



---

**Trading Bay Production Facility  
Former Fire Training Area  
Per- and Polyfluoroalkyl Substances Groundwater  
Sampling Work Plan**

---

**Prepared by Jacobs Technology Inc.  
949 East 36<sup>th</sup> Ave., Suite 500  
Anchorage, Alaska 99508**

This document has been prepared by Jacobs Technology Inc. The material and data in this report were prepared under the supervision and direction of the undersigned.

*Gregory Rutkowski*

---

**Gregory Rutkowski, PMP  
ADEC Qualified Environmental Professional**

**December 2019**



## Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan

### TABLE OF CONTENTS

SECTION	PAGE
ACRONYMS AND ABBREVIATIONS .....	iii
1.0 INTRODUCTION .....	1
2.0 LOCATION .....	2
3.0 SITE BACKGROUND .....	3
3.1 Previous Site Characterization Activities and Site Visit .....	3
4.0 SAMPLING PLAN .....	6
4.1 Monitoring Well Development .....	6
4.2 Groundwater Sampling .....	6
4.3 Cleanup and Screening Levels .....	9
4.4 Survey .....	9
4.5 Investigation-Derived Waste .....	9
5.0 OBJECTIVES .....	11
5.1 Monitoring Well L-MW-2 .....	11
5.2 Monitoring Well K-MW-2 .....	11
5.3 Monitoring Well K-MW-1 .....	11
5.4 Monitoring Well J-MW-1 .....	12
6.0 REPORTING .....	13
7.0 SCHEDULE .....	14
8.0 PERSONNEL .....	15
9.0 REFERENCES .....	16

### TABLE

Table 1	PFAS Analyte List, Limits of Detection, and Cleanup and Screening Levels ...	8
---------	--	---



## **Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan**

---

### **APPENDICES**

- Appendix A    Figures
- Appendix B    Site Visit Photo Log
- Appendix C    Standard Operating Procedures
- Appendix D    ADEC Sampling Requirement Letter
- Appendix E    PFAS User Guide



## **Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan**

---

### **ACRONYMS AND ABBREVIATIONS**

µg/L	micrograms per liter
AAC	Alaska Administration Code
ADEC	Alaska Department of Environmental Conservation
AFFF	aqueous film forming foam
bgs	below ground surface
BTOC	below top of casing
EtFOSAA	n-ethyl perfluorooctane sulfonamido acetic acid
Hilcorp	Hilcorp Alaska, LLC
MeFOSAA	n-methylperfluorooctane sulfonamidoacetic acid
PFAS	per- and polyfluoroalkyl substances
PFBS	perfluorobutanesulfonic acid
PFHpA	perfluoroheptanoic acid
PFNA	perfluorononanoic acid
PFOA	perfluorooctanoic acid
PFOS	perfluorooctanesulfonic acid
PFOSA	perfluorooctanesulfonamide
PFHxS	perfluorohexanesulfonic acid
SGS Orlando	SGS North America's Orlando, Florida Laboratory
TBPF	Trading Bay Production Facility



## **Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan**

---

(intentionally blank)



## **Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan**

---

### **1.0 INTRODUCTION**

This work plan describes groundwater sampling activities proposed for the Trading Bay Production Facility (TBPF) former fire training area. This sampling is being conducted based on a requirement from the Alaska Department of Environmental Conservation (ADEC) submitted to Hilcorp Alaska, LLC (Hilcorp) in a letter dated 18 September 2019 (Appendix D). In recent years, per- and polyfluoroalkyl substances (PFAS) have been recognized as an emerging contaminant by ADEC. In October 2018, ADEC published cleanup levels for perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) in soil and groundwater (Alaska Administrative Code Chapter [AAC] Title 18, Chapter 75 [18 AAC 75]).



## **Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan**

---

### **2.0 LOCATION**

The TBPF is a remote onshore crude oil and natural gas processing facility on the west side of Cook Inlet, Alaska, that has been in operation for more than 40 years. Crude oil, produced water, and natural gas are transported to TBPF via pipelines from offshore platforms in Cook Inlet and separated into three product streams. The crude oil is piped via sub-sea pipeline to the east side of Cook Inlet, and the natural gas is piped north for distribution by utility companies. The produced water is held in onsite retention ponds, treated and then discharged to Cook Inlet under National Pollution Discharge Elimination System permit AKG-31-5000. The TBPF is located on private property, currently owned by Hilcorp in Sections 5 and 6, Township 8 North, Range 14 West, Seward Meridian, latitude 60.816507, longitude - 151.788497. A site map for the facility is presented in Appendix A, Figure 1.



## **Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan**

### **3.0 SITE BACKGROUND**

In July 1996, Union Oil Company of California and Marathon Oil Company signed Compliance Order by Consent No. 91-23-053-02 with the ADEC addressing soil and groundwater contamination at TBPf as the result of multiple releases at the facility. Various remedial activities have occurred since including installation and operation of an air sparging system and groundwater monitoring activities.

The TBPf includes a former fire training area located along the north side of the road that connects the air strip and the main facility complex (area designation L from the remedial investigation [Montgomery Watson 1994]). This fire training area is no longer in use, and conversations with field personnel indicate it has not been in use since at least the mid-1990s. Historical use of this fire training area may have resulted in the release of aqueous film forming foam (AFFF) to the ground and potentially allowed for transport to groundwater. AFFF contains PFAS, including PFOS and PFOA, which have been listed as hazardous substances in 18 AAC 75 (ADEC 2018). In the 27 October 2018 update to 18 AAC 75, ADEC published soil and groundwater cleanup levels for PFOS and PFOA.

#### **3.1 PREVIOUS SITE CHARACTERIZATION ACTIVITIES AND SITE VISIT**

On 7 October 2019, a utility water well (Water Well #3R) was sampled for PFAS due to its proximity to the former fire training area. Water Well #3R is located approximately 200 feet south of the historical fire training area (Appendix A, Figure 1). The suspected groundwater flow direction is east-southeast, toward Cook Inlet, which would put Water Well #3R crossgradient of the former fire training area. Water Well #3R was installed to a depth of approximately 175 feet below ground surface (bgs) with a 16.5-foot well screen. During well installation water was encountered at depths of 46 to 48.5 feet bgs and 85 to 87 feet bgs before the well screen was set at a depth of 159 to 176.5 feet bgs. Between the shallower aquifers and the aquifer that the well was set in was a layer of blue clay between 87 and 146 feet bgs, a silt layer between 146 and 155 feet bgs, and another layer of blue clay between 155 and 159 feet bgs. These clay and silt layers likely restrict migration of contaminants to the deeper aquifer.





## **Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan**

The sample collected from Water Well #3R was analyzed by SGS North America's Orlando, Florida Laboratory (SGS Orlando). SGS Orlando reported all PFAS compounds for which they held accreditation, and all results were nondetect with limits of detection less than the applicable cleanup levels (ADEC 2018) and screening levels (ADEC 2019a), indicating groundwater in the vicinity of Water Well #3R is not impacted by the former fire training activities (Hilcorp 2019).

During the October 2019 site visit, Jacobs Technology Inc. personnel inspected the former fire training area and adjacent areas. Appendix B contains photographs taken during the site visit. The northern portion of the former fire training area was covered with approximately 1 foot of standing water, and the southern portion consisted of saturated soil. A concrete pad is present in the center of the former fire training area. The training area has a 3- to 4-foot-high berm around the perimeter except for the northeast corner where an outflow trench is present. The outflow trench drains toward a 9-foot-deep drainage ditch, which flows to the north. In addition to the outflow trench, a drain pipe was observed along the side of the 9-foot-deep drainage ditch. The inlet for this pipe was not identified but could have been covered with vegetation or standing water within the former fire training area. A fabric liner was observed near the outflow trench indicating the former fire training area may be lined, which may be why standing water was present.

Four monitoring wells were identified adjacent to and downgradient of the former fire training area as follows:

- Monitoring well L-MW-2 – Located approximately 40 feet east of the eastern berm of the former fire training area. This monitoring well has a total depth of 28.9 feet below top of casing (BTOC) and a water level of 11.72 feet BTOC.
- Monitoring well K-MW-1 – Located approximately 315 feet southeast of the southeast corner of the former fire training area. This monitoring well has a total depth of 9.5 feet BTOC and a water level of 7.51 feet BTOC.
- Monitoring well K-MW-2 – Located approximately 250 feet east of the eastern edge of the former fire training area. This monitoring well has a total depth of 26.6 feet BTOC and a water level of 12.31 feet BTOC.
- Monitoring well J-MW-1 – Located approximately 250 feet northeast of the northeast corner of the former fire training area. This monitoring well has a total depth of 28.9 feet BTOC and a water level of 11.2 feet BTOC.



## **Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan**

The approximate locations of these four monitoring wells are presented in Appendix A, Figure 2.



### 4.0 SAMPLING PLAN

#### 4.1 MONITORING WELL DEVELOPMENT

The four monitoring wells proposed for sampling were installed in the early 1990s as part of a remedial investigation at the TBPf. None of the four monitoring wells have been sampled in many years, and during the 2019 site visit they were noted as having sediment and/or other debris in the bottom. These monitoring wells will be re-developed prior to sampling in accordance with Standard Operating Procedure JE-SOP-1200 (Appendix C). Re-development will remove settled silt, sand, and other debris via inertial pumping.

#### 4.2 GROUNDWATER SAMPLING

The contractor will mobilize an ADEC Qualified Environmental Professional to perform groundwater sampling activities. Groundwater sampling will be performed in accordance with ADEC regulations (18 AAC 75) (ADEC 2018), the *Field Sampling Guidance* (ADEC 2019b) and will use the guidance provided in the PFAS User Guide (Appendix E to this work plan). All materials and sampling supplies that will come into contact with the monitoring well, sampling equipment, sample containers, and the groundwater will be PFAS-free.

Analytical samples will be collected from monitoring wells L-MW-2, K-MW-1, K-MW-2, and J-MW-1 using a peristaltic or submersible pump and silicone or high-density polyethylene tubing. Depth to water and well depth measurements will be taken using an Oil/Water interface probe and recorded on the Low-Flow Groundwater Sampling Worksheet (Appendix C). All groundwater samples will be analyzed for PFAS by U.S. Environmental Protection Agency Method 537 revision 1.1.

Low-flow groundwater sampling techniques will be used to collect all groundwater samples. Using this methodology, the pump rate will be set at 0.1 to 0.5 liters per minute (L/min) with a goal of limiting the sustained water drawdown to a maximum of 0.1 meters (4 inches). During the purging process, field personnel will monitor water quality parameters and purge volume. Purging will be considered complete when at least three well volumes are removed, and water



## **Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan**

quality parameters stabilized. Water quality parameters are considered stabilized when three consecutive measurements are within the following:

- $\pm 3$  percent for temperature (minimum of  $\pm 0.2$  degrees Celsius)
- $\pm 0.1$  for pH
- $\pm 3$  percent for conductivity
- $\pm 10$  millivolts for redox potential
- $\pm 10$  percent for dissolved oxygen
- $\pm 10$  percent for turbidity or three consecutive readings of less than 10 Nephelometric Turbidity Units

A minimum of three (minimum of four if using temperature as an indicator) of these parameters must be monitored and recorded (ADEC 2019b). If water quality parameters do not stabilize, the well purge will be considered complete when five well volumes have been purged.

Analytical samples will be submitted to SGS Orlando. SGS Orlando holds a current National Environmental Laboratory Accreditation Method 537 and is Alaska-certified to analyze potable water, non-potable water, and solid and chemical materials. SGS Orlando will report the PFAS analytes presented in Table 1.



## Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan

**Table 1**  
**PFAS Analyte List, Limits of Detection, and Cleanup and Screening Levels**

PFAS Analyte	CAS Number	SGS Orlando Limit of Detection (µg/L)	Cleanup or Screening Level (µg/L)
Perfluorobutanoic acid (PFBA)	375-22-4	0.0080	-
Perfluoropentanoic acid (PFPeA)	2706-90-3	0.0040	-
Perfluorohexanoic acid (PFHxA)	307-24-4	0.0040	-
PFHpA	375-85-9	0.0040	0.07 <sup>b</sup>
PFOA	335-67-1	0.0040	0.40 <sup>a</sup> (0.07 <sup>b</sup> )
PFNA	375-95-1	0.0040	0.07 <sup>b</sup>
Perfluorodecanoic acid (PFDA)	335-76-2	0.0040	-
Perfluoroundecanoic acid (PFUnA)	2058-94-8	0.0040	-
Perfluorododecanoic acid (PFDoA)	307-55-1	0.0040	-
Perfluorotridecanoic acid (PFTrDA)	72629-94-8	0.0040	-
Perfluorotetradecanoic acid (PFTA)	376-06-7	0.0040	-
PFBS	375-73-5	0.0040	2.0 <sup>b</sup>
Perfluoropentanesulfonic acid (PFPiA)	2706-91-4	0.0040	-
PFHxS	355-46-4	0.0040	0.07 <sup>b</sup>
Perfluoroheptanesulfonic acid (PFHpS)	375-92-8	0.0040	-
PFOS	1763-23-1	0.0040	0.40 <sup>a</sup> (0.07 <sup>b</sup> )
Perfluorononanesulfonic acid (PFNS)	68259-12-1	0.0040	-
Perfluorodecanesulfonic acid (PFDS)	335-77-3	0.0040	-
PFOSA	754-91-6	0.0040	-
MeFOSAA	2355-31-9	0.016	-
EtFOSAA	2991-50-6	0.016	-
4:2 Fluorotelomer sulfonate (4:2 FTS)	757124-72-4	0.0080	-
6:2 Fluorotelomer sulfonate (6:2 FTSA)	27619-97-2	0.0080	-
8:2 Fluorotelomer sulfonate (8:2 FTOH)	39108-34-4	0.0080	-
HFPO-DA (GenX)	13252-13-6	0.020	-
ADONA	919005-14-4	0.0080	-
9CI-PF3ONS (F-53B Major)	756426-58-1	0.0080	-
11CI-PF3OUdS (F-53B Minor)	763051-92-9	0.0080	-

**Notes:**

<sup>a</sup> ADEC Table C Groundwater Human Health Cleanup Level from 18 AAC 75.345 (ADEC 2018).

<sup>b</sup> For screening purposes only. ADEC Technical Memorandum *Action Levels for PFAS in Water and Guidance on Sampling Groundwater and Drinking Water* (ADEC 2019a). Per this Technical Memorandum the sum of the five PFAS chemicals PFHpA, PFOA, PFNA, PFHxS, and PFOS should not exceed 0.07 µg/L in groundwater and surface water used as drinking water. A separate action level for the shorter-chain PFBS is set at 2.0 µg/L.

For definitions, refer to the Acronyms and Abbreviations section.



### 4.3 CLEANUP AND SCREENING LEVELS

ADEC has published groundwater human health cleanup levels for two PFAS chemicals (PFOA and PFOS) in 18 AAC 75, Table C (ADEC 2018). In addition, ADEC has action levels published for six PFAS chemicals (perfluoroheptanoic acid [PFHpA], PFOA, perfluorononanoic acid [PFNA], perfluorobutanesulfonic acid [PFBS], perfluorohexanesulfonic acid [PFHxS], and PFOS) when groundwater or surface water contaminated with those chemicals is used for drinking water (ADEC 2019a). The sum of the concentrations of PFHpA, PFOA, PFNA, PFHxS, and PFOS should not exceed 0.07 micrograms per liter ( $\mu\text{g/L}$ ) in drinking water. A separate drinking water action level for the shorter-chain PFBS is set at 2.0  $\mu\text{g/L}$ .

The four monitoring wells proposed for sampling are installed in the shallow unconfined aquifer at the TBPF, which is currently not used as a drinking water source. Therefore, the drinking water action levels included in this work plan will be used for screening purposes only.

### 4.4 SURVEY

The top of casing elevation for each monitoring well will be measured using a real-time kinematic global positioning system unit capable of meeting ADEC's vertical accuracy requirement of 0.01 feet and horizontal accuracy requirement of 1.0 feet (ADEC 2013).

### 4.5 INVESTIGATION-DERIVED WASTE

Investigation-derived waste will include purge and decontamination water and disposable sampling supplies. The purge and decontamination water will be treated onsite using a granular activated carbon filtration system to remove any potential contaminants. The purge and decontamination water will be stored onsite in drums or other suitable containers pending treatment and analysis. Both pre-treatment and post-treatment samples will be collected for the purge and decontamination water. Once the post-treatment sample results have verified the treated water has concentrations of PFOA and PFOS less than the ADEC 18 AAC 75, Table C groundwater cleanup levels (ADEC 2018), the water will be discharged to the ground surface in the vicinity of the monitoring wells. Discharge to the ground surface will not occur within 100 feet of surface water, a private water supply, or a fresh water supply system; or



## **Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan**

within 200 feet of a water source serving as a community water system, a non-transient non-community water system, or a transient non-community water system. Disposable sampling supplies will be disposed of as general trash unless they are grossly contaminated.



### **5.0 OBJECTIVES**

The objective of this sampling effort is to determine if the former fire training activities conducted at the TBPF adversely impacted groundwater. Due to the lack of records, it is uncertain how often, if ever, AFFF was used for fire training activities. It is also uncertain if AFFF was released to the ground surface where it could potentially migrate to groundwater because the former fire training area may be lined.

#### **5.1 MONITORING WELL L-MW-2**

Monitoring well L-MW-2 is located directly adjacent to the former fire training area. Although this monitoring well provides a high likelihood of determining the presence or absence of PFAS contamination, it is also crossgradient of two potential release points – the drainage trench at the northeast corner of the training area and the outflow pipe that enters the drainage ditch north of this well. Because the drainage ditch flows to the north, a contaminated groundwater plume may not be intercepted by this monitoring well; therefore, three additional monitoring wells are proposed to be sampled as part of this investigation.

#### **5.2 MONITORING WELL K-MW-2**

Monitoring well K-MW-2 is located directly downgradient from the former fire training area and will be used to determine if PFAS contaminants are migrating away from the former fire training area.

#### **5.3 MONITORING WELL K-MW-1**

Monitoring well K-MW-1 is located downgradient and crossgradient (south) of the suspected groundwater flow direction away from the former fire training area. Sampling of this well will account for variations in the suspected groundwater flow direction and dispersion of contaminants within the aquifer.





### **5.4 MONITORING WELL J-MW-1**

Monitoring well J-MW-1 is located downgradient and crossgradient (north) of the suspected groundwater flow direction away from the former fire training area. Sampling of this well will account for variations in the suspected groundwater flow direction and dispersion of contaminants within the aquifer.



## **Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan**

---

### **6.0 REPORTING**

A groundwater sampling report that summarizes water quality monitoring data and analytical results will be prepared. The groundwater sampling report will present the water quality parameters measured in the field, a description of the sampling activities, the analytical results (including the laboratory data package[s]), survey data, work plan deviations (if any), field notes, and photograph documentation of the sampling activities. The report will also include recommendations for a path forward for the site.



## **Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan**

---

### **7.0 SCHEDULE**

Fieldwork will occur during Summer or Fall 2020. Laboratory analyses may require up to four weeks for completion. The groundwater sampling report will be submitted by end of year 2020.



## **Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan**

---

### **8.0 PERSONNEL**

ADEC Qualified Environmental Professional(s) will be utilized to complete the onsite groundwater sampling activities and to review the report prior to submission. Laboratory samples will be submitted to SGS Orlando for analysis. The project chemist will review all analytical records provided by the laboratory and complete ADEC Laboratory Data Review Checklists, which will be included with the report.



## Per- and Polyfluoroalkyl Substances Groundwater Sampling Work Plan

---

### 9.0 REFERENCES

- ADEC (Alaska Department of Environmental Conservation). 2013 (September). *Monitoring Well Guidance*. Division of Spill Prevention and Response Contaminated Sites Program.
- ADEC. 2018 (October). *Oil and Other Hazardous Substances Pollution Control*, as amended through 27 October 2018. Alaska 18 AAC 75.
- ADEC. 2019a (2 October). *Technical Memorandum Action Levels for PFAS in Water and Guidance on Sampling Groundwater and Drinking Water*.
- ADEC. 2019b (22 October). *Field Sampling Guidance*.
- Hilcorp (Hilcorp Alaska, LLC). 2019 (November). *Trading Bay Productions Facility Water Wells #3R and #4 Sampling Report*. Prepared by Jacobs Technology Inc.
- Montgomery Watson. 1994 (June). *Marathon Oil Company Trading Bay Remedial Investigation*.

## **Appendix A**

### **Figures**



Document Path: O:\Alaska\GIS\cook\_inlet\infrastructure\prod-trans\TBPF\mxd\TBPF\_GW\_Sampling\_Jacobs\_Fig1\_SiteMap\_11x17L\_v01.mxd



Hilcorp Alaska, LLC  
3800 Centerpoint Drive, Suite 1400  
Anchorage, AK 99503



**Legend**

- |                                  |               |
|----------------------------------|---------------|
| Water Well #3R Location          | Pipeline Type |
| ADEC Contaminated Sites - Status | OIL           |
| Active (Location Approx.)        |               |
| Cleanup Complete                 |               |
| Berm - Former Fire Training Area |               |

Alaska State Plane Zone 4 NAD 1983 (feet)

0 50 100 Meters

0 100 200 300 400 500 Feet



Date Prepared: 10/25/2019	Company Name: Hilcorp Alaska, LLC.	Drawn By: HAK - MRA
SITE MAP		
TRADING BAY PRODUCTION FACILITY, COOK INLET, ALASKA		
Scale: @ 11x17 map size 1 in = 250 feet	Figure No: <b>1</b>	



Document Path: O:\Alaska\GIS\cook\_inlet\Infrastructure\prod-trans\TBPF\mxds\TBPF\_GW\_Sampling\_Jacobs\_Fig2\_LocationMap\_11x17L\_v01.mxd



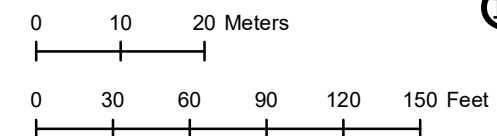
3800 Centerpoint Drive, Suite 1400  
Anchorage, AK 99503



#### Legend

- Berm - Former Fire Training Area
- ▶ Drainage Ditch
- Outflow Pipe
- Outflow Trench
- GAS
- OIL
- ⊙ Monitoring Well Location

Alaska State Plane Zone 4 NAD 1983 (feet)



Date Prepared: 10/25/2019	Company Name: Hilcorp Alaska, LLC.	Drawn By: HAK - MRA
LOCATION MAP		
TRADING BAY PRODUCTION FACILITY, COOK INLET, ALASKA		
Scale: @ 11x17 map size 1 in = 75 feet	Figure No: <b>2</b>	



**Appendix B**  
**Site Visit Photo Log**

## Hilcorp TBPF Former Fire Training Area

### PHOTOGRAPH LOG TABLE OF CONTENTS

<b><u>Photo Number</u></b>	<b><u>Page</u></b>
<b>Photo No. 1</b> – 7 October 2019 Flooded portion of the former fire training area, within the berm. View facing east-northeast.....	B-1
<b>Photo No. 2</b> – 7 October 2019 Outflow trench in the northeast corner of the former fire training area berm. View facing northeast.....	B-1
<b>Photo No. 3</b> – 7 October 2019 Outflow pipe entering the drainage ditch. Valve in the open position but no water is flowing. The location of the intake for this pipe is unknown. View facing west.....	B-2
<b>Photo No. 4</b> – 7 October 2019 Monitoring well L-MW-2 located between the former fire training area berm and the drainage ditch. View facing west. ....	B-2
<b>Photo No. 5</b> – 7 October 2019 Monitoring well K-MW-2 located downgradient of the former fire training area. View facing east. ....	B-3
<b>Photo No. 6</b> – 7 October 2019 Monitoring well J-MW-1 located downgradient and cross-gradient (north) of the suspected groundwater flow direction. View facing northeast. ....	B-3
<b>Photo No. 7</b> – 7 October 2019 Liner material visible within the berm of the former fire training area, just south of the outflow trench. View facing down. ....	B-4

## **Hilcorp TBPF Former Fire Training Area**

(intentionally blank)

## Hilcorp TBPB Former Fire Training Area



**Photo No. 1 – 7 October 2019**

Flooded portion of the former fire training area, within the berm. View facing east-northeast.



**Photo No. 2 – 7 October 2019**

Outflow trench in the northeast corner of the former fire training area berm. View facing northeast.

## Hilcorp TBPF Former Fire Training Area



**Photo No. 3 – 7 October 2019**

Outflow pipe entering the drainage ditch. Valve in the open position but no water is flowing. The location of the intake for this pipe is unknown. View facing west.



**Photo No. 4 – 7 October 2019**

Monitoring well L-MW-2 located between the former fire training area berm and the drainage ditch. View facing west.



## Hilcorp TBPB Former Fire Training Area



**Photo No. 5 – 7 October 2019**

Monitoring well K-MW-2 located downgradient of the former fire training area. View facing east.



**Photo No. 6 – 7 October 2019**

Monitoring well J-MW-1 located downgradient and cross-gradient (north) of the suspected groundwater flow direction. View facing northeast.

## Hilcorp TBPB Former Fire Training Area



**Photo No. 7** – 7 October 2019

Liner material visible within the berm of the former fire training area, just south of the outflow trench. View facing down.

**Appendix C**  
**Standard Operating Procedures**



## Well Installation and Development

Document No: <b>JE-SOP-1200</b>	Page: <b>1 of 6</b>
Effective Date: <b>27 October 2019</b>	Rev. <b>1.4</b>

### TABLE OF CONTENTS

<b>1.0</b>	<b>SCOPE AND APPLICATION</b>	<b>1</b>
<b>2.0</b>	<b>EQUIPMENT</b>	<b>1</b>
<b>3.0</b>	<b>PROCEDURES</b>	<b>2</b>
3.1.	Verification of Materials and Equipment	3
3.2.	Monitoring Well Installation	3
3.3.	Monitoring Well Development	4
<b>4.0</b>	<b>HEALTH AND SAFETY</b>	<b>5</b>
<b>5.0</b>	<b>REFERENCES</b>	<b>6</b>

### ATTACHMENTS

- Attachment 1 Well Construction Forms
- Attachment 2 Well Development Form
- Attachment 3 Using Proactive Monsoon-style Pumps

#### 1.0 SCOPE AND APPLICATION

This standard operating procedure (SOP) describes the installation and development of groundwater monitoring wells exclusive of services provided by the drilling subcontractor (e.g., drill-rig operation). This SOP provides a standard set of procedures applicable under typical site conditions and equipment; they may vary as dictated by actual site conditions and equipment characteristics. Field notes shall be sufficiently specific to document adherence to these procedures or to record all relevant details of any variances.

This SOP is consistent with *Monitoring Well Guidance* issued by the Alaska Department of Environmental Conservation (ADEC 2013), which provides an overview of considerations, equipment, and procedures. Additional guidance may be found in EM 1110-1-4000 *Engineering and Design — Monitoring Well Design, Installation, and Documentation at Hazardous Toxic, and Radioactive Waste Sites* (USACE 1998) and in D5521-05 *Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers* (ASTM 2005). For specific well locations and dimensions, refer to the project work plan.

#### 2.0 EQUIPMENT

The drilling subcontractor will supply all materials and equipment necessary to drill the requisite boreholes in accordance with JE-SOP-1100 *Drilling and Core Logging* and will install the monitoring wells according to depths in the work plan and specifications in this SOP (also stated in the drilling subcontract Statement of Work [SOW]). Equipment provided by Jacobs may include, but is not limited to, equipment tabulated in Table 1.

**Table 1**  
**Well Installation and Development Equipment**

Activity	Type/Name	Quantity	Notes
All	Modified Level D PPE	Per person	See site safety and health plan
	Camera	1	
	Logbook, ballpoint pen/felt tip marker	As needed	
	Isobutylene calibration gas	1	To calibrate the PID
	Nylon twine	As needed	
Well Installation	Tape measure	1 per sampling team	Engineer scale (hundredths of a foot), preferable
	Weighted downhole tape measure (tag tape)	1	Optional (drillers should supply), a spare may be useful
	Well installation form	1 per well	
Well Development	Well development form	1 per well	
	Oil/Water interface probe	1	Product/water level measurements
	Foot valve, surge disk, and rigid tubing	1	Decontaminate the foot valve and surge disk between each well; discard the tubing.
	Submersible pump (stainless steel centrifugal Proactive™ Monsoon pump with low-flow controller, or equivalent)	1	Use for later-stage purging and low-flow monitoring groundwater parameters for stabilization
	Sprinkler pump (aboveground centrifugal pump)	1	Optional; useful for removing large volumes of silt and fine sand laden water if the water table isn't too deep
	Inertial pump (Waterra pump, or similar) and tubing	1	Optional, consider for deep wells greater than approximately 30 feet
	Disposable polyethylene bailers	As needed	
	5-gallon bucket	As needed	
	Graduated cylinder or beaker	1	1 liter, for measurement of volume of recovered product and low-flow pumping rate.
	YSI water-quality meter (or similar)	1	Should include a flow-through cell and calibration reagents
	Hach portable turbidimeter (or similar)	1	Should include calibration standards
	Potable water and/or deionized water	As needed	Used for decontamination of development equipment
	Tubing	As needed	Appropriately sized to match selected pumps

### 3.0 PROCEDURES

Borings necessary for installation of monitoring wells will be advanced by the drilling subcontractor in accordance with JE-SOP-1100 *Drilling and Core Logging* and in the drilling subcontract SOW. Monitoring wells will be installed as described in the work plan, this SOP, and the drilling subcontract

SOW. These procedures detail verification of materials and equipment, monitoring well construction, and monitoring well development,

### 3.1. Verification of Materials and Equipment

As part of pre-mobilization submittals, the driller will provide a list of materials with manufacturer specifications, equipment lists, and equipment inspections. As part of mobilization, the materials and equipment should be checked to verify the following:

- Expected quantities of all materials and equipment have arrived on site.
- Well screens are of specified length and slot size.
- Screens, riser segments, and end caps are flush-threaded and packaged to prevent accidental contamination.
- Sand, bentonite, cement, and concrete mix are of the specified grades, are dry, and are stored so as to remain dry.

Monitoring wells will be constructed from materials specified in the work plan. Typical materials are listed in Table 2.

**Table 2**  
**Typical Well Construction Materials**

Item	Material	Notes
Well screen	Schedule 40 PVC with 0.010 or 0.020 inch slots	2-inch, ASTM F480 flush threads, 10 feet long. Slot size matched to filter pack (0.010 for 20/40 or 16/30; 0.020 for 10/20 or 16/30)
Well riser	Schedule 40 PVC with flush threads	2-inch, ASTM F480 flush threads
Well end cap	Schedule 40 PVC	ASTM F480 flush threads at the connection to the well screen, adhesives or solvents shall not be used; a frost-anchor end cap may be employed to inhibit frost-jacking.
Centralizer	Stainless steel or plastic	Optional (based on work plan), capable of maintaining the well screen in the center of the boring during construction
Filter pack	Silica sand (10/20, 16/30, and 20/40 are typical gradations)	Colorado Silica or equivalent; gradation specified by the work plan or matched to lithology of the screened interval.
Annular seal	Medium sodium bentonite chips or cement-bentonite grout	Cement-bentonite grout mix design and placement are specified in JE-SOP-1210 <i>Annular Seal Grout Design and Placement</i> , or are determined by the work plan
Concrete (surface completion)	Concrete	The material should be fast/quick set concrete mixed according to the manufacturers specifications.

### 3.2. Monitoring Well Installation

Drilling is covered in JE-SOP-1100 *Drilling and Core Logging*. If the boring is deeper than the desired well depth, the excess depth will be backfilled with silica sand or natural collapse as the drill string is withdrawn. In general, the following steps are completed as the well is installed.

- Assemble the well string piece by piece and lower completed sections into the annulus of the drilling tooling. The completed portion of the well string must be securely clamped or held to prevent it from falling to the bottom of the boring as additional pieces are added. Log the

dimensions of end cap, screen, and riser on the Well Construction Form (Attachment 1). If used, a centralizer should be attached 1 foot above the top of the well screen.

- Place the filter-pack sand in the annular space between the screen and the drilling tooling. Ideally, the filter pack will extend from 1 foot below the screen base to 2 feet above the screen top. The filter pack will be emplaced as the tooling is slowly withdrawn in order to minimize natural collapse. The depth to the consolidated sand will be continuously monitored with a tag tape, and the volume of sand will be noted in order to evaluate the extent of natural collapse
- Place the annular from approximately 2 feet above the top of the well screen to 2 feet below ground surface (bgs). The seal shall be composed of hydrated bentonite chips if above the water table or of coated bentonite pellets if below the water table. Grout (JE-SOP-1210 *Annular Seal Grout Design and Placement*) may be used after at least 2 feet of chips or pellets have been placed. Progress will be monitored by measuring how much bentonite/grout has been placed in the borehole compared with the borehole volume and with a tag tape as bentonite/grout reaches 25 feet bgs and shallower. The volume of bentonite/grout will be noted in the field notes.

For flush surface completions, excess well riser will be cut at approximately 6 inches bgs and a waterproof, lockable well plug will be installed. A vault with a diameter of at least 6 inches and with a 12-inch skirt shall be placed over the well head. The flush mount will be placed in concrete and set flush with existing grade and the concrete pad sloping slightly (i.e., recessed), minimizing the collection of rainwater or meltwater, while remaining compatible with snow plowing or lawn mowing. The concrete pad should be approximately 18 inches in diameter and at least 4 inches thick at the edges, thickening to 6 inches or more at the vault.

For stick-up surface completions, the well riser will be cut at approximately 2 feet above ground surface and secured to the surrounding surface in a manner that will eliminate the potential for frost-heave. To complete the monument, a steel protective outer casing at least 5 feet long and extending approximately 0.5 feet above the top of the riser will be installed. The distance below ground may be adjusted if the outer casing would conflict with the filter pack. The annular space between the outer casing and the borehole will be backfilled with pea gravel, sand or concrete to be compatible with surrounding conditions, and a locking cap shall be installed over the well riser. Bollards are typically installed around stick-up monitoring wells located in trafficked areas.

Depths and materials used, and length of riser cut off will be verified by Jacobs field personnel. A Well Construction Form (Attachment 1) shall be completed for each well.

### 3.3. Monitoring Well Development

Monitoring wells will be developed no sooner than 24 hours after installation, and sampled no sooner than 24 hours after development. Typical steps for well development are as follows:

- Remove settled fines. Remove silt and fine sand from the bottom of the well via inertial pumping using rigid tubing equipped with a foot valve. The thickness of accumulated fines can be substantial (e.g., 1.5 feet or more), depending upon the aquifer matrix. PVC chips and shavings from riser trimming may clog the foot valve and require periodic clearing. For deep wells (total depth of 60 feet or more below top of casing) or prolonged efforts, a motorized inertial pump (i.e., Waterra pump) should be considered. In a pinch, a weighted bailer can be used.
- Mobilize and remove additional fines. Surge and purge systematically over the entire submerged length of the well screen until produced water is relatively clear (e.g., turbidity less than 200 nephelometric turbidity units [NTU]) or only one borehole volume remains to be pumped before maximum purge volume will be reached.
  - Initially, add a surge disk to the foot valve and continue inertial pumping up and down and submerged length of the screen. As production of fines decreases (produced water still opaque but no longer thickened by suspended fines), development can switch using a submersible pump.
  - With a submersible pump running continuously at a sustainable flow rate, surge a 0.5 to 1.0 foot interval of the screen and then purge until the freshly suspended fines are cleared before moving on to the next interval. Proceed gently at first to avoid clogging the

pump or discharge line with freshly suspended fines. To avoid burning out the motor in a Proactive Monsoon-style pump, follow the procedures in Attachment 3 Sections 3.2 and 3.3. Other pump styles have similar concerns but different control systems.

- Flush suspended fines. Purge without surging to finish removing mobilized fines. If turbidity appears to have stabilized and the maximum purge volume has not been reached, purging can be ended if at least the minimum volume has been purged and if turbidity is less than 100 NTU and low-flow stability of water quality parameters can be achieved. The flow rate should be reduced to less than 1 liters per minute, no lower than 50 milliliters per minute (mL/min) (0.26 to 0.013 gallons per minute [gpm]) if attempting to reach stability. A water quality parameter is stable when three successive readings at 5-minute intervals are within the stability range listed in Table 3. Purging has reached stability when any three parameters have stabilized. These conditions are based on low-flow sampling guidance (ADEC 2017) but with a higher allowable pumping rate.
  - The minimum purge volume is three borehole volumes (calculated from the borehole diameter and the length of screen below the water table, corrected for 30 percent porosity of the filter pack) and twice the volume of water added during drilling and construction.
  - The maximum purge volume is seven borehole volumes beyond the minimum.

**Table 3**  
**Stability Criteria for Low-Flow Purging**

Parameter	Units	Stability Criterion	Recording Precision
pH	—	±0.1	0.01
Conductivity	µS/cm	±3%	1
Turbidity	NTU	± 10% or <10	0.1
Oxidation Reduction Potential (ORP)	mV	±10	1
Dissolved Oxygen (DO)	mg/L	±10% or 0.3 mg/L (whichever is greater)	0.1

**Notes:**

µS/cm = microSiemens per centimeter

mg/L = milligrams per liter

mV = millivolts

NTU = nephelometric turbidity units

Stability criteria from ADEC Field Sampling Guidance (ADEC 2017) with alternative thresholds for turbidity and DO at low values.

Low-yielding wells are exceptions to the above procedure. Such wells should be purged dry, then either be allowed to recover to within 1 foot of the original water level or be filled with potable water to the static water level for surging. Add water as needed to maintain the water level during surging. Complete the development process by pumping the well dry again, or, if surging has resulted in a sustainable yield on the order of 500 mL/min (0.13 gpm), follow the standard procedure above to the extent possible.

Well development activities will be recorded for each monitoring well on a Well Development Form (Attachment 2). Water levels and total well depth measurements should be measured and recorded to the nearest 0.01 feet.

#### 4.0 HEALTH AND SAFETY

Procedures for working with potentially hazardous materials, as well as the relevant Safety Data Sheets (SDS) for each chemical that will be used at the site, are included in the Site Safety and Health Plan. Personnel using this procedure must be trained on the information contained in the SDSs, engineering controls, and the personal protective equipment (PPE) outlined in this procedure.

Care must be used when handling well construction materials to prevent the possible spreading of contaminants in the work area or vertically within a boring location. At a minimum, Level D PPE, including hard hats, safety toe boots, hearing protection, nitrile gloves, and safety glasses, will be worn while installing monitoring wells. Purged groundwater will be handled and disposed of as described in the waste management section of the work plan.

## **5.0 REFERENCES**

ADEC (Alaska Department of Environmental Conservation). 2013 (September). *Monitoring Well Guidance*.

ADEC. 2019 (October). *Field Sampling Guidance*. Division of Spill Prevention and Response Contaminated Sites Program.

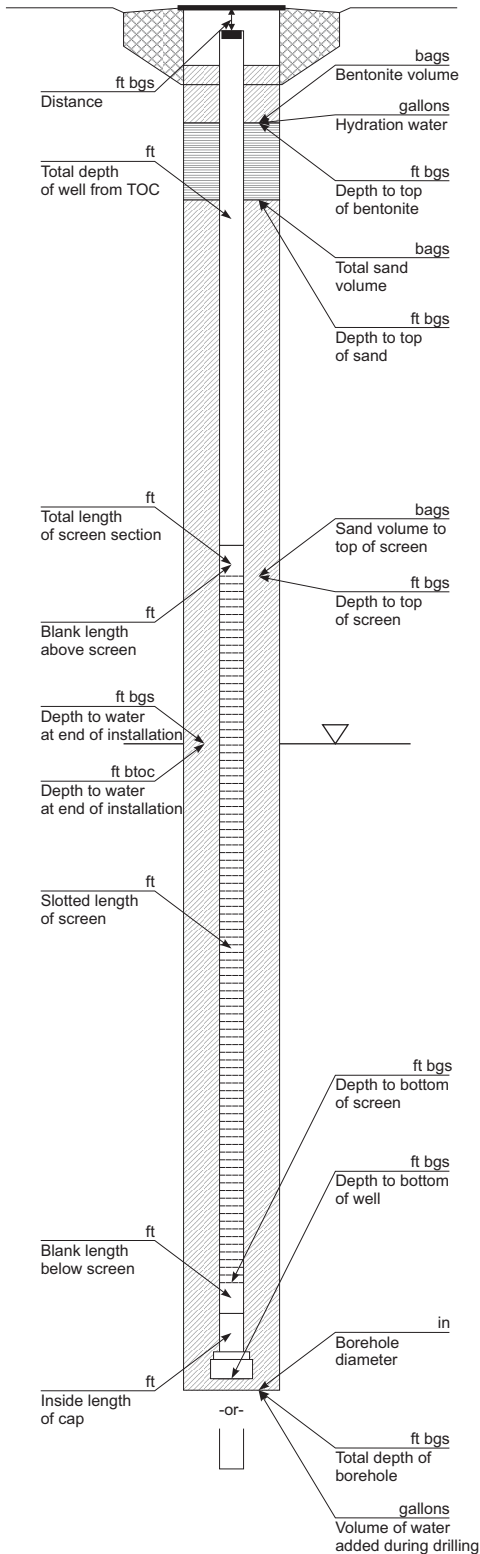
ASTM (American Society for Testing and Materials). 2005. *Standard Guide for Development of Ground-Water Monitoring Wells in Granular Aquifers*. D5521-05. West Conshohocken, Pennsylvania.

ASTM. 2006. *Standard Practice for Description and Identification of Soils (Visual-Manual Procedure)*. D2488-06. West Conshohocken, Pennsylvania.

ASTM. 2007. *Standard Practice for Description of Frozen Soils (Visual-Manual Procedure)*. D4083-89 (Reapproved 2007). West Conshohocken, Pennsylvania.

USACE (U.S. Army Corps of Engineers). 1998 (November). *Engineering and Design — Monitoring Well Design, Installation, and Documentation at Hazardous Toxic, and Radioactive Waste Sites*. EM 1110-1-4000.

**ATTACHMENT 1**  
**Well Construction Forms**



## Vault

Size: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_

## Concrete around Vault

Type: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_

## Well Riser

Size: 2-inch Sch 40, ASTM F480 flush threads  
Material: PVC  
Manufacturer: \_\_\_\_\_

## Well Screen

Size: 2-inch Sch 40, ASTM F480 flush threads  
Slot size: 0.020 in | 0.010 in  
Sand size (if pre-pack): 20/40 | 16/30 | 10/20  
Material: PVC  
Manufacturer: \_\_\_\_\_

## End Cap

## Bentonite (sodium)

Size: \_\_\_\_\_, 50 lb bag  
Manufacturer: \_\_\_\_\_

## Sand

Size: \_\_\_\_\_, 50-lb bag  
Manufacturer: Colorado Silica

## Sand Utilization for 100% Open Hole (No Collapse)

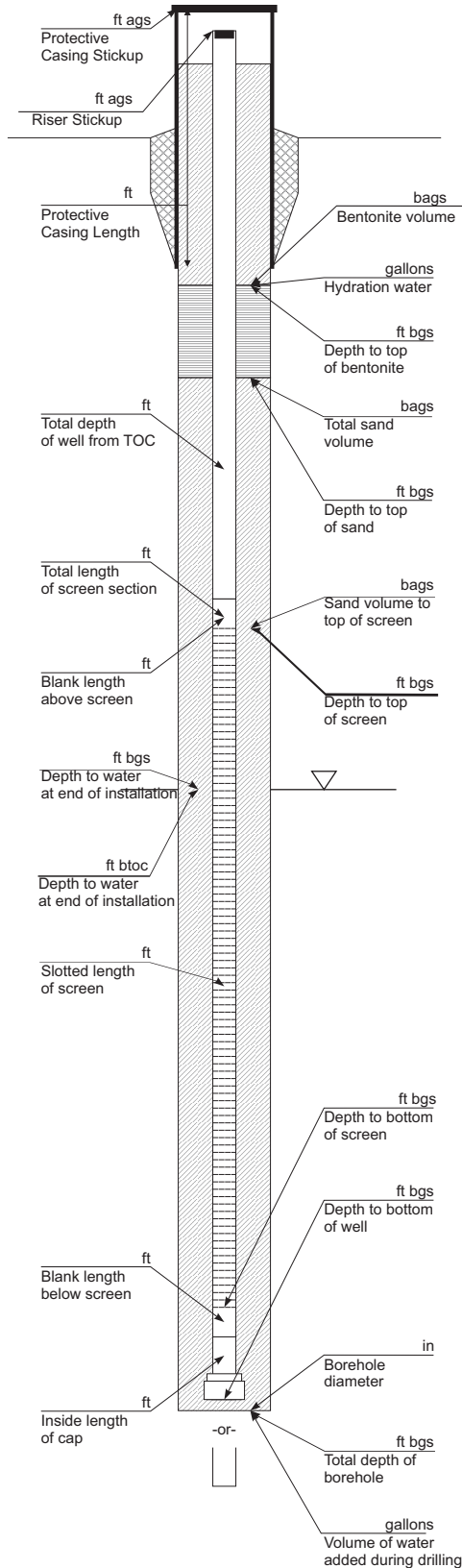
Borehole Diameter		Sand Volume (2-inch Well)		
Inches	Feet	Bags/ft	Bags/11 ft	ft/Bag
4.5	0.38	0.18	1.9	5.7
6	0.50	0.35	3.8	2.9
8	0.67	0.65	7.1	1.5

## Note:

50-lb bag = 0.504 ft³ based on a porosity of 0.4, corresponding to a bulk density of 99.3 lbs/ft³.

## Other Notes





## Vault

Size: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_

## Material around Protective Casing

Type: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_

## Well Riser

Size: 2-inch Sch 40, ASTM F480 flush threads  
Material: PVC  
Manufacturer: \_\_\_\_\_

## Well Screen

Size: 2-inch Sch 40, ASTM F480 flush threads  
Slot size: 0.020 in | 0.010 in  
Sand size (if pre-pack): 20/40 | 16/30 | 10/20  
Material: PVC  
Manufacturer: \_\_\_\_\_

## End Cap

## Bentonite (sodium)

Size: \_\_\_\_\_, 50 lb bag  
Manufacturer: \_\_\_\_\_

## Sand

Size: \_\_\_\_\_, 50-lb bag  
Manufacturer: \_\_\_\_\_

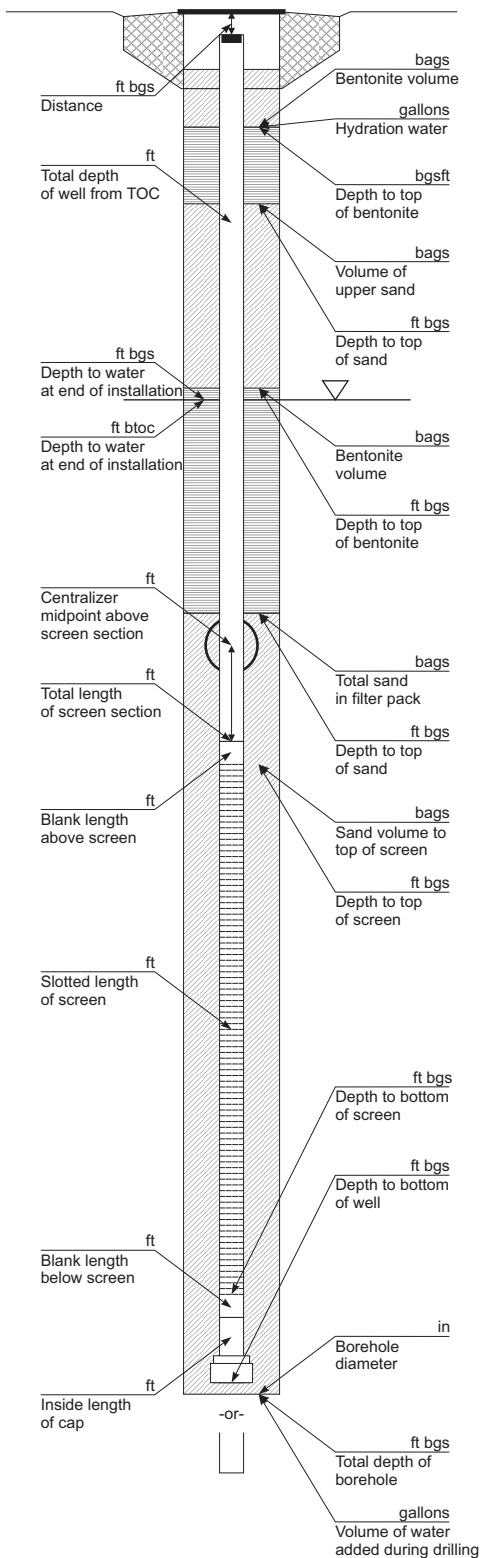
## Sand Utilization for 100% Open Hole (No Collapse)

Borehole Diameter		Sand Volume (2-inch Well)		
Inches	Feet	Bags/ft	Bags/11 ft	ft/Bag
4.5	0.38	0.18	1.9	5.7
6	0.50	0.35	3.8	2.9
8	0.67	0.65	7.1	1.5

## Note:

50-lb bag = 0.504 ft³ based on a porosity of 0.4, corresponding to a bulk density of 99.3 lbs/ft³.

## Other Notes



## Vault

Size: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_

## Concrete around Vault

Type: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_

## Well Riser

Size: 2-inch Sch 40, ASTM F480 flush threads  
Material: PVC  
Manufacturer: \_\_\_\_\_

## Well Screen

Size: 2-inch Sch 40, ASTM F480 flush threads  
Slot size: 0.020 in | 0.010 in  
Sand size (if pre-pack): 20/40 | 16/30 | 10/20  
Material: PVC  
Manufacturer: \_\_\_\_\_

## End Cap

## Bentonite (sodium)

Size: \_\_\_\_\_, 50 lb bag  
Manufacturer: \_\_\_\_\_

## Sand

Size: \_\_\_\_\_, 50-lb bag  
Manufacturer: Colorado Silica

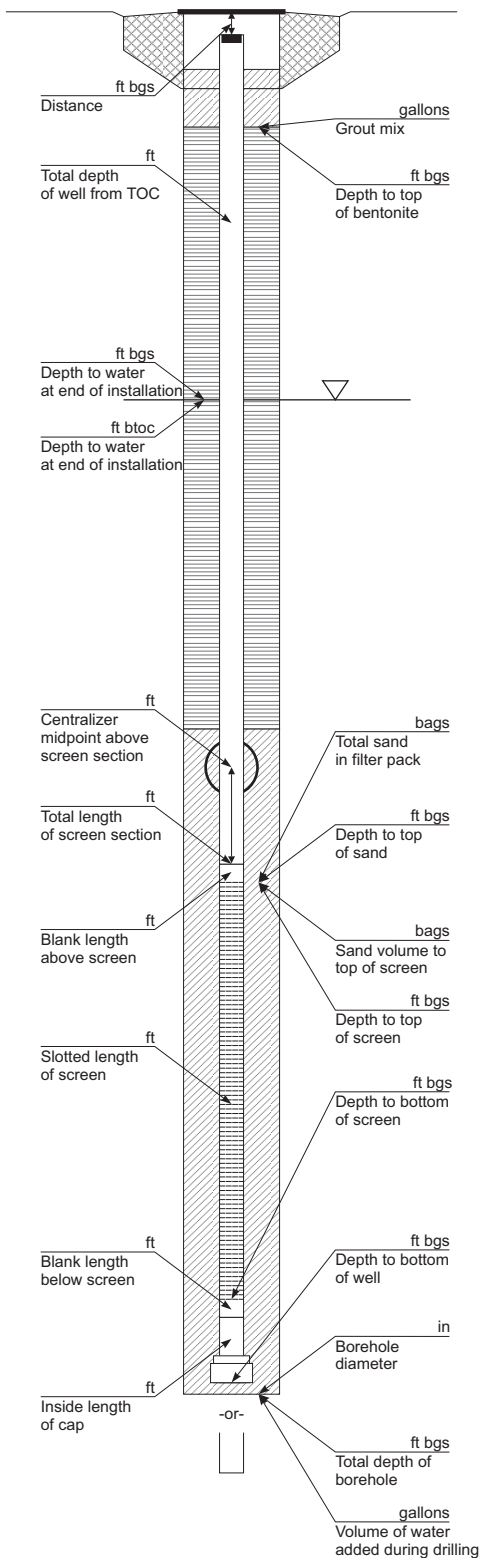
## Sand Utilization for 100% Open Hole (No Collapse)

Borehole Diameter		Sand Volume (2-inch Well)		
Inches	Feet	Bags/ft	Bags/11 ft	ft/Bag
4.5	0.38	0.18	1.9	5.7
6	0.50	0.35	3.8	2.9
8	0.67	0.65	7.1	1.5

### Note:

50-lb bag = 0.504 ft³ based on a porosity of 0.4, corresponding to a bulk density of 99.3 lbs/ft³.

## Other Notes



## Vault

Size: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_

## Concrete around Vault

Type: \_\_\_\_\_  
Manufacturer: \_\_\_\_\_

## Well Riser

2" Sch 40 PVC, ASTM F480 flush threads  
Manufacturer: \_\_\_\_\_

## Well Screen

0.020" slotted, 2" Sch 40 PVC, ASTM F480 flush threads  
Manufacturer: \_\_\_\_\_

## End Cap

## Sand

Size: 16/30, 50-lb bag (0.5 ft³ or 3.8 gal @ 0.4 porosity)  
Manufacturer: Colorado Silica

## Bentonite (sodium)

Size: powder, 50 lb bag (0.7 ft³ or 5.2 gal)  
Manufacturer: \_\_\_\_\_

## Portland Cement

Size: 94 lb bag (1.0 ft³ or 7.48 gal)  
Manufacturer: \_\_\_\_\_

## Grout Mix (~35 gal batch)

Design: Water:Bentonite:Cement = 4:1:1 by volume)  
Water (30 gal): \_\_\_\_\_  
Bentonite (1.25 bags): \_\_\_\_\_  
Cement (1 bag): \_\_\_\_\_

## Grout and Sand Utilization for 100% Open Hole (No Collapse)

Borehole Dia.		Sand Volume		Grout Volume	
Inches	Feet	Bags/10ft	ft/Bag	gal/10ft	ft/35gal
6	0.50	3.5	2.9	13	27
8	0.67	6.5	1.5	24	14
10	0.83	10.4	1.0	39	9

## Other Notes

**ATTACHMENT 2**  
**Well Development Form**

**JACOBS®**

## Well Information

$$\text{Max Purge Vol} = \frac{\text{Min Purge Vol}}{\text{Min Purge Vol}} \text{ gal} + 7 * \frac{\text{Borehole Vol}}{\text{Borehole Vol}} \text{ gal} = \frac{\text{Max Purge Vol}}{\text{Max Purge Vol}} \text{ gal}$$

## Additional observations on back

## Well Development Data Sheet



<u>Site Name</u>	<u>Event</u>	<u>Well ID</u>	<u>Project Number</u>
		<u>Date</u>	<u>Developer Initials</u>

[illegible]

**ATTACHMENT 3**  
**Using Proactive Monsoon-style Pumps**

## Lesson Learned

# Using Proactive Monsoon-style Pumps for Well Development and Groundwater Grab Sampling

David Ward 2016.04.12

## **1.0 ACTIVITY, LOCATION, AND EQUIPMENT**

- Well development and groundwater grab sampling from the water table at approximately 50 feet bgs. Sand, silt, and PVC sawdust presented pumping challenges.
- JBER Site SS109, 2016.03.28-04.07
- Proactive Mega-Monsoon stainless steel submersible pump and controller. This system is powered by 12 volts DC from a portable battery or by connecting to a vehicle battery and is capable of lifting water 180 feet (output pressure of 90 psi).

## **2.0 DIFFICULTIES ENCOUNTERED**

- At least two pump motors burned out; they smelled like scorched electronics and no longer ran. New motors cost \$270 from TTT.
- A good flow rate could not always be achieved.
- The controller could not always be ramped up to full output, and the pump produced little or no flow.
- The portable battery discharged rapidly and was sufficient for only a single grab sample.

## **3.0 DISCUSSION**

### **3.1 Burned-Out Motors**

A motor probably burns out in about 30 seconds if it jams while running at nearly full power. Burned out motors can be avoided by understanding the controller display and taking appropriate action. The important characteristics of the display are as follows:

- The controller displays the actual output voltage. Under constant conditions, the output varies by a volt or two with time.
- The controller will typically show 22 to 23 volts for a Mega Monsoon motor at full power immersed in water (head has little effect), slightly higher if running in air.
- If the controller can be adjusted up to only 8 to 12 volts, the motor is jammed and acting like a short circuit; it is cooking and will burn out in a few tens of seconds.



- If the output voltage falls by more than a volt or two during steady-state operation, the motor is having difficulty and could be on the verge of jamming and cooking.

Output of the controller is adjustable from zero to approximately 28 volts. At a given setting, as load increases, the output voltage will sag because the controller cannot keep up with the power demand. A good motor running under normal load will not cause a major sag in output voltage. Head has little effect on load. Maximum normal load occurs at full flow against negligible head. If flow is blocked (resulting in maximum head), the load decreases because water in the pump cavity just goes around in a circle instead of being accelerated upward and out of the pump. Without water circulation, however, heat can build up, and overheating could become a problem after several minutes.

### 3.2 Avoiding Motor Burnout

The voltages below are based on field observations with one Mega Monsoon controller and pump system on 2016.04.07. They are not based on rigorous testing under controlled conditions. Use as guidance and err on the side of caution.

Procedures for avoiding motor burnout are as follows:

1. Initially, ramp up the voltage quickly and observe the plateau voltage:
  - a. **8 to 12 volts – the motor is jammed! IMMEDIATELY turn the voltage back down to zero or the motor will be irreparably cooked in about 30 seconds.**
  - b. 13 to 21 volts – the motor is overloaded and water flow will be weak.
    - i. 13 to 17 volts – the motor is close to jamming. Turn the voltage back down to zero and check the pump.
    - ii. 18 to 19 volts -- the motor should be okay if conditions don't get worse. Watch it closely (but checking the pump would be better).
    - iii. 20 to 21 volts – there is little concern, but keep an eye on it
  - c. 22 to 23 volts – the pump is running freely. Proceed with adjusting the voltage to obtain the desired flow rate.
2. During operation, if an increase of more than 2 volts is needed to maintain flow, take steps as necessary:
  - d. Check the plateau voltage as in (1) above and take appropriate action.
  - e. Stop the pump. It will be back-flushed as water drains from the discharge line back into the well.
  - f. Pull the pump from the well, clear any sand, gravel, or debris from the intake and impeller, and clear the discharge tubing.

### 3.3 Development and Grab Sampling Using a Proactive Monsoon-Style Pump

Development and grab sampling present a substantial risk of jamming the pump. Newly installed wells typically contain some fine sand and substantial silt from the filter pack and surrounding aquifer matrix and PVC sawdust from trimming the well riser, all of which must be removed by the development process. The well installed for the CRP project at Eielson in 2015 contained 1.5 feet of silt before development! Grab sampling through hollow-stem auger tooling does not seek to remove sand and silt, but the pump needs to be placed close to the water-soil interface in order to maximize achievable drawdown and water production but not suck up soil.

Development should proceed as follows (see JE-SOP-1200 *Well Installation and Development* Rev. 1 for more details):

1. Clear sand and PVC sawdust using an inertial pump (foot valve and rigid HDPE tubing).
2. Clear silt by surging and purging with a Monsoon-style pump. Watch the flow rate and controller voltage carefully following the procedures in Section 3.2 *Avoiding Motor Burnout*. Heavy silt loads can clog the discharge line and even jam the pump.

Grab sampling with a Monsoon-style pump should proceed as follows:

1. Lower the pump to the water-soil interface and then raise it 0.25 to 0.5 feet and securing it. Detecting the interface can be difficult at depths of 50 feet or more because the change in tension becomes proportionally less when the pump reaches the interface as more cable is hanging.
2. Run the pump following the procedures in Section 3.2 *Avoiding Motor Burnout*.
3. If the pump is jamming, if the flow rate seems low, or if the controller voltage seems high, clear any obstructions from the pump and discharge lines and re-check the position of the pump with respect to the water-soil interface.

### 3.4 Battery Life

To ensure sufficient and continuous power for the duration of collection of a grab sample or development of a well, use a battery that is simultaneously being charged, e.g., a battery in an idling vehicle or a battery being charged by a generator. Many generators include a 12 volt output for this purpose, but a battery charger (capable of rapid charging) plugged into the 120 volt AC outlet of a generator would also work. In this arrangement, the battery serves as a power conditioner to smooth the output of the charging device. Although running directly off the charger (no battery) may be possible, the controller might perform poorly or even be damaged if the output of the charger is ragged.

### Low-Flow Groundwater Sampling

Document No: <b>JE-SOP-4000</b>	Page: <b>1 of 7</b>
Effective Date: <b>27 October 2019</b>	Rev. <b>5</b>

#### TABLE OF CONTENTS

<b>1.0</b>	<b>SCOPE AND APPLICATION</b>	<b>1</b>
<b>2.0</b>	<b>CRITICAL ISSUES</b>	<b>1</b>
2.1.	Sample Containers, Preservation, Handling, and Storage	1
2.2.	Cross Contamination	1
<b>3.0</b>	<b>DEFINITIONS AND ACRONYMS</b>	<b>2</b>
<b>4.0</b>	<b>EQUIPMENT</b>	<b>2</b>
<b>5.0</b>	<b>PROCEDURES</b>	<b>3</b>
5.1.	Recording Field Observations	3
5.2.	Field Instrument Calibration	3
5.3.	Site Preparation and Air Monitoring	4
5.4.	Free Product and Water Level Measurement	4
5.5.	Purging	4
5.6.	Groundwater Sample Collection	6
<b>6.0</b>	<b>HEALTH AND SAFETY</b>	<b>7</b>
<b>7.0</b>	<b>REFERENCES</b>	<b>7</b>

#### ATTACHMENTS

ATTACHMENT 1 Groundwater Sampling Form

#### 1.0 SCOPE AND APPLICATION

This SOP describes the collection of representative water samples from groundwater monitoring wells using low-flow sampling procedures that are in accordance with the *Field Sampling Guidance* issued by the Alaska Department of Environmental Conservation (ADEC 2017). These procedures are also in accordance with the *Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedure* (U.S. Environmental Protection Agency [EPA] 2017). Sampling from temporary well points is covered separately in JE-SOP-4010 *Groundwater Grab Sample Collection*.

This SOP defines standard procedures applicable under typical site conditions and equipment; they may be varied as dictated by actual site conditions and equipment. Field notes shall be sufficiently detailed to document adherence to these procedures or to record the relevant details of any variances.

#### 2.0 CRITICAL ISSUES

##### 2.1. Sample Containers, Preservation, Handling, and Storage

Samples will be collected into appropriate sample containers (with preservative, if required by the analytical method) provided by the analytical laboratory. Upon collection, containers will be labeled with the sample identification string, at a minimum. Samples will be stored at 0-6 °C. Prior to shipment, containers will be labeled with work-plan specified documentation (typically sample name, date and time of collection, sampler initials, and requested analysis). Samples will then be packaged and shipped to the analytical laboratory for analysis.

##### 2.2. Cross Contamination

To prevent cross-contamination between wells, dedicated tubing will be placed in each well or disposable tubing will be used. All non-disposable equipment that may directly or indirectly contact samples (i.e., the submersible pump and the water level indicator or oil/water interface probe) will be thoroughly decontaminated prior to being placed in a well. See JE-SOP-2000 *Decontamination* for decontamination procedures. To further reduce the risk of significant cross contamination, sampling of a series of wells should proceed from lowest to highest expected levels of contamination, if possible.

### 3.0 DEFINITIONS AND ACRONYMS

In-line definitions of acronyms and abbreviations are omitted for readability.

°C	degrees Celsius
µS/cm	microSiemens per centimeter
bgs	below ground surface
btoc	below top of casing
gpm	gallons per minute
mg/L	milligrams per liter
mL/min	milliliters per minute
mV	millivolts
NTU	nephelometric turbidity units
PID	photoionization detector
PPE	personal protective equipment\
SSHP	site safety and health plan
SOP	standard operating procedure
SOW	statement of work
VOC	volatile organic compound
TD	total depth
YSI	Yellow Springs Instruments

### 4.0 EQUIPMENT

Typical groundwater sampling equipment is listed in Table 1.

**Table 1: Equipment for Low-Flow Groundwater Sampling**

Type/name	Quantity	Notes
Modified Level D PPE	per person	As specified in the SSHP.
Camera	1	
Logbook, ballpoint pen/felt tip marker	as needed	
RAE Systems MiniRAE photoionization detector (PID) (or similar)	1	Monitor air conditions in accordance with the Work Plan and SSHP.
Isobutylene calibration gas	1	For PID calibration.
Groundwater sampling form	1 per well	
Sample labels	as needed	The Work Plan specifies the information to be included.
Sampling containers and packing materials	as needed	Lab-supplied bottles contain preservatives appropriate to the specified by the analytical method. Beware; concentrated acids or methanol may be present.
Tape measure	1	Engineer scale (hundredths of a foot), preferable
Water level indicator or oil/water interface probe	1	Use an interface probe if free product is potentially present.

Type/name	Quantity	Notes
Submersible pump system (stainless steel centrifugal or bladder pump with low-flow controller, or equivalent)	1	Pushes groundwater to the surface. If the Work Plan does not specify a pump type, this type will be used for sampling.
Peristaltic pump system	as needed	Creates a vacuum to bring groundwater to the surface. Use for sampling only if specified in the Work Plan. Useful for free product recovery.
Tubing	as needed	Sized to match the pump.
Tubing cutter	1	Ratcheting tubing cutting pliers are best, side-cutting pliers are okay.
Tubing pinch clamp	1	Use locking pliers or a small screw clamp (C clamp) to throttle the flow to provide backpressure and achieve a more stable flow rate with a submersible pump, if needed.
Tee with valve	1	To be placed in-line ahead of the flow-through cell for collection of turbidity samples during purging.
Disposable polyethylene bailers and nylon twine	as needed	For recovering free product.
5-gallon bucket	as needed	
Graduated pitcher	2	1 gallon/4 liter, for measuring flow rate and collecting purge water.
YSI water-quality meter (or similar) with flow-through cell	1	Include calibration reagents.
Hach turbidimeter (or similar)	1	Include calibration standards.
Alconox solution (or equivalent)		Use for decontaminating sampling equipment.
Potable or deionized water	as needed	Use for rinsing sampling equipment following decontamination.

## 5.0 PROCEDURES

### 5.1. Recording Field Observations

The Groundwater Sampling Form (Attachment 1) provides spaces for all routinely collected information during the sampling process for monitoring wells. Additionally, blank space on the second page may be used for any non-routine observations.

The logbook should be used to record all calibration information including calibration checks. It should also contain a running list of wells sampled, needing to note only starting and ending times; all other sampling information for monitoring wells will be recorded on the well specific sampling form.

### 5.2. Field Instrument Calibration

Field instruments will be calibrated in accordance with the manufacturer's recommended procedures. Operation and maintenance manuals will be available in the field for reference. Instrument accuracy will be evaluated at the beginning of each day prior to use. If any reading deviates by more than 5% from the nominal value for the standard (more than 0.1 for pH), the sensor or instrument will be re-calibrated.

### **5.3. Site Preparation and Air Monitoring**

Use plastic sheeting on the ground surrounding the well as necessary to provide a clean working area and minimize contact between sampling equipment and potentially contaminated soil.

Air will be monitored for organic vapors using a PID (typically, a RAE Systems MiniRAE 2000). Procedures in the SSHP shall be followed if organic vapors are detected above concentrations listed in the air monitoring section of the SSHP. PID readings will be collected for the instances described below:

- Ambient conditions in the breathing zone (prior to opening the well or removing the well plug)
- In the headspace in the monitoring well, immediately after removing the well plug (open the well vault or protective casing and remove any standing water prior to removing the well plug)
- In the breathing zone after the well plug has been removed

### **5.4. Free Product and Water Level Measurement**

The depth to free product (if present) and the depth to groundwater will be measured with an interface probe. Interface probes provide distinct responses when immersed in nonconductive product or conductive water. The order of activities is as follows:

- Identify the TOC reference elevation mark
  - Use the pre-existing mark or notch on the casing
  - If no pre-existing mark, use a Sharpie-style marker or a file to mark or notch the outside edge of the top of the well riser on the north side
- Product and water level measurements (measured to the nearest 0.01 foot)
  - Measure the depth to free product (if present)
  - Measure the thickness of free product (if present)
  - Measure the depth to groundwater (don't disturb the water column; total depth will be measured after sampling)
- Free product removal (if more than 0.1 feet thick)
  - Remove free product with a bailer or peristaltic pump
  - Determine the volume of product removed
  - Dispose of in accordance with the Work Plan
  - Wells with free product are generally not sampled (consult the Work Plan)

### **5.5. Purging**

Controlled purging is a key feature of low-flow sampling that ensures sampled water is representative of water in the surrounding aquifer. Purging is controlled by observing the following limits:

- Drawdown is less than 0.3 feet, if possible.
- The flow rate is between 50 and 500 mL/min..
- Water quality parameters listed in Table 2 are recorded at 5-minute intervals on the Groundwater Sampling Form (Attachment 1) until stability is achieved.
- Sampling occurs after stabilization or 3 casing volumes have been purged.

The purging phase of groundwater sampling consists of the steps below:

1. Lower the pump (intake tubing if using a peristaltic pump) to the target depth below the static water level. Record the depth of the pump on the groundwater sampling form. For wells screened across the groundwater interface, a pump intake within 1.0 foot of the static water

level is typically used.

For wells with submerged screens, set the pump intake at the middle of the screened interval. If well construction information is unavailable, set the pump intake at 7 feet from the bottom of the well (if total depth is unknown, measure the total depth now). Purging of more than 3 casing volumes (Step 3b) may be advisable in case the well has an extended sump and the actual screened interval is higher in the riser.

2. Begin purging water into a graduated container at 50 mL/min. Slowly increase the flow rate while monitoring drawdown until the flow rate reaches 500 mL/min (0.13 gpm) or the drawdown approaches 0.3 feet. If drawdown is the limiting factor, try not to exceed 0.25 feet initially to allow for increasing drawdown during the course of purging and sampling. During purging, adjust the flow rate as needed within the 50 to 500 mL/min range to maintain drawdown at 0.3 feet or less. If drawdown exceeds 0.3 feet at the minimum flow rate (50 mL/min), ignore the drawdown limit.
3. After turbidity lessens (purge water begins clear up considerably), connect the turbidity tee and flow-through cell to measure water quality parameters at 3-5 minute intervals. Continue to purge until water quality stabilizes or three well casing volumes are removed.
  - a. A water quality parameter is stable when three successive readings are within the stability criterion listed in Table 1. Purging has reached stability when any three parameters (excluding temperature) have stabilized.

Note: The turbidity sample is collected from a tee in the tubing ahead of the flow-through cell. A valve on the branch of the tee is opened for sampling. If a tee and valve are not available, a final turbidity sample will be collected after the flow-through cell has been removed (Step 4).

- b. The casing volume is calculated from the nominal diameter of the casing and the length of the water column in the well. Because the current depth of the well will not be measured until after sampling to avoid stirring up settled silt, use the as-built depth or a recent previous depth measurement as a proxy for the current depth. If no previous depth measurement is available, conservatively assume the length of the water column to be 8 feet for a well screened across the water table, or measure the depth and wait 24 hours before sampling, if possible.

For wells with submerged screens (top of screen below the water table), use the length of the screen plus the length of the filter pack above the screen (typically 2 feet) for the length of the water column.

Casing volume calculations are detailed on the groundwater sampling form (Attachment 1).

- c. If a well purges dry, it will be allowed to recharge for 24 hours, and then it will be sampled without further purging.
4. To prepare for sampling, remove the turbidity tee and flow-through cell from the discharge line while continuing to pump into a container at the established rate. If no turbidity tee was used, collect and measure the final turbidity sample.

Table 2 Stability Criteria for Low-Flow Purging

Parameter	Units	Stability Criterion	Recording Precision	Typical Range in Groundwater
pH	—	±0.1	0.01	5 to 8
Temperature	°C	not used	0.01	0.1 to 15
Conductivity	µS/cm	±3%	1	80 to 1,000
Turbidity	NTU	±10% or <10	0.1	0.3 to >900
Oxidation Reduction Potential (ORP)	mV	±10	1	-120 to 350
Dissolved Oxygen (DO)	mg/L	±10% or ±0.3 (whichever is greater)	0.1	0 to 12

**Notes:**

Stability criterion from ADEC Field Sampling Guidance (ADEC 2017) with alternative thresholds for turbidity and DO at low values.

**5.6. Groundwater Sample Collection**

1. Don new nitrile gloves prior to handling sample bottles.
2. Collect samples in the appropriate containers (with preservatives if required by the analytical methods). Use secondary containment to catch any accidental overflow.
  - Samples will be collected in the following order VOCs, GRO, SVOCs (including pesticides and herbicides), DRO/RRO, PCBs, and metals.
  - 40-mL vials for volatiles must be filled slowly to prevent splashing, entrainment of air bubbles, and attendant loss of volatiles. Reduce the pumping rate as needed (this flow rate is not measured or recorded). Avoid touching the mouth of the discharge line, the rim of the vial, or the inside of the cap. A septum that falls out of the cap onto the ground cannot be used. Fill the vial completely so that a convex meniscus forms. Slight overfilling would have no consequence but should be avoided. If overfilling is happening frequently, reduce the flow rate. Cap the vial and tighten the cap firmly. Invert the vial, tap it firmly against your free hand, and check for the presence of air bubbles. If bubbles are present, uncap; add a few drops of water, recap, and check again. If bubbles are still present, consider starting over with another vial. Bubbles may be unavoidable if groundwater is supersaturated with gas (usually carbon dioxide).
  - Acid-preserved bottles may be slightly pressurized by acid vapor if the lab added concentrated acid rather than 1:1 diluted acid. Open preserved bottles downwind, out of the breathing zone.
  - Fill all bottles to somewhere in the shoulder area. Slight overfilling would have no analytical consequence, but significant overfilling would dilute the preservative and potentially cause the results to be flagged as biased low.
  - Collect the work-plan-prescribed QC samples. Typical QC samples include MS/MSDs, field duplicates, and decontamination blanks. Trip blanks are supplied by the laboratory for volatile analyses and should accompany each cooler that contains such samples.
3. Record the sampling time and sample bottles on the groundwater sampling form (Attachment 1). If preprinted labels have been prepared, add the date, time, and sampler initials, and apply to each sample container. If labels will be prepared later, clearly label each container with the



well ID. Place all samples in a pre-chilled cooler with sufficient gel ice to chill the samples to 0-6°C. Transfer the samples to a refrigerator as soon as possible.

4. Remove the submersible pump.
5. Measure the total depth of the well to the nearest 0.01 feet from the TOC reference mark. This depth may be compared to the as-built depth or measurements during previous sampling events to determine the thickness of accumulated silt (if any).
6. Decontaminate the pump and interface probe/water level indicator with Alconox solution followed by rinsing with potable/deionized water. Because the flow-through cell is never in contact with sampled water, rinsing may be sufficient, although Alconox solution may be used freely on the plastic cell components if a residue is visible or significant contamination is suspected. The water quality sensors should generally only be rinsed and then stored in pH 4 buffer solution; more than brief exposure to the Alconox solution could damage the pH sensor.
7. Handle waste water and used gloves in accordance with the waste management section of the Work Plan. Note the disposition of waste water on the groundwater sampling form (Attachment 1).

## **6.0 HEALTH AND SAFETY**

Procedures for working with potentially hazardous materials as well as the relevant Material Safety Data Sheets (MSDS) for each chemical that will be used at the site are included in the SSHP. Personnel using this SOP must be trained on the information contained in the MSDSs, engineering controls, and the personal protective equipment (PPE) outlined in the SSHP.

All water samples will be treated as potentially containing contaminants of concern. Care must be used when handling water samples to prevent the possible spread of contaminants in the work area. At a minimum, Level D PPE, including nitrile gloves and safety glasses, will be worn while collecting water samples. Purged groundwater will be handled and disposed of as described in the waste management section of the Work Plan.

Acid-preserved sample bottles may be slightly pressurized by acid vapor if the lab added concentrated acid rather than 1:1 diluted acid. Open preserved bottles downwind, out of the breathing zone.

## **7.0 REFERENCES**

ADEC (Alaska Department of Environmental Conservation). 2019 (October). *Field Sampling Guidance*. Division of Spill Prevention and Response Contaminated Sites Program.

EPA (U.S. Environmental Protection Agency). 2017 (September). Low Stress (low flow) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells. Rev. 4. EQASOP-GW4.

**ATTACHMENT 1**  
**Groundwater Sampling Form**

**JACOBS**

## Well Information

## Well Purging Information

[illegible]

## Page 1

## Groundwater Sampling Data Sheet

<u>Site Name</u>	<u>Event</u>	<u>Well ID</u>	<u>Project Number</u>
		<u>Date</u>	<u>Sampler Initials</u>

[illegible]

**Appendix D**  
**ADEC Sampling Requirement Letter**



THE STATE  
of **ALASKA**  
GOVERNOR MICHAEL J. DUNLEAVY

Department of Environmental  
Conservation

DIVISION OF SPILL PREVENTION AND RESPONSE  
Contaminated Site Program

43335 Kalifornsky Beach Road, Suite 11  
Soldotna, AK 99669  
Main: 907.262.5210  
Fax: 907.262.2294

File: 2337.38.007

September 18, 2019

Kelley Nixon  
Hilcorp Alaska, LLC.  
3800 Centerpoint Drive, Suite 1400  
Anchorage AK 99503

Re: Trading Bay Facility  
Hazard ID: 1263  
Requirement for PFAS Sampling

Dear Ms. Nixon;

The Alaska Department of Environmental Conservation Contaminated Sites Program (ADEC), is requiring Hilcorp to develop a work plan to sample for per- and polyfluoroalkyl substance (PFAS) compounds in the monitoring wells in proximity to the Fire Training Area of the Trading Bay site. The work plan should address which wells will be sampled, special considerations for sample handling, and which laboratory will be utilized for testing. The Fire Training Area is located at Area L on the attached site figure.

As you may be aware, ADEC has adopted soil and groundwater cleanup levels for perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic acid (PFOA) individually. In order to better define the potential impacts from past hazardous substance releases at the Trading Bay Facility, DEC requires that existing representative monitoring wells at the site be sampled and analyzed for the two PFOA and PFOS compounds.

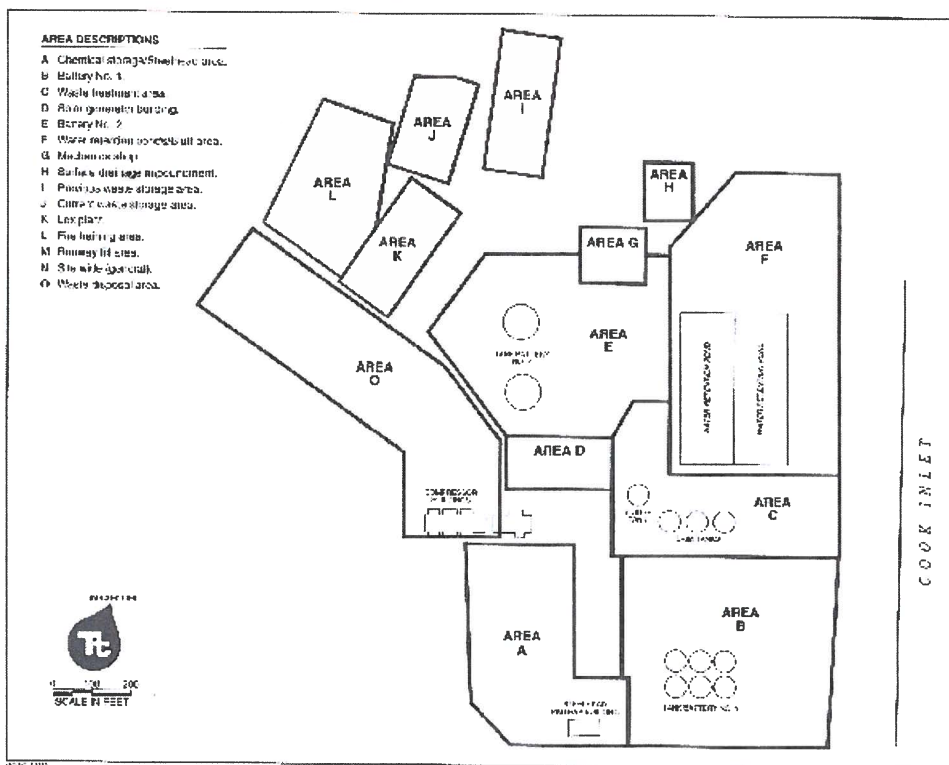
Please submit a work plan by November 1, 2019 for conducting the required sampling and analysis. If you have questions about this letter, or any other aspect of this project, please contact me at (907) 262-3412, or by e-mail at [peter.campbell@alaska.gov](mailto:peter.campbell@alaska.gov)

Sincerely,

A handwritten signature in black ink, appearing to read "Peter Campbell".

Peter Campbell  
Environmental Program Specialist

# Trading Bay Site Showing Area Designation Used in RI



**Appendix E**  
**PFAS User Guide**





# PFAS **USER GUIDE**

**SGS**

# ANALYSES OF PER- AND POLYFLUORO ALKYL SUBSTANCES (PFAS) BY LC-MS/MS

## WHAT ARE PFAS COMPOUNDS?

Per- and Polyfluoroalkyl Substances (PFAS) are classified as contaminants of emerging concern (CECs) based on increasing environmental and health concerns and consequent developing regulatory standards. Comprising a class of over 3,000 identified fluorinated compounds; they are used in the manufacture of many products such as PTFE (polytetrafluorethylene), textile coatings, firefighting foams, semi-conductors, paper and packaging coating additives, cleaning products, pesticides and metal plating process agents. The C-F bond is the strongest known in organic chemistry, making PFAS persistent in the environment. Longer chain PFAS are bioaccumulative as well. Key PFAS classes of concern include perfluoroalkyl carboxylic acids (PFCAs) such as PFOA, and perfluoroalkyl sulfonic acids (PFSAs) such as PFOS. Many PFAS will transform in the environment or via biological processes to form PFCAs or PFSAs.

There are no federal drinking water standards established for PFAS substances. However, in 2016, the EPA released drinking water health advisories of 70 parts per trillion for the sum of PFOS and PFOA to protect Americans from adverse health effects caused over a lifetime of exposure. Other countries, and select U.S. states have implemented regulations for a broader group of PFAS and the development of regulatory guidance is on-going.

## BENEFITS OF SERVICE

As an emerging contaminant requiring evolving analytical methods, it is important that you get the highest degree of positive identification and accurate quantification. Analytical methods must be rugged and use defined best practices updated to reflect current understanding. SGS provides you industry leading testing experience over 16 years and more than 80,000 processed PFAS samples. SGS has multiple facilities in North America with broad accreditation scope including DoD, NELAP, and ISO17025.

We support your PFAS needs by:

- ANALYSIS of PFAS compounds of concern with the widest range of PFAS analytes and matrices available commercially
- INSTRUMENTAL CAPACITY to address growing market demands for volume and turn-around-time with our network of 12 LC/MS/MS instruments available for PFAS analysis
- TOP (Total Oxidizable Precursor) analysis - providing you comprehensive information on unknown precursors at your site
- METHOD DEVELOPMENT - adapting to changing analytical needs. PFAS analytical methodologies and regulations are in a state of rapid transition. SGS AXYS is at the forefront of these changes, through collaboration with leading technical and regulatory groups. As the PFAS analytical requirements change, SGS helps you meet your evolving PFAS data needs.

SGS has a wide variety of analytical options to support many and varied PFAS studies. Your SGS representative can assist you to determine the right service for your needs.

## TOTAL OXIDIZABLE PRECURSORS (TOPS)

TOP is an analytical procedure for transforming PFAS Precursors in a sample to measurable perfluorinated carboxylic acids (C4-C14), and is used to estimate potential PFCA contributions from unknown precursors. TOP uses persulfate-mediated hydroxyl radical oxidation to convert precursors to terminal PFCAs. The analysis may be applied with pre- and post-conversion measurements. The measured increase in PFCAs in the post-conversion analysis compared to pre-conversion values, represents a measure of the potential precursors in the sample. This data may be useful to clients concerned with studying overall PFAS in specific environments/sites, and to provide comprehensive assessments of remediation success.

## CONTINUED COMPETITIVE ADVANTAGE

Our unrivalled analytical experience, capabilities and capacity offer you the best choice for your PFAS testing needs.

Consequently, SGS is the first choice for many government agencies, consultants and EHS managers. Our continuous improvement and quality control practices ensure comprehensive, current and defensible data.

Our PFAS Analyses include:

- A wide range of matrices to analyze 24 - 33 PFAS compounds in water, soil, sediments, biosolids and tissues/ biofluids.
- Specific analyte lists applicable to air, biological tissue and serum are available
- Specialized tests for precursors such as PAPs, diPAPs, FTCAs, FTUCAs etc, and for isomer speciation.
- Use of isotope dilution/internal standard methods in all matrices except prescriptive EPA 537 drinking water analysis
- Best in class reporting limits for low level PFAS work
- 8 dedicated LC/MS/MS instruments specifically for PFAS analysis in our network
- Technical expertise with more than 30 years of analytical experience and over 80,000 samples processed for PFAS
- Multiple accreditations including DoD, ELAP/TNI and ISO17025
- Demonstrated analytical proficiency demonstrated through regular PE studies and worldwide inter-calibration studies
- The most experienced technical assistance available for SGS clients



## PFAS ANALYTES

ANALYTE	ACRONYM	CAS #
PERFLUOROALKYL CARBOXYLIC ACIDS		
Perfluorobutanoic acid	PFBA	375-22-4
Perfluoropentanoic acid	PFPeA	2706-90-3
Perfluorohexanoic acid	PFHxA	307-24-4
Perfluoroheptanoic acid	PFHpA	375-85-9
Perfluorooctanoic acid	PFOA	335-67-1
Perfluorononanoic acid	PFNA	375-95-1
Perfluorodecanoic acid	PFDA	335-76-2
Perfluoroundecanoic acid	PFUnDA or PFUnA	2058-94-8
Perfluorododecanoic acid	PFDoDA or PFDoA	307-55-1
Perfluorotridecanoic acid	PFTrDA	72629-94-8
Perfluorotetradecanoic acid	PFTeDA	376-06-7
PERFLUOROALKYL SULFONIC ACIDS		
Perfluorobutanesulfonic acid	PFBS	375-73-5
Perfluoropentanesulfonic acid	PFPeS	2706-91-4
Perfluorohexanesulfonic acid	PFHxS	355-46-4
Perfluoroheptanesulfonic acid	PFHpS	375-92-8
Perfluorooctanesulfonic acid	PFOS	1763-23-1
Perfluorononanesulfonic acid	PFNS	474511-07-4
Perfluorodecanesulfonic acid	PFDS	335-77-3
PERFLUOROCTANE SULFONAMIDES		
Perfluorooctane sulfonamide	FOSA or PFOSA	754-91-6
N-Methyl perfluorooctane sulfonamide	N-MeFOSA	31506-32-8
N-Ethyl perfluorooctane sulfonamide	N-EtFOSA	4151-50-2
PERFLUOROCTANE SULFONAMIDO ACETIC ACIDS		
N-Methyl perfluorooctanesulfonamidoacetic acid	N-MeFOSAA	2355-31-9
N-Ethyl perfluorooctanesulfonamidoacetic acid	N-EtFOSAA	2991-50-6
PERFLUOROCTANE SULFONAMIDO ETHANOLS		
N-Methyl perfluorooctane sulfonamidoethanol	N-MeFOSE	24448-09-7
N-Ethyl perfluorooctane sulfonamidoethanol	N-EtFOSE	1691-99-2
FLUOROTELOMER SULFONATES		
4:2 Fluorotelomer sulfonate	4:2 FTS	757124-72-4
6:2 Fluorotelomer sulfonate	6:2 FTS	27619-97-2
8:2 Fluorotelomer sulfonate	8:2 FTS	39108-34-4
PERFLUOROETHER CARBOXYLIC/SULFONIC ACIDS (PFECA/PFESA)		
Tetrafluoro-2-(heptafluoropropoxy)-propanoic acid (GenX)	HFPO-DA	13252-13-6
4,8-dioxo-3H-perfluorononanoic acid	ADONA	919005-14-4
9-chlorohexadecafluoro-3-oxanone-1-sulfonic acid (F-53B Major)	9Cl-PF3ONS	756426-58-1
11-chloroeicosafluoro-3-oxaundecane-1-sulfonic acid (F-53B Minor)	11Cl-PF3OUDS	763051-92-9

REPORT LISTS*										CERTS		
PFOA GENX	PFOS	UCMR3 List	EPA 537 List	EPA 537.1 List	NH Short List	NH Long List	TCEQ List	NY List	MI List	QSM 5.1 "List"	DOD ELAP	FL NELAC
					X	X	X	X	X	X	X	X
					X	X	X	X	X	X	X	X
			X	X	X	X	X	X	X	X	X	X
	X		X	X	X	X	X	X	X	X	X	X
X	X		X	X	X	X	X	X	X	X	X	X
	X		X	X	X	X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X	X	X	X	X	X	X
			X	X		X</						

# SAMPLING, SHIPPING & HANDLING

MATRIX	CONTAINER	PRESERVATIVE	MATRIX CODE ON COC	METHOD	NOTES
Soil, sediment	1x4 oz. HDPE	none	SO/SED	537 performance-based	
Groundwater, surface water, water	2x125 ml HDPE	none	GW/SW/WW	537 performance-based	
Groundwater, surface water, water needing lower RLs	2x250 ml HDPE	none	GW/SW/WW	537 performance-based	
Effluent	2x125 ml HDPE	TRIZMA	WW or EF	537 performance-based	Finished samples may need TRIZMA. TRIZMA is a buffer and removes free chlorine.
Drinking water	2x250 ml HDPE or PP	TRIZMA	DW	537	
Drinking water not for compliance	2x250 ml HDPE	TRIZMA	WW	537 performance-based	Matrix code DW triggers the lab to use method 537 so samples need to be logged as WW.
Air					contact Orlando lab for specifics
Tissue					contact SGS AXYS for specifics

## SAMPLING GUIDELINES

When sampling for PFAS, use best practices prior to and during sampling to avoid residual PFAS on sampling equipment, cross contamination issues, and sample heterogeneity in high surfactant situations. Your SGS project manager can provide more information.

Using new nitrile gloves, collect the sample for PFAS first, prior to collecting samples for any other parameters into any other containers. This avoids contact with any other type of sample containers, bottles or package materials.

Do not place the sample bottle cap on any other surface when collecting the sample.

Avoid all contact with the inside of the sample bottle or its cap.

When the sample is collected and capped, place the sample bottle(s) in an individual sealed plastic bag (e.g. Ziploc) separate from all other sample parameter bottles.

To facilitate whole container aqueous analysis, it may be necessary to provide samples of different bottle sizes.

DO NOT USE ITEMS	DO USE ITEMS
FIELD EQUIPMENT ITEMS	
No Teflon™ containing materials	High-density polyethylene (HDPE) and polypropylene (PP) materials
Do not store samples in containers made of LDPE materials	Acetate liners
No Teflon™ tubing	Silicon tubing
No waterproof field books	Loose paper (non-waterproof)
No plastic clipboards, binders, or spiral hard cover notebooks	Aluminum field clipboards or with Masonite
No Post-It Notes	Sharpies®, pens
No chemical (blue) ice packs	Regular ice
FIELD CLOTHING AND PPE ITEMS	
No new clothing or water resistant, waterproof, or stain-treated clothing, clothing containing Gore-Tex™	Well-laundered clothing, defined as clothing that has been washed 6 or more times after purchase, made of synthetic or natural fibers (preferably cotton)
No clothing laundered using fabric softener	No fabric softener
No boots containing Gore-Tex™	Boots made with polyurethane and polyvinyl chloride (PVC)
No Tyvek®	Cotton Clothing
No cosmetics, moisturizers, hand cream, or other related products as part of personal cleaning/showering routine on the morning of sampling	Sunscreens – All Organic Natural Sunscreen, that are “free” or “natural”. Check the label Insect Repellents – Natural preparations, DEET (check the label)
SAMPLE CONTAINERS ITEMS	
No LDPE or glass containers	HDPE or polypropylene
No Teflon™-lined caps	Lined or unlined HDPE or polypropylene caps
RAIN GEAR ITEMS	
No waterproof or resistant rain gear	Tent that is only touched or moved prior to & following sampling activities
EQUIPMENT DECONTAMINATION ITEMS	
No Decon 90	Alconox® and/or Liquinox®
No water from an on-site well	Potable water from municipal drinking water supply
FOOD ITEMS	
No food and drink, with exceptions noted on the right	Bottled water and hydration drinks (i.e. Gatorade® and Powerade®) to be brought and consumed only in the staging area

## SHIPPING

Please include a fully completed chain-of-custody with each shipment. All sample documentation must be received for the samples to be accepted for analysis.

Samples are accepted Monday through Friday from 8 am – 5 pm. Samples are accepted Saturday delivery by Federal Express only. Other arrangements may be made as necessary.



# ACCREDITATIONS SUMMARY

STATE	POTABLE WATER (SDWA)	NON- POTABLE WATER (CWA)	SOLID AND CHEMICAL MATERIALS (RCRA)	TISSUE	SERUM PLASMA
Alabama	O* W*	O* W* S*	O* S*		
Alaska	O W	O W	O		
Arizona	O	O* W* S*	O* S*		
Arkansas	O* W*	O* W* S*	O* S*		
California	O	O* W* S*	O* S*		
Colorado	O* W*	O* W* S*	O* S*		
Connecticut	O* W*	O* W* S*	O* S*		
Delaware		O* W* S*	O* S*		
DoD ELAP/ISO 17025	O W	O S	O S		
DoD QSM 5.1.1., Table b-15	NA	O S	O S		
Florida	O W	O S	O S	S	
Georgia	O* W*	O* W* S*	O* S*		
Hawaii	O* W*	O* W* S*	O* S*		
Idaho		O* W* S*	O*		
Illinois	O* W*	O* W* S*	O* S*		
Indiana	O* W*	O* W* S*	O* S*		
Iowa	O* W*	O* W* S*	O* S*		
Kansas	O	O* W* S*	O*		
Kentucky	O* W*	O* W* S*	O* S*		
Louisiana	O W	O	O		
Maine	W	W* S*			
Maryland	O* W*	O* W* S*	O* S*		
Massachusetts	O* W*	O* W* S*	O* S*		
Michigan	O* W*	O* W* S*	O* S*		
Minnesota	W	W S	S	S	
Mississippi	O* W*	O* W* S*	O* S*		

STATE	POTABLE WATER (SDWA)	NON- POTABLE WATER (CWA)	SOLID AND CHEMICAL MATERIALS (RCRA)	TISSUE	SERUM PLASMA
Missouri		O* W* S*	O* S*		
Montana	W	O* W* S*	O* S*		
Nebraska	O	O* W* S*	O*		
Nevada	O	O	O		
New Hampshire	O W	O W	O		
New Jersey	O W	O W S	O S	S	
New Mexico	O* W*	O* W* S*	O* S*		
New York	O W	O* W* S*	O* S*		
North Carolina	O* W*	O* W* S*	O* S*		
North Dakota	O W	O* W* S*	O* S*		
Ohio	W*				
Oklahoma	O* W*	O* W* S*	O* S*		
Oregon	O W	O	O		
Pennsylvania	O W	O* S*	O* S*		
Rhode Island	O*	O*	O* S*		
South Carolina	O* W*	O* W* S*	O* S*		
South Dakota	O* W*	O* W* S*	O* S*		
Tennessee		O* W* S*	O* S*		
Texas	O* W*	O* W* S*	O* S*		
Utah	O	O	O		
Vermont	O W	O* W* S*	O* S*		
Virginia	O* W*	O* W* S*	O* S*		
Washington	O W	O S	O S		
West Virginia		O* S*	O* S*		
Wisconsin	W*	W* S*			
Wyoming		O* W* S*	O* S*		
ISO/IEC 17025		S**	S	S	S
Updated March 2019					

O Accreditation for Orlando, FL laboratory

S Accreditation for SGS Axys, Sidney, BC laboratory

W Accreditation for Wilmington, NC laboratory

\* Accreditation not required under this state program, o is either not needed or is covered under another program (different matrix, NELAP, etc.). SGS is fully qualified to perform work for this program.

\*\* The ISO 17025 accreditation granted by Canada does not distinguish between potable and non-potable water. In some Canada jurisdictions labs are required to have separate licensing; in addition to accreditation. SGS AXYS does not hold any accreditation, licensing, or recognition specific for drinking water.

NOTE SGS AXYS Analytical Services Ltd. is now certified in Total Oxidizable Precursors (TOP) in Canada. This is a new test that includes a measurement of sample PFAS content plus the potential of the sample to form PFAS from the presence of PFAS ‘precursor’ compounds.

# GLOSSARY OF TERMS

AFFF	Aqueous film forming foams
ASTM	American Society for Testing and Materials
CWA	Clean Water Act
CoC	Contaminant of concern
CoPC	Contaminant of potential concern
DoD	Department of Defense
DW	Drinking water
EPA	Environmental Protection Agency
FFTA	Firefighting training area
FRBs	Field Reagent Blanks
FTS	Fluorotelomer sulfonate
GC/MS	Gas chromatography/mass spectroscopy
GW	Ground Water
HAs	Health advisories
HDPE	High-density polyethylene
HPLC	High performance liquid chromatography
HRMS	High resolution mass spectrometry

ID	Isotope Dilution
IEC	International Electrotechnical Commission
ISO	International Organization for Standardization
LC-MS/MS	Liquid chromatography tandem mass spectrometry
LDPE	Low-density polyethylene
MCL	Maximum Contaminant Level
mg/kg	milligram per kilogram
MS	Matrix spike
MSD	Matrix spike duplicate
NELAP	National Environmental Laboratory Accreditation Program
ng/l	nanogram/liter
NPDES	National Pollution Discharge Elimination System
PAH	Polynuclear aromatic hydrocarbon
PE	Polyethylene

PFAS	Perfluoroalkyl and polyfluoroalkyl substance(s)
PFCs	Perfluorinated compounds
PFOA	Perfluorooctanoic acid
PFOS	Perfluorooctanesulfonic acid
PHA	Provisional health advisory
PP	Polypropylene
PPE	Personal protective equipment
ppm	parts per million
ppt	parts per trillion
PTFE	Polytetrafluoroethylene
QA/QC	Quality Assurance/Quality Control
QSM	Quality systems manual
RCRA	Resource Conservation and Recovery Act
RL	Reporting limit
SDWA	Safe Drinking Water Act
SPE	Solid phase extraction
SW	Solid waste
TOP	Total Oxidizable Precursor
ug/l	microgram per liter



# PFAS FREE DRILLING

SGS's North American Drilling Division has over 30 years of experience with more than 6,500 completed projects within the United States and the U.S. Virgin Islands. Our expansive, diverse fleet of drills ranges from the smallest Geoprobe 420M up to full size Sonic, Air Rotary, Mud Rotary, Dual Rotary and Hollow-Stem rigs.

We are setting standards of excellence in the drilling industry by proudly offering certified PFAS-Free Drilling. All drilling lubricants, consumables, down-hole rod/ augers and bits as well as our on-site water supply well have been tested and are certified PFAS-free by SGS. In addition, our staff has practical field experience with PFAS investigation/characterization jobs. We are well versed in preparation requirements to prevent interference from our activities on your project.

These measures are incomparable in the industry and ensure reliably sampled, representative and defensible test results.

# NORTH AMERICA PFAS BY FACILITY

## ORLANDO, FL USA LABORATORY

- Full Service Regulatory Analysis
- PFAS in Drinking Water by EPA 537 rev. 1.1
- PFAS in Groundwater, NPG and Solids by isotope dilution (ID)
- DoD QSM 5.1 / NELAP / ISO 17025 accredited
- State accreditations for DW, NPW, and Solids where available (see table)

## WILMINGTON, NC, USA LABORTAORY

- HRMS Specialty (Dioxin/Furans, PCB Congeners, HRMS PAHs, HRMS Pesticides)
- Source Evaluation, Contaminated-Sites and NPDES analyses
- PFAS in Drinking Water, Water and Solids by internal standard approaches
- DoD QSM 5.1 / NELAP / ISO 17025 accredited

## SGS AXYS, SIDNEY, BC, CANADA LABORATORY

- HRMS, LC-MS/MS, GC-MS trace snd ultra-trace, all matrices excluding DW
- PFAS in Water, Solids, Tissue, Serum, Method Development (multiple target analyte methods)
- DoD QSM 5.1 / NELAP / ISO 17025 accredited
- Also offers other PFAS analysis (such as polyfluorinated phosphorous compounds, extended precursor list)
- TOP (aqueous, solids)
- AFFF products and manufacturing intermediates

## WEST CREEK, NJ, USA DRILLING

- United States, Virgin Islands
- Sampling for PFAS in Drinking Water, Water and Solids
- Certified PFAS Free Drilling



## WHY SGS

SGS is the world's leading inspection, verification, testing and certification company. Recognized as the global benchmark for quality and integrity, we employ over 95 000 people and operate a network of more than 2 400 offices and laboratories around the world.

**FOR ADDITIONAL INFORMATION  
PLEASE CONTACT YOUR LOCAL SGS  
REPRESENTATIVE AT +1 800 329 0204  
PFAS.EXPERT@SGS.COM OR VISIT  
WWW.SGS-EHSUSA.COM/PFAS**



**WWW.SGS.COM**

**WHEN YOU NEED TO BE SURE**

**SGS**