevent exposure, pour material slowly, stay upwind, and wear work gloves and safety glasses. If contact occurs, personnel will thoroughly wash the affected area with water and flush their eyes.

CHEMICAL			respiratory system, skin, or eyes.	
NOISE	Elevated noise levels.	Drilling operations.	Personnel could be exposed to elevated noise levels when operating the drill and working near drilling operations resulting in hearing damage.	Personnel will wear hearing protection (e.g., ear plugs) when operating and working near the drill. Non-essential personnel will maintain a 20-foot buffer zone around the drill when possible. Hearing protection will be administered and used in accordance with the policies and procedures outlined in the Pioneer Corporate HASP.
ELECTRICAL	Contact with underground and/or overhead utilities.	Sites.	Injury, death or property damage could occur from equipment contact with underground and/or overhead utilities while drilling boreholes.	Personnel will follow the underground and overhead utilities procedures as outlined in the Pioneer Corporate HASP. Personnel will avoid areas with underground and overhead utilities hazards as much as possible.
BODY MECHANICS	Bending, squatting, and kneeling.	During fieldwork activities.	Bending, squatting, and kneeling during fieldwork activities could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work and they will take breaks when necessary.
	Improper lifting.	Sites.	Back injuries and muscle/back strains could result when using improper techniques to lift and carry tools and equipment.	Personnel will use proper lifting techniques – get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder's height. Two workers will lift/handle heavy items.

GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces, and steep slopes.	Walking/working on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Personnel will wear work boots with good traction and ankle support. They will plan their path and walk cautiously. If using bentonite as annular sealant, avoid bentonite contact with water on the ground. Pour the bentonite slowly to prevent spills and slippery surfaces.
WEATHER	Cold/heat stress.	Outdoor sites.	Exposure to cold climates may result in cold burns, frostbite, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers and loose clothing). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in the applicable SSHASP and/or Pioneer Corporate HASP.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Personnel will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoor sites.	Personnel could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.
BIOLOGICAL	Plants, insects, and animals.	Outdoors.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First aid kits will be available in company vehicles. Personnel with allergies will notify their supervisor.

MECHANICAL	Pinch points.	During fieldwork activities.	Personnel could be exposed to pinch points when opening and closing gates, vehicle doors, carrying cases, and well caps or when using hand tools and equipment resulting in personal injuries such as scrapes, cuts, and broken fingers.	Personnel will be aware of finger/hand placement and not put fingers/hands between objects. Personnel will also wear work gloves to protect against pinch-point injuries and inspect all tools/equipment prior to each use.
	Rotating parts of the drill.	Drilling operations.	Inadvertent contact with rotating parts could result in fingers/hands becoming pinched or caught causing scrapes, cuts, and/or broken bones.	Personnel will avoid touching rotating parts of the drill. The drill operator and helpers will not wear loose clothing/jewelry. Personnel will know the location of all emergency shutoffs on the drill. Non-essential personnel will maintain a 20-foot buffer zone around the drill when possible.
PRESSURE	Pressurized hydraulic hoses.	Drilling operations.	Hydraulic hoses could burst/rupture resulting in inadvertent contact with hydraulic fluid or personal injury due to being struck by hoses.	The operator will inspect the drill and document inspections daily before starting work. The operator will also replace/repair all faulty equipment before starting work. When inspecting equipment, personnel will wear work gloves to prevent possible exposures to hydraulic fluids. Non-essential personnel will maintain a 20-foot buffer zone around the drill.
THERMAL	Hot surfaces.	Drilling operations.	The equipment components could become hot during drilling operations and direct contact	Personnel will avoid contact with hot surfaces, and they will wear work gloves as needed.

			with these components could cause skin injuries.	
HUMAN FACTORS	Inexperienced and improperly trained worker.	Sites.	Inexperienced personnel and improper training could cause incidents resulting in adverse health effects and/or property damage.	Personnel will be properly trained in the procedure described above and other applicable procedures. Personnel will follow the stop work policy, if there are any issues.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	**Personal Protective Equipment** (PPE): Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, nitrile gloves, and leather gloves.
APPLICABLE SDSs	**Safety Data Sheets** (SDSs) will be maintained based on the site characterization and contaminants.
REQUIRED PERMITS/ FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
DRAWINGS	Map with site location and well locations.
RELATED SOPs/ PROCEDURES/ WORK PLANS	SOP-GW-12 Well Development Using a Modified Over-Pumping Technique.
TOOLS	Varies depending on selected drilling technique.
FORMS/ CHECKLIST	Field logbook and well installation log.

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Ken Manchester	**04/23/2018**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman	**04/23/2018**

PURPOSE	To provide standard instructions for well development and the removal of fine grained sediments from the vicinity of the well screen. Well development allows the water to flow freely from the formation into the well and reduces the turbidity of the water during groundwater sampling. Initial well development is critical to ensure that the well has the pumping volume required for future use.
SCOPE	This practice is for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed procedure described below. This Standard Operating Procedure (SOP) discusses well development using a modified over-pumping technique and can be used with the following pumps: peristaltic, low flow Grundfos, PROACTIVE 12-volt submersible, and Grundfos Redi-Flo II. Less vigorous methods of well development include bailers or manual surge blocks. These methods are addressed in other SOPs. If a well requires more vigorous development than over-pumping (e.g., soil types, chemicals used during installation, large required production volumes, etc.), a well installer or subcontractor may be required to complete the development.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work performed under this Standard Operating Procedure (SOP) will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
1. Select pump.	The table below summarizes the types of pumps Pioneer has readily available for well development. Personnel should select the appropriate pump for the well development required using the table below.

Pump/ Development Type	Well Diameter (inches)	Max Well Depth (ft)	Anticipated Production
Bailer[1]	1	100	Poor to Good
	≥2	100	Poor
Manual Surge Block[1]	1	100	Poor to Good
	≥2	100	Poor
Peristaltic Pump	1	25	Poor to Good
	2	25	Poor
Low Flow Grundfos	≥2	200	Poor to Good
PROACTIVE 12-volt Submersible Pump	≥2	80	Good
Grundfos Redi-Flo II	≥2	250	Good
Subcontractor/Well Installer	≥2	>250	Poor to Good

1. If a bailer or manual surge block is the only alternative, the modified over-pumping technique cannot be used. Instead, personnel should follow the appropriate, alternative SOP.

2. Gather information.	Review the Site Sampling and Analysis Plan (SAP) or Work Plan for purge water containment requirements. Compile the necessary equipment and well installation information (e.g., total depth, screen interval, etc.) prior to traveling to the site.
3. Set up equipment.	Upon arrival at the well/piezometer to be developed, place the containers that will be used to contain purge water (if required) in an accessible location. Set up the remainder of the equipment adjacent to the well, within spill containment if required.
4. Take and initial DTW reading.	Open the well/piezometer and take an initial depth to water (DTW) reading following the instructions outlined in SOP-GW-03 Depth to Water Level Measurements. Record the initial DTW in the field logbook and on the well development field data sheet.
5. Check the total depth of the well.	Check the total depth of the well by turning off the buzzer on the DTW meter and lowering probe to the bottom of the well. Record this information in the field logbook and on the well development field data sheet. Remove the DTW probe from the well. Record the screen depth and length (available from the well installation log).
6. Set up pump and tubing.	If needed, attach an appropriate length of disposable or decontaminated tubing to the pump outlet or put tubing in the pump head. Don a new, clean pair of gloves prior to handling the tubing. Lower pump or tubing into the well. The pump intake should be located near the bottom of the screened interval. If the screen extends to the bottom of the well, make sure the intake for the pump is located above any slurry that may be present in the bottom of the well, approximately 1/2 to 1 foot above the bottom if using the submersible pumps.

	If using a peristaltic pump, tubing can be located closer to the bottom of the well as slurry will only clog the tubing and not damage the pump itself. If using a submersible 12-volt pump without a controller, put a valve on the discharge end of tubing and securely fasten. Record the depth of the pump intake in the field logbook and on the well development field data sheet.
7. Measure DTW with the pump installed.	Put the DTW probe back in the well and make sure it is turned on. Record the DTW with the pump installed.
8. Turn the pump on and adjust water flow.	If using a 12-volt submersible pump, start the pump with the attached discharge valve all the way open. If using a Grundfos pump with a controller or a peristaltic pump, turn the pump on and raise the pumping rate slowly until water starts to flow. Monitor the DTW meter; the water elevation should drop until the tubing is full and water is flowing freely. If the water elevation continues to drop after water is flowing smoothly, turn flow down using either the discharge valve or the controller until the water elevation stabilizes. Record the time development starts, the stabilized water elevation, and an estimate of volume purged in the field logbook and on the well development field data sheet as "Initial Drawdown."
9. Measure the stabilized water flow rate.	Measure the stabilized water flow rate using an appropriately-sized container (e.g., graduated cylinder, marked beaker, marked bucket, etc.) and a stopwatch to determine the volume of water per minute being purged from the well. Record the water flow rate in the field logbook and on the well development field data sheet.
10. Record the characteristics of the purged water.	Record the color of water, presence of sand or silt, and any odors or sheen. If the water is not extremely dirty, run an initial turbidity measurement and record.
11. Track the volume of water being removed.	Track the volume of water being removed. Volume may be calculated by either multiplying the elapsed time by the water flow rate or multiplying the number of buckets/drums purged by the volume of the bucket/drum. Keep a record of time, water removed, turbidity measurements and DTW readings in the field logbook and on the well development field data sheet.
12. Measure and record the field parameters.	Once the water appears to be clear, begin measuring field parameters. At a minimum, measure temperature, pH, specific conductivity (SC), and turbidity. If required by the SAP or Work Plan, measure and record the oxidation reduction potential (ORP) and dissolved oxygen (DO). Depending on the water flow rate field parameter probes can be placed in a 5-gallon bucket, in a ½- to 1-liter beaker or in a flow thru cell. Turnover of water in the container should be quick (e.g., 1 to 2 minutes). As an example, if the water is purging

	at 4 gallons a minute, a 5-gallon bucket could be used, as turnover in the bucket would be about 1 minute. If water is purging at 1 to 2 gallons a minute, a liter beaker may be more appropriate. If the water is fairly clear, a flow through cell with appropriately sized bypass tubing can be used with any flow rate. The flow through cell allows the water in the bypass tubing to be discharged directly into a storage container or to the ground a safe distance downgradient from the well. Record parameter measurements every 5 to 10 minutes. Record DTW measurements and estimated volume along with the parameter readings in the field logbook and/or on the well development field data sheet.
13. Purge the well and monitor drawdown.	If possible, when turbidity falls below 50 Nephelometric Turbidity Unit (NTU), increase the flow by adjusting the discharge valve or turning up the controller. Purge the well at about twice the stabilized water flow rate determined in Steps 8 and 9. Monitor drawdown constantly as you do not want to purge the well dry. • The water elevation may stabilize at a level lower than the initial DTW reading. If so, record how long it took to stabilize at the lower level, the amount of water purged, and the new DTW elevation in the field logbook and on the well development field data sheet. • If the water elevation in the well drops to about 4 to 5 feet above the pump intake (the acceptable drawdown elevation should be adjusted based on the water column, screen length and depth of the well being developed; ideally you want to develop the well along the entire screen length), turn the discharge valve or controller below the starting flow rate and allow the well to "recover." Record the duration, amount purged, and DTW when done with the initial over-pumping of the well. • If the pump is purging at maximum capacity, or if no drawdown occurs at a higher flow, turn the pump off, let the well "recover" for 1 to 5 minutes, and turn the pump back on. Record the duration of the stoppage and the new starting water level in the field logbook and on the well development field data sheet.
14. Continue monitoring turbidity and recording field parameters.	Turbidity may increase after the over-pumping or stopping. Continue recording field parameters unless the turbidity exceeds 1000 NTU. At this point, remove the field parameter probes and wait for the water to clear up before recording field parameters. Note this in the field logbook or on the well development field data sheet. Once turbidity measures less than 50 NTU, repeat Steps 12 and 13 until the clarity of water does not change significantly between lower and higher flows.
15. Adjust pump as needed.	If time permits (as designated in the SAP or Work plan) and the stabilized water level allows, raise the pump to the midpoint of the screen and repeat Steps 12 through 14, recording time, field parameters, volume purged, and DTW readings until turbidity readings are less than 50 NTU.
16. Continue monitoring turbidity and	The well is considered developed when 3 consecutive readings for turbidity are below the SAP or Work Plan designated requirements (e.g., the Clark Fork River Superfund Site Investigation SOP [ARCO, 1992] requires readings below 5 NTU, and the U.S.

field parameters to determine if the well is developed.	Environmental Protection Agency [EPA] well development protocol requires readings below 50 NTU) and the remaining required field parameters have stabilized. Water quality parameters are considered stable when three consecutive readings are as follows: • Temperature range is no more than +/- 1 degree Celsius (°C); • pH varies by no more than 0.1 pH units; and • SC readings are within 3% of the average.
17. Record the final DTW and calculate the total amount of water purged.	Before turning off the pump, record a final DTW. Calculate the total amount of water purged and record the volume in the field logbook and on the well development field data sheet.
18. Dispose of the purge water and tubing.	Dispose of the purge water and tubing as outlined in the SAP or Work Plan.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Potential contact with contaminated soils and water.	During well development.	Inadvertent exposure to contaminated soils and water could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Personnel will wear nitrile gloves and safety glasses when contact with purge water is possible. Pour purge water from buckets into disposal area/containers used to contain purge water slowly to prevent splashes and skin contact. Keep control of high-flow discharge hoses to prevent water spraying and skin contact.
	Carbon monoxide (CO).	Generator.	Potential exposure to CO when working around the generator could result in irritated eyes, headache, nausea, weakness, and dizziness.	Personnel will stay up wind when working around the generator. The generator will not be operated indoors or near openings to any buildings that might be occupied.
	Contact with gasoline.	Fueling the generator.	Inadvertent exposure via inhalation and/or skin contact can result in adverse health effects and skin irritation if contact with gasoline occurs.	Personnel will fuel the generator in a well-ventilated area, stand up wind while fueling, and minimize splash hazards so skin contact does not occur. Wear nitrile gloves when removing the fuel cap and filter.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
NOISE	Elevated noise levels.	Using the generator.	Exposure to elevated noise levels from the generator may result in hearing damage.	Personnel will set up the generator away from the well development activities to prevent exposure to elevated noise levels.
ELECTRICAL	Improper use of the generator.	Sites (during we conditions).	Electrocution, shock, death, or equipment damage could be caused when using a generator during wet conditions.	If personnel must use a generator when it is wet outside, the generator will be protected from moisture and it will be equipped with a Ground Fault Circuit Interrupter (GFCI). Keep extension cord (if used) and connections as dry as possible. Place generator on a surface where water cannot puddle or drain under it. Personnel will dry hands, if wet, before touching the generator. Items will be connected to the generator using heavy-duty extension cords that are specifically designed for outdoor use.
	Improper use of the 12-volt battery.	Using the battery to power the 12-volt submersible pump.	Personal injuries could result from improper use and maintenance of a 12-volt battery. Example are: shocks, acid burns on skin or eyes, skin burns from electrical charge transfer through a tool and into a metal ring or watch, and battery explosions.	Personnel will remove all jewelry before working with a 12-volt battery. Personnel will disconnect the negative cable first and re-connect it last to prevent getting a shock from current overflow. Personnel will use the battery in well-ventilated areas and inspect the battery before and after each use. Personnel will wear leather gloves and safety glasses when handling the battery.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
BODY MECHANICS	Improper lifting.	During well development.	Back injuries and muscle/back strains could result when using improper techniques to lift and carry tools and equipment.	Personnel will use proper lifting techniques – get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder's height. Two workers will lift/handle heavy items.
	Bending, squatting, and kneeling.	During well development.	Bending, squatting, and kneeling during work activities could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work and they will take breaks when necessary.
GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces and steep slopes.	Walking/working on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Personnel will wear work boots with good traction and ankle support. Personnel will be aware of walking/working surfaces and choose a path to avoid hazards. Keep work areas as dry as possible. If conditions are wet or muddy, wear muck boots.
WEATHER	Cold/heat stress.	Outdoor sites.	Exposure to cold climates may result in cold burns, frostbite, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors. Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in applicable SSHASP and/or Pioneer corporate HASP.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could result from lightning strike.	Personnel will follow the 30/30 rule during lightning storms.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
RADIATION	Ultraviolet (UV) radiation.	Outdoor sites.	Personnel could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.
BIOLOGICAL	Plants, insects, and animals.	Outdoors.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First-aid kits will be available on the site. Personnel with allergies will notify their supervisor.
MECHANICAL	Pinch points.	Well caps.	Personal injury could result from fingers getting pinched in well caps.	Personnel will wear leather gloves when removing well caps.
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained personnel.	Sites.	Inexperienced personnel and improper training could cause incidents resulting in adverse health effects and/or property damage.	Personnel will be properly trained in the procedure described above and other applicable procedures. Personnel will follow the stop work policy, if there are any issues.
SIMOPS	Not applicable.			

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	**Personal Protective Equipment** (PPE): Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, nitrile gloves, and work gloves.
APPLICABLE SDS	**Safety Data Sheets** (SDSs) will be maintained based on the site characterization and contaminants.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
DRAWINGS	
RELATED SOPs/ PROCEDURES /WORK PLANS	SOP-GW-03 Depth to Water Level Measurements
TOOLS	DTW meter, pump and tubing (see step 1 for pump selection), turbidity meter, container to measure water flow rate (e.g., graduated cylinder, marked beaker, marked bucket, etc.), stopwatch, field parameter meters, and containers to contain purge water (if required).
FORMS/ CHECKLIST	Field logbook, well development field data sheet, and well installation log.

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

SOP TECHNICAL AUTHOR	**DATE**
Julie Flammang **Julie Flammang**	**04/10/2018**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**04/10/2018**

PURPOSE	To provide standard instructions for the process of abandoning groundwater monitoring wells in accordance with the Montana Department of Natural Resources and Conservation (DNRC) regulations (Administrative Rules of Montana [ARM] 36.21.810).
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent in the risk-assessed work described below.
NOTES	Wells which have not been monitored for more than three years shall be deemed abandoned unless written permission is obtained from the board to maintain the well. Monitoring wells that have outlived their useful purpose shall be abandoned by one of the following methods: 1. Leaving the casing and screen in place, and sealing the casing and screen from the bottom up. 2. Removing the casing and/or screen, and filling the hole with sealing material from the bottom up, as the casing and/or screen is removed. 3. Other methods for abandonment with prior board approval. Instructions and general information for methods 1 and 2 are provided below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work performed under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Method 1. Leaving the casing and screen in place, and sealing the casing and screen from the bottom up.	
1. Seal the casing and screen from the bottom up.	If the casing and screen are left in place, seal the casing and screen from the bottom up by the following methods: a. Using a pump and hose or tremie pipe to conduct the sealing material to the bottom of the well; or b. By filling the casing and screen with bentonite pellets or chips placed in a manner that will prevent bridging. Metal casings shall be cut off three feet below the ground surface and the last three feet backfilled with naturally occurring soils.
Method 2. Removing the casing and/or screen, and filling the hole with sealing material from the bottom up, as the casing and/or screen is removed.	
2. Fill the hole with sealing material	The department recommends that the casing be removed in all possible instances.

as the casing and/or screen is removed.	If the casing and/or screen are removed, fill the hole with sealing material, concrete, or bentonite pellets or chips from the bottom up, as the casing and/or screen is removed. From six to three feet from the surface, add bentonite to the well. Fill the last three feet with naturally occurring soils.
Additional Information	The sealing material shall be bentonite pellets or chips, bentonite clay grout, neat cement grout, or concrete. The material may contain non-biodegradable fluidizing admixtures, provided they will not contaminate the groundwater. Sealing materials which settle shall be topped to provide a continuous column of grout to within three feet of the surface. For flowing wells, the abandonment procedures outlined in ARM 36.21.671 shall apply. A properly abandoned well shall not produce water nor serve as a channel for movement of water. A water well log report, fully describing all abandonment procedures, shall be submitted to the Ground Water Information Center (GWIC) of the MBMG within 60 days of abandoning the well.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Contaminated soils and groundwater.	Sites and wells.	Inadvertent exposure to contaminated soils and groundwater could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and leaving the site. Personnel will wear nitrile gloves and safety glasses if contact with contaminated soils, groundwater, and tools/equipment is possible.
	Bentonite.	Mixing the bentonite grout. Sealing the casing/screen or well's hole with bentonite (pellets or chips).	Exposure to bentonite via inhalation of dust and/or skin contact can result in adverse health effects.	Personnel will pour bentonite slowly, stay upwind, and wear work gloves and safety glasses. If contact with bentonite occurs, personnel will thoroughly wash the affected area with water and flush their eyes.
	Cement.	Preparing the concrete and neat cement grout. Sealing the well's hole with concrete or neat cement grout. Filling the surface of the abandoned well with cement.	Skin and eye contact with concrete/neat cement grout could result in chemical burns. Inhalation of cement dust is also possible when mixing the concrete/neat cement grout, which could result in adverse health effects.	Personnel will wear work gloves and safety glasses when mixing and handling concrete/neat cement grout. Personnel will also stay upwind and avoid breathing dust when mixing the concrete/neat cement grout. If contact direct contact occurs, personnel will thoroughly wash the affected area with water and flush their eyes.
	Cold patch asphalt.	Filling the surface of the abandoned well with cold patch asphalt.	Direct contact with cold patch asphalt could result in adverse health effects and injuries.	Personnel will wear work gloves and safety glasses when handling the cold patch asphalt.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
NOISE	Elevated noise levels.	Power-operated hand tools (e.g., rotary hammer and concrete saw).	Exposure to elevated noise levels could occur when using power-operated hand tools to remove concrete/asphalt around the well's casing.	Personnel will wear hearing protection (e.g., earplugs) if necessary.
ELECTRICAL	Power-operated hand tools (e.g., rotary hammer and concrete saw).	Removing concrete/asphalt around the well's casing.	Improper use and/or malfunction of power-operated hand tools may result in electric shock, fire, and serious personal injuries.	Personnel will practice the following: • Inspect the tool before and after each use. • Power tool plugs must match the outlet. • Avoid body contact with earthed or grounded surfaces, such as pipes, radiators, and ranges. • Do not expose the tool to rain or wet conditions. • Never use the cord for carrying, pulling or unplugging the tool. Keep cord away from heat, oil, sharp edges or moving parts.
	Generator.	Sites.	Generators pose a risk of shock and electrocution, especially if they are operated in wet conditions.	If personnel must use a generator when it is wet outside, the generator will be protected from moisture. The generator will also be equipped with a Ground Fault Circuit Interrupter (GFCI). Appliances will be connected to the generator using heavy-duty extension cords that are specifically designed for outdoor use.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
BODY MECHANICS	Awkward body positioning.	Well abandonment.	Bending, squatting, and kneeling for extended periods of time could result in muscle/back strains and fatigue.	Personnel should stretch prior to starting work and they will take breaks when necessary.
	Improper lifting techniques.	Lifting/carrying tools, equipment, and sealing materials.	Using improper lifting techniques when handling bags/containers with sealing materials (e.g., bentonite chips) and tools/equipment could result in back and muscle injuries.	Personnel will practice the following lifting techniques: get a good grip; keep the load close to the body; lift with legs and not with back; avoid twisting body while lifting; and avoid lifting loads above shoulder height. Two people will lift awkward/heavy items.
	Improper shoveling techniques.	Digging material around the well's casing with a hand shovel.	Using improper shoveling techniques could result in muscle and back injuries.	Personnel will practice the following shoveling techniques: keep feet wide apart; place front foot close to shovel; put weight on front foot, use leg to push shovel and shift weight to rear foot; keep the load close to the body; and turn feet in direction of throw.
GRAVITY	Uneven terrain.	Sites. Accessing wells.	Walking on uneven terrain could result in slips and falls causing personal injuries.	Personnel will wear work boots with good traction and ankle support, be aware of walking surfaces, choose a path to avoid hazards, and walk cautiously.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
GRAVITY (cont.)	Bentonite spills.	Mixing the bentonite grout. Sealing the casing/screen or well's hole with bentonite (pellets or chips).	If bentonite contacts water on the ground, the area could become slippery. Personnel could slip and fall resulting in personal injuries.	Personnel will pour bentonite slowly to prevent spills. If a spill occurs, thoroughly clean the area immediately.
WEATHER	Cold/hot temperatures.	Outdoor sites.	Exposure to cold temperatures may result in cold burns, frostbite, and hypothermia. Exposure to hot temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers, insulated gloves, etc.), remain hydrated, and have sufficient caloric intakes during the day. Personnel will use their field truck to take breaks, when needed. Personnel will also follow the procedures outlined in the Pioneer Heat/Cold Stress Program.
	Lightning.	Outdoor sites.	Electrocution, personal injuries, death, or equipment damage could be caused by lightning strike.	Personnel will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoor sites.	Exposure to UV radiation when working outdoors can cause sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
BIOLOGICAL	Plants, insects, and animals.	Outdoor sites.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Personnel will avoid contact with plants, insects, and animals. First-aid kits will be available on the site. Personnel with allergies will notify their supervisor.
MECHANICAL	Sharp edges.	Cutting tools and equipment (e.g., hand saw and concrete saw).	Personnel could be exposed to sharp edges when using cutting tools/equipment resulting in hand/finger injuries.	Personnel will visually inspect the cutting tools/equipment before each use, follow the manufacturer's safety recommendations, ensure the tool's protective guards are in place, wear work gloves, and watch for hand placement to avoid contact with cutting areas.
	Pinch points.	Wells and hand tools.	Personnel can be exposed to pinch points when removing well covers and using hand tools, which could result in hand/finger injuries.	Personnel will be aware of hand/finger placement and not put hands/fingers between object; they will wear work gloves if necessary. Personnel will inspect hand tools before each use and wear work gloves when using them.
	Flying debris.	Removing concrete/asphalt around the well's casing.	Exposure to flying debris is possible when using power-operated tools to remove/cut concrete/asphalt around the well's casing.	Personnel will wear safety glasses, ensure the tool's protective guards are in place, and keep face away from cutting operations.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
MECHANICAL (cont.)	Rotating/moving parts.	Power-operated hand tools (e.g., rotary hammer and concrete saw).	Direct contact with rotating/moving parts from power-operated hand tools could result in hand/finger injuries.	Personnel will practice the following: • Do not use power-operated hand tools while you are tired. • Prevent unintentional starting. Ensure the switch is on the off positon before connecting to the power source, picking up or carrying the tool. • Do not overreach. Keep proper footing and balance at all times. • Do not wear loose clothing or jewelry. Keep your hair, clothing and gloves away from moving parts.
	Heavy equipment.	Removing the well's casing with heavy equipment.	Ground personnel could be struck by/caught between heavy equipment resulting in serious personal injuries.	Ground personnel will practice the following: • Be aware of your surroundings and watch out for moving equipment. • Maintain a safe distance from moving equipment. • Before approaching the equipment, communicate with the operator by establishing eye contact and waving. • Approach equipment only when it is not in motion and it is safe to approach. For example, when the bucket of excavator is on the ground and the operator has signaled that it is safe to approach.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
PRESSURE	Pressurized lines.	Heavy equipment.	Exposure to pressurized hydraulic lines from heavy equipment is possible. Failure or malfunction of lines could result in injuries.	Heavy equipment contractor will inspect the equipment daily. Ground personnel will maintain a safe distance from active heavy equipment.
	Pressurized grout mixture.	Grout pump.	Direct contact with pressurized grout mixture when pumping grout down the well could result in personal injuries.	Personnel will pump the grout mixture down the well carefully and will avoid contact with the pump's discharge.
THERMAL	Hot surfaces.	Power-operated hand tools (e.g., rotary hammer and concrete saw).	Power-operated hand tools may get hot during use and direct contact with hot surfaces could cause skin injuries.	Personnel will wear work gloves and avoid contact with hot surfaces.
HUMAN FACTORS	Inexperienced and improperly trained personnel.	Conducting work activities.	Inexperienced personnel and improper training could cause incidents resulting in injuries and/or property damage.	Personnel will be properly trained in this procedure and other applicable procedures. Personnel will also implement stop work procedures when necessary.
	Public/ unauthorized people.	Sites.	Interaction with the public/ unauthorized people is possible, which could interfere with work activities and result in personal injuries and/or	If members of the public/unauthorized people enter the work area, personnel will stop work. Work will not resume until they have left the area. If necessary, personnel will delineate the work area with traffic cones and caution tape.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
			property damage.	
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Long-sleeved work shirt, high-visibility vest/outwear, long pants, safety glasses, hard hat, work gloves, and steel-toed boots.
APPLICABLE SDS	Bentonite, cement, and cold patch asphalt. Additional Safety Data Sheets (SDSs) will be maintained based on site characterization and contaminants.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	
TOOLS	
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Charles Peterson	**03/17/2017**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman	**03/17/2017**

Revisions:

Revision	Description	Date

PURPOSE	To provide standard instructions for sampling soil from a liner using a Geoprobe® unit.
SCOPE	Pioneer Technical Services, Inc. (Pioneer) prepared this practice for the workforce and this Standard Operating Procedure (SOP) applies to all work performed by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent (as defined by OSHA) in the risk-assessed procedure described below before performing the work.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is inaccurate or unsafe, personnel must notify the Project Manager, Safety Manager, and the SOP Technical Author to initiate appropriate revisions. Personnel will perform all work under this SOP in a manner that is consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plans (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Preparation	
1. Check of liner materials.	Make sure that the liner used to contain the soil in the Geoprobe® probe rods is made of material compatible with the contaminants being analyzed.
2. Verify utility locates and conduct site walk.	Confirm that the Pioneer Geoprobe® operators or the Geoprobe subcontractor has placed a utility locate ticket that covers the area to be sampled. Confirmation number needs to be provided to the Pioneer field team leader and put on the Job Risk Assessment or corresponding safety or permit form. Utility locates need to be called in a minimum of 48 business hours prior to the planned drilling activities. Conduct a site walk-through and determine any site-specific hazards associated with the sampling area. Discuss these with the sampling crew and note in the field logbook and Job Risk Assessment or corresponding safety form. As part of the site hazard assessment, identify possible locations for unidentified, privately installed underground utilities. For example, identify where natural gas pipes enter any structures on the property and confirm that gas lines from the street/alley have been marked. Check on yard lights or streetlights that are present with no overhead lines, underground wiring from a residence to outbuildings, or a possible gas line to a grill or outdoor kitchen. Adjust sample locations based on this information. Before probing activities begin, verify that the ground has been marked with the location of underground utilities listed on the locate ticket. If needed, adjust sample locations based on identified or potential utility locations. See the Trenching, Excavation, and Ground Disturbance Program information in Pioneer's Corporate HASP to identify safe distances for drilling when adjacent to specific buried utilities.

3. Set up the sample and staging area.	Cover a folding table with plastic. The table should be at least as long as the liners to be sampled. A tailgate covered with plastic can also be used. If the only available surface is the ground, place several layers of plastic a couple of feet longer than the liners. Secure the layers of plastic so they do not blow around during sampling. In addition to the sampling area, a staging area for unsampled core needs to be designated. This area should also be covered with plastic to keep the liners clean before placement on the sampling area.
4. Mark the liners.	As the Geoprobe® operator removes core (liners) from the probe rods, mark with a waterproof marker the "top" and "bottom" of the liner as well as the interval that the liner represents. Cap the liner ends with vinyl or Teflon end caps. Move core to the staging area.
5. Record information provided by the operator.	If possible, confer with the Geoprobe® operator for any issues associated with probing each interval. Potential problems they may report: • A loss of material due to a rock blocking the tube. • A section that drilled extremely easy indicating material that was easily compressed such as clay or debris. • The presence of a potential void. • A problem with recovery due to saturated soil. • Heaving sands, which could result in overestimation of the width or depth of a layer due to re-coring of the same interval. • Recognition of slough into the hole prior to drilling the next interval. Record any information provided by the operator in the field logbook or on the field data sheet. This information can be referenced when logging the core.
Sampling of Soil for Inorganic Constituents	
1. Cut the plastic liner lengthwise.	The Geoprobe® operator and/or helper will cut the top portion of the plastic liner lengthwise. The opening along the top should be at least 2 inches wide. Care should be taken when handling and working around the cut liner as the cut edges are sharp.
2. Place the liner on the prepared sampling surface.	Place the liner on the prepared sampling surface and take the cut portion off. The portion of the liner marked "top" should be placed in the same direction on the sample surface each time. Place the index cards marked "top" and "bottom" on the appropriate ends of the liner. Place an extended tape measure adjacent to the liner. Index cards marked with appropriate intervals can also be used. Take a picture of the exposed soil. Do not move the tape measure or core after the photo. If the core does not need to be photographed, and it is **NOT** being analyzed for organics, mark the liner at the appropriate foot intervals with a Sharpie®.

3. Measure and record material in the core.	Measure and record the number of inches of material in the core, this will be recorded in the field logbook or on the field data sheet as "length recovered" (e.g., 36 inches from a 4-foot push or 18 inches from a 2-foot push). This measurement should not include any material that appears to have sloughed from an upper interval (i.e., leaves or topsoil present at the top of deeper subsurface cores). Record this information in the field logbook or on a field data sheet as specified in the Sampling and Analysis Plan (SAP). Evaluate the recovery of the core based on the operator's comments. The preferred method is to determine the amount of material that represents 1 foot of the profile. For example, 36 inches of recovered soil from a 4-foot probe may indicate 9 inches were recovered per foot. An alternate method for determining interval depth is to assume that the 36 inches represents 36 inches from either the top or bottom of the probed interval and that there was no recovery for 4 inches of the interval. These are not precise ways to determine how far below ground surface a soil horizon lies, as different soil types and moisture levels will compress or expand differently when pushed with the probe. There is no way to determine where or whether compression / expansion in the soil profile occurred. Choose one of the methods and be consistent throughout the project. Another scenario that may occur is if the operator indicates an obstruction was encountered that may have blocked soil from entering the liner at the 2-foot interval in a probe. If there is only 24 inches of soil and a large rock present in the liner, this may represent only the 0-2 foot interval in that core and should be recorded that way in the field logbook or on the field data sheet along with the operator's comment.
4. Log the core.	Examine and log the material in the liner. Check the project specific documents for the amount of detail or type of information required from the core log. Pioneer has developed several different field data sheets to aid in collecting the correct information during core logging. Keep in mind that due to smearing of soil during probing, a coating of wet or fine material may be present on the outside of the soil core. Using a gloved finger, make indentations down the core noting differences in texture, color, staining, or odor; to avoid cross contamination, change fingers as you make indentations. Record this information in the field logbook or on the field data sheet.
5. Determine sample intervals.	Determine sample intervals as described in the SAP or Work Plan (WP). If the material is **NOT** being sampled for organics, the sample intervals can be marked on the liner using a Sharpie®. An alternate method would be to separate the sample intervals so that a gap exists between the intervals. This makes it easier to get the appropriate intervals in the sample if the tape measure is moved during sampling activities.
6. Collect soil samples.	Slide the tube to the end of the table or sampling surface. Using a new plastic disposable scoop, slide the appropriate marked sample interval into a new disposable foil pan, stainless steel bowl, or resealable plastic bag. Alternately, instead of a scoop

	you can use a gloved finger or a clean screwdriver. A screwdriver is particularly helpful if portions of the soil are hardpacked or compressed. Mix the material in the pan/bowl thoroughly and remove rock and debris greater than 0.5 inches. If more material is required to fill sample containers, a second hole can be probed immediately adjacent to the first and material from the second liner from the same interval can be added to the pan/bowl and mixed. Repeat this process for all intervals to be sampled. Decontaminated bowls and screwdrivers and new foil pans, new resealable plastic bags, and new disposable scoops should be used for each interval sampled. Be aware of the potential for cross contamination and if needed change gloves between intervals.
7. Put samples in containers.	Prepare the appropriate sample containers with a label as described in the SAP or the Quality Assurance Project Plan. Fill the sample containers with homogenized material from the pan/bowl using the associated sampling tool. After sampling, place the samples in a cooler with ice until they can be transported to the laboratory for analysis as described in SOP-SA-01 Soil and Water Sample Packaging and Shipping.
8. Record sampling information.	Record appropriate information about the sample collection (sample number and associated depth interval, time, date, sample containers, etc.) in the field logbook as discussed in SOP-SA-05 Project Documentation. Record additional information such as soil type and rock content if required by the SAP/WP.
9. Store or dispose of remaining core	Disposal or storage information should be available in the project-specific SAP/WP. In most cases, soil can be returned to the drill hole from which it came. If the information is not available in the SAP, discuss disposal requirements with the project manager.
Sampling of Soil for Organic Constituents	
1. Preparation prior to screening for volatile organic vapors in drill or Geoprobe® drill core.	**Photoionization detector (PID) meter readings are taken immediately upon opening the core, prior to any other sampling or logging activities. Soil samples can show significant losses in volatile organic compound (VOC) concentrations within only seconds of opening soil cores.** If measurements using an organic vapor detector, PID, are required, please refer to SOP-FM-01 Field Headspace Analysis and VOC Measurements with PID for information on calibrating and using a PID for headspace analysis and VOC measurements.
2. Place caps on the end of the core tubes.	Ensure that the Geoprobe® operator and/or helper place caps on the end of the core tubes immediately after removing the liner from the probe rod so that no VOCs escape prior to cutting open the core. Store capped core in the shade or on ice to avoid additional volatilization of VOCs. **Do not** have the operator/helper cut the tubes until just before core will be sampled.

3. Prepare the sample containers.	Based on information provided in the SAP/WP, prepare and label the appropriate sample containers. If samples are required, sample intervals may have been assigned in the SAP/WP, or samples may be collected based on PID or headspace readings or the presence of odor or staining. The sampler needs to understand sample collection protocol prior to opening the core liner. This is particularly important in collecting samples for VOC, volatile petroleum hydrocarbon (VPH), and/or extractable petroleum hydrocarbon [EPH] analysis. Ensure required sampling supplies are close at hand prior to opening core.
4. Cut the plastic liner lengthwise.	Have the Geoprobe® operator and/or helper cut the top portion of the plastic liner lengthwise. The opening should be at least 2 inches wide. **DO NOT REMOVE THE CUT PORTION OF THE LINER**. Care should be taken when handling and working around the cut liner as the cut edges are sharp.
5. Place the liner on the prepared sampling surface.	Place the liner on the prepared sampling surface. **Do not** remove the cut portion. Place the portion of the liner marked "top" in the same direction on the sample surface each time. Place the index cards marked "top" and "bottom" on the appropriate ends of the liner. Place an extended tape measure adjacent to the liner. Index cards marked with appropriate intervals can also be used.
6. Measure and record material in the core.	**Prior** to removing the cut portion of the liner, measure and record the number of inches of material in the core. See discussion in Step 3 of Sampling of Soil for Inorganic Constituents to determine how depth of sample intervals will be determined.
7. Take a picture of the exposed soil.	Remove the cut portion of the liner. Quickly take a picture of the exposed soil. Do not move the tape measure or core after the photo.
8. Conduct PID readings if required.	**The VOC and VPH samples need to be collected as quickly as possible after opening the tube.** If specified in the SAP/WP, use a PID to take readings of the length of the core, refer to SOP-FM-01 Field Headspace Analysis and VOC Measurements with PID for information on calibrating and using a PID for headspace analysis and VOC measurements.
9. Collect soil samples for VOC / VPH / EPH.	Collect the required VOC, VPH, or EPH samples directly from the tube using a plastic disposable scoop, gloved hand, or screwdriver. After VOC, VPH, and EPH samples are collected from all tubes/cores, collect inorganic (metals) samples if needed. The tape measure can be used to identify the intervals. Gaps from removed sample material should be left so that logging of the remaining core material can be completed. Place the soil directly into the sample container and fill the jar to the top allowing no head space (or as the laboratory directs). Be aware of the potential for cross contamination and if needed change gloves between intervals. New disposable scoops and a clean screwdriver should also be used for each sample interval. Immediately place the sample containers in a cooler with ice. Keep samples at 4 degrees Celsius (ºC) or less and under chain of custody protocols until they can be

	transported to the laboratory for analysis as described in SOP-SA-01 Soil and Water Sample Packaging and Shipping.
10. Record PID readings and VOC sample information in Logbook.	If PID screening is conducted, record results of the screening in the field documentation (project logbook or field data sheets) and include the highest reading from each interval, the actual location in the core (i.e., 10 inches from the bottom), and the calculated interval depth. Record the sample information for the VOC, VPH, or EPH samples in the logbook and include time, date, and type of containers collected.
11. Continue sampling cores for VOCs.	Once the VOC samples have been collected from a section of core, replace the end caps and put the cut portion of the liner back on the core. The core can then be moved back to the staging area so that the next section of core can be screened and sampled for VOCs as quickly as possible. Process all available core for VOC samples prior to collecting inorganic samples or logging the core.
12. Log the core.	Once all the VOC samples have been collected. Logging the core can begin. Move a piece of core to the sample table and remove the cut portion of the liner, *being careful to keep it horizontal so as not to shift "gap" areas*. Realign the tape measure with the bottom and top of the tube. Examine and log the material in the liner. Check the project-specific documents for the amount of detail or type of information required regarding the core log. Pioneer has developed several different field data sheets to aid in collecting the correct information during core logging. If the initial measurement of the length of core (Step 6 above) included slough, adjust the information on the field data sheet or logbook to reflect the actual length of core. Include information on material removed for VOC samples, as determined during sampling. Keep in mind that due to smearing of soil during probing, a coating of wet or fine material may be present on the outside of the soil core. Using a gloved finger, make indentations down the core and record the information in the field logbook or on the field data sheet; to avoid cross contamination, change fingers as you make indentations.
13. Prepare soil samples for additional analytes.	Sample intervals that are not going to be submitted for VOC, VPH, or EPH analysis can be sampled once logging of the core is completed. Ensure that all information from logging the core is recorded in the field logbook or on the field data sheet. Determine the intervals to be sampled for additional analytes. Separate the sample intervals for the inorganic samples, so that a gap is present between the intervals. This makes it easier to get the appropriate sections into the sample if the tape measure or core is moved. Record sample information and include interval sampled and associated sample number in the field logbook or on the field data sheet.

14. Collect soil samples.	Slide the tube to the end of the table or sampling surface. Using a new plastic disposable scoop, slide the appropriate marked sample interval into a new disposable foil pan or stainless steel bowl. Alternately, instead of a scoop you can use a gloved finger or a clean screwdriver. The screwdriver is particularly helpful if portions of the soil are hardpacked or compressed. Mix the material in the pan/bowl thoroughly and remove rock and debris greater than 0.5 inches. If more material is required to fill sample containers, a second hole can be probed immediately adjacent to the first and material from the second liner from the same interval can be added to the pan/bowl and mixed. Fill the sample containers with the homogenized materials from the pan/bowl using the associated sampling tool. Repeat this process for all intervals to be sampled. Be aware of the potential for cross contamination and if needed change gloves, screwdriver, or scoops between intervals.
15. Label the sample containers and store them in a cooler.	Make sure all sample containers are labeled correctly. These sample containers should also be placed in a cooler with ice (if required). Samples should be kept at 4 ºC or less (if required by the analytical method) and under chain of custody protocols until transport to the laboratory as described in SOP-SA-01 Soil and Water Sample Packaging and Shipping.
16. Record sampling information.	Record appropriate information about the sample collection (sample number and associated depth interval, time, date, sample containers, etc.) in the field logbook as discussed in SOP-SA-05 Project Documentation. Record additional information such as soil type and rock content if required by the SAP/WP.
17. Store or dispose of remaining core.	Disposal or storage information should be available in the project-specific SAP/WP. Soil with potential organic contamination will need to be contained for testing and potential landfarm treatment or disposal at an approved facility. If the information is not available in the SAP, discuss disposal requirements with the project manager. Removed soil may also be returned to the drill hole from which it came.
Decontamination of Equipment following both Organic or Inorganic Sampling	
1. Clean the plastic placed over the sample area.	Between each core, sweep or wipe down the plastic using paper towels wetted with deionized water (DI). If a particularly muddy core was sampled, the plastic may need to be replaced or a new piece placed over the sample area.
2. Decontaminate equipment.	Decontaminate the cutting tool, tape measure, and screwdrivers using paper towels wetted with a Liquinox/water mixture and the DI water spray bottle to rinse. If sampling for organics, use paper towels wetted with methanol for a final wipe down. If stainless steel bowls, spoons, and trowels were used, please follow instructions in SOP-DE-02 Equipment Decontamination.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
CHEMICAL	Potential contact with contaminated soil and groundwater.	Sites.	Inadvertent exposure to contaminated soil and groundwater could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Personnel will wear nitrile gloves and safety glasses when contact with soil and groundwater is possible. Sampling will be conducted outdoors or in a trailer with open doors.
	Exposure to hydraulic fluids.	Geoprobe® operations.	Exposure to hydraulic fluids could occur while working around the Geoprobe® due to equipment malfunction/ failure resulting in personal injuries.	The operator will inspect the Geoprobe® and document inspections daily before starting work. The operator will also replace/repair all faulty equipment before starting work. When inspecting equipment, personnel will wear work gloves to prevent possible exposures to hydraulic fluids. Non-essential personnel will maintain a 20-foot buffer zone around the Geoprobe®.
	Liquinox.	Equipment decontamination.	Personnel could be exposed to Liquinox via ingestion and skin/eye contact when decontaminating the equipment resulting in adverse health effects.	Personnel will wear nitrile gloves and eye protection when decontaminating the equipment.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
	Methanol.	Equipment decontamination.	Personnel could be exposed to methanol via skin/eye contact and ingestion/ inhalation when decontaminating equipment. Exposure could cause irritation of skin/eye. Adverse health effects can also result if methanol is ingested and/or inhaled. Direct contact with methanol during winter months can result in skin discomfort due to rapid evaporative cooling.	Personnel will prevent skin/eye contact with methanol and they will wear nitrile gloves and safety glasses when handling methanol. Personnel will use methanol in well-ventilated areas. Personnel will also practice proper personal hygiene – wash hands prior to eating/drinking, after decontamination procedures, and when leaving the site. During winter months, personnel will wear a pair of liner gloves underneath nitrile gloves.
NOISE	Elevated noise levels.	Geoprobe® operations.	Personnel could be exposed to elevated noise levels when working near the Geoprobe® operations resulting in hearing damage.	Personnel will wear hearing protection (e.g., ear plugs) when working near the Geoprobe®. Non-essential personnel will maintain a 20-foot buffer zone around the Geoprobe®, when possible. Hearing protection will be administered and used in accordance with the policies and procedures outlined in the Pioneer Corporate HASP.
ELECTRICAL	Not applicable.			

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
BODY MECHANICS	Bending, squatting, and kneeling.	During fieldwork activities.	Bending, squatting, and kneeling during fieldwork activities could result in muscle/ back strains or other injuries.	Personnel should stretch prior to starting work and they will take breaks when necessary.
	Improper lifting / handling of heavy items.	During field work activities.	Back injuries and muscle/back strains could result when using improper techniques to lift/carry heavy coolers and containers with core pieces.	Personnel will use proper lifting techniques – get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder height. Two workers will lift/handle heavy items as needed.
	Flying debris.	Geoprobe® operations.	Eye injuries could result from flying debris when working around Geoprobe® operations.	Personnel will wear safety glasses when working around Geoprobe® operations. Non-essential personnel will maintain a 20-foot buffer zone around the Geoprobe® when possible.
GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces, and steep slopes.	Walking/working on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Personnel will wear work boots with good traction and ankle support. They will plan their path, walk cautiously, and keep work areas as dry as possible. Personnel will wear muck boots as necessary.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
WEATHER	Cold/heat stress.	Outdoor sites.	Exposure to cold climates may result in cold burns, frostbite, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers and loose clothing). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in the applicable SSHASP and/or Pioneer corporate HASP.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Personnel will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoors sites.	Personnel could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.
BIOLOGICAL	Plants, insects, and animals.	Outdoors.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First aid kits will be available in company vehicles. Personnel with allergies will notify their supervisor.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
MECHANICAL	Sharp edges and cutting tool.	Plastic liners and cutting tool.	Personal injury could result while cutting the plastic liners open to collect the soil samples. The plastic liners could also have sharp edges after they are cut. Cuts and scrapes could result from direct contact with sharp edges.	Personnel will use a specialized tool to cut the plastic liners and they will wear work gloves to prevent hand injuries. Personnel will use a tray and clamp to hold the plastic liner in place and keep it from moving around. Personnel will be aware of hand placement to prevent exposure to sharp edges and cutting tool.
PRESSURE	Pressurized hydraulic hoses.	Geoprobe®.	Hydraulic hoses could burst/rupture resulting in inadvertent contact with hydraulic fluid or personal injury due to being struck by hoses.	The operator will inspect the Geoprobe® and document inspections daily before starting work. The operator will also replace/repair all faulty equipment before starting work. When inspecting equipment, personnel will wear work gloves to prevent possible exposures to hydraulic fluids. Non-essential personnel will maintain a 20-foot buffer zone around the Geoprobe®.
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained personnel.	Sites.	Inexperienced personnel and improper training could cause incidents resulting in adverse health effects and/or property damage.	Personnel will be properly trained in the procedure described above and other applicable procedures. Personnel will follow the stop work policy if there are any issues.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
SIMOPS (Simultaneous Operations)	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	**Personal Protection Equipment** (PPE): Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, nitrile gloves, and leather gloves.
APPLICABLE SDSs	**Safety Data Sheets** (SDSs) will be maintained based on the site characterization and contaminants. Safety Data Sheets are available to Pioneer personnel on the internal website under Safety.
REQUIRED PERMITS/ FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
DRAWINGS	Map with site location and sample locations.
RELATED SOPs/ PROCEDURES/ WORK PLANS	SOP-FM-01 Field Headspace Analysis and VOC Measurements with PID, SOP-SA-01 Soil and Water Sample Packaging and Shipping, SOP-DE-02 Equipment Decontamination (Inorganic Contaminants), and SOP-SA-05 Project Documentation.
TOOLS/ EQUIPMENT	Sample area – plastic sheeting, folding table (1 or 2), tape to secure plastic, tape measure, index cards to indicate top and bottom, camera, PID (if required), plastic disposable scoops or stainless steel spoons or spatulas, screwdrivers, filled DI water spray bottle, filled Liquinox/water spray bottle, methanol, paper towels, foil disposable pans or stainless steel bowls, sample containers, cooler, ice, dual blade cutter, and liner holders.
FORMS/ CHECKLIST	Field logbook and field data sheets.

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

SOP TECHNICAL AUTHOR	DATE
Julie Flammang **Julie Flammang**	**11/18/2020**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**11/18/2020**

PURPOSE	To provide standard instructions for sampling soil cores generated during sonic drilling.
SCOPE	Pioneer Technical Services, Inc. (Pioneer) prepared this practice for the workforce and this Standard Operating Procedure (SOP) applies to all work performed by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent (as defined by OSHA) in the risk-assessed procedure described below before performing the work.
DISCUSSION	Sonic drilling is accomplished by maintaining resonance of the drill string using an oscillator (the sonic drill head). As the resonance occurs, the soil immediately adjacent to the tooling is loosened and can move freely. Sonic drilling is particularly effective in areas where conventional drilling techniques might have problems, such as the presence of abundant cobbles or boulders, extremely dense till or cemented sands and gravels. The steps to soil collection using a sonic drill rig are as follows: 1. Sonically advance a core barrel into undisturbed soil. Runs are typically 10 feet, but longer or shorter runs are also possible. 2. Sonically override the core barrel with casing to the same depth. 3. Remove the core barrel to the surface and extrude the sample into a plastic sleeve in short sections for easy handling.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is inaccurate or unsafe, personnel must notify the Project Manager, Safety Manager, and the SOP Technical Author to initiate appropriate revisions. Personnel will perform all work under this SOP in a manner that is consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plans (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
Preparation	
1. Verify utility locates and conduct site walk.	Confirm that the drilling subcontractor has placed a utility locate ticket that covers the area to be sampled. Confirmation number needs to be provided to Pioneer and put on the Job Risk Assessment or corresponding safety or permit form. Utility locates need to be called in a minimum of 48 business hours prior to the planned drilling activities. Conduct a site walk-through and determine any site-specific hazards associated with the sampling area. Discuss these with the sampling crew and note in the field logbook and Job Risk Assessment or corresponding safety form. As part of the site hazard assessment, identify possible locations for unidentified, privately installed underground utilities. For example, identify where natural gas pipes enter any structures on the property and confirm that gas lines from the street/alley have been marked. Check on yard lights or streetlights that are present with no overhead lines,

	underground wiring from a residence to outbuildings, or a possible gas line to a grill or outdoor kitchen. Adjust sample locations based on this information. Before drilling activities begin, verify that the ground has been marked with the location of underground utilities listed on the locate ticket from the drilling subcontractor. If needed, adjust sample locations based on identified or potential utility locations. See the Trenching, Excavation, and Ground Disturbance Program information in Pioneer's Corporate HASP to identify safe distances for drilling when adjacent to specific buried utilities.
2. Set up the sample area.	Designate an area near the drill rig that can be used for sampling and logging of core. The location should be out of the way of the drillers, but close enough to facilitate movement of the core to the area. Lay out sheets of plastic (visqueen) that are at least 15 feet long for 10-foot runs of core. Enough plastic should be laid out that all the core from the drill hole can be accommodated. The plastic sleeves containing the core need to be laid out with space between them to allow access (walkways) for sampling and logging. Alternatively, core can be transferred to core boxes from the core sleeve prior to any logging or sampling activities. In that case, cover a folding table with plastic. The table should be at least as long as the sleeves to be sampled. A tailgate covered with plastic can also be used. If the only available surface is the ground, place several layers of plastic a couple of feet longer than the liners on the ground. Secure the layers of plastic so they do not blow around during sampling. In addition to the sampling area, a staging area for unsampled core needs to be designated. This area should also be covered with plastic to keep the sleeves clean before placement on the sampling area.
3. Determine the length of the cores.	Discuss with the drilling crew the length of core they will be providing in each plastic sleeve. In most cases, this will be about 10 feet. If volatile organic compounds (VOC)/volatile petroleum hydrocarbon (VPH) or other air sensitive analytes are being considered, a shorter length of core (e.g., 2 feet) might be appropriate for the best results.
4. Mark the core.	As the drilling crew brings the plastic sleeve containing core to the sampling area, they should identify the top of the interval and place it on the sheet of plastic in the appropriate location to keep the core in order from top to bottom.
5. Record information provided by the operator.	If possible, confer with the sonic drill operator for any issues associated with coring each interval. Potential problems they may report: • A loss of material due to a rock blocking the core barrel. • A section that drilled extremely easy indicating material that was easily compressed such as clay or debris. • The presence of a potential void. • A problem with recovery due to saturated soil. • Heaving sands, which could result in overestimation of the width or depth of a layer due to re-coring of the same interval. • Their recognition of slough into the hole prior to drilling the next interval.

	Record any information provided by the operator in the field logbook or on a field data sheet. This information can be referenced when logging the core.
Sampling Soil for Inorganic Constituents	
1. Slice the plastic along the top.	Using a utility knife or something similar, slice the plastic along the top. Be aware that if the soil is saturated it may flow out of the plastic. Additionally, water from saturated core may need to be "blocked" from flowing onto other sections of core (potential cross contamination). Place index cards or some other marker at intervals along the core. If possible (and the plastic is not wet), intervals can be marked on the plastic. Place a reel type tape measure along the core, so it can be easily referenced but out of the way. If core boxes are being used, prior to opening the sleeve, cut (using a utility knife) the core sleeve into sections that will fit in the core boxes in logical intervals (2 feet, 2.5 feet, etc.). Make sure that each core box is marked with "top" and "bottom" and the order of boxes (1, 2, etc.) for the core being placed in the box so that they can be correctly arranged for logging and sampling activities.
2. Split the core and take pictures of the core.	If the core is cohesive, split the core lengthwise into 2 subsamples using a new disposable plastic spatula and/or stainless-steel blade. Photograph the complete length of the core in approximately 2-foot segments from directly overhead using parallel camera movement and a high-resolution setting. These photographs can be stitched together later to provide a continuous photographic record of the core. Take additional photographs of subsamples for documentation as necessary. If required, take an overview picture of the exposed soil.
3. Measure and record material in the core.	Evaluate the recovery of the core based on the operator's comments. Be aware that once the core is cut open and released from the plastic, there may be some expansion. Recovery in general from sonic drill rigs is fairly complete. If there was trouble with the recovery, the operator should indicate in general where that might have occurred. Record any additional information in the field logbook or on a field data sheet. Measure and record the number of inches of material in the core. This will be recorded in the field logbook or on the field data sheet as "length recovered" (e.g., 36 inches from a 5-foot run or 96 inches from a 10-foot run). This measurement should not include any material that appears to have sloughed from an upper interval such as leaves or topsoil present at the top of deeper subsurface cores. If heaving sands are present, the actual measurements of the new interval may be difficult to determine; confer with the driller as to where material from the new interval may start. Record this information in the field logbook or on a field data sheet as specified in the Sampling and Analysis Plan (SAP). The preferred method for determining interval depths is to determine the amount of material that represents 1 foot of the profile. For example, 26 inches of recovered soil from a 2-foot interval may indicate that 13 inches of core represents 1 foot. An alternate method for determining interval depth is to assume that 96 inches actually represents 96 inches from either the top or the bottom of a 120-inch interval and that there was no recovery for 12 inches of the interval. These are not precise ways to determine how far below ground surface a soil horizon lies, as different soil types and moisture levels will

	compress or expand differently when drilled and then released with the opening of the sleeve. There is no way to determine where or whether compression/expansion in the soil profile occurred. Choose one of these methods and be consistent throughout the project. Another scenario that may occur would be if the operator indicates that an obstruction was encountered that may have blocked soil from entering the casing at a specific depth. If there is only 60 inches of soil and a large rock present in the sleeve, this may represent only the 0-to-5 foot interval in that core and should be recorded that way in the field logbook or on the field data sheet along with the operator's comment. If core boxes are being used, mark the calculated interval for the core in each box, on both top and bottom portions of the box.
4. Log the core.	Examine and log the material in the core. Check the project specific documents for the amount of detail or type of information required from the core log. Pioneer has developed several different field data sheets to aid in collecting the correct information during core logging. Keep in mind that sonic-generated samples are not "undisturbed." The oscillation during drilling causes movement in the soil immediately adjacent to the core barrel. In softer bedrock, this may open fractures or round off edges of the material. Material closer to the center of the core should be used for logging and sampling. Using a gloved finger or scoop, make indentations down the core noting differences in texture, color, staining or odor if needed. The core may be unconsolidated enough that this is not required. Record information in the field logbook or on a field data sheet. Be aware of potential cross contamination when logging intervals that may be sampled. Change gloves or scoops as required. If required by the SAP or Work Plan (WP), photograph areas of interest.
5. Determine sample intervals.	Determine sample intervals as described in the SAP or WP. Using the extended tape measure, identify the intervals to be sampled. Record the sample interval information and associated sample number in the field logbook or on a field data sheet. If required in the SAP/WP, photograph sample intervals.
6. Collect soil sample.	For composite samples: Don clean nitrile gloves and use a new plastic disposable scoop for each composite sample. Place an equal aliquot of soil from each area to be composited into a new disposable foil pan, stainless-steel bowl, or resealable plastic bag. Samples covering an extended core interval (0-1 foot, 0-2 feet, etc.) should also be collected as composite samples. Mix the material thoroughly removing rock and debris greater than 0.5 inches. Fill the appropriate sample containers. If a lot of containers need to be filled, a larger sample interval may require compositing. For grab samples: Don clean nitrile gloves and use a new plastic disposable scoop for each sample. If more than 1 jar is required, place the material to be sampled in a new disposable foil pan, stainless-steel bowl, or resealable plastic bag. Mix the material thoroughly and remove rock and debris greater than 0.5 inches. Fill the appropriate sample containers. Alternately, a new scoop can be used to place material directly in the jar. Sample

	carefully so no particles larger than 0.5 inches are included in the sample. Grab sampling may occur when there is a small, stained area or a small amount of a material of interest in a soil profile.
7. Put sample in container.	Prepare the appropriate sample containers with a label as described in the SAP or the Quality Assurance Project Plan (QAPP). Fill the sample containers with homogenized material from the pan/bowl/bag using the associated sampling tool. After sampling, place the samples in a cooler with ice (if required). Samples should be kept at 4 degrees Celsius (ºC) or less (if required by the analytical method or SAP) and under chain of custody protocols until they can be transported to the laboratory for analysis, as described in SOP-SA-01 Soil and Water Sample Packaging and Shipping.
8. Repeat this process as needed.	Repeat this process, Steps 1 through 7, for each sleeve until the drill hole is complete.
Sampling Soil for Organic Constituents	
1. Preparation prior to screening for volatile organic vapors in drill core.	**Photoionization detector (PID) readings are always taken immediately on opening the core, prior to any other sampling or logging activities. Soil samples can show significant losses in VOC concentration within only seconds of opening soil cores.** If measurements using an organic vapor detector, PID, are required please refer to SOP-FM-01 Field Headspace Analysis and VOC Measurements with PID for information on using the PID.
2. Prepare the core.	Ensure that the drill operator and/or helper seals the ends of the plastic sleeve by tying or taping immediately after removing the core from the drill rod so that no VOCs escape prior to cutting open the core. Store sealed sleeves in the shade to avoid additional volatilization of VOCs. Evaluate the plastic sleeve of core to be sampled but **DO NOT** cut the plastic. If the soil is saturated, water or soil may flow out of the plastic after it is cut. Saturated core may need to be "blocked" from flowing onto other sections of core, to prevent cross contamination. Place index cards or some other marker at intervals along the core. If possible (and plastic is not wet), intervals can be marked on the plastic. Place a reel type tape measure along the core so it can be easily referenced but out of the way.
3. Prepare the sample container.	Based on information provided in the SAP/WP, prepare and label the appropriate sample containers. If samples are required, sample intervals may have been assigned in the SAP/WP, or samples may be collected based on PID or headspace readings or the presence of odor or staining. The sampler needs to understand sample collection protocol prior to opening the plastic core sleeve. This is particularly important in collecting samples for VOCs, VPH, and/or extractable petroleum hydrocarbon (EPH). Ensure required sampling supplies are close at hand prior to opening the core.

4. Measure material in the core.	Prior to cutting the plastic sleeve, measure and record the number of inches of material in the core. See discussion in Step 3 under **Sampling Soil for Inorganic Constituents** to determine how depth of sample intervals will be determined.
5. Cut the plastic sleeve.	Once the sample collection supplies are organized, use a utility knife or something similar and slice the plastic along the top. If core boxes are being used, label core boxes prior to dividing core. Boxes should be labeled with "top" and "bottom" and the order of boxes (1, 2, etc.) for the core being placed in the box so that they can be correctly arranged for logging and sampling activities. Cut the sleeve, using a utility knife, into sections that will fit in the core box in logical intervals (2 feet, 2.5 feet, etc.). Move quickly during the dividing process so minimal VOCs are lost.
6. Split the core.	If needed quickly split the core lengthwise into 2 subsamples using a new disposable plastic spatula, plastic scoop, and/or stainless-steel blade.
7. Conduct PID readings if required.	**The VOC and VPH samples need to be collected as quickly as possible after opening the plastic.** If specified in the SAP/WP, use a PID to take readings of the length of the core, refer to SOP-FM-01 Field Headspace Analysis and VOC Measurements with PID for information on using the PID. If volatiles are detected, return to those areas and record the highest reading as well as the amount of core involved. Evaluate the core for staining or other indications of organic contamination. Photographs can be taken of areas of interest prior to sampling, however, keep in mind that time is of the essence if samples are to be collected.
8. Prepare and collect soil samples for VOC/VPH/ EPH.	Collect the required VOC, VPH, or EPH samples directly from the core using a plastic disposable scoop or gloved hand. Sampling for non-organic constituents can be completed later. The tape measure can be used to identify the intervals. Gaps from removed sample material should be left so that logging of the remaining core material can be completed. Place the soil directly into the sample container and fill the jar to the top allowing no head space (or as the laboratory directs). Be aware of the potential for cross contamination and if needed change gloves or scoops between intervals. Immediately place the sample containers in a cooler with ice. Samples should be kept at 4 ºC or less and under chain of custody protocols until they can be transported to the laboratory for analysis, as described in SOP-SA-01 Soil and Water Sample Packaging and Shipping.
9. Record PID readings and VOC sample information in logbook.	If PID screening is conducted, record results of the screening in the field documentation (project logbook or field data sheets) including the highest reading from each interval and the actual location in the core (i.e., 10 inches from the bottom) and the calculated interval depth. Record the sample information for the VOC, VPH, or EPH samples in the logbook including sample interval and associated sample number, time, date, and type of containers collected.

10. Complete VOC sampling.	All VOC sampling of all core should be completed as soon as possible after core comes out of the ground. Once VOC samples have been collected from a section of core, set it aside or move on to the next section of core. Once **ALL** the core has been processed for VOC samples, then return to each core box or section and complete logging and additional sampling requirements.
11. Take pictures of the core.	If not already done, and if required by the SAP/WP, photograph the complete length of each core in approximately 2-foot segments from directly overhead using parallel camera movement and a high-resolution setting. These photographs can be stitched together later to provide a continuous photographic record of the core. Take additional photographs of subsamples for documentation as necessary. If required, take an overview picture of the entire length of core.
12. Complete any other required logging and sampling.	Follow Steps 4 through 8 under **Sampling Soil for Inorganic Constituents** to finish each core section.
Decontamination of Equipment following both Organic or Inorganic Sampling	
1. Decontaminate equipment.	Decontaminate the cutting tool and tape measure, as well as any other reusable equipment using paper towels wetted with a Liquinox/water mixture and the deionized (DI) water spray bottle to rinse. If sampling for organics, use paper towels wetted with methanol for a final wipe down. If stainless-steel bowls, spoons, and trowels were used, please follow the SOP-DE-02 Equipment Decontamination.
2. Clean the plastic placed over the sample area.	If a table is used, between each core, sweep or wipe down the plastic using paper towels wetted with DI water. If a particularly muddy core was sampled, the plastic may need to be replaced or a new piece placed over the sample area.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
CHEMICAL	Potential contact with contaminated soil and groundwater.	Sites.	Inadvertent exposure to contaminated soil and groundwater could lead to adverse health effects.	Personnel will practice proper personal hygiene – wash hands prior to eating/drinking and when leaving the site. Personnel will wear nitrile gloves and safety glasses when contact with soil and groundwater is possible. Sampling will be conducted outdoors or in a trailer with open doors.
	Exposure to hydraulic fluids.	Drilling operations.	Exposure to hydraulic fluids could occur while working around the drill due to equipment malfunction/failure resulting in personal injuries.	The operator will inspect the drill and document inspections daily before starting work. The operator will also replace/repair all faulty equipment before starting work. When inspecting equipment, personnel will wear work gloves to prevent possible exposures to hydraulic fluids. Non-essential personnel will maintain a 20-foot buffer zone around the drill.
	Liquinox.	Equipment decontamination.	Personnel could be exposed to Liquinox via ingestion and skin/eye contact when decontaminating the equipment resulting in adverse health effects.	Personnel will wear nitrile gloves and eye protection when decontaminating the equipment.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
	Methanol.	Equipment decontamination.	Personnel could be exposed to methanol via skin/eye contact and ingestion/ inhalation when decontaminating equipment. Exposure could cause irritation of skin/eye. Adverse health effects can also result if methanol is ingested and/or inhaled. Direct contact with methanol during winter months can result in skin discomfort due to rapid evaporative cooling.	Personnel will prevent skin/eye contact with methanol and they will wear nitrile gloves and safety glasses when handling methanol. Personnel will use methanol in well-ventilated areas. Personnel will also practice proper personal hygiene – wash hands prior to eating/drinking, after decontamination procedures, and when leaving the site. During winter months, personnel will wear a pair of liner gloves underneath nitrile gloves.
NOISE	Elevated noise levels.	Drilling operations.	Personnel could be exposed to elevated noise levels when working near the drilling operations resulting in hearing damage.	Personnel will wear hearing protection (e.g., ear plugs) when working near the drill. Non-essential personnel will maintain a 20-foot buffer zone around the drill when possible. Hearing protection will be administered and used in accordance with the policies and procedures outlined in the Pioneer Corporate HASP.
ELECTRICAL	Not applicable.			
BODY MECHANICS	Bending, squatting, and kneeling.	During fieldwork activities.	Bending, squatting, and kneeling during fieldwork activities could result in muscle/back strains or other injuries.	Personnel should stretch prior to starting work and they will take breaks when necessary.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
	Improper lifting/ handling of heavy items.	During field work activities.	Back injuries and muscle/back strains could result when using improper techniques to lift/ carry heavy coolers and containers with core pieces.	Personnel will use proper lifting techniques – get a good grip, keep the load close to the body, lift with legs and not with back, and avoid lifting loads above shoulder height. Two workers will lift/handle heavy items as needed.
	Flying debris.	Drilling operations.	Eye injuries could result from flying debris when working around drilling operations.	Personnel will wear safety glasses when working around drilling operations. Non-essential personnel will maintain a 20-foot buffer zone around the drill when possible.
GRAVITY	Falls from slips and trips.	Uneven terrain, slick/muddy/wet surfaces, and steep slopes.	Walking/working on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Personnel will wear work boots with good traction and ankle support. They will plan their path, walk cautiously, and keep work areas as dry as possible. Personnel will wear muck boots as necessary.
WEATHER	Cold/heat stress.	Outdoor sites.	Exposure to cold temperatures may result in cold burns, frostbite, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers and loose clothing). Personnel will remain hydrated and will have sufficient caloric intakes during the day. Personnel will follow procedures outlined in the applicable SSHASP and/or Pioneer corporate HASP.
	Lightning.	Outdoor sites.	Electrocution, injury, death, or equipment damage could be caused by lightning strike.	Personnel will follow the 30/30 rule during lightning storms.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS
This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
RADIATION	Ultraviolet (UV) radiation.	Outdoors sites.	Personnel could be exposed to UV radiation during summer months causing sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.
BIOLOGICAL	Plants, insects, and animals.	Outdoors.	Exposure to plants, insects, and/or animals may cause rashes, blisters, redness, and swelling.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Avoid contact with plants, insects, and animals. First aid kits will be available in company vehicles. Personnel with allergies will notify their supervisor.
MECHANICAL	Blade from cutting tool.	Cutting tool.	Direct contact with the blade of the cutting tool used for slicing the plastic sleeves could result in cuts and scrapes.	Personnel will inspect the cutting tool prior to each use and be aware of hand placement to prevent exposure to the blade. Personnel will also wear work gloves.
PRESSURE	Pressurized hydraulic hoses.	Drilling operations.	Hydraulic hoses could burst/rupture resulting in inadvertent contact with hydraulic fluid or personal injury due to being struck by hoses.	The operator will inspect the drill and document inspections daily before starting work. The operator will also replace/repair all faulty equipment before starting work. When inspecting equipment, personnel will wear work gloves to prevent possible exposures to hydraulic fluids. Non-essential personnel will maintain a 20-foot buffer zone around the drill.
THERMAL	Not applicable.			

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
HUMAN FACTORS	Inexperienced and improperly trained personnel.	Sites.	Inexperienced personnel and improper training could cause incidents resulting in adverse health effects and/or property damage.	Personnel will be properly trained in the procedure described above and other applicable procedures. Personnel will follow the stop work policy if there are any issues.
SIMOPS (Simultaneous Operations)	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	**Personal Protection Equipment** (PPE): Hard hat, safety glasses, high-visibility work shirt or vest, long pants, work boots, nitrile gloves, and leather gloves.
APPLICABLE SDSs	**Safety Data Sheets** (SDSs): Liquinox and Methanol. Safety Data Sheets are available to Pioneer personnel on the internal website under Safety.
REQUIRED PERMITS/ FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
DRAWINGS	Map with site location and sample locations.
RELATED SOPs/ PROCEDURES/ WORK PLANS	SOP-SA-01 Soil and Water Sample Packaging and Shipping, SOP-DE-02 Equipment Decontamination, and SOP-FM-01 Field Headspace Analysis and VOC Measurements with PID.
TOOLS/ EQUIPMENT	Sample area – plastic sheeting, tape measure, index cards to indicate top and bottom, camera, PID meter (if required), plastic disposable scoops or stainless-steel spoons or spatulas,

	screwdrivers, DI water spray bottle, Liquinox/water spray bottle, methanol, paper towels, foil disposable pans or stainless-steel bowls, sample containers, and cutting tool (e.g., utility knife).
FORMS/ CHECKLIST	Field logbook and field data sheets.

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

SOP TECHNICAL AUTHOR	**DATE**
Julie Flammang **Julie Flammang**	**11/16/2020**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**11/16/2020**

PURPOSE	This Standard Operating Procedure (SOP) establishes the requirements for documenting and maintaining field logbooks and photographs. These procedures shall apply to all types of air, soil, water, sediment, biological, and/or core samples collected in environmental investigation by Pioneer Technical Services, Inc. (Pioneer). These procedures apply from the time field work begins until site activities are completed.
SCOPE	Pioneer prepared this practice for the workforce and this SOP applies to all work performed by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work shall be trained and competent (as defined by OSHA) in the risk-assessed procedure described below before performing the work.
NOTES	Please be very aware that logbooks are a **LEGAL** document. As such, they can and most likely will be placed into the public domain with any final reports to clients. They can also be used as evidence for a trial or lawsuit. They can be used to ask questions and to respond in a deposition. They will be used by other Pioneer personnel for data validation, report writing, and for referencing project- or sample-specific information. Beyond being used and reviewed by the client and agencies, they also might be shared with other consulting firms. Be very careful in what and how any information is written. The language used in the logbook should be factual and objective. Logbooks will contain a complete description of field activities, so that the event can be recreated without having to rely on field team memories. Decision making parameters and consultation with clients, subcontractors, or agency personnel should always be recorded. Any deviations from a Sampling and Analysis Plan (SAP)/Quality Assurance Project Plan (QAPP)/Work Plan (WP) or contract requested by agencies, client, subcontractors, property owners, or any stake holder should always be recorded in detail. Any deviation from the SAP/QAPP/WP or contract due to a decision of field personal should also be recorded. If any deviation will result in a change of scope, require additional compensation, or affect the quality of the samples or information to be collected the Project Manager should be notified. The conversation and decision by the Project Manager will also need to be recorded in the logbook. **Refer to the PowerPoint presentation available on the Pioneer SharePoint Field Sampling site, *Logbook and Decontamination Requirements Review Presentation* 20XX – where XX is the most recent year).** The presentation details the logbook and field data sheet requirements and includes checklists of required elements to ensure collection of proper field information.

WORK INSTRUCTIONS

The following instructions provide guidance to perform the task in a safe, accurate, and reliable manner. If these instructions present information that is inaccurate or unsafe, personnel must notify the Project Manager, Safety Manager, and the SOP Technical Author to initiate appropriate revisions. Personnel will perform all work under this SOP in a manner that is consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plans (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
1. Logbooks.	A designated field logbook will be used for each field project. The logbooks will be bound and have consecutively numbered pages. If requested by the Project Manager, use a separate field logbook for each field task within a larger project. Label each logbook cover with the project name, dates that it covers, and logbook number. Use a waterproof marker, such as a Sharpie©, to write down the information. Write relevant project personnel names and phone numbers, such as the Project Manager, Pioneer safety personnel, client representative, field team leaders, agency contacts, and subcontractor names on the first page of the logbook, so they can be easily referenced. The information recorded in these logbooks must be written **legibly** in **black** indelible ink. Begin a new page for each day's notes. Write on every line of the logbook. If a blank space is necessary for clarity, such as a change of subject, skip one line before beginning the new subject. Do not skip any pages or parts of pages unless a day's activity ends in the middle of a page. Draw a diagonal line through any blank spaces of three lines or more and add your initial and the date to prevent unauthorized entries. All corrections will consist of a single strike-out in ink, followed by the author's initials and the date. Information not related to the project should not be entered in the logbook. The language used in the logbook should always be factual and objective. Add the following entries into the project logbook for each field day: 1. On the logbook cover: project name, dates that logbook covers, and logbook number. 2. On the first page: relevant project personnel names and phone numbers, such as the Project Manager, Pioneer safety personnel, client representative, field team leaders, agency contacts, and subcontractor names. 3. A description of the field task (i.e., monthly groundwater level monitoring). 4. Time and date fieldwork started. 5. Location and/or a description of the work areas including sketches, if needed, any maps or references needed to identify locations, and sketches of construction activities. If the location has been documented in the logbook during/prior visits, only changes in conditions should be noted. 6. Names and company affiliations of field personnel.

7. Name, company affiliation or address, and phone number of any field contacts or official site visitors.

8. Meteorological conditions at the beginning of fieldwork and any ensuing changes in these conditions.

9. Details of the fieldwork performed and reference to field data sheets, if used.

10. Deviations from the task-specific SAP, WP, or SOP.

11. All field measurements performed. If field data sheets are used to record field measurements or observations (logging of drill core, blow counts, water quality parameters) the specific field data sheet needs to be referenced in the logbook. If associated with a specific sample, for example groundwater collected from a well, the final water quality stabilization parameters should be listed with the sample information in the logbook.

12. Any field analytical results (such as X-ray fluorescence [XRF] or field iron tests) should be recorded in the logbook. If this information is recorded on field data sheets or maps, those sheets or maps should be referenced. If information from one of these documents is used for decision making (i.e., to stop boring), the result and decision should be recorded in the logbook.

13. Personnel and equipment decontamination procedures, if appropriate.

For field samples, the following entries will be made for **every sample collected**, whether or not the sample is submitted to a laboratory:

1. Sample location and field sample identification number for every sample collected.

2. The number and type of sample containers collected for the sample (1 - 1L Poly, etc.).

3. Type of sample preservation and or preparation (i.e., raw, filtered, sieved) for each sample container.

4. Analytes or analytical method associated with each sample container.

5. If the analytical laboratory requests additional containers from a natural sample to complete their quality assurance and control (record this with the sample container). A laboratory will often ask for additional volume for their matrix spike or duplicate analysis.

6. Date and time of sample collection; the start time for the collection of each sample should be recorded. This start time will also be recorded on the sample containers and the chain of custody form for the laboratory. The start time for collection of the sample starts the clock on the analytical holding time. If a sample takes a long time to collect due to the number of sample containers or the sample collection procedure, the sample completion time should also be recorded.

7. If the sample is a composite sample, the start and end time of sample collection should be recorded.

   Information about the number of aliquots included in the sample should also be recorded (i.e., samples from 8 holes from 0-6 inches were collected or 4 locations along 10 feet of stream were sampled and mixed).

8. Field quality control sample identification (i.e., field duplicate of [associated field sample number], field blank, or equipment rinsate blank). For equipment rinsate blank, the equipment "rinsed" for the blank should be identified. The method of collection for this sample also needs to be described. For example:

   a. For a field blank: deionized (DI) water poured directly into sample bottles (bottle code from DI water container should be recorded).
   b. For a duplicate sample: fill sample bottles immediately following natural sample or collect sample from the same sample hole immediately following collection of natural sample into separate pan; mix each and place in appropriate bottles.
   c. For an equipment rinsate: DI water (record DI water container code) poured or ran through [identify which piece of equipment] into appropriate sample containers.

   Information on preparing field quality control samples is discussed in Pioneer SOP-SA-03A Field Quality Control Samples for Water Sampling and SOP-SA-03B Preparation of Equipment Rinsate Blanks for Submersible Pumps.

9. Split samples taken by other parties. Note the type of sample, sample location, time/date, name of individual for whom the split was collected, that individual's company, and any other pertinent information. How the split sample was collected should also be recorded. Was it collected as a duplicate sample (separate collection) or as a replicate sample (all material collected and then mixed and divided into individual containers)? Replicate soil and surface water samples are more appropriate for this type of sample.

10. Sampling method, particularly any deviations from the SAP and SOP. A generalized description of the sampling procedure can be described at the beginning of the project logbook and then the page can be referenced for succeeding sampling days, if sampling protocol will be the same for every sample. If referencing a description, make sure that any deviations associated with the individual sample are recorded, such as refusal in hole 2 and 4 at 5 inches.

11. Documentation or reference of preparation procedures for reagents or supplies that will become an integral part of the sample, if available. This information may not be available for water or soil sampling bottles that come preserved from the laboratory or for preservatives provided by the laboratory. Bottle blanks will need to be used to evaluate the provided reagents.

12. The laboratory where the samples will be sent. Note that this might be container specific (i.e., organic sample containers may be going to one laboratory and inorganic

	samples may be shipped to a different laboratory). If this is the case, the laboratory performing analysis should be listed with the analytical method/analyte descriptions as discussed above. 13. Chain of Custody Form: Information on sample submittal to laboratories needs to be recorded in the logbook to maintain chain of custody for the samples. This information will include the following: a. The samples shipped to each laboratory: the samples can be listed individually or listed as a general description of the samples shipped (i.e., all EPH, TPH samples collected on specific dates). b. The method shipped (i.e., FedEx Overnight, UPS ground, or hand delivered). c. Any tracking numbers associated with the shipment. d. Number of shipping containers shipped or delivered. e. Date and time sample containers were relinquished. Any documentation from the transport company (receipts or tracking numbers) and copies of chain of custody forms included in the shipping containers will be placed in the project record file and retained to prove chain of custody was maintained. Further information on preparing samples for shipping is detailed in Pioneer SOP-SA-01 Soil and Water Sample Packaging and Shipping and SOP-SA-04 Chain of Custody Forms for Environmental Samples. No bound field logbooks will be destroyed or thrown away even if they are illegible or contain inaccuracies that require a replacement document. If the logbook is replaced, write REPLACED on the cover of the logbook and reference the new logbook and number. The original logbook should be referenced at the beginning of the replacement logbook along with the reason the original was replaced. Keep in mind that any information not recorded in a logbook or on a field data sheet or comparable document is not part of the project documentation and **cannot be used**. If a sample is not recorded in the logbook or associated documentation it **does not exist** and cannot be used for decision making purposes.
2. Photographs.	Take photographs of field activities using a digital camera. Photographs should include a scale in the picture when practical. Telephoto or wide-angle shots are not recommended; if you take these types of photographs, they should be identified as such. The following items will be recorded in the bound field logbook or on a field data sheet for each photograph taken: 1. The photographer's name, the date and time of the photograph, and the general direction faced. 2. A brief description of the subject and the fieldwork portrayed in the picture. 3. Sequential number of the photograph.

	An electronic copy and/or a hard copy of the photographs will be placed in task files in the field office after each day of field activities. Supporting documentation from the bound field logbooks or field data sheets will be photocopied and placed in the task files to accompany the photographs once the field activities are complete.

HEALTH SAFETY SECURITY ENVIRONMENT (HSSE) CONSIDERATIONS

This section to be completed with concurrence from the Safety and Health Manager.

SOURCE	*HAZARDS*	*WHERE*	*HOW, WHEN, RESULT*	*CONTROLS*
CHEMICAL	Not applicable.			
NOISE	Not applicable.			
ELECTRICAL	Not applicable.			
BODY MECHANICS	Not applicable.			
GRAVITY	Not applicable.			
WEATHER	Not applicable.			
RADIATION	Not applicable.			
BIOLOGICAL	Not applicable.			
MECHANICAL	Not applicable.			
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Not applicable.			
SIMOPS (Simultaneous Operations)	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	**Personal Protection Equipment** (PPE): None Required
APPLICABLE SDSs	**Safety Data Sheets (**SDSs) will be maintained based on site characterization and contaminants. Safety Data Sheets are available to Pioneer personnel on the internal website under Safety.
REQUIRED PERMITS/ FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
DRAWINGS	
RELATED SOPs/ PROCEDURES/ WORK PLANS	SOP-SA-01 Soil and Water Sample Packaging and Shipping SOP-SA-03A Field Quality Control Samples for Water Sampling SOP-SA-03B Preparation of Equipment Rinsate Blanks for Submersible Pumps SOP-SA-04 Chain of Custody Forms for Environmental Samples
TOOLS/ EQUIPMENT	Field logbook, Sharpie©, black pen, and digital camera.
FORMS/ CHECKLIST	Field data sheets.

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

SOP TECHNICAL AUTHOR	DATE
Patricia Olson **Patricia Olson**	**04/14/2022**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman **Tara Schleeman**	**04/14/2022**

PURPOSE	To provide standard instructions for operating survey equipment, staking, flagging and painting survey marks, and recording of field work performed.
SCOPE	This practice has been prepared for the Pioneer Technical Services, Inc. (Pioneer) workforce and applies to work carried out by and on behalf of Pioneer. All members of the Pioneer workforce who conduct the work will be trained and competent in the risk-assessed work described below.

WORK INSTRUCTIONS

The following instructions are intended to provide sufficient guidance to perform the task in a safe, accurate, and reliable manner. Should these instructions present information that is inaccurate or unsafe, operations personnel must bring the issue to the attention of the Project Manager and the appropriate revisions made. All work performed under this SOP will be consistent with procedures and policies described in the appropriate Operation, Maintenance, and Monitoring (O&M) Plan (where applicable), appropriate Site-Specific Health and Safety Plan (SSHASP), and Pioneer Corporate Health and Safety Plan (HASP).

TASK	INSTRUCTIONS
1. Storing survey equipment.	Store survey equipment in a secure, climate-controlled weatherproof area when not in use.
2. Charging Global Positioning System (GPS), robot, and data collector batteries.	Charge batteries used in survey equipment in a climate-controlled weatherproof area. The use of a surge protector (power strip) to supply power to the battery chargers is recommended. Only use manufacturer's approved batteries and chargers.
3. Transporting survey equipment in vehicles.	Transport survey equipment in a weatherproof area of a vehicle to prevent unnecessary exposure to elements that could adversely affect the calibration of various survey instruments and their accessories. Secure equipment in the vehicle during transportation so that it does not become a projectile in the case of an accident or other sudden maneuver.
4. Setting stakes/lath and hubs.	Setting of survey stakes and hubs often requires the use of a 3-to 4-pound engineer or drilling hammer (hand held) (refer to Figure 1) or a 8- to 12-pound sledgehammer, and a gad (frost pin) (refer to Figure 2) manufactured and/or distributed by Red Top or Lo-Ink, designed to mushroom and not splinter when struck, to create a pilot hole in various soil surfaces in order to set the stake or hub.

Figure 1 – Drilling Hammer

Figure 2 – Gad (Frost Pin)

The gad (frost pin) will be from an authorized survey supply company. Any type of gad (frost pin) that is made of a material that can create shrapnel (i.e., jack hammer bits) or from an unauthorized survey supply company will not be used. When hammering stakes/hubs into surface, care will be taken to avoid splintering of stake/hub.

Set the hubs and stakes/lath in the following manner:

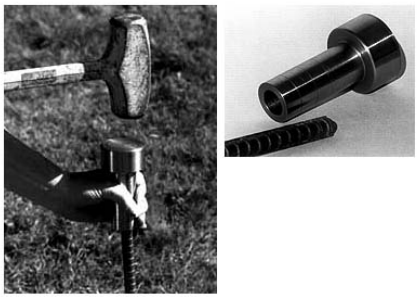
- After determining the position of the hub/stake/lath, determine the soil condition.
- If soil is loose or non-compacted, simply drive the hub/stake/lath into the ground until the hub/stake/lath is stable.

If soil is hard packed or compacted, use the following steps:

- Make a pilot hole using a gad.
- Grip the gad in your non-dominant hand halfway up the length of the gad and place the point of the gad at the desired position of the survey point.
- Using the drilling hammer in your dominant hand, strike the top of the gad a sufficient number of times to make a pilot hole of the desired depth.
- To remove the gad from the pilot hole, strike the sides of the gad with the drilling hammer in opposing horizontal directions to loosen the gad.
- Remove the gad from the pilot hole and insert the hub/stake/lath into the ground until the hub/stake/lath is stable.

5. Setting rebar.

Setting of rebar is necessary to establish control points and property corners. The use of a rebar driver (refer to Figure 3) manufactured and/or distributed by Surv-Kap or Lo-Ink, designed to mushroom and not splinter when struck, will be utilized to prevent mushrooming of the rebar and to allow for a larger striking surface. The proper sized driver for the proper sized rebar will be used (i.e., ½ inch for #4 rebar, 5/8 inch for #5 rebar, etc.).

	 Figure 3 – Rebar Driver Set rebar in the following manner: • After determining the desired position of the property corner or control point, select a section of 5/8-inch rebar (12-inch length for control points, 24-inch length for property corners). • Inspect the section of rebar and ensure that it is straight and free of burrs at the ends. • Place one end of the rebar at the desired position and hold it with your non-dominant hand. • Place the rebar driver over the end of the rebar. Using the drilling hammer (held in your dominant hand), strike the rebar driver until the bottom of the rebar driver contacts the surface that the rebar is being driven into. This will leave the rebar exposed approximately 2½ inches, allowing either a plastic or aluminum survey cap to be placed on the exposed end of the rebar. • Drive the rebar and cap flush with the surface by placing a "cap driver" (sold by Surv-Kap) over the cap and striking the "cap driver" to set the cap flush to the surface. • In the event that a control point or property corner needs to be set in a paved surface, a pilot hole will be drilled first with a hammer drill and the correct sized bit.
6. Checking points daily.	Check points will be performed daily (per job) to verify the following: • Base point and height of base are correct. • Survey coordinate system and datum are correct. • Control remains within project specifications.
7. Using point ranges.	The following point ranges will be used on all jobs: • 1-299 Project Control (found or set). • 300-499 Found Monuments. • 500-999 Calculated Monuments. • 1000-2999 Calculated Design. • 3000-Infinity Topo and staking store points.

8. Booking of survey activities.	Record surveying activities on a daily basis (per job) in a field book to facilitate the ease of record keeping and the ability at a later date to recall the activity performed. The following will be the minimum data recorded in the field book:
	
	• Job name, location, coordinate system, and vertical datum used (header page) along with a brief description of the survey activities performed.
	• Date of field work and initials of all crew members.
	• Base point used along with height and type of measure up (fixed height, slant height, center bumper height, bottom of antenna mount, etc.).
	• Check point(s) used with Δ Northing, Δ Easting, and Δ Elevation differences written along with "Stored As" point (i.e., CK7-5 would be the 5th check point on CP7).
	• Any new control points or bench marks set (or found) along with their description.
	• Description of property corners set or found (e.g., type of rebar/cap, found stone, pipe, etc.) along with ties to any accessories (e.g., fence corners, bearing trees, road intersections, etc.).
	• Point ranges stored and a brief description (e.g., 3001-4063 – topo of road and ditches from xxx intersection to xxx intersection).
	• Type of alignments staked and the point range that staked points were stored in.
	• Occupy and backsight points for conventional survey work (gun work) along with backsight check and points staked – per set up.
	• Any changes in rod height and the associated point ranges.
	• Leveling bench marks, foresights, backsights, and side shots will be recorded (when leveling is performed).
	• Any pertinent sketches deemed necessary.
	• Any issues with equipment, land owners, contractors, etc. that arise.
	• Any other information deemed pertinent by the individual performing the survey.
	
	Field books will be numbered in the following manner:
	
	• Volume by county using the Montana County numbers (i.e., Silver Bow is 1, Deer Lodge is 30, Lewis and Clark is 5, etc.).
	• Book by series (e.g., B1, B2, B3, etc.).
	• County name.
	• All of the above will be marked on the front outside cover and the side binding of the field book.
	• The title page at the beginning of the book will be filled out with the office information/address that the surveyor performing the work is based out of.
	  o An example of field book number is: V1-B4 Silver Bow (i.e., Volume 1 – Book 4 of Silver Bow County).
	  o Each individual page will be numbered as such (i.e., V1-B4-1, V1-B4-2, etc.) in the upper right hand corner of each page. One page is considered to be both the left and right page of any given field book when in an open position.

	o Once a field book is filled, the index at the front of the book will be filled in to aid in future tracking of field work already performed. The preferred type of field book is a Rite in the Rain All-Weather Transit No.300 series. **Note: all of the above is necessary to provide for an accurate means of recalling activities performed.**
9. Painting and flagging of survey marks.	 Figure 4 – Spray Paint Use the following steps when painting and flagging survey marks: • Stand upwind of survey marks to be painted. • Invert spray can, aim nozzle at survey mark, and depress nozzle spraying paint in a sweeping motion. • After desired amount of paint has been dispensed, point nozzle straight up and depress nozzle on quick time to prevent clogging. • Flagging will be tied securely to the mark or stake as necessary. **Note: per the Mine Safety and Health Administration regulations, spray paint will not to be stored in the cab of any vehicle. If it is necessary to warm cold paint cans up, do not leave cans unattended in the vehicle, and do not place them directly over heat vents.**
10. Placing control points.	Locations of control points, especially those that may be used for a GPS base point or Total Station, will be placed in a safe location away from overhead and underground utilities and out of the lanes of traffic. The GPS control will be in an area that is obstruction free in order to have the best view of satellites in the sky. A minimum of three control points per project will be established, preferably intervisible. The preferred primary control type is a #5 rebar (12 inches long) with a 2 inch aluminum control cap marked with the Control Point Number and the year it was set stamped into it. Secondary control (i.e., any control that will not be used for longer than one month) can be a 60D nail and flagging, RR spike, hub and tack, or other acceptable “temporary” style of control.

HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.				
SOURCE	***HAZARDS***	***WHERE***	***HOW, WHEN, RESULT***	***CONTROLS***
CHEMICAL	Potential contact with contaminated soils and dust.	Reclamation sites.	Adverse health effects could result from ingesting and/or inhaling contaminated soils/dust.	Personnel will practice proper personal hygiene: wash hands prior to eating/drinking and when leaving the site. Work will be suspended during high wind conditions that may produce large amounts of visible dust. Personnel will wear nitrile gloves, if contact with contaminated soil is possible.
	Fumes from marking paint.	Survey marks.	Inhalation of paint fumes when placing survey marks could result in adverse health effects such as headaches/ dizziness.	Personnel will stay upwind from the paint being sprayed.
NOISE	Not applicable.			
ELECTRICAL	Equipment contact with overhead utilities.	Sites with overhead utilities.	Injury, death or property damage could occur from survey equipment (i.e., survey rod) contact with overhead utilities.	Personnel will follow the procedures outlined in the Pioneer Overhead Utilities Program. When possible, personnel will avoid areas with overhead utility hazards.
	Equipment contact with underground utilities.	Sites.	Injury, death or property damage could occur from survey equipment (i.e., gad, stake, and rebar) contact with underground utilities.	Personnel will follow the procedures outlined in the Pioneer Trenching, Excavation, and Ground Disturbance Program.

BODY MECHANICS	Repetitive motion.	Body.	Repetitive motion when reaching and positioning while using tools and survey equipment could result in injuries such as muscle strains.	Personnel will maintain a balanced position when reaching and positioning survey equipment. They will bend at knees while keeping back straight and upright to paint, place or pound in survey markers. Personnel should also stretch before starting work and will take breaks when necessary.
	Lifting and carrying tools and equipment.	Sites.	Improper lifting and carrying tools and equipment could result in back injuries and muscle/back strains.	Personnel will use proper lifting techniques: get a good grip, keep the load close to your body, lift with legs and not with back, and avoid lifting loads above shoulder height. Two people will lift heavy objects, if necessary.
GRAVITY	Uneven terrain, slick surfaces, and steep slopes.	Sites.	Walking/working on slick/muddy/wet and uneven terrain could cause slips and trips resulting in falls and injuries.	Personnel will wear work boots with good traction and ankle support, be aware of working/walking surfaces and choose a path to avoid hazards, keep work areas as dry as possible, and wear muck boots as necessary.
WEATHER	Cold/hot temperatures.	Outdoor sites.	Exposure to cold climates may result in cold burns, frostbite, and hypothermia. Exposure to high temperatures may result in heat cramps, heat exhaustion, or heat stroke.	Training on signs and symptoms of cold/heat stress is required. Personnel will wear appropriate clothing when working outdoors (e.g., layers and loose clothing), remain hydrated, and have sufficient caloric intakes during the day. Personnel will use their field vehicle to take breaks, when needed. Personnel will also follow the procedures outlined in the Pioneer Heat/Cold Stress Program.

WEATHER (cont.)	Lightning.	Outdoor sites.	Electrocution, injury, death or equipment damage could be caused by lightning strike.	Personnel will follow the 30/30 rule during lightning storms.
RADIATION	Ultraviolet (UV) radiation.	Outdoor sites.	Exposure to UV radiation during summer months can cause sun burns, skin damage, and eye damage.	Personnel will wear safety glasses with tinted lenses, long-sleeve work shirts, and long pants. Personnel should wear sunscreen, if necessary.
BIOLOGICAL	Plants, insects, and animals.	Outdoor sites.	Exposure to plants, insects, and animals may cause rashes, blisters, redness, swelling, and other injuries.	Training on the signs and symptoms of exposure to plants, insects, and animals is required. Personnel will avoid contact with plants, insects, and animals. First aid kits will be available on the site. Personnel with allergies will notify their supervisor.
MECHANICAL	Driving.	Sites.	Interaction with light and heavy equipment could result in vehicle incidents. Driving on uneven/muddy/ slick terrain could also result in vehicle incidents.	Personnel will maintain communication with equipment operators and other site personnel, yield to haul traffic, and use defensive driving techniques. Personnel will not approach active heavy equipment with vehicle. If site conditions are not safe, postpone work or access the site using another means or route.
	Unsecured equipment.	Vehicle.	Injury could result from being struck by an unsecured piece of equipment while driving.	Personnel will secure equipment to vehicle.

MECHANICAL (cont.)	Contact with engineer or drilling hammer.	Setting survey stakes and hubs.	Injuries to hands, foot, and knees could result when using an engineer or drilling hammer to set survey stakes and hubs.	Personnel will wear work gloves and steel-toed boots. Personnel will also keep knees away from the survey gad while creating a pilot hole. Be aware of finger/hand placement and do not put fingers/hands between objects. Inspect tools prior to each use.
	Flying debris.	Setting survey stakes, hubs, and rebar.	Survey gad, stakes, hubs, and rebar could splinter and/or break while being struck with hammer and flying pieces could cause eye injuries.	Personnel will wear safety glasses. Personnel will use survey gad designed to mushroom and not splinter when struck. When establishing control points/property corners, personnel will use a rebar driver to set up rebar. Personnel will also inspect survey gad, stakes, hubs, and rebar prior to installing them.
	Pinch points.	Hand tools and equipment.	Exposure to pinch points when using hand tools and equipment could result in personal injuries.	Personnel will wear work gloves to protect against pinch-point injuries. Inspect all tool and equipment prior to each use.
PRESSURE	Not applicable.			
THERMAL	Not applicable.			
HUMAN FACTORS	Inexperienced and improperly trained personnel.	Sites.	Inexperienced personnel and improper training could cause incidents resulting in injuries and/or property damage.	Personnel will be trained in this procedure and other applicable procedures. Personnel will implement stop work procedures, if necessary.
SIMOPS	Not applicable.			

ADDITIONAL HSSE CONSIDERATIONS This section to be completed with concurrence from the Safety and Health Manager.	
REQUIRED PPE	Long-sleeved work shirt, high-visibility vest/outwear, long pants, safety glasses, hard hat, work globes, and steel-toed boots.
APPLICABLE SDS	Survey Marking Paint. Additional Safety Data Sheets (SDSs) will be maintained based on site characterization and contaminants.
REQUIRED PERMITS/FORMS	Per site/project requirements.
ADDITIONAL TRAINING	Per site/project requirements.

DRAWINGS, DOCUMENTS, AND TOOLS/EQUIPMENT The following documents should be referenced to assist in completing the associated task.	
P&IDS	
DRAWINGS	
RELATED SOPs/PROCEDURES/ WORK PLANS	
TOOLS	Hand-held GPS, survey rod, engineer or drilling hammer, sledgehammer, survey gad, stakes, lath, rebar, rebar driver, survey cap, cap driver, paint cans, and field book.
FORMS/CHECKLIST	

APPROVALS/CONCURRENCE By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.	
SOP TECHNICAL AUTHOR	**DATE**
Mike Newhouse	**08/16/2016**
SAFETY AND HEALTH MANAGER	**DATE**
Tara Schleeman	**10/24/2016**

APPROVALS/CONCURRENCE

By signing this document, all parties acknowledge the completeness and applicability of this SOP for its intended purpose. Also, by signing this document, it serves as acknowledgement that I have received training on the procedure and associated competency testing.

Revisions:

Revision	Description	Date

Attachment B
Field Forms

Geoprobe Soil Log

Project:	Hole No:
Contactor: Pioneer Technical Services	Geoprobe:
Date:	Operator:
Logged By:	Weather:

Core:	Depth Core Represents	Actual Measured Length	Inches per 1 foot	Photo Number/ Description	Drillers Notes	Core Start Time	Samples Collected (XRF/LAB)

Measured Length (in)	Length Represented	Color	Description	Time	PID Reading

ORDER FOR DESCRIPTIONS

Density

- Very soft, Soft, Medium Stiff, Stiff, Stiff, Very Stiff, Hard
- Very loose, Loose, Medium Dense, Dense, Very Dense
- SEE TABLE

Moisture Content

- Dry, Moist, Wet
- See Table

General Color

Soil Description

- Minor soil type name with "y" added if ≥ 30 percent and ≤ 50%
- Descriptive adjective for main soil type
  - Particle-size distribution adjective for gravel and sand (fine – coarse)
  - Plasticity adjective (slight to high) and soil texture (silty or clayey) for inorganic and organic silts or clays
- Main soil type's name (**all capital letters**)
- Descriptive adjective such as trace (0-5%), slightly or some (5-12%), for minor soil type

Structures

- See Tables

Geologic Classification

- If applicable – alluvium, fill, tailings, slag, debris

USCS Classification

- See Tables

Examples:

Medium dense, wet, dark brown, sandy SILT, trace of clay, numerous organics and strong organic odor (marsh deposits) ML.

Medium stiff, moist, dark gray, medium plastic silty CLAY, slightly sandy, laminated with light gray silt (tailings), CL

Very dense, moist, light brown, slightly silty, sandy fine gravel, trace of cobbles, scattered roots, GP-GM

Density/Consistancy Word Choices

Consistency of Fine-Grained Soils-Silts, Clays

Consistency	Results of Manual Manipulation
Very Soft	Specimen (height = twice the diameter) sags under its own weight; extrudes between fingers when squeezed
Soft	Specimen can be pinched in to between the thumb and forefinger; remolded by light finger pressure
Medium stiff	Can be imprinted easily with fingers; remolded by strong finger pressure
Stiff	Can be imprinted with considerable pressure from fingers or indented by thumbnail
Very stiff	Can be barely imprinted by pressure from the fingers or indented by thumbnail
Hard	Cannot be imprinted by fingers or difficult to indent by thumbnail

Density of Coarse or Cohesionless Soils-Gravels/Sands and Silt
Very loose
Loose
Medium Dense
Dense
Very Dense

WATER CONTENT

Description	Conditions
Dry	No sign of water and soil dry to touch
Moist	Signs of water and soil is relatively dry to touch
Wet	Signs of water and soil definitely wet to touch; granular soil exhibits some free water when densified, saturated

SIZES FOR SOIL DESCRIPTIONS

Term	Example	Size
Boulders	> Basketball size	> 12"
Cobbles	Fist to Basketball size	3"-12"
Gravel – Coarse	**Thumb to fist size**	**¾"-3"**
Gravel – Fine	**Pea to Thumb size**	**5 mm to ¾"**
Sand – Coarse	**Rock salt to pea size**	**2 mm to 5 mm**
Sand – Medium	**Sugar to rock salt**	**0.4 mm to 2 mm**
Sand – Fine	**Flour to sugar**	**0.08 mm to 0.4 mm**
Fines – Clay and silt	**Grains are not visible**	**<0.08 mm**

Boulders and cobbles are not considered soil or part of the soil's classification or description, except under miscellaneous descriptions; i.e. --, with cobbles at about 5 percent (volume).

Well graded coarse-grained soil - contains a good representation of all particle sizes from largest to smallest, with ≤ **12% fines**.
Poorly graded coarse-grained soil is uniformly graded with most particles about the same size or lacking one or more intermediate sizes, with 12% fines.

Describe type and size of organic debris

Adjective	Presence as % by Volume
Occasional	0-1%
Scattered	1-10%
Numerous	10-30%
Organic – as a minor constituent in description	30-50%
PEAT – MAJOR constituent	50-100%

Highly Organic Materials

These materials containing a predominance of undecomposed plant or woody fiber are described as follows:

- *Root Mat*: Pronounced structure of living root fibers characteristic of marsh or swampy deposits.
- *Peat*: Fossiliferous root mat with a varying degree of decomposition, often containing a matrix of amorphous, colloidal organic clays and silts.
- *Humus*: Decomposed root and leaf litter, characteristic of organic forest cover in well-drained areas.

SOIL PLASTICITY DESCRIPTIONS

Plasticity Adjective	Dry Strength	Smear Test	Thread Smallest Diameter, in. (mm)	ML & MH (SILT)	CL & CH (CLAY)	OL & OH (ORGANIC SILT OR CLAY)
nonplastic	none-crumbles into powder with mere pressure	gritty or rough	ball crakcs	----	----	ORGANIC SILT
low plasticity	low-crumbles into powder with some finger pressure	rough to smooth	1/4 to 1/8 (3 to 6)	----	silty	ORGANIC SILT
medium plastic	medium - breaks into pieces or crumbles with considerable finger pressure	smooth and dull	1/16 (0.5 to 1)	clayey	silty to no adj.	ORGANIC clayey SILT
highly plastic	high- cannot be broken with finger pressure; will break into pieces between thumb and a hard surface	shiny	1/32 (0.75)	clayey	----	ORGANIC silty CLAY
very plastic	very high - can't be broken between thumb and a hard surface	very shiny and waxy	1/64 (0.5)	clayey	----	ORGANIC

Thread Test:

Moisture is added or worked out of a small ball (about 1 1/2-inch diameter) and the ball is kneaded until it consistency approaches medium stiff to stiff and it breaks, or crumbles. A thread is then rolled out to the smallest diameter possible before disintegration. The smaller the thread achieved, the higher the plasticity of the soil. Fine-grained soils of high plasticity will have threads smaller than 1/32 inch in diameter. Soils with low plasticity will have threads larger the 1/8 inch in diameter

Layered Soils

Type of Layer	Thickness	Occurrence
Parting	< 1/16 in.	
Lamination	< ¼ in.	
Seam	1/16 to ½ in.	
Layer	½ in. to 12 in.	
Stratum	> 12 in.	
Pocket	Small erratic deposit	
Lens	Lenticular deposit	
Varved (also layered)		Alternating seams or layers of silt and/or clay and sometimes f. sand
Occasional		One or less per foot of thickness or laboratory sample inspected
Frequent		More than one per foot of thickness or laboratory sample inspected

Place the thickness designation before the type of layer, or at the end of each description and in parentheses, whichever is more appropriate.

Examples of descriptions for layered soils are:

- Medium stiff, moist to wet 1/4"-3/4" interbedded seams and layers of: gray, medium plastic, silty CLAY (CL); and lt. gray, low plasticity SILT (ML); (Alluvium).

Other Layer Adjectives

Description	Criteria (thickness)
Stratified	Alternating Layers
Interbedded	Alternating Layers > ½" thick
Laminated	Alternating layers < ¼" thick
Fractured	Breaks easily along definite fractured planes
Slickensided	Polished, glossy, striated, fracture planes
Blocky	Easily breaks into small angular lumps
Lensed	Small pockets of different soils
Homogeneous	Same color and appearance throughout
Sheared	Disturbed texture, mix of strengths

Coarse- Grained Soils			
Coarse-Grained Soils	Gravel and Gravelly Soils	GW	Well-graded gravels or gravel- sand mixtures, little or no fines
		GP	Poorly graded gravels or gravel- sand mixtures, little or no fines
		GM	Silty gravels, gravel-sand-silt mixtures (more than 12% fines)
		GC	Clayey gravels, gravel-sand- clay mixtures (more than 12% fines)
	Sand and Sandy Soils	SW	Well-graded sands or gravelly sands, little or no fines
		SP	Poorly graded sands or gravelly sands, little or no fines
		SM	Silty sands, sand-silt mixtures (more than 12% fines)
		SC	Clayey sands, sand-silt mixtures (more than 12% fines)

Well Graded - all particle sizes are present, less than 12% fines

Poorly Graded - most particles are about the same size or missing 1 or 2 sizes, 12% fines

FINE - GRAINED SOILS			
Fine-Grained Soils	Silts and Clays Liquid Limit < 50	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity
		CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
		OL	*Organic* silts and organic silt- clays of low plasticity
	Silts and Clays Liquid Limits ≥ 50	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts
		CH	Inorganic clays of high plasticity, fat clays
		OH	*Organic* clays of medium to high plasticity, organic silts
Highly *Organic* Soils		Pt	Peat and other highly organic soils

ROCK DESCRIPTIVE TERMS

Term		Defining Characteristics	
Hardness	Soft	Scratched by fingernail	
	Moderately Hard	Scratched easily by penknife	
	Hard	Difficult to scratch with a penknife	
	Very Hard	Cannot be scratched by penknife	
Weathering	Unweathered	Rock is unstained. May be fractured, but discontinuities are not stained.	
	Slighty	Rock is unstained. Discontinuities show some staining on the surfaces of rocks, but discoloration does not penetrate rock mass.	
	Moderate	Discontinuity surfaces are stained. Discoloration may extend into rock along discontinuity surfaces.	
	High	Individual rock fragments are thoroughly stained and may be crumbly.	
	Severe	Rock appears to consist of gravel-sized fragments in a "soil" matrix. Individual fragments are thoroughly discolored and can be broken with fingers.	
Bedding Planes	Laminated	< .04 in.	< 1 mm
	Parting	.04 in. - .24 in.	1mm - 6mm
	Banded	.24 in. - 1in.	6 mm - 3 cm
	Thin	1 in. - 4 in.	3 cm - 9.1 cm
	Medium	4 in. - 12 in.	9.1 cm - 30.5 cm
	Thick	12 in.- 36 in.	30.5 cm - 1m
	Massive	> 36 in.	> 1 m
Joints and Fracture Spacing	Very tight	< 2 in.	< 5.1 cm
	Tight	2 in. - 1ft.	5.1 - 30.5 cm
	Moderately tight	1ft. - 3 ft.	30.5 cm - 91.4 cm
	Wide	3 ft. - 10 ft.	91.4 cm - 3 M
	Very wide	> 10 ft.	> 3 M
Voids	Porous	Smaller than a pinhead. Their presence is indicated by the degree of absorbency.	
	Pitted	Pinhead size to a 1/4 inch. If only thin walls separate the individual pits, the core may be described as honeycombed.	
	Vug	1/4 inch to the diameter of the core. The upper limit will vary with core size.	
	Cavity	Larger than the diameter of the core.	

Rock Particle Percent Composition Estimation

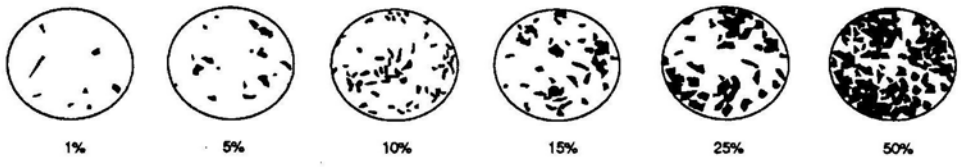


Figure 3 Rock Descriptive Terms

Corrective Action Report/ Corrective Action Plan

Project ID	Project Name	Document ID

Preparer's Signature/Submit Date	Submitted to:

Description of the requirement or specification	
Reason for the Corrective Action	
Location, affected sample, affected equipment, etc. requiring corrective action	
Suggested Corrective Action	(Continue on Back)
Corrective Action Plan	(Continue on Back) ☐ Approval signature/date:_____
	Approval of corrective actions required by EPA? ☐ Yes ☐ No ☐ EPA approval name/date:_____ ☐ Corrective actions completed name/date:_____
Preventative Action Plan	(Continue on Back) ☐ Preventative actions completed name/date:_____

Corrective Action Report/
Corrective Action Plan

Suggested Corrective Action (Continued)	
Corrective Action Plan (Continued)	
Preventative Action Plan (Continued)	

Attachment C
Montana Well Abandonment Report

MONTANA WELL ABANDONMENT REPORT

1. EXISTING GWICID: _____

2. WELL OWNER:

Name_____

Mailing address_____

_____

3. WELL LOCATION: List ¼ from smallest to largest

_____ ¼ _____ ¼ _____ ¼ _____ ¼, Section _____

Township ___ N/S Range ___ E/W County _____

Lot _____ , Tract/Blk ____ Subdivision Name _____

Well Address _____
GPS ☐ Yes ☐ No
Latitude _____ Longitude _____

Error as reported by GPS locator (+ feet) _____

Horizontal datum ☐ NAD27 ☐ WGS84

4. WELL USE: ☐ Domestic ☐ Stock ☐ Irrigation

☐ Public water supply ☐ Monitoring Well

☐ Geothermal ☐ Closed System ☐ Open System

☐ Reinjection ☐ Extraction ☐ Other: _____

5. TYPE OF WELL BEING ABANDONDED:

☐ Drilled ☐ Bored ☐ Jetted ☐ Hand Dug ☐ Other: _____

6. TYPE OF CASING:

☐ Steel Dia._____in.

☐ Plastic Dia. _____in.

☐ Concrete Dia._____in.

☐ Other Dia._____in.

If other, type :_____

Was any casing removed? ☐ yes ☐ no
If yes, type (steel, pvc, etc.) _____
Amount removed _____ ft.

If more than one type: _____
Amount removed _____ft.

Was casing driven down ward? ☐ yes ☐ no
If yes, feet below ground surface _____ ft.

Was casing Ripped or Perforated? ☐ yes ☐ no

7. WELL DATA:

Depth of well: _____ ft.

Static water level _____ ft.

Closed-in artesian pressure _____ psi.

Was well disinfected before decommissioning? ☐ yes ☐ no

If yes, type and amount of disinfectant used:_____

_____

8. WELL LOG: Record sealing material used and depth(s)

Depth, Feet		Material type of material used to seal well (example: neat cement, bentonite chips, naturally occurring soils).
From	To	
		☐ Neat Cement
		☐ High-solids Bentonite Grout
		☐ Bentonite Chips
		☐ Other (describe under remarks)

9. DATE WELL DECOMMISSIONED: _____

10. REMARKS: _____

_____

_____

_____

_____

11. DRILLER/CONTRACTOR:
All work performed and reported in this decommissioning log is in compliance with the Montana well abandonment standards. This report is true to the best of my knowledge.

Name, firm, or corporation (print)_____

Address_____

Signature_____

Date _____ License no. _____

License type: ☐ MWC ☐ WWC ☐ WWD

This report can be emailed to GWIC@mtech.edu, faxed to the GWIC office at (406) 496-4343, or sent to:

Ground Water Information Center
1300 W. Park St.
Butte, MT 59701-8997

Montana Bureau of Mines and Geology
The University of Montana
1300 West Park Street
Butte, MT 59701

Attachment D
Montana Well Log Report

MONTANA WELL LOG REPORT

Form No. 603 R2-04

Well ID# _____

This log reports the activities of a licensed Montana well driller and serves as the official record of work done within the borehole and casing and describes the amount of water encountered. **This form is to be completed by the driller and filed with MBMG within 60 days of completion of the work. Acquiring Water Rights is the well owner's responsibility and is not accomplished by the filing of this report.**

Well log information is stored in the Groundwater Information Center at the Montana Bureau of Mines and Geology (Butte) and water right information is stored in the Water Rights Bureau records (Helena).

For fields that are not applicable, enter NA. Record additional information in the REMARKS section.

1. WELL OWNER:

Name _____

Mailing address _____

_____

2. WELL LOCATION: List ¼ from smallest to largest

_____ ¼ _____ ¼ _____ ¼ _____ ¼, Section_____

Township____ N/S Range____ E/W County _____

Lot _____ , Tract/Blk ____ Subdivision Name _____

Certificate of Survey _____

Well Address _____

GPS ☐ Yes ☐ No

Latitude_____ Longitude _____

Error as reported by GPS locator (± feet) _____

Horizontal datum ☐ NAD27 ☐ WGS84

3. PROPOSED USE: ☐ Domestic ☐ Stock ☐ Irrigation

☐ Public water supply ☐ Monitoring Well

☐ Geothermal ☐ Closed System ☐ Open System ☐ Reinjection

☐ Extraction H_2O Temp _____ Number of Wells in System _____

☐ Other: _____

4. TYPE OF WORK:

☐ New well ☐ Deepen existing well ☐ Abandon existing well

Method: ☐ Cable ☐ Rotary ☐ Other: _____

5. WELL CONSTRUCTION DETAILS:

Borehole:

Dia._____in. from _____ ft. to _____ ft.

Dia._____in. from _____ ft. to _____ ft.

Dia._____in. from _____ ft. to _____ ft.

Casing:

Steel: Wall thickness _____ ☐ Threaded ☐ Welded

Dia._____in. from _____ ft. to _____ ft.

Dia._____in. from _____ ft. to _____ ft.

Casing Shoe: ☐ Yes ☐ No

Plastic: Pressure Rating_____ lbs. ☐ Threaded ☐ Welded

Dia._____in. from _____ ft. to _____ ft.

Perforations/Slotted Pipe:

Type of perforator used_____

Size of perforations/slots _____ in. by_____in.

_____no. of perforations/slots from _____ ft. to_____ ft.

_____no. of perforations/slots from _____ ft. to_____ ft.

Screens: ☐ Yes ☐ No

Material_____

Dia._____ Slot size _____ from_____ft. to _____ ft.

Dia._____ Slot size _____ from _____ft. to _____ ft.

Gravel Packed: ☐ Yes ☐ No

Size of gravel _____

Gravel placed from _____ ft. to_____ ft.

Packer: ☐ Yes ☐ No

Type _____ Depth(s) _____

Grout: Material used_____

Depth from _____ft. to _____ ft. OR ☐ Continuous feed

6. WELL TEST DATA:

A well test is required for all wells. (*See details on well log report cover.*)

☐ Static water level_____ft. below top of casing **or**

☐ Closed-in artesian pressure _____ psi.

How was test flow measured:

bucket/stopwatch, weir, flume, flowmeter, etc _____

Yellowstone Controlled Groundwater Area - Water Temperature_____°F

☐ AQUIFER TEST DATA FORM ATTACHED

Test - 1 hour minimum

Drawdown is the amount water level is lowered below static level.
All depth measurements shall be from the top of the well casing.
Time of recovery is hours/minutes since pumping stopped.

Air test*

_____gpm with drill stem set at_____ ft. for _____ hours

Time of recovery _____hrs/min. Recovery water level _____ ft.

OR Bailer test*

_____gpm with _____ ft. of drawdown after_____hours

Time of recovery _____hrs/min. Recovery water level _____ ft.

OR Pump test*

Depth pump set for test_____ft.

____gpm pump rate with_____ ft. of drawdown after ____ hrs pumping

Time of recovery _____ hrs/min. Recovery water level _____ ft.

OR Flowing Artesian*

_____ gpm for _____ hours

Flow controlled by _____

**During the well test the discharge rate shall be as uniform as possible. This rate may or may not be the sustainable yield of the well. Sustainable yield does not include the reservoir of the well casing.*

7. WELL LOG: Record depth(s) that water is encountered.

Depth, Feet		Material: color/rock and type/descriptor (example: blue/shale/hard, or brown/gravel/water, or brown/sand/heaving)
From	To	

☐ ADDITIONAL SHEETS ATTACHED

8. DATE WELL COMPLETED: _____

9. REMARKS: _____

_____

10. DRILLER/CONTRACTOR'S CERTIFICATION:

All work performed and reported in this well log is in compliance with the Montana well construction standards. This report is true to the best of my knowledge.

Name, firm, or corporation (print) _____

Address _____

Signature _____

Date _____ License no. _____

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Montana Bureau of Mines & Geology
The University of Montana
1300 West Park Street
Butte, MT 59701