Tier 5 Well Installation Work Plan

Stericycle Georgetown Site

Prepared for:

Stericycle
Environmental Solutions

Prepared by:

PIONEER TECHNOLOGIES CORPORATION

5205 Corporate Center Ct. SE, Suite A
Olympia, Washington 98503
Phone: 360.570.1700
Fax: 360.570.1777
www.uspioneer.com

July 2018

Table of Contents

Section 1: Introduction 1-1

1.1 Site Location 1-1
1.2 Site Background 1-1
1.3 Objective 1-2
1.4 Document Organization 1-3

Section 2: Tier 5 Well Installation Activities 2-1

2.1 Monitoring Wells Installation 2-1
2.2 Sampling 2-3
2.3 Laboratory Analysis 2-3

Section 3: Project Schedule and Reporting 3-1

Section 4: References 4-1

Figures

Figure 1 Site Location
Figure 2 Proposed Monitoring Well Locations

Tables

Table 1 Proposed Groundwater Monitoring Well Description and Rationale
Table 2 Project Team
Table 3 Constituent Reporting Limits for Groundwater Laboratory Analysis

Appendices

Appendix A Standard Operating Procedures

List of Acronyms

Acronym	Explanation
BE	Burlington Environmental, LLC
CCEF	Cumulative Cancer Exceedance Factor
CNCEF	Cumulative Noncancer Exceedance Factor
EDR	Engineering Design Report
EF	Exceedance Factor
Former Georgetown Facility	Former RCRA-permitted waste management facility at 734 South Lucile Street in the Georgetown community of Seattle, Washington
GPS	Global Positioning System
NAD	North American Datum
NAVD	North American Vertical Datum
PSC	Philip Services Corporation
PIONEER	PIONEER Technologies Corporation
PLP	Potentially-Liable Party
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
Site	Former Georgetown Facility
SMD	Sub-membrane Depressurization
SOP	Standard Operating Procedure
SSD	Sub-slab Depressurization
Stericycle	Stericycle Environmental Solutions, Inc.
VI	Vapor Intrusion
VIAM	VI Assessment and Mitigation
VI Buildings	15 Buildings with VI Mitigation Systems
VIRL	Vapor Intrusion Remediation Level
VOC	Volatile Organic Compound
Work Plan	Tier 5 Well Installation Work Plan

SECTION 1: INTRODUCTION

Burlington Environmental, LLC (BE) operates the former Resource Conservation and Recovery Act (RCRA) permitted waste management facility at 734 South Lucile Street in the Georgetown community of Seattle, Washington (former Georgetown facility). The Georgetown facility is a wholly-owned subsidiary of Philip Services Corporation (PSC) which is a wholly-owned subsidiary of Stericycle Environmental Solutions, Inc., (Stericycle). Stericycle is conducting corrective action at the former Georgetown facility (site) per requirements in its RCRA dangerous waste permit (WAD 00081 2909).

Additional groundwater data are needed to perform Tier 5 vapor intrusion assessment and mitigation (VIAM) evaluations for the buildings in the East of 4th portion of the site to determine whether or not the vapor intrusion (VI) mitigation systems in the 15 buildings (VI buildings) can be shut down and removed (see Figure 1). The Tier 5 method was established in the 2011 Ecology-approved Revised Engineering Design Report (EDR), Appendix G: Vapor Intrusion Assessment and Mitigation Plan (AMEC Geomatrix, Inc. 2011; PIONEER Technologies Corporation [PIONEER] 2011). The purpose of this Tier 5 Well Installation Work Plan (Work Plan) is to present the objective of the proposed dedicated Tier 5 monitoring well installation activities and the schedule for completing the proposed work.

1.1 Site Location

The site is located in the Georgetown neighborhood of Seattle, Washington, in King County (see Figure 1). In the Public Land Survey System, the former Georgetown facility is located in the SW¼, of the NE¼, of Section 20, T.24.N, R.4.E, and approximately latitude 40° 33' N. and longitude 122° 19' W (PSC 2001). The site is bordered by the Union Pacific Railroad Argo Yard to the north and east and commercial, industrial, and residential properties to the south and west. The Duwamish Waterway is approximately 0.8 miles west of the former Georgetown facility. The direction of groundwater flow near the site is southwest. Land use in the vicinity of the site is mixed residential, commercial, and industrial.

1.2 Site Background

1.2.1 Five-Tiered VIAM Process

A five-tiered VIAM process has been used to determine if buildings at the site warrant investigation, require mitigation through an interim measure, or meet the decision criteria for shutting down existing mitigation systems (PSC 2002; PIONEER 2011, AMEC Geomatrix, Inc. 2011). The activities that are conducted in each tier are as follows:

- Tiers 1 & 2: Groundwater data are compared to groundwater VI remediation levels (VIRLs) to determine if there is a potential VI concern in residential (Tier 1) or commercial (Tier 2) buildings. Cancer and noncancer exceedance factors (EFs) are calculated and if either of the EFs exceeds 10 (indicating that the cancer risk is greater than 1E-05 or the hazard index is greater than one), the building should be evaluated further (in Tier 3) or move directly to Tier 4.
- Tier 3: Building-specific sampling is conducted to determine whether or not a VI mitigation system (Tier 4) is warranted.

- Tier 4: A VI mitigation system is installed and operated to mitigate the VI pathway.
- Tier 5: Groundwater data from the four most recent sampling events during the last two years are compared to VIRLs on a well-by-well basis. Buildings proximate to wells with cumulative cancer EFs (CCEFs) less than or equal to 1 and cumulative noncancer EFs (CNCEFs) less than or equal to 10 will be identified as candidates for VI mitigation system shutdown.

Thirty-three VI mitigation systems have been installed at the site using the VIAM process. Stericycle (referred to as the East of 4th potentially-liable party [PLP]) is responsible for 15 of the systems; three other PLPs (referred to as the West of 4th PLPs) are responsible for the other 18 systems (see Table 1 and Figure 1).[1] This work plan is limited to the systems in the East of 4th area. The VI mitigation systems (i.e., sub-slab depressurization [SSD] or sub-membrane depressurization [SMD] systems) were installed to mitigate the migration of subsurface vapors into the indoor air of overlying buildings which resulted, or may have resulted (in instances where mitigation systems were installed without the collection of indoor air samples), in concentrations that exceeded action levels established by Ecology.

1.2.2 Tier 5 VIAM Evaluation Process

The Tier 5 process is used to determine when a building VI mitigation system is a candidate for shutdown and removal. Tier 5 is only applicable at buildings where groundwater is the source of volatile organic compounds (VOCs) in indoor air. The five steps of a Tier 5 VIAM evaluation are summarized in the following bullets:

- Step 1: Identify candidate buildings for VI mitigation system shutdown based on reduction in groundwater concentrations
- Step 2: Perform building-specific confirmation groundwater sampling on candidate buildings (if necessary)
- Step 3: Perform building-specific confirmation air sampling (if necessary)
- Step 4: Shut down the VI mitigation system
- Step 5: Remove the VI mitigation system

1.3 Objective

The objective of the proposed Tier 5 well installation is to fill data gaps identified during previous Tier 5 VIAM evaluations. Based on the results of Tier 5 VIAM evaluations, the data set from in-place monitoring wells was not robust enough to determine whether or not buildings with VI mitigation systems were candidates for shutdown and removal (PIONEER 2015, 2017). The proposed monitoring wells will be installed within 100 feet of buildings with VI mitigation systems and screened across the water table. The data collected from the new monitoring wells will be used with data from existing wells located within 100 feet of VIAM buildings, if available.

[1] Art Brass Plating, Blaser Die Casting, and Capital Industries were identified as additional PLPs between 2005 and 2009.

1.4 Document Organization

This Work Plan is organized as follows:

- Section 2: Tier 5 Well Installation Activities
- Section 3: Project Schedule and Reporting
- Section 4: References

SECTION 2: TIER 5 WELL INSTALLATION ACTIVITIES

Tier 5 well installation activities are being conducted at the site to provide additional groundwater data for evaluating whether or not the 15 VI mitigation systems in the East of 4th VIAM buildings can be shut down and removed. The well installation activities will include installing four new dedicated Tier 5 monitoring wells, sampling the wells during groundwater monitoring events, analyzing the samples, and evaluating the sample results. The proposed Tier 5 VIAM evaluation activities are presented in this section.

2.1 Monitoring Wells Installation

Four new dedicated monitoring wells are proposed for the site. The wells will be installed within 100 feet and upgradient (in most places) of VIAM buildings where no monitoring wells have been installed (see Figure 2). Well locations are limited by aboveground and belowground obstacles. The proposed monitoring well locations were selected to fill data gaps identified during the previous Tier 5 VIAM evaluations (see Table 1; PIONEER 2015, 2017). The proposed monitoring wells will be screened across the water table to provide data for future Tier 5 VIAM evaluations.

The proposed well locations, premobilization activities, and installation activities associated with the well installations are presented in this section.

2.1.1 Proposed Well Locations

The proposed well locations are presented on Figure 2 and summarized below. All proposed well locations are on City of Seattle right-of-way property.

- One monitoring well is proposed upgradient of 416 S Lucile St to provide water table data for evaluating:
  - 416 S Lucile St
  - 412 S Lucile St
  - 406 S Lucile St
  - 402 S Lucile St
- One monitoring well is proposed in the alley behind 605 S Brandon St to provide water table data for evaluating:
  - 601 S Brandon St
  - 605 S Brandon St
  - 611 S Brandon St
- One monitoring well is proposed upgradient of 5403 Maynard Ave S to provide water table data for evaluating:
  - 5403 Maynard
  - 615 S Brandon S
- One monitoring well is proposed upgradient of 707 S Lucile St to provide water table data for evaluating that building.

2.1.2 Premobilization Activities

Premobilization activities will include inspecting the proposed locations, notifying owners/tenants, acquiring access agreements and permits, performing a utility search, and preparing the site. The premobilization activities are summarized in this section.

- **Inspecting the proposed monitoring well locations**. Stericycle will inspect the proposed monitoring well locations prior to installation to ensure that the locations can be accessed safely. Any potential issues will be documented and the location will be adjusted as needed.
- **Notifying property owners**. Stericycle will notify property owners and tenants of its intent to install a monitoring well on or near their property. The written notification will include:
  - The proposed location;
  - The types of activities that are anticipated during the field activities;
  - The anticipated schedule; and
  - The potential disruptions the owners/tenants can expect (e.g., blocked driveways).
- **Acquiring access agreements, if needed**. Stericycle will acquire written access agreements from the owners, in which Stericycle is granted permission to perform investigation activities on their property.[2] The access agreements will include a schedule for conducting the fieldwork.
- **Acquiring permits, if needed**.
  - The Stericycle project manager will notify the Stericycle facility manager to arrange for investigation-derived wastes to be transported to the facility for treatment and/or transfer.
  - The driller will obtain well-installation permits from Ecology for all of the wells.
- **Performing a utility search.** An independent contractor will perform an underground utility locate after access agreements have been signed but before installation activities begin. If the location of an Ecology-approved monitoring well needs to be moved more than 30 feet, Stericycle will notify the Ecology project manager prior to well installation(s).
- **Preparing the site**. The following activities will be performed prior to installing the monitoring wells:
  - Traffic cones or barricades and/or one or more flaggers will be used
  - Brush and debris will be cleared from the location
  - Surface pavement will be removed via sawing or coring
  - Wastes will be placed in receptacles
  - An area will be set up for sample logging, field screening, and sample labeling

2.1.3 Installation Activities

A Washington State-licensed driller will perform all drilling and well installation activities. The wells will be installed in accordance with the following Stericycle Standard Operating Procedures (SOPs) which are included in Appendix A:

- No. PSC-105: Groundwater Monitoring Well Installation

[2] No access agreements are needed for the Tier 5 well installations as all proposed locations are on City of Seattle right-of-way property.

- No. PSC-121: Monitoring Well Development
- No. PSC-200: Equipment Decontamination Procedures
- No. PSC-400: Document Procedures

Wells will be identified using a three-sequence, alpha-numerical identification (e.g., VIT5-01-WT). The identification will include:

- Three letters and one number to identify the wells are for Tier 5 VIAM evaluation (i.e., VIT5)
- Two numbers to identify the well (e.g., 01); and
- Two letters (e.g., WT) to identify the total depth of the well screen which will be the water table.

After the well installation is complete, Stericycle will contract a Washington State registered land surveyor to survey the new well locations. The survey will include determining the horizontal and vertical well coordinates for the following points:

- The ground surface;
- The top of casing; and
- The water elevation (i.e., the top of the dedicated sampling equipment).

A permanent mark will be placed on the casing of each well to identify the surveyed point.

All survey coordinates will be the same as coordinate system and datum from previous project surveys. The horizontal will be the Washington State Plane Coordinate System, North Zone (North American Datum [NAD] 1983). The vertical will be the North American Vertical Datum (NAVD) 1988. A City of Seattle global positioning system (GPS) survey control point will be used as the master benchmark for the survey; the horizontal and vertical errors will be no greater than 0.10 feet and 0.01 feet, respectively.

2.2 Sampling

The wells will be sampled biannually as part of the groundwater monitoring program until the Tier 5 process for each of the areas is complete. One sample will be collected from the water table interval at each new monitoring well during each event. The wells will be sampled as long as the VI mitigation system in at least one of the associated VIAM building(s) is operating. All sampling will be conducted in accordance with the groundwater sampling methodology presented in the Sampling and Analysis Plan (SAP) included with the Final Inhalation Pathway Interim Measures Work Plan (PSC 2002). No soil sampling or characterization activities will be conducted because the wells are very shallow and a sufficient understanding of the area's lithology has already been established. Groundwater is the only medium that will be sampled under this Work Plan.

2.3 Laboratory Analysis

The groundwater samples will be collected in 4 x 40 mL glasses with hydrochloric acid and submitted to Stericycle's contracted, state-certified laboratory (ALS Environmental in Kelso, Washington) for VOC analysis using the USEPA Method 8260 SIM. The constituent list and associated reporting limits are presented in Table 3. James McAteer of QA/QC Solutions, LLC will validate the data from the laboratory before the data are reported.

SECTION 3: PROJECT SCHEDULE AND REPORTING

Stericycle will begin premobilization activities immediately and well installation activities within 30 days of Ecology's approval of this Work Plan. Stericycle's goal is to install the monitoring wells in August 2018 based on team members' availability.

Samples will be collected from the new monitoring wells during the next groundwater monitoring event, which is scheduled for third quarter 2018. The results of the groundwater monitoring event will be included in the third quarter 2018 groundwater monitoring report and the biannual Tier 5 VIAM evaluation.

SECTION 4: REFERENCES

AMEC Geomatrix, Inc. 2011. Revised Engineering Design Report. PSC Georgetown Facility. Seattle, Washington. February

PSC. 2001. Final RFI Well Installation Work Plan. Georgetown Facility. November 16.

PSC. 2002. Revised Inhalation Pathway Interim Measures Work Plan. Philip Services Corporation Georgetown Facility. August 12.

PIONEER. 2011. Vapor Intrusion Assessment and Mitigation Plan. Philip Services Corporation Georgetown Facility, Seattle, Washington. June.

PIONEER. 2015. Tier 5 Evaluation of the Vapor Intrusion Mitigation Systems in Georgetown. November 3.

PIONEER. 2017. 2017 Tier 5 Evaluation. Georgetown Site. November.

Tables

Table 1: Proposed Groundwater Monitoring Well Description and Rationale

Well Identification	Screen Interval	Rationale
VIT5-01-WT	Water Table	The location of this well was selected to monitor VOC concentrations in shallow groundwater upgradient and within approximately 100 feet of the following buildings with mitigation systems: ▪ 5403 Maynard Ave S ▪ 615 S Brandon St ▪ 611 S Brandon St
VIT5-02-WT	Water Table	The location of this well was selected to monitor VOC concentrations in shallow groundwater within approximately 100 feet of the following buildings with mitigation systems: ▪ 605 S Brandon St ▪ 601 S Brandon St
VIT5-03-WT	Water Table	The location of this well was selected to monitor VOC concentrations in shallow groundwater upgradient and within approximately 100 feet of the following buildings with mitigation systems: ▪ 416 S Lucile St ▪ 412 S Lucile St ▪ 406 S Lucile St ▪ 402 S Lucile St
VIT5-04-WT	Water Table	The location of this well was selected to monitor VOC concentrations in shallow groundwater upgradient and within approximately 100 feet of 707 S Lucile St.

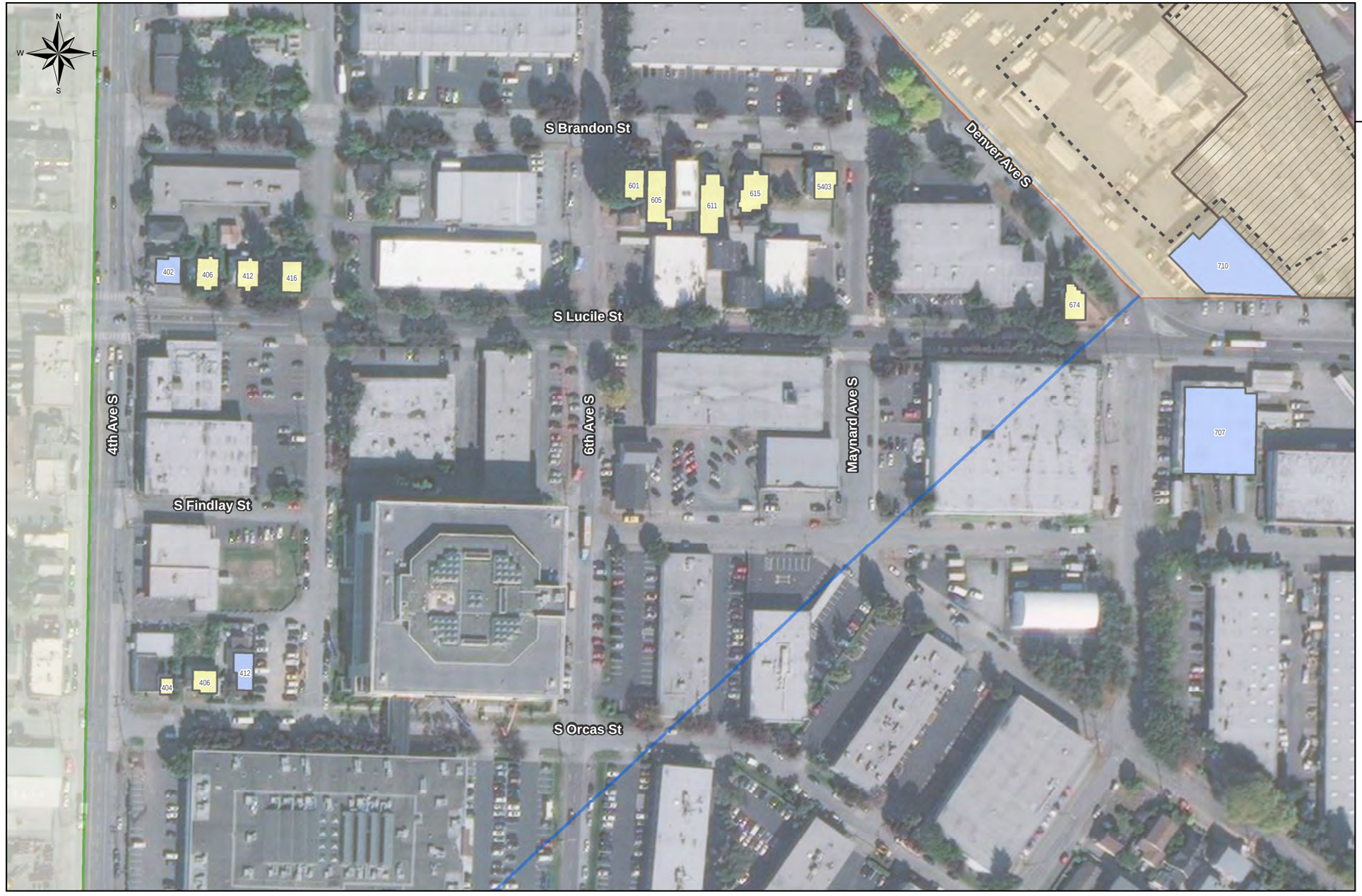
Table 2: Proposed Project Team

Position	Name	Contact Information	Responsibility
Stericycle Project Manager	Bill Beck	william.beck@stericycle.com office: 425.227.6149	Oversees all project activities. Point of contact between Stericycle, Ecology, PLPs, and building owners/tenants.
PIONEER Project Manager	Chris Waldron	waldronc@uspioneer.com office: 360.570.1700	Oversees all VI evaluation and data management. Responsible for calculating VIRLs and cleanup levels.
Field Lead	Jimmy McKechnie	jmckechnie@pscnow.com cell: 253.244.0188	Oversees all field work.
Geologist	Tasya Gray	ngray@dofnw.com office: 425.827.4588	Oversees all groundwater field activities including drilling, sampling, and documentation.

Table 3: Constituent Reporting Limits for Groundwater Laboratory Analysis

Constituent	Reporting Limit ALS Method 8260 SIM (ug/L)
1,1,1-Trichloroethane	0.5
1,1-Dichloroethane	0.5
1,1-Dichloroethylene	0.5
1,2,4-Trimethylbenzene	2
1,2-Dichloroethane	0.5
1,3,5-Trimethylbenzene	2
2-Hexanone	20
Benzene	0.5
Chloroethane	0.5
Chloroform	0.5
Ethylbenzene	0.5
Naphthalene	2
Propylbenzene	2
Tetrachloroethylene (PCE)	0.5
Toluene	0.5
Trichloroethylene (TCE)	0.5
Vinyl chloride	0.5
cis-1,2-Dichloroethylene	0.5
p-Isopropyltoluene	2
sec-Butylbenzene	2
trans-1,2-Dichloroethylene	0.5

Figures



Legend

- Former Georgetown Facility
- HCIM Wall
- Areas 1 and 2
- Area 3
- Commingled Plume Area***

VIAM Building

- Commercial Use
- Residential Use

0 330 Feet

PIONEER TECHNOLOGIES CORPORATION

Site Location
Tier 5 Well Installation Work Plan
Stericycle Georgetown Site

Figure 1

Document Path: G:\Projects\PSC\GIS\Source\Maps\Maps 2018\Tier 5\Work Plan\Fig-1-Site-Location.mxd; Author: ; Date Saved: 7/26/2018

Legend

- Proposed Monitoring Well Location
- Existing Direct Push Location
- Existing Monitoring Well Location
- Former Georgetown Facility
- HCIM Wall
- Areas 1 and 2
- Area 3
- Commingled Plume Area***

VIAM Building

- Commercial
- Residential

0 330 Feet

PIONEER TECHNOLOGIES CORPORATION

Proposed Monitoring Well Locations
Tier 5 Well Installation Work Plan
Stericycle Georgetown Site

Figure 2

Document Path: G:\Projects\PSC\GIS\SourceMaps\Maps 2018\Tier 5\Work Plan\Fig-2-Sample-Locations.mxd; Author: ; Date Saved: 7/26/2018

Appendix A

Groundwater Monitoring Well Installation

Written By:	Approved By:	Date:	QA Concurrence:	Date:
Carolyn Mayer	Carolyn Mayer	7/1/98	Laurel Muselwhite	7/1/98

This SOP contains nine sections:

1.0 Purpose
1.0 Application
1.0 References
1.0 Associated SOPs
1.0 Installation Equipment and Materials
1.0 Monitoring Well Installation Procedure
1.0 Standard Surface Finishing Designs
1.0 Documentation
1.0 Measure of Proficiency

1.0 Purpose

The purpose of this SOP is to provide geotechnical field personnel with an outline of the specific information needed to install and construct monitoring wells in both unconsolidated and bedrock media. The required equipment and documentation are also outlined for each of these procedures. The recommended monitoring well design, as presented in this SOP, is based on the assumption that the objective of the program is to obtain representative ground water information and water quality samples from aquifers.

1.0 Application

Ground water monitoring wells are generally used as collection points for ground water samples and as measuring points for aquifer hydraulic properties.

This SOP provides a step-by-step guideline to be followed by the site geologist to design and install monitoring wells suited to these purposes.

1.0 References

ASTM Proposed Recommended Practice for Design and Installation of Ground Water Monitoring Wells in Aquifers (February 19, 1990).

U.S. EPA, Office of Solid Waste. 1992. RCRA Ground-Water Monitoring Draft Technical Guidance. November.

Driscoll, Fletcher G. 1986. Groundwater and Wells. Second Edition. Published by Johnson Filtration Systems, Inc., St. Paul Minnesota.

1.0 Associated SOPs

PSC-103
PSC-121
PSC-400

1.0 Installation Equipment and Materials

The following equipment should be provided and maintained by the site geologist:

- a calibrated photoionization detector; isobutylene span gas, regulator, and tedlar bag;
- a weighted fiberglass tape calibrated to .001 foot and of sufficient length to reach the bottom of the deepest bore hole;
- a wooden folding ruler calibrated to a .001 foot;
- an electric water level indicator, immiscible phase probe or chalked steel tape for obtaining water level measurement to an accuracy of .001 foot;
- a field notebook and calculator.
- a camera;

- a small file or saw to permanently mark a double notch at the top of the well casing/riser;
- permanent marker or paint pen to mark the identification of the well on the steel pipe finish;
- a sufficient supply of blank daily drilling reports and monitoring well construction field forms;
- a copy of the Field Operations Plan including, at a minimum, the Field Sampling Plan, the Health and Safety Plan and the Quality Assurance Project Plan
- all required personnel protective equipment as defined in the Health and Safety Plan;
- a sufficient amount of deionized water to hydrate the bentonite.
- A brass or hardened-steel security lock.

The drilling contractor is responsible for providing the following:

- well screen and riser components with flush joints with square profile threads to obtain water tight seals;
- machine slotted well screens (0.010 size);
- bentonite pellets or chips;
- "quick-set" additive (if necessary when cold weather conditions);
- filter sand;
- a steam cleaner;
- cement grout, mixer, tremie pipe;
- the project specific required surface finishing materials; and
- all required personnel protective equipment as defined in the Health and Safety Plan.

6.0 Monitoring Well Installation Procedure

Once a stable bore hole has been advanced to the desired depth in accordance with Standard Operating Procedure PSC-103, the installation of a well screen and riser will proceed as follows:

Materials Inspection and Cleaning

- decontaminate both inside and outside of the well screen, bottom plug and riser immediately prior to assembly and installation, using a water source of known chemistry and a mild non-phosphate detergent then rinse with deionized water; store decontaminated riser and screen in an area free of contaminants and cover with plastic sheeting;

- inspect all materials prior to assembly to insure material integrity.

Bore Hole Preparation

- if viscous drilling fluids were introduced to the borehole, then the borehole should be flushed with clean water of known chemistry. This is done to remove all viscous drill fluids from the bore hole which could prevent proper setting of well construction materials;

- record the volume of water introduce into the bore hole and recovered from the bore hole during flushing. The difference in there two volumes requires recovery during well development in addition to the calculated well volume to be removed PSC-121.

- check the total depth of the bore hole using a weighted fiberglass tape and a constant datum such as the ground surface. Bore holes that are partially obstructed by caved or blow-in sediments should be cleared in accordance with Standard Operating Procedure PSC-103 prior to initiating well installation;

- a 1.0 foot thick base layer of filter san should be placed at the base of the bore hole using a decontaminated, flush threaded, one inch internal diameter (minimum) tremie pipe. Alternatively, the filter sand may be added directly between the rise pipe and the auger or casing. Verify the depth of the top of the sand base;

Monitoring Well Pre-assembly

- pre-cut the uppermost section of the well riser so that when the well is in place, the top of the well riser will be approximately 4 to 6 inches below the ground surface for flush finished wells, or 3.0 feet above the ground surface for wells designed with a standpipe finish;

- permanently identify the survey and measuring point on the upper rim of the well riser by cutting a double notch into the rim (Figure 1);

Monitoring Well Installation

- quickly assemble the well within the bore hole by adding sections to the top of the column until the screened section is set at the desired depth. Care should be taken to prevent any materials from entering the well during down hole assembly;

- use of a geosock to prevent fines from entering the well should be discussed on an individual basis per project. If used, slip it on over the screened interval as the well is being assembled.

- cap the well riser to prevent materials from entering the well during construction;

- begin placing the chemically inert filter pack within the annular space surrounding the well screen while simultaneously removing the augers or casing;

- the filter pack should be added slowly in order to prevent bridging of the sand between the riser and the borehole or auger; when adding filter pack below the water table or to a deep well, a tremie pipe should be used;

- add the filter sand until it extends no more than 2.0 feet inside the auger or casing, then pull the casing upward allowing the filter sand to flow from the bottom, filling the resultant annular space. Frequent depth measurements should be taken using a weighted tape to verify the effectiveness of this procedure. The augers or casings should not be extracted in greater than 2.0 foot increments to minimize the potential for native sediments to cave or slump into the annular space;

- continue placing the filter pack until it extends above the screen for a distance equal to approximately 20% of the total screened interval, but not less than 2.0 feet above the top of the screen. Where there is a hydraulic connection between the zone to be monitored and the overlying strata, this upward extension of the filter pack should be minimized, subject to the construction described above, to prevent seepage from upper zones which may result in less than representative sampling;

- it is optional to place a secondary, finer filter pack directly above the first to prevent intrusion of the bentonite seal into the primary filter pack. This filter pack should be designed with a vertical thickness ranging between 0.5 and 2.0 feet. As with the primary filter pack, the secondary filter must not extend into an overlying hydrologic unit. The need for this filter pack should consider the gradation of the primary filter pack, the hydraulic heads between adjacent units, and the potential for grout intrusion into the primary filter pack;

- place an annular sealant seal directly above the filter pack(s) while continuing to remove the augers or casing in 2.0 foot increments. This seal consisting of bentonite pellets or chips, should extend a minimum of 3.0 feet above the top of the filter pack. Frequent depth measurements should be taken using a weighted tape to verify the efficiency of this procedure.

- pour water of a known chemistry over the bentonite pellets or ships if the seal is located in the vadose (unsaturated) zone (i.e., above the water table) to hydrate the bentonite. Record the amount of water added during this procedure for corrected well water removal during well development (PSC-121).

- fill the remaining annular space with a bentonite grount slurry continuing to remove the augers or casing in two foot increments. The slurry should extend to approximately 5.0 to 6.0 feet below ground surface and all augers or casing should be withdrawn. Allow 24 hours to settle and set;

- top-off the grouted column to 5.0 to 6.0 feet below the ground surface and allow to set overnight.

6.0 Standard Surface Finishing Designs

The following defined our standard "flush mount" and "stand pipe" monitoring well finishing procedures:

7.1 Standard Flush Mount Finish

This finishing design (Figure 2) is used when monitoring wells are installed in high traffic areas or other areas where a low profile design is needed. Flush mount wells are less preferable than stand pipe wells because there is a greater chance of surface water entering a flush mount well. The standard flush mount finish is constructed as follows:

- add filter sand to the annular space above the grouted column to a depth of approximately 3.5 feet below ground surface;
- center a 4.0 foot length of 4 or 5 inch diameter steel casing, with locking steel cap into the bore hole. This casing should be placed so that the locking lid rests approximately 2 inches above the top of the capped well riser, and is seated a minimum of 6 inches into the filter sand;
- place a bentonite seal using water of known chemistry;
- place filter sand in the annular space between the well riser and the steel casing to a depth of 1.0 foot below ground surface;
- center a 13 inch diameter, aluminum cast, manhole-type cover equipped with a water tight gasket and a 1.0 foot aluminum vertical extension, over the locking steel casing. The top of the aluminum cover should be approximately a ¼ inch above the ground surface;

- add grout to the excavated area, allowing the grout to flow into the annular spacing surrounding the steel casing. Fill the excavation evenly to a depth of approximately 8 inches below the ground surface and allow to settle and set (to shorten the setting time, the use of adding "quick-set" to the grout is acceptable). The bottom few inches of the aluminum cover should be seated in the cement;

- add cement to the excavated area surrounding the aluminum cover until the cement is flush with the ground surface. Gently grade and smooth the cement from the edge to the cover, so that runoff is away from the well and allow to set;

- permanently identify the well by labeling the cement pad, aluminum cover and lid to the locking steel casing; and

- secure well with an approved brass or hardened-steel lock.

7.2 Standard Stand Pipe Finish

This finishing design (Figure 3) is used when the flush finish design is not needed. The standard stand pipe finish is constructed as follows:

- add filter sand to the annular space above the grouted column to a depth of approximately 1.5 feet below ground surface;

- center a 5.0 foot length of 4 or 5 inch inside diameter steel casing, with locking steel cap into the bore hole. This casing should be placed so that the locking lid rests approximately 2 inches above the top of the capped well riser, and is seated a minimum of 6 inches into filter sand;

- place filter sand in the annular space between the well riser and the steel casing to ground surface;

- excavate a 2.5 foot square which measures approximately 6 inches deep around the edges and grades deeper with depth at a slope of approximately 45° toward the bore hole. Take care to minimize the deposition of soil into the annular space outside the steel casing;

- using 2' x 6' lumber, construct a 3.0 foot square wooden frame and insert the frame into the excavation. Situate the frame so that all edges are flush with the ground surface;

- place three 3.0 foot long steel bumper guards in the excavation to protect the stand pipe from damage resultant from vehicular traffic on the line;

- add cement to the excavated area, allowing the cement to flow into the annular spacing surrounding the steel casing, until the cement is flush with the ground surface. Gently grade and smooth the cement from the edge to the casing, so the runoff is away from the well, and allow to set (to shorten the setting tiem, the sue of adding "quick-set" to the cement is acceptable under cold weather conditions);

- permanently identify the well by labeling the cement pad, stand pipe and lid to the locking steel casing; and,

- secure well with an approved brass or hardened-steel lock and record key number in field log book.

8.0 Documentation

Documentation of all monitoring well installation activities including all geotechnical forms and the maintenance of a detailed field notebook will be recorded in accordance with Standard Operating Procedure PSC-400.

9.0 Measure of Proficiency

Field staff will demonstrate proficiency on this SOP by successfully completing Sections 6.0, 7.0 and 8.0 a minimum of twice under the direct supervision of the Corrective Actions Manager or a designee.

Monitoring Well Development

Written By:	Edited by:	Approved By:	QA Concurrence:
Carolyn Mayer	Tasya Gray	Carolyn Mayer	Kevin McNeil
11/23/97	7/24/01	7/24/01	7/24/01

This SOP contains nine sections:

1.0 Purpose
2.0 Application
3.0 References
4.0 Associated SOPs
5.0 Equipment
6.0 Decontamination
7.0 Well Development Procedures
  7.1 New Well Development Procedure
  7.2 Existing Well Development Procedure
8.0 Documentation
9.0 Measure of Proficiency

1.0 Purpose

The purpose of this SOP is to provide field personnel with a set of guidelines to assure proper monitoring well development. According to EPA all monitoring wells should be developed to create an effective filter pack around the well screen, to rectify damage to the formation caused by drilling, to remove fine particulates from the formation near the borehole, and to assist in restoring the natural water quality of the aquifer in the vicinity of the well.

2.0 Application

This SOP provides a step-by-step guideline to be followed by the field sampling crew for performing or overseeing monitoring well development.

3.0 References

RCRA Groundwater Monitoring Draft Technical Guidance (Nov. 1992) EPA/530-R-93-001

4.0 Associated SOPs

PSC-200 – Equipment Decontamination Procedure
PSC-300 – Photo-ionization Detector Calibration and Operation
PSC-400 – Documentation Procedures

5.0 Equipment

The following equipment is necessary to properly develop a ground water monitoring well:

- A well key, hand drill, socket set, pad lock key, or other well access equipment.
- A calibrated photo-ionization detector (PID) to monitor and record the well headspace.
- An electric water meter and oil/water interface probe calibrated to a hundredth of a foot, and sufficiently long to reach the bottom of the well.
- Well purging equipment (e.g. bailer, silicone line, PVC pipe, plug, pump, tubing, power supply, and extension cord), as needed.
- A solid PVC surge block.
- A sufficient number of 55-gallon drums (including lids, gaskets, and fasteners) to contain all purge water, unless other water handling arrangements have been made.
- A calibrated water quality meter that measures temperature, pH, specific conductivity, dissolved oxygen, redox potential, and turbidity.
- All required documentation including sample labels, field books, sampling forms, and chains-of-custody.
- Personal protective equipment as described in the Site Health and Safety Plan.

- Decontamination equipment as specified in the Work Plan.

6.0 Decontamination

All equipment that will come in contact with the well water will be decontaminated prior to arrival on site, relocation on site, and site exit. Standard Operating Procedure PSC-200 shall be followed.

7.0 Well Development Procedures

Upon arrival at each well, the following procedures shall be followed:

- Suit up in appropriate personal protective equipment as described in the Site Health and Safety Plan.

- Brush any soil or vegetation and pump any standing water away from the well opening.

- Lay plastic sheeting around well to place equipment on and keep cords, tubing and pumps from touching the ground.

- Open the well cap.

- Monitor the headspace within the well using the PID (PSC-300 for PID operation). This is done by placing the instrument probe at the opening of the well, and recording the reading in the field book and on the appropriate field forms.

- Measure and record the depth to LNAPL, water, DNAPL, and total depth of the well using a decontaminated oil/water interface probe or water level indicator (depending on the historical presence of NAPLs in the well). All LNAPL and DNAPL measurements are to be made in accordance with PSC-120. Measurements are to be made to the nearest one hundredth of a foot and recorded in the field book and on the appropriate field form.

- Compute the unit purge volume using the following formula and the input values on the attached Well Volumes Sheet.

  1 well volume (including annular space) = [x(total well depth – water level)] + [y(total well depth – bottom of seal)]

where "x" is the Casing/Riser Volume per Unit Length, Internal (gal/ft) and "y" is the Annular Volume per Unit Length (gal/ft)

7.1 New Well Development Procedure

- If a submersible pump is to be used for well development, gently lower the pump to the well bottom. If a non-submersible pump is used, lower the tubing to the bottom of the well.

- Begin to purge the well at a rate sufficient to remove fines, slowly run the pump up and down the well over the length of the screen, and initiate physical water quality testing at least every 20% water removed for temperature, pH, conductivity, dissolved oxygen, and turbidity.

- A minimum of three and maximum of five well volumes (including annular space) will be removed. If this is the first time the well has been developed and water was used in the drilling process, the volume of water introduced into the formation during well formation must also be removed during development. *Purging is completed once the following has occurred:*
  - *the minimum purge volume has been removed and the water quality parameters have stabilized by the following screening requirements for three consecutive readings: Turbidity <5 NTU, specific conductivity within 10% of each other, and pH within 0.5 units; OR*
  - *the well runs dry; OR*
  - *five purge volumes and drilling process water volumes have been removed.*

- Measure total depth of well after development.

- Containerize all purge water in 55-gallon drums, unless other handling arrangements have been made.

- Record additional information such as unique odors or water color, and a description of the suspended particle content in the field notes and on appropriate field forms.

- Upon completion of development, both the well and the purge drums are to be properly sealed and secured.

- All drums are to be permanently labeled as follows:

Well ID
Facility Name
Drum Contents
Date
Drum Number

- Close the well appropriately and record any well integrity concerns in the field book and on the sampling form.

7.2 Existing Well Development Procedure

- Remove pump from well.
- Attach one length of twine to the surge block or use a drill rig or tripod and lower it to the bottom of the well.
- Vigorously begin moving the surge block up and down in the well creating a surging action across the screened interval. This action will bring the finer grained materials into suspension.
- Remove the surge block.
- Begin to purge the well at a sufficient rate to remove fines and initiate physical water quality testing at a minimum of every 20% water removed for turbidity.
- Repeat surging and purging to reduce silt presence in water and keep checking total depth measurements.
- A minimum of three and maximum of five well volumes (including annual space) will be removed. *Purging is completed once the following has occurred:*
  - *the minimum purge volume has been removed and the water quality parameters have stabilized by the following screening requirements for three consecutive readings: Turbidity <5 NTU, specific conductivity within 10% of each other, and pH within 0.5 units; OR*
  - *the well runs dry; OR*
  - *five purge volumes and drilling process water volumes have been removed.*
- Measure total depth of well after development.

- Containerize all purge water in 55-gallon drums, unless other handling arrangements have been made.

- Record additional information such as unique odors or water color, and a description of the suspended particle content in the field notes and on appropriate field forms.

- Upon completion of development, both the well and the purge drums are to be properly sealed and secured.

- All drums are to be permanently labeled as follows:
  Well ID
  Facility Name
  Drum Contents
  Date
  Drum Number

- Close the well appropriately and record any well integrity concerns in the field book and on the sampling form.

8.0 Documentation

Documentation of all monitoring well development activities including all field forms and the maintenance of a detailed field notebook are described in PSC-400.

9.0 Measure of Proficiency

Field staff will demonstrate proficiency on this SOP by successfully completing sections 6.0, 7.0, and 8.0 a minimum of twice under the direct supervision of the Corrective Actions Manager or her/his designee.

Equipment Decontamination Procedure
SOP No. PSC - 200
Origination Date: 10/28/99
Revision Date:
Revision No.0

Written By:	Approved By:	Date:	QA Concurrence:	Date:
Tasya Gray	Carolyn Mayer	10/28/99	Carolyn Mayer	10/28/99

This SOP contains eight sections:

1.0 Purpose
2.0 Application
3.0 References
4.0 Associated SOPs
5.0 Equipment
6.0 General Decontamination Procedures
  6.1 Water Level Indicator Decontamination Procedure
  6.2 Oil/Water Interface Probe Decontamination Procedure
7.0 Specific Decontamination Procedures
  7.1 Grundfos EZ-Reel Portable Pump Decontamination Procedure
8.0 Documentation
9.0 Measure of Proficiency

1.0 Purpose

The purpose of this SOP is to provide field personnel with an outline of the procedure and frequency of decontaminating equipment that has come into contact with monitoring well water.

2.0 Application

This SOP provides a step-by-step guideline to be followed by the field sampling crew to prevent cross-contamination between monitoring wells and preserve well integrity.

3.0 References

RCRA Groundwater Draft Technical Guidance (EPA, 1992)

6.2 Decontamination When Inorganic Constituents Are of Interest

- Wash the equipment with a solution of nonphosphate detergent (Alconox) and water.
- Rinse the equipment with tap water.
- Rinse the equipment with 10% Nitric Acid solution.
- Rinse the equipment with DI water.

7.0 Specific Decontamination Procedures

7.1 Non-Dedicated Submersible Pump Decontamination Procedure

After sampling or developing a well using a non-dedicated submersible pump, decontaminate the pump as follows:

- Use hose to spray off EZ-Reel with tap water.
- Place pump into the PVC pipe.
- Fill the PVC pipe with tap water and Alconox.
- Run the pump until the pipe is empty, refilling it with tap water 3 times, running the discharge decontamination water into a 55-gallon drum.
- Remove the pump and wash out the pipe using tap water from the hose.
- Place the pump in the pipe again and fill with tap water.
- Repeat the process, running the pump until the pipe empties 3 times, then fill the pipe with 1L of Hexane.
- Repeat the process, running the pump until the pipe empties, then remove the pump and rinse out the pipe with tap water.
- Place the pump back in the pipe and fill with tap water.
- Run the pump until the pipe empties 3 times, then fill the pipe with 1L of 10% Nitric Acid.
- Run the pump until it empties, then rinse it with di-ionized water and refill the pipe with di-ionized water.
- Run the pump until the pipe empties three times with the di-ionized water.

8.0 Documentation

Documentation of all decontamination procedures associated with monitoring well activities including all field forms and the maintenance of a detailed field notebook as described in PSC-400.

Documentation Procedures

Written By:	Approved By:	Date:	QA Concurrence:	Date:
Carolyn Mayer	Carolyn Mayer	11/23/97	Laurel Muselwhite	11/23/97

This SOP contains seven sections:

1.0 Purpose
2.0 Application
3.0 References
4.0 Associated SOPs
5.0 Field Books
6.0 Field Forms
7.0 Measure of Proficiency

1.0 Purpose

The purpose of this SOP is to outline, in detail, the required documentation needed to maintain accurate logs and files of all field procedures conducted by Philip Services Corporation (PSC).

2.0 Application

This SOP provides documentation guidelines, including examples, required for all geotechnical exploratory and sampling procedures conducted or overseen by PSC personnel (see Table 1).

3.0 References

None

4.0 Associated SOPs

PSC-100	PSC-101	PSC-102	PSC-103
PSC-104	PSC-110	PSC-111	PSC-120
PSC-121	PSC-122	PSC-123	PSC-124
PSC-125	PSC-126	PSC-127	PSC-200
PSC-201	PSC-202	PSC-300	PSC-301
PSC-302			

5.0 Field Books

All field books should be pocket size "Rite in the Rain" or equivalent and should have non-removable pages. These field books are to be dedicated to a project, and the corrective actions' project manager is responsible for maintaining a field book inventory. This inventory should include a numbering and tracking mechanism for each field book assigned to a particular case.

Each field book is to be maintained as follows:

- Label the outside front cover with the following information: Burlington Environmental dba Philip Services Corporation, Facility Name, Dates Included, and Book Number. The inside cover should include: Burlington Environmental d.b.a. Philip Services Corporation, Project Manager's Name, 955 Powell Avenue, Renton, WA 98155, (206) 227-XXXX, Dates Included, and Book Number.

- Inside the cover, list the full names and initials of each person working on the project that will be referred to in the field book.

- Maintain all field notes directly in the field books (i.e. notes are not to be taken then transferred to the field books at a later time).

- Record all field notes in permanent ink (sharpie markers)

- Initial, date, and number each page upon completion.

- Correction of mistakes are made with a single line and initialing the correction.

- Avoid blank spaces within the notes. Unavoidable blank spaces are to be struck with a single line.

Examples of information required in the field book include:

- The date of entry
- Time of entry for specific events (in military time)
- A meteorological description of daily changes
- Personnel present including arrival and departure times and affiliations
- Make, model and condition of equipment used
- The time interval and reasons for delays including a detailed description of corrective actions taken by the field crew.
- A detailed description and rationale for any deviations for the Work Plan, Sampling Plan, or Health and Safety Plan.

6.0 Field Forms

The field forms have been designed to detail all steps, actions, and readings associated with specific field procedures. These forms are to be completed in full. No sections are to be left blank, if a section is "not applicable", it is to be indicated as such. All forms, including location diagrams, are to be completed in the field with permanent ink. Refer to Table 1 to see which forms are required for specific field procedures. Examples of each form are also attached.

7.0 Measure of Proficiency

Proficiency assessment for documentation is associated with specific procedural proficiency, therefore, no separate proficiency measures for documentation are needed.