TECHNICAL MEMORANDUM

Additional Groundwater Characterization Investigation Work Plan

PREPARED FOR:	Tom Alcamo - EPA
PREPARED BY:	CH2M
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PROJECT NUMBER:	677664CH
REVISION NO.:	01

962314

CH2M HILL, Inc. (CH2M) has prepared this investigation work plan (IWP) for the U.S. Environmental Protection Agency (EPA) to describe the methods and procedures that will be implemented during supplemental remedial design investigation (RDI) activities at the Velsicol Chemical Corporation/Pine River Superfund Site (site) located in St. Louis, Michigan. The data collection activities described in this technical memorandum will be used to support the remedial designs (RDs) for multiple components of the OU1 remedy described in the June 22, 2012, Record of Decision (ROD; EPA 2012), specifically:

- In situ chemical oxidation of Potential Source Area (PSA) 3.
- New dense nonaqueous phase liquid (DNAPL)/groundwater collection system (GWCS) segment near WMW-19.
- DNAPL collection sump near WMW-48D.
- Groundwater pump and treat system.
- Perimeter drain system.
- Vertical barrier.

Liquids collected from the DNAPL/GWCS, DNAPL collection sump, groundwater pump and treat system, and perimeter drain system will all be conveyed to an onsite water treatment plant (WTP). The primary purpose of this work is to help refine the understanding of contaminant distribution in groundwater that will be treated by the WTP. A portion of the work performed under this IWP will provide supplemental data for the upgradient slurry wall (UGSW) investigation that was performed in 2019 and 2020, and will ultimately be used for the vertical barrier RD. This work is being performed under Work Assignment Form No. 201-RDRD-0532, Contract No. EP-S5-06-01.

Site Description

The site, National Superfund database identification number MID00722439, encompasses a 52-acre land parcel commonly referred to as the former plant site (FPS) and includes the adjacent or nearby properties (ANP). A chemical plant once occupied the FPS, which is in a predominantly residential area. The Pine River flows along the western and northern boundary of the FPS into Mill Pond, where a hydroelectric dam is located (about 0.25 mile east of the FPS). The boundary of the 52-acre FPS is fenced and gated for access control; in the absence of site personnel, the gates providing access to the property are securely locked to prevent site entry. Figure 1 shows the FPS location and the surrounding operable units.

The Velsicol Chemical Corporation/Pine River Superfund Site consists of four OUs, as follows:

- OU1—FPS and ANP
- OU2—Contaminated sediments in the Pine River downstream of the site to the St. Louis hydroelectric dam (for which the RA has been completed)
- OU3—Pine River sediments stretching from the St. Louis hydroelectric dam to approximately 1.25 miles downstream of the dam, for which feasibility study (FS) activities are ongoing
- OU4—Pine River sediments stretching from approximately 1.25 miles downstream of the St. Louis hydroelectric dam to the confluence of the Pine, Chippewa, and Tittabawassee rivers, for which remedial investigation (RI) activities are ongoing

EGLE was the lead agency during the RI/FS project phases, and EPA was the support agency. EPA is the lead agency for the RD and RA phases, and EGLE is the support agency.

Field Activities

Field activities will include static water level measurements and groundwater monitoring and sampling.

Site-wide Static Water Level Measurements

A site-wide groundwater elevation measuring event will be performed prior to the start of groundwater sampling. Groundwater elevations will be used during the RD to evaluate groundwater flow, update the site groundwater flow model, and create a transient flow model. Table 1 presents the manual groundwater-level monitoring network. Monitoring well locations are illustrated on Figure 2. The FOP for groundwater level and total depth measurements is included in Attachment 1.

During manual groundwater-level measurement activities, the material condition of each monitoring well will be inspected and documented. The results of the material inspection will be submitted to EPA.

Groundwater Sampling

Groundwater samples will be collected from the monitoring wells listed in Table 2. These locations were chosen to support one or more future designs for the remaining components of the OU1 remedy. Groundwater sampling is anticipated to occur in October or November 2020. Monitoring well locations are illustrated on Figure 2. Samples will be submitted to the subcontract laboratory(ies) for analysis.

The FOPs for groundwater sampling activities, field water quality measurements, sampling instrument calibration, and equipment decontamination procedures are included in Attachment 1. All wastes generated will be handled according to the Investigation Derived Waste (IDW) section (below) and the IDW Handling and Disposal FOP (Attachment 1).

Groundwater samples will be collected using low flow sampling techniques. Groundwater samples collected from each monitoring well will be purged at a rate of less than 0.5 liters per minute using a bladder pump or a peristaltic pump (depending on depth to groundwater) and clean, disposable, down-hole tubing. Samples will be collected into certified, clean containers provided by the subcontract laboratory(ies).

Samples and the associated quality assurance/quality control samples will be submitted to the subcontract laboratory(ies) for analysis in accordance with the *Final Quality Assurance Project Plan Addendum 1, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan, Operable Unit 1—Former Plant Site Remedial Design* (QAPP; CH2M 2017). Samples will be analyzed for the parameters listed in Table 3. Field tests will also be performed to determine the ferrous iron ($Fe2^{+}$) concentration at each monitoring well that is sampled.

Field Quality Assurance/Quality Control

All RDI field activities will follow quality assurance procedures in accordance with the CH2M QAPP (CH2M 2017). A brief summary of the quality assurance procedures is discussed in the following subsections.

Field Duplicate Samples

Field duplicates (FDs) are two (or more) field samples taken at the same time in the same location. They are intended to represent the same population and are taken through all steps of the analytical procedure in an identical manner. These samples are used to assess precision of the entire data collection activity, including sampling, analysis, and site heterogeneity. Duplicate samples are collected simultaneously or in immediate succession, using identical recovery techniques, and are treated in an identical manner during storage, transportation, and analysis. Duplicate samples will be analyzed at a rate of at least one per 10 samples collected.

Equipment Blanks

Equipment blanks will be collected and analyzed to determine the effectiveness of equipment decontamination procedures in accordance with the FOP on Equipment Blank Preparation (Attachment 1). Equipment blanks will be collected for non-disposable sampling equipment that contacts sample media (i.e. tubing), and at a minimum of one per week or one per event, whichever is more frequent, per sampling crew for each set of decontaminated equipment type. Equipment blanks will be collected immediately after the equipment has been decontaminated. Equipment blanks will not be collected for single-use sampling equipment (i.e. disposable tubing).

A consistent volume of laboratory-grade distilled and deionized water will be poured directly into or over the decontaminated sampling equipment and then collected in a sample container and submitted for laboratory analysis.

Matrix Spike/Matrix Spike Duplicate

Matrix spike (MS)/matrix spike duplicate (MSD) sample is an aliquot of sample spiked with known concentrations of specific analytes. The spiking occurs before sample preparation and analysis at the laboratory. MS/MSD samples will be used by the laboratories to assess the precision and accuracy of sample analysis. Sample containers will be filled and stored in the same manner as FD samples. The frequency for MS/MSD sample collection and analysis will be at least 1 per 20 samples collected.

Temperature Blanks

A temperature blank will be included in each cooler to allow the laboratory receiving the shipment of samples to determine if the samples have been maintained at the proper temperature. Temperature blanks will consist of an unpreserved sample container filled with distilled water. One temperature blank will accompany each sample cooler being shipped to the laboratory.

Sample Nomenclature

Samples will be labeled in accordance with the QAPP (CH2M 2017). A sample identification (ID) system will be used to identify each sample, including duplicate and blank samples. The sample number will be a unique identifier, which is required by the Earthsoft EQuIS Site Management software, and compatible with EPA's EDMAN Electronic Data Deliverables format.

Each sample, regardless of analytical protocol, will also be assigned a CH2M site-specific identifier, which will contain a sampling area and sample-specific location identifier that indicates where the sample was obtained. The sample number and station location identifier will be included on the sample label and chain-of-custody record.

The site-specific identifier is based on the following system:

- **Site**—VCS (Velsicol Chemical Site)
- **Sampling Area**—Operable Unit 1 (OU1)
- **Sample Matrix**—The sample matrix location code consists of 2 letters indicating one of the types of sample locations as follows:
  - GW = Groundwater
  - EB = Equipment Blank
  - IDW = Investigation-Derived Waste Disposal Sample
- **Station Location**—The well identification numbers and letters will be included in the sample nomenclature.
- **Sample Date** – The date the sample was collected in MMDDYY format.
- **QC Samples**—FDs will have an "FD" appended to the end of the station location identifier. MS/MSDs are not identified in the station location identifier, but are identified in the Special Instructions section of the chain-of-custody form.

Examples

- **VCS-OU1-GW-WMW31D-110220** is a groundwater sample collected from monitoring well WMW-31D on November 2, 2020, in the FPS.
- **VCS-OU1-GW-WMW21S-110220** is a groundwater sample collected from monitoring well WMW-21S on November 2, 2020, in the FPS.
- **VCS-OU1-EB-002** is the second (002) EB sample collected for samples collected under this IWP.
- **VCS-OU1-GW-WMW31D-110220-FD** is an FD of VCS-OU1-GW-WMW31D-110220, which is a groundwater sample collected from monitoring well WMW-31D on November 2, 2020, in the FPS.

Sample Handling and Management

Samples will be labeled, packaged, and shipped to the subcontract laboratory(ies) in accordance with the QAPP (CH2M 2017) and the Sample Handling and Chain-of-Custody Procedures, and Packing and Shipping of Environmental Samples FOPs (Attachment 1). The field team leader (FTL) or designee will be responsible for sample collection, sample packing, and coordination of sample shipments. Samples will be individually identified and labeled after collection in accordance with the Sample Identification Procedures outlined in the QAPP (CH2M 2017), and placed inside a plastic cooler with bagged ice. Sample information will then be entered into the sample management program (Scribe) and a chain-of-custody record will be generated. Sample labels may be preprinted with static information, minimizing the amount of data that must be entered in the field. Any changes to label information by the sampler will require the accompaniment of the sampler's initials. The following information will be included on the label:

- SAS Number—EPA unique number for sample tracking
- Sample ID
- Date of collection
- Time of collection (using 24-hour clock)
- Analytical parameters
- Preservative used (if any)

The chain-of-custody record will be enclosed inside a re-sealable plastic bag and placed inside the cooler to accompany the samples. Once sample packing is complete, the cooler will be sealed using strapping tape, custody seals, and clear packaging tape to cover the custody seals. Samples will be transported to

the subcontract laboratory by same day courier service (provided by the subcontract laboratory) or shipped overnight via FedEx.

Field Documentation

The FTL or designee(s) will record information pertinent to field activities in a field logbook as outlined in the Note-taking and Field Logbook FOP (Attachment 1). The following information will be included:

- Heading including date, project name and specific task, client, and physical location.
- Site conditions, health and safety tailgate topics, and quality tailgate topics.
- Names, titles, and organization of personnel onsite, names and titles of visitors, and times of visits.
- Field observations; time of specific activities; details on sampling activities, including type of sampling, time of sampling, and sample numbers; references to field forms used and/or type of document generated; and lists and descriptions of photographs taken to document field activities.
- Specific problems, including equipment malfunctions and their resolutions.
- Unexpected or adverse field conditions that may inhibit the field team's ability to perform the day's activity or that may affect the accuracy of the data collected.
- Decontamination of sampling equipment.
- Equipment Calibration Records:
    - Calibration of the YSI-600 water quality meter and Hach turbidity meter, for groundwater parameter monitoring, is to be performed daily following the FOP on Field Water Quality Measurements and Calibration included in Attachment 1. Calibration is to be performed using standardized calibration materials.
    - Calibration of the photoionization detector (PID; discussed in the Health and Safety section) is to be performed daily following the PID calibration and operation FOP included in Attachment 1.
- Additional information may be recorded at the discretion of the FTL.

Field personnel will complete, sign and date forms in the field and submit them daily to the Field Quality Manager (FQM). The FQM will review the data sheets to ensure that all necessary information has been recorded. Dates and times will be compared across field documentation (for example, sample labels and chain-of-custody forms will be compared to field data sheets and the field notebook) to ensure consistency. Completed and reviewed field forms will be filed onsite in a project-specific file.

At the conclusion of the event, scanned copies of all field records, chain-of-custody forms, and photos will also be uploaded to a specified network location.

Health and Safety

CH2M will abide by U.S. Occupational Safety and Health Administration (OSHA) regulations and the site-specific health and safety plan (HASP) (CH2M, 2020). The HASP will be kept onsite during all field activities and a copy will be maintained in the project files. Prior to onsite field activities, CH2M field personnel will conduct a field chartering meeting during which the scope of work, site-specific, and task-specific hazards are reviewed.

Personal Protective Equipment

Personal Protective Equipment (PPE) must be worn by field personnel at all times when actual or potential hazards exist. All field personnel will refer to and follow procedures outlined in the HASP (CH2M, 2020). Fieldwork for this RDI will be performed in Modified Level D:

- Work clothes or cotton overalls.
- Safety-toe, chemical-resistant boots, or safety-toe leatherwork boots with outer rubber boot covers.
- Surgical-style nitrile gloves.
- Hardhat.
- Safety glasses with side shield protection.
- Hearing protection.

Air Monitoring

Air monitoring procedures will be completed in accordance with the HASP (CH2M, 2020). The potential presence of volatile organic compounds within the FPS requires air monitoring using a PID to monitor the breathing zone during sampling activities. Air monitoring activities will be documented in the field book and/or field data sheets. Documented information will include the following:

- Calibration information
- Weather conditions
- Monitoring well ID/sample location
- Instrument reading
- Date and time of the reading

The PID(s) will be calibrated daily utilizing compressed gas cylinders per manufacturer's instructions and as outlined in the PID calibration and operation FOP. Calibration results will be recorded in the field logbook and/or on equipment calibration forms as a record of equipment accuracy and consistency. If equipment calibration does not meet manufactures specifications or if equipment is not operating correctly it will not be used.

Coordination with Other On-Site Activities

Other on-site activities will be in progress during the groundwater sampling event, including, but not limited to in situ thermal treatment system construction and weekly groundwater collection trench operations and waste hauling. The FTL will coordinate with other CH2M staff and subcontractors, as appropriate, to notify them of the groundwater level measuring and sampling activities.

Field Equipment Decontamination

Dedicated, single-use sampling equipment will be used during groundwater sample collection when possible. Equipment that will be used at multiple locations (i.e. water level meters) will be decontaminated with a thorough scrub using Alconox/Liquinox and clean water between well locations.

Investigation Derived Waste

Solid IDW (PPE and used sampling equipment – i.e. disposable tubing and nitrile gloves) generated during groundwater sampling activities will be placed in garbage bags and disposed in the onsite dumpster.

Liquid IDW (decontamination water) generated during field activities is expected to be minimal and will be placed in the existing frac tank onsite and be disposed during routine waste water removal

operations. Since there are multiple frac tanks onsite, field staff will communicate with the FTL prior to transferring IDW from the 5-gallon buckets to ensure the IDW is placed in the appropriate frac tank.

Reporting

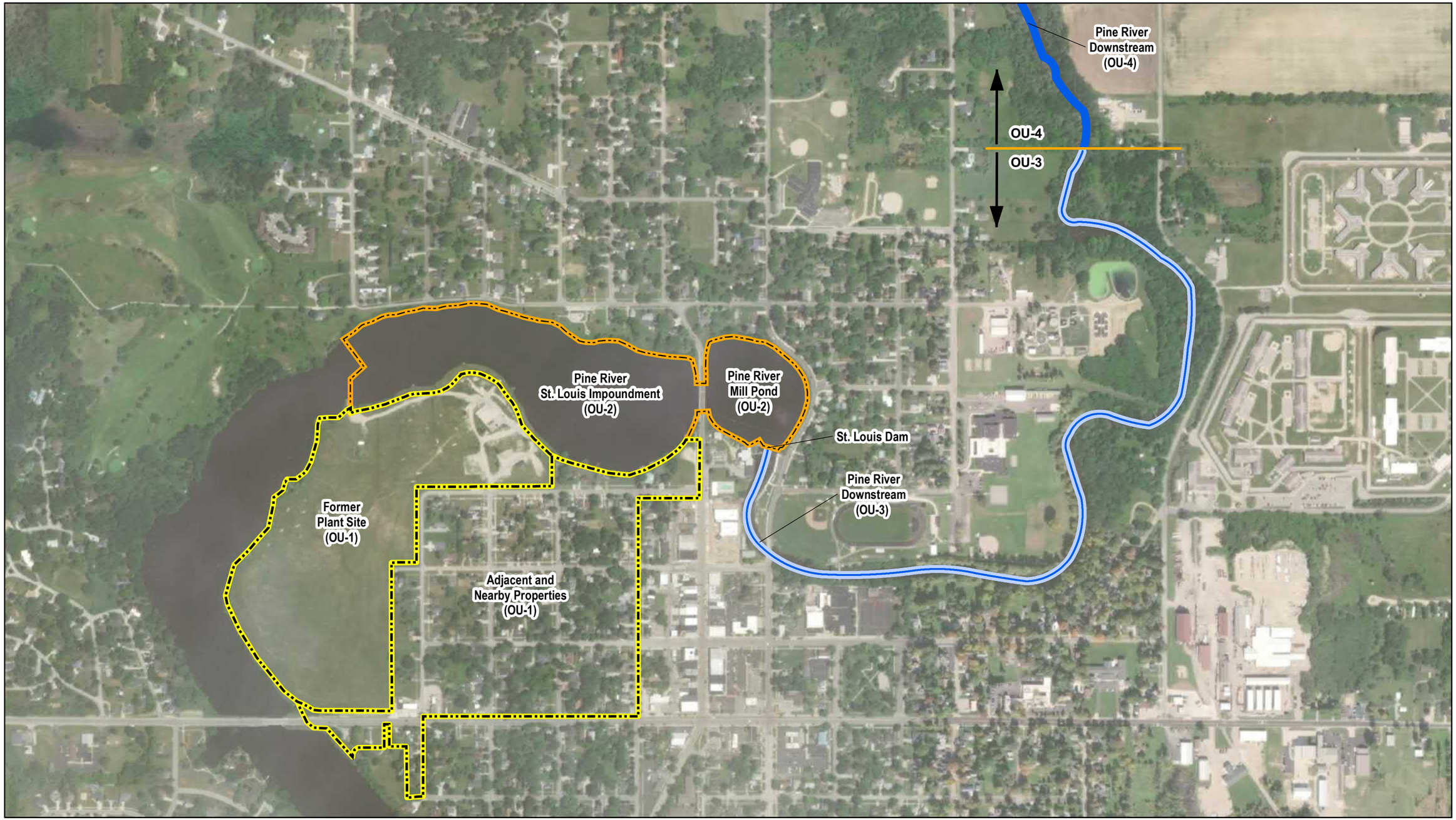
Upon receipt of the analytical results, a technical memorandum (TM) summarizing the groundwater monitoring event will be submitted. The TM will include text, figures, summary table(s), and the data validation report.

References

CH2M HILL, Inc. (CH2M). 2017. *Final Quality Assurance Project Plan Addendum 1, Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan, Operable Unit 1—Former Plant Site Remedial Design.* May.

CH2M HILL, Inc. (CH2M). 2020. *Health and Safety Plan, Velsicol Chemical Superfund Site, St. Louis, Michigan*. April.

Figures



Legend

- Former Plant Site and Adjacent and Nearby Properties (OU-1)
- Pine River - St. Louis Impoundment (OU-2)
- Pine River (OU-3)
- Pine River (OU-4)

N

0 300 600
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Figure 1
Study Areas and Operable Units
Upgradient Slurry Wall Investigation
Velsicol Chemical Corporation Superfund Site
St. Louis, Michigan

ch2m

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FIGURE 2

Manual Groundwater Level Monitoring Well Network

Velsicol Chemical Corporation Superfund Site

St. Louis, Michigan

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Tables

Table 1. Manual Groundwater Level Monitoring Well Network

Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Shallow Unit	Till Unit	Lower Unit	City Well Intake Zone Unit
CMW11S	CMW11I	CMW11D	MSW-5 (Sentry)
CMW12S	CMW12I	CMW12D	MSW-6 (Sentry)
CMW14S	CMW13I	CMW14D	MSW-7 (Sentry)
CMW15S	CMW14I	CMW15D	MSW-8 (Sentry)
CMW16S	CMW15I	CMW16D	MW-31D4 (Sentry)
CMW20S	CMW16I	CMW17D	MW-35D3 (Sentry)
CMW21S	CMW17I	CMW18D	MSW-36D4 (Sentry)
CMW23S	CMW19I	CMW19D	MSW-38D4 (Sentry)
CMW24S	CMW20I	CMW20D	WMW-47D
CPZ-1X	CMW21I	CMW21D	WMW-48D2
CPZ-1I	CMW22I	CMW23D	WMW-49D
CPZ-1IP	CMW23I	CMW24D	WMW-50D
CPZ-2X	CMW24I	CATW1D	WMW-51D
CPZ-2I	WMW-17I	CATW2D	WMW-53D
CPZ-3X	WMW-19I	CATW3D	WMW-55D
CPZ-3I	WMW-21I	CATW4D	
CPZ-4X	WMW-22I	GWM-1D	
CPZ-4I	WMW-24I	GWM-7D	
CPZ-4IP	WMW-29I	GWM-10D	
CPZ-5X	WMW-30I	GWM-14D	
CPZ-5I	WMW-31I	GWM-15D	
CPZ-6X	WMW-34I	GWM-16D	
CPZ-6I	WMW-37I	WMW-16D2a	
CPZ-7X	WMW-38I	WMW-17D	
CPZ-7I	WMW-40I	MW-17D2	
CPZ-8X	WMW-41I	WMW-18D	
CPZ-8I	WMW-42I	WMW-19DR	
CPZ-8IP	WMW-44I	WMW-19D2	
CPZ-9X	WMW-45I	WMW-20D	
CPZ-9I	WMW-46I	WMW-21DR	
CPZ-9IP	WMW-47I	WMW-21D2R	
CPZ-10X	WMW-48I1	WMW-22D	
CPZ-10I	WMW-48I2	WMW-24D	
CPZ-11X	WMW-49I	WMW-27D	
CPZ-11I	WMW-50I	WMW-28D	
CPZ-12X	WMW-52I	WMW-30D	
CPZ-12I	WMW-53I	WMW-31D	
CPZ-12IP	WMW-54I	WMW-31Da	
CPZ-13X	WMW-55I	WMW-32D	
CPZ-13I	MW-16I	WMW-33D	
CPZ-14X	MW-21I	WMW-36D	
CPZ-14I	MW-23I	WMW-37D	
CPZ-14IP	MW-27I	WMW-38D	
CPZ-15X		WMW-39D	
CPZ-15I		WMW-40D	
CPZ-16X		WMW-41D	
CPZ-16I		WMW-42D	
CPZ-17X		WMW-43D	
CPZ-17I		WMW-44D	
CPZ-17IP		WMW-48D1	
CPZ-18X		WMW-52D	
CPZ-18I		WMW-54D	
CPZ-19X			
CPZ-19I			
CPZ-20X			
CPZ-20I			

Table 1. Manual Groundwater Level Monitoring Well Network
Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Shallow Unit	Till Unit	Lower Unit	City Well Intake Zone Unit
CPZ-20IP			
CPZ-21X			
CPZ-21I			
CPZ-22X			
CPZ-22I			
CPZ-23X			
CPZ-23I			
CPZ-23IP			
CPZ-24X			
CPZ-24I			
CPZ-25X			
CPZ-25I			
CPZ-26X			
CPZ-26I			
CPZ-26IP			
CPZ-27X			
CPZ-27I			
CPZ-28X			
CPZ-28I			
CPZ-29X			
CPZ-29I			
CPZ-29IP			
CPZ-30X			
CPZ-30I			
CPZ-31X			
CPZ-31I			
CPZ-32X			
CPZ-32I			
CPZ-32IP			
CPZ-33X			
CPZ-33I			
CPZ-34X			
CPZ-34I			
CPZ-35X			
CPZ-35I			
CPZ-36X			
CPZ-36I			
CPZ-36IP			
CPZ-37X			
CPZ-37I			
CPZ-38X			
CPZ-38I			
CPZ-38IP			
CPZ-39X			
CPZ-39I			
CPZ-40X			
CPZ-40I			
CPZ-40IP			
CPZ-41X			
CPZ-41I			
CPZ-42X			
CPZ-42I			
GWM-1A			
GWM-1B			
GWM-1C			
GWM-2			

Table 1. Manual Groundwater Level Monitoring Well Network
Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Shallow Unit	Till Unit	Lower Unit	City Well Intake Zone Unit
GWM-3			
GWM-4a			
GWM-5a			
GWM-6			
GWM-7			
GWM-8			
GWM-9			
GWM-10			
GWM-11			
GWM-12A			
GWM-13			
GWM-14			
GWM-16S			
WMW-17S			
WMW-18S			
WMW-19S			
WMW-20S			
WMW-21S			
WMW-22S			
WMW-23S			
WMW-24S			
WMW-25S1			
WMW-25S2			
WMW-26S1			
WMW-26S2			
WMW-27S			
WMW-28S			
WMW-30S			
WMW-31S			
WMW-37S			
WMW-38S			
WMW-39S			
WMW-40S			
WMW-41S			
WMW-42S			
WMW-44S			
WMW-46S			
WMW-47S			
WMW-50S			
WMW-53S			
WMW-54S			
MPZ-20			
MPZ-22			
MPZ-23			
MPZ-24			
MPZ-25			
MPZ-26			
MPZ-27			
MPZ-28			
WPZ-01X			
WPZ-01I			
WPZ-02X			
WPZ-02I			
WPZ-03X			
WPZ-03I			
WPZ-04X1			

Table 1. Manual Groundwater Level Monitoring Well Network
Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Shallow Unit	Till Unit	Lower Unit	City Well Intake Zone Unit
WPZ-04X2			
WPZ-04I			
WPZ-05X			
WPZ-05I			
WPZ-05IP			
WPZ-06X			
WPZ-06I			
WPZ-06IP			
WPZ-07X			
WPZ-07I			
WPZ-07IP			
WPZ-08X			
WPZ-08I			
WPZ-08IR			
WPZ-08IP			
WPZ-09X			
WPZ-09I			
WPZ-09IP			
WPZ-10X			
WPZ-10I			
WPZ-10IP			
WPZ-11X1			
WPZ-11X2			
WPZ-11I			
WPZ-11IP			
WPZ-12X			
WPZ-12I			
WPZ-12IP			
WPZ-13X			
WPZ-13I			
WPZ-14X			
WPZ-14I			
WPZ-14IP			
WPZ-15X			
WPZ-15I			
WPZ-15IP			
WPZ-16X			
WPZ-16I			
WPZ-16IP			
WPZ-17			
WPZ-18			

Table 2. Monitoring Well Sampling Network

Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Count	Monitoring Well ID	Hydrogeologic Unit	Reason for Sample Collection
1	WMW-48D1	Lower	**Gauge for NAPL only**. DNAPL collection sump RD and WTP RD
2	WMW-48D2	Lower	DNAPL collection sump RD and WTP RD
3	CMW-19I	Till	DNAPL/GWCS Expansion
4	MW-34I	Till	DNAPL/GWCS Expansion
5	WMW-19I	Till	DNAPL/GWCS Expansion
6	CMW-11D	Lower	GES
7	CMW-12D	Lower	GES
8	CMW-14D	Lower	GES
9	CMW-15D	Lower	GES
10	CMW-16D	Lower	GES
11	CMW-17D	Lower	GES
12	CMW-18D	Lower	GES
13	CMW-20D	Lower	GES
14	CMW-21D	Lower	GES
15	CMW-23D	Lower	GES
16	GMW-07D	Lower	GES
17	MW-31D	Lower	GES
18	MW-31D4	Lower	GES
19	MW-31DA	Lower	GES
20	MW-35D3	Lower	GES
21	WMW-16D2A	Lower	GES
22	WMW-19DR	Lower	GES
23	WMW-21DR	Lower	GES
24	WMW-30D	Lower	GES
25	WMW-33D	Lower	GES
26	WMW-36D	Lower	GES
27	WMW-40D	Lower	GES
28	WMW-42D	Lower	GES
29	WMW-43D	Lower	GES
30	WMW-44D	Lower	GES
31	CMW-11S	Shallow	Perimeter Drain
32	CMW-12S	Shallow	Perimeter Drain
33	CMW-15S	Shallow	Perimeter Drain
34	CMW-16S	Shallow	Perimeter Drain
35	CMW-20S	Shallow	Perimeter Drain
36	CMW-23S	Shallow	Perimeter Drain
37	CMW-24S	Shallow	Perimeter Drain
38	G13 (GWM-10)	Shallow	Perimeter Drain
39	GMW-02	Shallow	Perimeter Drain
40	GMW-03	Shallow	Perimeter Drain
41	GMW-05A	Shallow	Perimeter Drain
42	GMW-06	Shallow	Perimeter Drain
43	GMW-13	Shallow	Perimeter Drain
44	WMW-17S	Shallow	Perimeter Drain
45	WMW-18S	Shallow	Perimeter Drain

Table 2. Monitoring Well Sampling Network

Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Count	Monitoring Well ID	Hydrogeologic Unit	Reason for Sample Collection
46	WMW-19S	Shallow	Perimeter Drain
47	WMW-20S	Shallow	Perimeter Drain
48	WMW-21S	Shallow	Perimeter Drain
49	WMW-22S	Shallow	Perimeter Drain
50	WMW-23S	Shallow	Perimeter Drain
51	WMW-25S1	Shallow	Perimeter Drain
52	WMW-25S2	Shallow	Perimeter Drain
53	WMW-26S1	Shallow	Perimeter Drain
54	WMW-26S2	Shallow	Perimeter Drain
55	WMW-40S	Shallow	Perimeter Drain
56	WMW-41S	Shallow	Perimeter Drain
57	WMW-42S	Shallow	Perimeter Drain
58	CMW-14S	Shallow	PSA-3
59	GMW-04A	Shallow	PSA-3
60	GMW-07	Shallow	PSA-3
61	WMW-44S	Shallow	PSA-3
62	CPZ-27I	Shallow	Supplemental Data Collection for UGSW Evaluation
63	CPZ-27X	Shallow	Supplemental Data Collection for UGSW Evaluation
64	CPZ-28I	Shallow	Supplemental Data Collection for UGSW Evaluation
65	CPZ-28X	Shallow	Supplemental Data Collection for UGSW Evaluation
66	CPZ-29I	Shallow	Supplemental Data Collection for UGSW Evaluation
67	CPZ-29X	Shallow	Supplemental Data Collection for UGSW Evaluation
68	MW-31S	Shallow	Supplemental Data Collection for UGSW Evaluation (ANP)
69	WMW-24S	Shallow	Supplemental Data Collection for UGSW Evaluation (ANP)
70	WMW-38S	Shallow	Supplemental Data Collection for UGSW Evaluation (ANP)
71	WMW-39S	Shallow	Supplemental Data Collection for UGSW Evaluation (ANP)

Table 3. Sample Analysis

Velsicol Chemical Corporation Superfund Site, St. Louis, Michigan

Analysis Group[1] / Analyte	Container(s)[2]	Analytical Method	Analytical Lab
VOCs	(3) 40-ml glass vials with HCl to pH <2 preservation	SW-846 8260	TBD
SVOCs	(2) 1-L amber glass	SW-846 8270	TBD
Pesticides	(2) 1-L amber glass	SW-846 8081	TBD
PCBs	(2) 1-L amber glass	SW-846 8082	TBD
Total Metals	(1) 500-mL plastic	SW-846 6010/6020	TBD
Alkalinity	(1) 250-mL plastic	SM 2320	TBD
Chloride	(1) 250-mL plastic	EPA 300	TBD
Sulfate	(1) 500-mL plastic	EPA 300	TBD
Nitrate	(1) 500-mL plastic	EPA 300	TBD
Bromide	(1) 250-mL plastic	EPA 300	TBD
Nitrite	(1) 500-mL plastic	EPA 300	TBD
Ammonia	(1) 500-mL plastic	EPA 350	TBD
Total Organic Carbon (TOC)	(3) 40-ml glass vials with H3PO4 to pH<2 preservation	EPA 415	TBD
4-Chlorobenzene Sulfonic Acid (pCBSA)	(1) 125-mL plastic	SW-846 8321	TBD
Field Tests - See Table 2 for wells that require field testing			
Ferrous Iron (Fe^{2+})	NA	Hach Colorimeter and Fe^{2+} Reagent	NA

[1]For full list of analytes in specific analysis group, consult project chemist.

[2]Container list is anticipated and will be updated once lab subcontract is awarded.

Attachment 1

FIELD OPERATING PROCEDURE

Equipment Blank Preparation

I. Purpose and Scope

The purpose of this field operating procedure (FOP) is to prepare blanks to determine whether decontamination procedures are adequate and whether any cross-contamination is occurring during sampling because of contaminated air and dust. The general protocols for preparing equipment blanks are outlined in this FOP. The actual equipment to be rinsed will depend on the requirements of the specific sampling procedure.

II. Equipment and Materials

- Blank liquid (use ASTM International [ASTM] Type II or laboratory-grade water)
- Millipore (or similar) deionized water
- Sample bottles as appropriate
- Gloves
- Preservatives as appropriate

III. Procedures and Guidelines

Decontaminate all sampling equipment that has come in contact with sample according to FOP *Equipment Decontamination Procedures.*

To collect an equipment blank for volatile analysis from the surfaces of sampling equipment other than pumps, pour blank water over one piece of equipment and into two 40-milliter vials until there is a positive meniscus, then seal the vials. Note the sample number and associated piece of equipment in the field notebook as well as the type and lot number of the water used.

For nonvolatiles analyses, one aliquot is to be used for equipment. For example, if a pan and trowel are used, place trowel in pan and pour blank fluid in pan such that pan and trowel surfaces that contacted the sample are contacted by the blank fluid. Pour blank fluid from pan into appropriate sample bottles.

Do not let the blank fluid come in contact with any equipment that has not been decontaminated.

When collecting an equipment blank from a pump, run an extra gallon of deionized water through the pump while collecting the pump outflow into appropriate containers. Make sure the flow rate is low when sampling volatile organic compounds. If a Grundfos Redi-Flo2 pump with disposable tubing is used, remove the disposable tubing after sampling but before decontamination. When decontamination is complete, put a 3- to 5-foot segment of new tubing onto the pump to collect the equipment blank.

To collect a field blank, slowly pour ASTM Type II or laboratory-grade water directly into sample containers. Document and ship samples in accordance with the procedures for other samples. Collect next field sample.

IV. Attachments

None.

V. Key Checks and Items

- Wear gloves.
- Do not use any nondecontaminated equipment to prepare blank.
- Use ASTM-Type II or laboratory-grade water.

FIELD OPERATING PROCEDURE

Equipment Decontamination Procedures

I. Purpose and Scope

The purpose of this field operating procedure (FOP) is to provide general guidelines for the decontamination of personnel, sampling equipment, monitoring equipment and heavy equipment used in potentially contaminated environments.

II. Equipment and Materials

- Distilled or deionized water
- 2.5-percent (W/W) Alconox, Liquinox, or equivalent phosphate-free detergent and water solution
- Large plastic pails or tubs for Alconox, Liquinox, or equivalent and water, scrub brushes, squirt bottles for detergent solution resealable plastic bags, paper towels, and sheets
- 55-gallon drum approved by the U.S. Department of Transportation (DOT) for disposal of waste OR an onsite 5,000-gallon double-walled with inherent secondary containment storage tank (or equivalent).
- Unpowdered chemical-resistant gloves (i.e., nitrile gloves)
- Aluminum foil
- Brooms and other brushes for dry cleaning of large pieces of soil on heavy equipment
- Steam pressure washer
- Decontamination area for heavy equipment (e.g., drill rigs, backhoe, DPT, tooling) with secondary containment to capture decontamination water.

III. Procedures and Guidelines

Heavy Equipment Decontamination

The following procedures are to be performed after the completion of tasks whenever the potential for contamination exists and upon leaving the exclusion zone:

1. Use a broom or brush to remove large pieces of impacted soil on all heavy equipment, before mobilizing to next boring. Place soil in appropriate investigation-derived waste drums.
2. After the final depth has been attained and all samples have been collected, retrieve all tooling and casing from ground.
3. Powerwash rotosonic tooling and casing as it is retrieved from ground. Containerize decontamination water beneath the rig and transfer to portable container before transferring to final staging area onsite.
4. Powerwash backhoe bucket with steam cleaner and collect water in secondary containment system.
5. Power wash Geoprobe rods in the decontamination area.
6. Decontaminate sensitive membrane interface probes following manufacturers' recommendations.
7. Transfer decontamination water from portable tank to 5,000-gallon double-walled with inherent secondary containment storage tank (or equivalent) using a sump pump and hose.

8. All heavy equipment only requires final decontamination with steam power washer when demobilizing from the Velsicol Former Plant Site. All decontamination water should be contained and transferred to storage tanks in the staging area.

Personnel Decontamination

The following procedures are to be performed after the completion of tasks whenever the potential for contamination exists and upon leaving the exclusion zone:

1. Wash boots in detergent solution, and then rinse with water. If disposable latex booties are worn over boots in the work area, remove and discard into a DOT-approved 55-gallon drum.
2. Remove and discard outer chemical-resistant gloves into a DOT-approved 55-gallon drum.
3. Remove disposable coveralls (Tyveks) and discard into a DOT-approved 55-gallon drum (if worn).
4. Remove respirator (if worn). Dispose of filter cartridges and replace daily.
5. Remove inner gloves and discard.
6. Shower entire body at the end of the workday, including hair, either at the work site or at home.
7. Sanitize respirator (if worn).

Sampling Equipment Decontamination—Other Equipment

Reusable sampling equipment is decontaminated after each use as follows:

1. Wear unpowdered chemical-resistant gloves.
2. Rinse and scrub with potable water.
3. Wash all equipment surfaces that came in contact with the potentially contaminated soil/water with detergent solution.
4. Rinse with potable water.
5. Rinse with distilled water.
6. Completely air dry or wipe dry with a clean paper towel. Wrap exposed areas with aluminum foil (shiny side out) or enclose equipment in clean plastic for transport and handling if equipment will not be used immediately.
7. Collect all rinsate and place in a DOT-approved 55-gallon drum.
8. Dispose of decontamination materials (e.g., plastic sheeting and tubing) that have come in contact with used decontamination fluids or sampling equipment in DOT-approved 55-gallon drums.

Health and Safety Monitoring Equipment Decontamination

1. Wrap soil contact points in plastic before use, to reduce need for subsequent cleaning.
2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with detergent solution, and finally twice with a towel (wet with distilled water). Dispose of all used paper towels in a DOT-approved 55-gallon drum.

Sample Container Decontamination

The outside of sample bottles or containers filled in the field may need to be decontaminated before being packed for shipment or handled by personnel without hand protection. The procedure for sample container decontamination is as follows:

1. Wipe container with a paper towel dampened with detergent solution, or immerse in the solution **after the containers have been sealed**. Repeat the above steps using potable water.

2. Dispose of all used detergent solution and paper towels in a DOT-approved 55-gallon drum or in trash bags placed into appropriate dumpsters, keeping liquids and solids in separate drums.

IV. Attachments

None.

V. Key Checks and Items

- Do not use acetone for decontamination.
- Drum or place in dual-walled onsite container all contaminated rinsate.
- Clean sampling tools with solutions of Alconox, Liquinox, or equivalent phosphate-free detergent and distilled water.

FIELD OPERATING PROCEDURE

Field Water Quality Measurements and Calibration

I. Purpose

This document provides a general guideline for using the YSI 600XLM or similar device for field water quality measurements (such as pH, specific conductance, dissolved oxygen, oxidation reduction potential [ORP], and temperature) and using a device for measuring turbidity. The operator's manual should be consulted for detailed calibration and operating procedures.

II. Scope and Applicability

All water quality measurements will be taken in accordance with this field operating procedure (FOP). Record keeping to document calibration activities and environmental sample results will be documented in the field logbook in accordance with FOP *Note-Taking and Field Logbook*.

III. Example Equipment and Materials

- Nitrile gloves
- Field notebook
- YSI 600XLM Water Quality Meter, or similar device
- Distilled or deionized water in spray bottle
- Liquinox in spray bottle
- Calibration standard solution for pH (4, 7, and 10), conductivity, and ORP
- HACH turbidity meter, or similar device

IV. Procedures / Guidelines

Calibration

Before each day's use, clean the YSI probe according to the manufacturer's direction and calibrate using specified solutions. Follow the instructions provided with the water quality meter. If there is a problem with calibration, the meter will return an error. In this case, the cause of the error must be researched in the manual or with the supplier of the equipment before using. Calibrate temperature probe with a laboratory-grade thermometer using hot and cold tap water to establish accuracy over a range of temperatures.

Prior to each day's use, confirm calibration of the Hach turbidity meter according to the manufacturer's direction. Turbidity will be measured in nephelometric turbidity units.

Sample Measurement

As the water passes through the probe, allow readings to stabilize and record in the field notebook or on proper documentation sheets.

IV. Attachments

None.

V. Key Checks/Items

- Calibrate meters

- Clean probe with Liquinox and rinse with deionized or distilled water before calibrating, between calibration fluids, and when done
- Refer to operations manual for recommended maintenance
- Check batteries, and have a replacement set on hand
- Store the YSI probe in nondeionized water when not in use to prevent damage to the dissolved oxygen membrane; if the membrane is damaged, the replacement method can be found in the manual

Groundwater Sampling Procedures

I. Purpose and Scope

This field operating procedure (FOP) presents general guidelines for collecting groundwater or groundwater grab samples from monitoring wells using low-flow sampling techniques. The *Water Level and Total Depth Measurements* FOP should be consulted in conjunction with this FOP.

II. Equipment and Materials

- Field logbook and waterproof pen
- Clean latex or nitrile gloves
- Clean Department of Transportation (DOT)-approved 55-gallon steel drums with labels or other labeled container(s)
- Clean 5-gallon bucket
- Groundwater pump
  - Adjustable rate, submersible pumps are preferred (centrifugal or bladder pump)
  - Peristaltic pump with portable battery may be used with caution. EPA guidance states that that "suction pumps are not recommended because they may cause degassing, pH modification, and loss of volatile compounds."
- Water level meter
- Groundwater quality meter capable of collecting groundwater quality parameters using a flow-through cell (YSI or similar water quality meter; capable of measuring temperature, specific conductance, dissolved oxygen, turbidity, pH, and oxidation-reduction potential [Eh, or oxidation reduction potential (ORP)] or equivalent)
- Hach DR900 Colorimeter, or equivalent
- Ferrous Iron Reagent Powder Pillows
- Turbidity meter to obtain more accurate turbidity readings
- Disposable Teflon tubing
- Disposable silicon tubing (for peristaltic)
- Measuring cup to assess flow rate
- 1-micron filter for dissolved phase target analyte list (TAL) metals sample collection (if included in analyte list)
- Stopwatch
- Equipment/instrument decontamination materials (see *Equipment Decontamination Procedures* FOP)
- Laboratory-supplied analytical sample containers

Water Quality Indicator Parameters

The six field indicator parameters to be monitored include dissolved oxygen, turbidity, ORP, specific conductance, pH, and temperature. Of the parameters, dissolved oxygen, ORP, specific conductance, pH, and temperature are moderately to extremely sensitive to contact with atmospheric oxygen and will be measured in-line using a flow-through cell. Turbidity also will be measured separately to reduce the influence of suspended solids that are

retained in the flow-through cell. Indicator parameters will be monitored continuously during purging and values recorded every 5 minutes.

Dissolved Oxygen, ORP, Specific Conductance, pH, and Temperature

The stabilization criteria for dissolved oxygen, ORP, specific conductance, pH, and temperature are three successive readings separated by a time interval sufficient to pump at least one sampling tubing volume plus flow-through cell volume of water through the system at a flow rate equal to or greater than 100 milliliters per minute (mL/min) but less than 500 mL/min while not lowering the water level in the well more than 0.5 foot, within the following ranges:

- Dissolved oxygen: ±0.1 milligrams per liter (mg/L) for values less than 1 mg/L, *or* ±10 percent for values greater than 1 mg/L
- Eh (ORP): ±10 millivolts (mV)
- Conductivity: ±20 micromhos per centimeter (μmho/cm)
- pH: ±0.1 unit
- Temperature: ±0.5 degrees Celsius (°C)

Note: A minimum of three system volumes must be purged before evaluating whether stabilization criteria are met and purging is complete before sampling.

Turbidity

Turbidity is considered stabilized if values are less than 50 nephelometric turbidity units (NTUs) for 3 successive readings. If the other parameters stabilize but turbidity remains greater than 50 NTUs, field personnel should continue purging at the determined sustainable flow rate to determine whether the turbidity decreases with additional pumping. If turbidity does not decrease, the project manager should be notified. It should be noted that turbidity measurements may not stabilize within the aforementioned criteria before collecting a sample in accordance with the procedures for purging a low-recovery well.

III. Procedures and Guidelines

1. Set up and calibrate instruments in accordance with manufacturer's instructions.
2. Decontaminate sampling equipment and other instruments to be placed in the monitoring well riser before sampling in accordance with the *Equipment Decontamination Procedures* FOP.
3. Measure the depth to groundwater before performing low-flow sampling, as described in the *Water Level and Total Depth Measurements* FOP. **Do not measure the depth to the bottom of the well at this time** in order to reduce the possibility that accumulated sediment in the well will be disturbed. Obtain total well depth from the monitoring well development log, or acquire total depth during water level measurements, but the well should not be sampled the same day as depth to bottom is measured.
4. Place field equipment and supplies on clean plastic sheeting to minimize contamination.
5. Determine the system volume, which is the volume of water that will pass through the tubing in the well, pump, and flow-through cell. A minimum of three system volumes must be purged before evaluating whether stabilization criteria are met and purging is complete before sampling.
6. Follow these procedures if using a peristaltic pump:
    a. Connect the silicone tubing to the peristaltic pump.
    b. Lower the Teflon tubing slowly to the top of the water column. The field team should use a tape measure to measure out the tubing.
    c. Place the tubing intake at the depth where the highest contaminant concentrations are present. If this depth is unknown, place the tubing intake in the middle of the well screen if the entire length of the well

screen is below the potentiometric surface. If the potentiometric surface is within the well screen, the intake should be set approximately 2 feet off the bottom of the well to minimize the intake of fines accumulated on the bottom of the well and maximize the length of water column above the tubing intake.

d. Cut the Teflon tubing, secure to the top of the well riser with a clamp, and connect to the silicone tubing in the peristaltic pump. Allow extra polyethylene tubing in case the water does not recharge as fast as the pumping rate, so the tubing can be lowered farther into the well.

e. Ensure that the pump flow direction is correct on the peristaltic pump. It is best to verify the flow direction before connecting the polyethylene tubing by inserting the silicone tubing in a cup of distilled water.

f. Connect silicone tubing to the water quality meter flow through cell (bottom connector). Run the outlet tubing (upper connector) to the 5-gallon bucket.

7. Follow these procedures if using a centrifugal pump:

   a. Connect Teflon tubing to pump.

   b. Lower the pump slowly to the required depth, and use a tape measure to measure the tubing.

   c. Place the pump intake at the depth where the highest contaminant concentrations are present. If this depth is unknown, place the pump intake in the middle of the well screen if the entire length of the well screen is below the potentiometric surface. If the potentiometric surface is within the well screen, the intake should be set approximately 2 feet off the bottom of the well to minimize the intake of fines accumulated on the bottom of the well and maximize the length of water column above the tubing intake.

   d. Connect the Teflon tubing to the bottom of the flow through cell. Run the outlet tubing from the upper connector to the 5-gallon bucket.

8. Start pumping. Purge rate should be less than 500 mL/min. Monitor the water level carefully after beginning the pumping process.

9. Turn on the groundwater parameter field instrument and let the readings stabilize. Once temperature has stabilized for 30 seconds, record initial groundwater parameters and depth to groundwater on a groundwater purging and sampling form.

10. Containerize purged groundwater initially in a plastic 5-gallon bucket and subsequently transfer to a clean 55-gallon steel drum or other labeled storage container.

11. Purge to stability with a total water surface drop of 0.5 foot or less if water level is stable or only slowly dropping, to ensure stagnant water stored in the well casing is not being sampled and that only fresh groundwater is sampled.

12. Monitor carefully if water level is dropping more than 0.3 foot every 5 minutes. Consider lowering the purge rate to keep the water level drop to less than 0.3 foot every 5 minutes, and a total water table drop of 0.5 foot or less.

13. Do not sample at this time if the decline in the water level continues at more than 0.3 foot every 5 minutes and the flow rate is 150 mL/min or less, and if the water table does not stabilize at a 0.5-foot or less drop below the water table in the well prior to purging, because only stagnant water standing in the well is entering the pumping system. Call the project manager or senior consultant and determine another method for sampling the well.

14. Disconnect the Teflon tubing from the flow-through cell if the well was purged. **Groundwater samples must never be collected from the outlet of the flow-through cell.** When collecting samples, ensure that the flow rate of the pump is equal to or less than the flow rate used to purge the monitoring well. Collect groundwater samples directly from the outlet of the polyethylene tubing starting with volatile organic compound (VOC) samples first.

15. If sampling for dissolved phase TAL metals, collect by attaching a 1-micron filter to the tubing and purging the water through the filter and into the sample jar.
16. Follow the attached procedures to complete field testing for ferrous iron. Record results on sampling form.
17. Label the sample containers following the collection of groundwater samples, and place the samples in an ice-bearing cooler away from sources of cross-contamination.
18. Remove the tubing from monitoring well and discard. Secure the well cap and lid on the well immediately after removing the tubing to prevent objects from being dropped in the well.
19. Decontaminate all equipment and instruments in accordance with the *Equipment Decontamination Procedures* FOP.
20. Store instruments in accordance with the manufacturer's instructions.
21. Purged groundwater will be handled in accordance with the site management plan.

IV. Attachments

- Hach Testing Procedures for Ferrous Iron
- Low Flow Groundwater Sampling Form

V. Key Checks and Items

- Ensure that the water quality meters are calibrated and cared for in accordance with manufacturer's instructions.
- Keep sampling system and monitoring probes out of direct sunlight.
- Verify dissolved oxygen readings by checking reported dissolved oxygen against a chart and correlating theoretical readings at actual site temperatures. Do not record any dissolved oxygen readings that are outside theoretical limits or that do not make sense, such as negative concentrations.
- Check that the flow direction switch on the peristaltic pump is in the correct direction. Flow in the wrong direction may create bubbles in the well riser, thus affecting dissolved oxygen readings.
- Charge battery to peristaltic pump and water quality meter when not in use. Low battery on the water quality meter may not allow unit to connect properly with sonde.

Iron, Ferrous

DOC316.53.01049

1,10-Phenanthroline Method[1] **Method 8146**

0.02 to 3.00 mg/L Fe^{2+} **Powder Pillows**

Scope and application: For water, wastewater, seawater, brine solutions, produced waters and hydraulic fracturing waters.

[1] Adapted from Standard Methods for the Examination of Water and Wastewater, 15th ed. 201 (1980).

Test preparation

Instrument-specific information

Table 1 shows all of the instruments that have the program for this test. The table also shows sample cell and orientation requirements for reagent addition tests, such as powder pillow or bulk reagent tests.

To use the table, select an instrument, then read across to find the applicable information for this test.

Table 1 Instrument-specific information

Instrument	Sample cell orientation	Sample cell
DR6000 DR3800 DR2800 DR2700 DR1900	The fill line is to the right.	2495402
DR5000 DR3900	The fill line is toward the user.	
DR900	The orientation mark is toward the user.	2401906

Before starting

Samples must be analyzed immediately after collection and cannot be preserved for later analysis.
Install the instrument cap on the DR900 cell holder before ZERO or READ is pushed.
For the best results, measure the reagent blank value for each new lot of reagent. Replace the sample with deionized water in the test procedure to determine the reagent blank value. Subtract the reagent blank value from the sample results automatically with the reagent blank adjust option.
Review the Safety Data Sheets (MSDS/SDS) for the chemicals that are used. Use the recommended personal protective equipment.
Dispose of reacted solutions according to local, state and federal regulations. Refer to the Safety Data Sheets for disposal information for unused reagents. Refer to the environmental, health and safety staff for your facility and/or local regulatory agencies for further disposal information.

Items to collect

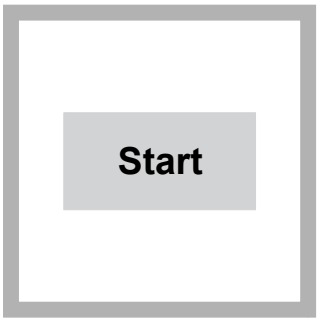
Description	Quantity
Ferrous Iron Reagent Powder Pillows, 25 mL	1
Sample cells. (For information about sample cells, adapters or light shields, refer to Instrument-specific information on page 1.)	2

Refer to Consumables and replacement items on page 4 for order information.

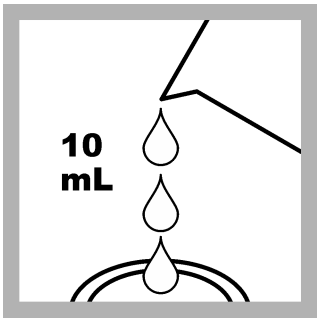
Sample collection

- Analyze the samples immediately. The samples cannot be preserved for later analysis.
- Collect samples in clean glass or plastic bottles with tight-fitting caps. Completely fill the bottle and immediately tighten the cap.
- Prevent agitation of the sample and exposure to air.

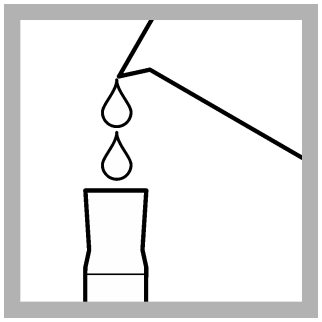
Test procedure



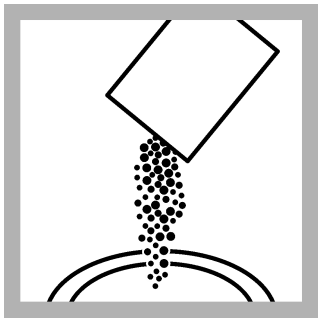
1. Start program **255 Iron, Ferrous**. For information about sample cells, adapters or light shields, refer to Instrument-specific information on page 1.



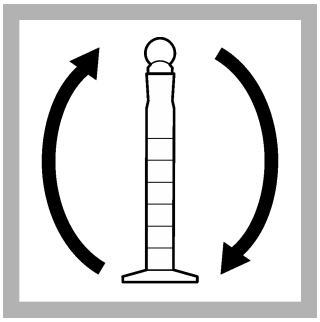
2. Prepare the blank: Fill the sample cell with 10 mL of sample.



3. Prepare the sample: Fill a mixing cylinder to the 25-mL line with sample.

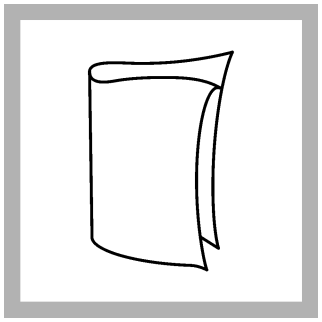


4. Add the contents of one Ferrous Iron Reagent Powder Pillow to the mixing cylinder.
An orange color shows if ferrous iron is present in the sample.

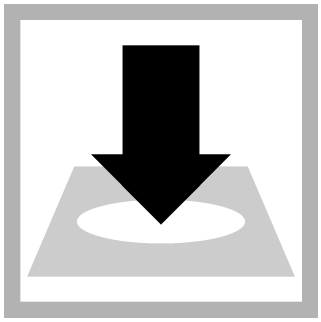


5. Put the stopper on the mixing cylinder. Invert the mixing cylinder several times to mix.
Undissolved powder does not affect accuracy.

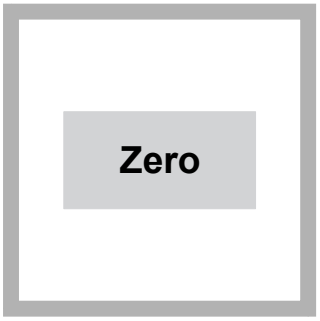
6. Start the instrument timer. A 3-minute reaction time starts.



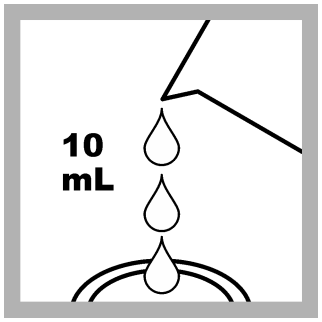
7. When the timer expires, clean the blank sample cell.



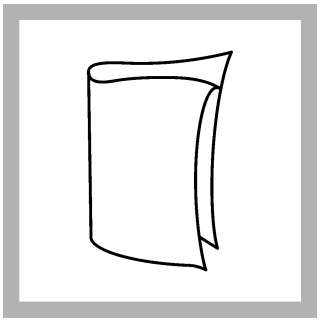
8. Insert the blank into the cell holder.



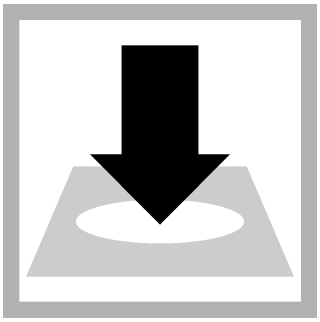
9. Push **ZERO**. The display shows 0.00 mg/L Fe^{2+}.



10. Fill a second sample cell with 10 mL of the reacted prepared sample.



11. Clean the prepared sample cell.



12. Insert the prepared sample into the cell holder.

13. Push **READ**. Results show in mg/L Fe^{2+}.

Accuracy check

Standard solution method

Use the standard solution method to validate the test procedure, the reagents and the instrument.

Items to collect:

- Ferrous Ammonium Sulfate, hexahydrate
- 1-L volumetric flask, Class A
- 100-mL volumetric flask, Class A
- 2-mL volumetric pipet, Class A and pipet filler
- Deionized water

1. Prepare a 100-mg/L Fe^{2+} ferrous iron stock solution as follows:
   a. Add 0.7022 g of ferrous ammonium sulfate, hexahydrate into a 1-L volumetric flask.
   b. Dilute to the mark with deionized water. Mix well.
2. Prepare a 2-mg/L ferrous iron standard solution as follows:
   a. Use a pipet to add 2.00 mL of the 100-mg/L Fe^{2+} ferrous iron stock solution into a 100-mL volumetric flask.
   b. Dilute to the mark with deionized water. Mix well. Prepare the standard solution immediately before use.
3. Use the test procedure to measure the concentration of the prepared standard solution.
4. Compare the expected result to the actual result.

   Note: *The factory calibration can be adjusted slightly with the standard calibration adjust option so that the instrument shows the expected value of the standard solution. The adjusted calibration is then used for all test results. This adjustment can increase the test accuracy when there are small variations in the reagents or instruments.*

Method performance

The method performance data that follows was derived from laboratory tests that were measured on a spectrophotometer during ideal test conditions. Users can get different results under different test conditions.

Program	Standard	Precision (95% confidence interval)	Sensitivity Concentration change per 0.010 Abs change
255	2.00 mg/L Fe^{2+}	1.99–2.01 mg/L Fe^{2+}	0.021 mg/L Fe^{2+}

Summary of method

The 1,10-phenanthroline indicator in the Ferrous Iron Reagent reacts with ferrous iron (Fe^{2+}) in the sample to form an orange color in proportion to the iron concentration. Ferric iron (Fe^{3+}) does not react. The ferric iron concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test. The measurement wavelength is 510 nm for spectrophotometers or 520 nm for colorimeters.

Consumables and replacement items

Required reagents

Description	Quantity/test	Unit	Item no.
Ferrous Iron Reagent Powder Pillow, 25 mL	1	100/pkg	103769

Recommended standards and apparatus

Description	Unit	Item no.
Balance, analytical, 80 g x 0.1 mg 100–240 VAC	each	2936701
Ferrous Ammonium Sulfate, hexahydrate, ACS	113 g	1125614
Flask, volumetric, Class A, 1000 mL glass	each	1457453
Pipet filler, safety bulb	each	1465100
Pipet, volumetric, Class A, 1.00 mL	each	1451535
Water, deionized	4 L	27256
Wipes, disposable	280/pkg	2097000

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08/2019, Edition 11

Low Flow Ground Water Sampling Form

Project Name: Velsicol Chemical Corporation Superfund Site RDI Project Number: 677664CH Page

Sample Source (Well No./Location): _____ Date: _____

Weather Conditions: _____

Well Condition: _____

Sample Team:

Well Stabilization Data

Well Datum: TOC Purge Method: Low Flow Time Purging begins (T_o): _____

Well Diameter & Type: _____ Equipment: _____ Water Level at time T_o: _____

Well Depth: _____ (ft) _____ Time Purging ends (T_1): _____

Static Water Level: _____ (ft) _____ Water Level at time T_1: _____

Water Column: _____ (ft) _____

System Volume: _____ (gal) _____

Pump intake: _____ (ft bgs) PID Reading: _____

***Purge minimum of 3 system volumes before evaluating whether stabilization criteria is met and purging is complete before sampling.**

Time	Volume Removed (gal)	pH ±0.1 unit	SPCOND (mS/cm) ±20 µmho/cm = ±0.02 mS/cm	TEMP (deg C) ±0.5 degrees Celsius	Eh/ORP (mV) ±10 millivolts	Water level (ft)	DO (mg/L) < 1mg/L = ±0.1 mg/L; > 1mg/L = ±10 %	Turbidity (NTU) < 50 NTU	Purge rate (mL/min) < 500 mL/min with drawndown < 0.5 ft	Appearance

Sample Information

Sample ID: _____

Analysis: _____

Ferrous Iron Concentration: _____ mg/L

Date: _____

Time: _____

Field Filtering: N/A

Laboratory: _____

Method of Shipment: _____

Remarks : _____

FIELD OPERATING PROCEDURE

Groundwater Level and Total Depth Measurements

I. Purpose and Scope

This field operating procedure (FOP) provides guidelines for measuring depths to groundwater and total depth in soil borings, piezometers, and monitoring wells. This FOP also covers the topic of measuring nonaqueous phase liquid (NAPL) that may be present. It includes only guidelines for discrete measurements of static groundwater levels.

II. Equipment and Materials

- Field logbook and waterproof pen
- Equipment/instrument decontamination materials (see FOP *Equipment Decontamination Procedures*)
- Well keys and wrenches/T-bar
- Clean latex or nitrile gloves
- Electronic water level meter or oil/water interface probe (Solinst or equivalent) with a minimum 100-foot tape with graduations in increments of 0.01-foot or less

III. Procedures and Guidelines

1. Set up instrument in accordance with manufacturer's instructions.
2. Decontaminate equipment/instruments in accordance with FOP *Equipment Decontamination Procedures*.
3. Open the protective cover on well.
4. Unlock and remove all monitoring well caps. A minimum time of 30 minutes shall be allotted between the removal of a well cap and measuring the depth to groundwater in the same monitoring well unless the well casing has a hole in it to allow barometric pressures to constantly equilibrate. This will allow the groundwater surface within the riser to stabilize with atmospheric pressure prior to taking a depth to water measurement.
5. Lower the probe slowly into the monitoring well or soil boring until the probe just contacts the groundwater surface; the unit will respond with a tone or light signal. Make sure that the top of the riser pipe does not have a sharp edge that may damage the protective coating around the wires in the tape.
6. Note the depth to groundwater relative to a reference point indicated on the monitoring well riser pipe. If no reference is clearly visible, reference the northern edge of the riser pipe or soil boring. Measure the distance from this point to the closest interval marker on the tape, and record the water level reading in the field logbook.
7. Measure water levels to the nearest 0.01-foot.
8. Record the condition of the concrete pad, padlock, well cap, protective cover, and bollards (if present) in the field logbook, along with the depth to the groundwater surface.
9. Compare the newly measured depth to water in each well to the historical depth to water in that and adjacent wells and re-measure if the new data are outside the historical range for an individual well or if the new data are inconsistent with general patterns of water table rise and fall, considering all wells being monitored. (For example, if most wells measured are generally a few feet higher than the past monitoring event but one well is measured as being several feet lower than past data indicate, re-measure and verify the depth.)

10. The total depth of the monitoring well or soil boring should be measured and recorded in the field logbook every time the well is monitored. The total well depth shall be measured in the same general manner as the depth to groundwater, except that no indication light or buzzer will be produced by the instrument when bottom is reached. Instead, the field personnel will have to monitor the relative weight of the tape and probe as it is lowered into the well and use feel to determine when bottom is reached. The feel of the bottom of the well should also be recorded. This would be soft if the bottom appears to be covered in silt, or firm if the bottom feels clean.
11. Decontaminate the probe and tape as it is removed from the well or boring in accordance with FOP *Equipment Decontamination Procedures*.

If NAPL (dense or light) is anticipated or encountered, an oil/water interface probe shall be used to determine the depth to the top of NAPL and depth to groundwater. If NAPL is encountered, a solid tone will sound from the oil/water interface probe. The probe must be lowered very slowly through the NAPL to obtain an accurate depth to groundwater without agitating the NAPL. When the probe passes through the NAPL and contacts groundwater, the solid tone will change to a beeping tone. The depths to both media shall be measured in the same manner as previously discussed and recorded in the field logbook. If possible, the color and consistency of the NAPL should also be recorded in the field logbook.

IV. Attachments

None.

V. Key Checks and Items

- Verify that the battery of the water level meter or oil/water interface probe is charged before each use by pressing the test button on the side of the unit.
- Verify that the unit is operating correctly by testing the probe in tap water (not distilled or deionized water) and verifying that the light and buzzer are activated at the same depth. If one measures higher or lower than the other, continue testing in tap water and determine which indicator is more accurate, and use that indicator for the field measurements.
- Inspect the tape for abrasions that may have exposed the wires. The unit will not function properly if there is a short in the wiring.
- It is recommended that a map of all wells to be monitored be carried into the field when monitoring occurs.
- Prior to mobilizing to the site, use historical data to determine which wells to be monitored are cleanest and which are dirtiest/most contaminated, and start monitoring with the clean wells first and move to the more contaminated wells last.

Investigation-derived Waste Handling and Disposal

I. Purpose and Scope

This field operating procedure (FOP) covers the handling and disposal of IDW, which are the waste materials generated during a field investigation. Some of the waste materials may be classified as hazardous waste. All IDW must be disposed of in accordance with local, state, and federal regulations.

Materials that may become IDW requiring proper treatment, storage and disposal include the following:

- Personal protective equipment (PPE), such as disposable coveralls, gloves, booties, and respirator canisters.
- Disposable equipment, such as plastic ground and equipment covers, aluminum foil, Teflon tubing, broken or unused sample containers, sample container boxes, and tape.
- Excessive soil from sampling activities
- Groundwater obtained through well development, purging or sampling.
- Decontamination fluids such as spent solvent and wash water.

II. Equipment and Materials

- Field logbook and waterproof pen
- Waste Tracking Log
- 55-gallon drums approved by the U.S. Department of Transportation
- Ratchet wrench
- Waste labels: “Analysis Pending”, “Nonhazardous Waste”, and “Hazardous Waste”
- Clean latex or nitrile gloves

III. Procedures and Guidelines

All IDW will be handled in accordance with federal and state regulations, as well as any site-specific requirements. If IDW is identified as potentially hazardous waste based on analytical data, it must be segregated from IDW that will be treated as nonhazardous for further characterization.

The following IDW will be placed in 55-gallon drums approved by the U.S. Department of Transportation:

- Used PPE identified as potentially hazardous waste

The following IDW will be temporarily containerized, then transported to the staging area and transferred into a 5,000-gallon double-walled with inherent secondary containment storage tank (or equivalent):

- Purge water
- Decontamination fluids

All IDW **not identified as potentially hazardous waste** will be managed as follows:

- Used PPE will be placed in containers or trash bags and disposed of as a solid waste in an appropriate licensed landfill.

Labeling

All IDW containers will be labeled to identify their waste status. Labels shall be obtained from the field team leader. Containers being used to store/accumulate waste shall include one of the following labels:

- “Nonhazardous Waste”
- “Analysis Pending” or “Waste Material”
- “Hazardous Waste”

Before affixing the label, prepare containers by wiping any residue from outer surfaces that may prevent legible and permanent labeling. Labels will include the following information:

- Type of waste
- Location from which the waste was generated
- Accumulation start date
- Any other information required (that is, point of contact with phone number)

Waste Accumulation Area Management

All IDW identified as potentially hazardous will be transferred as soon as practical to a temporary storage area inside the Velsicol Former Plant Site as identified by the field team leader. The following requirements apply to the waste storage areas:

- Hazardous wastes and waste awaiting designation will be stored separately in the waste accumulation area.
- All containers will be stored on wooden pallets.
- Store containers in rows based on the waste stream designators.

Offsite Disposal

Offsite IDW disposal will be coordinated by the Subcontractor following applicable state and federal regulations. Arrangements will be made immediately upon completion of drilling and sampling activities to have the contracted waste handling firm remove the waste from the site. The need for waste disposal analysis will be determined as discussed with the contract waste handler before the onset of field events.

IV. Attachments

Waste Tracking Log (can be modified for project needs)

V. Key Checks and Items

- Perform a visual inspection to verify that drums are not damaged prior to use. Do not use damaged drums for IDW storage or disposal.
- Ensure that there is enough space between drums for inspection.
- Keep labels on drums out of direct sunlight to avoid fading.
- Update Waste tracking Log daily.
- Inspect waste accumulation area weekly, at a minimum. Note observations in field logbook.

Form A.13 Waste Tracking Log

TO No	Project No	Project Name	Site Description	Container Type	Container Desig.	Waste Profile Sample No	Sub-contractor	Transporter	Date Transported	Transporter EPA ID	Load ID	Disposal Facility	Disp Fac EPA ID	Media	Waste Type (Haz, Nonhaz, TSCA)	Waste Code/ Haz Waste No	Disposal Date	Manifest Number	Disposal Treatment Method (Enter disposal quantity under appropriate method)					Certif of Disp/ Destruc Date	Comments/ Notes	File Status (see note)
																			Incineration	Recycle	Landfill	Other	Unit			

FIELD OPERATING PROCEDURE

Multi RAE Photoionization Detector Calibration and Operation

I. Purpose and Scope

The purpose of this Field Operating Procedure (FOP) is to provide general reference information for using the Multi RAE photoionization detector (PID) in the field. Calibration and operation, along with field maintenance, is included in this FOP. Review of the owner's instruction manuals is a necessity for more detailed descriptions.

II. Definitions

- ppm - parts per million: parts of vapor or gas per million parts of air by volume.
- Carbon Monoxide Sensor (CO) - Expresses the Carbon Monoxide concentration in ppm.
- Volatile Organic Compound (VOC) – Expresses the VOC concentration in ppm.
- Lower Explosive Limit (LEL) - Combustible gas is expressed as a percent of the lower explosive limit.
- Hydrogen Sulfide Sensor (H_2S) - Expresses the Hydrogen Sulfide concentration in ppm.
- Oxygen Sensor (OXY) - Expresses the Oxygen concentration as a percentage.

III. Procedures and Guidelines

The Multi RAE utilizes the principle of detecting sensors. The PID operates on the principle that most organic compounds and some inorganic compounds are ionized when they are bombarded by high-energy ultraviolet light. These compounds absorb the energy of the light, which excites the molecules and results in a loss of electron and the formation of a positively charged ion. The number of ions formed and the ion current produced is directly proportional to mass and concentration. The amount of energy required to displace an electron is called photo ionization potential (PIP). The air sample is drawn into an ultraviolet (UV) lamp using a pump or a fan. The energy of the lamp determines whether a particular chemical will be ionized. Each chemical compound has a unique ionizing potential. When the UV light energy is greater than the ionization potential of the chemical, ionization will occur. When the sample is ionized, the electrical signal is displayed on an analog or digital output. Although the output does not distinguish between chemicals, it does detect an increase in the ion current. If only one chemical is present in the air, it is possible to use PIDs quantitatively. Chemical structure and lamp intensity affects the sensitivity of the instrument to a given contaminant. All PID readings are relative to the calibration gas, usually isobutylene. It is important to calibrate the PID in the same temperature and elevation that the equipment will be used and to determine the background concentrations in the field before taking measurements. For environments where background readings are high, factory zero calibration gas should be used.

Note: for volatile and semi-volatile compounds, knowing the PIP is critical in determining the appropriate instrument to use when organic vapor screening. Consult the Quality Assurance Project Plan and manufacturer's manual to determine that the proper instrument has been selected for the contaminate vapors of interest. If an expected compound at a site has a PIP less than 11.7 electron volts (eV), it is possible to use a PID. If the ionization potential is greater than 11.7eV, a flame ionization detector is required.

The following subsections will discuss Multi RAE calibration, operation, and maintenance. These sections, however, do not take the place of the instruction manual.

Calibration

For Multi RAE configured with O_2, LEL, H_2S, CO, sensors and a 10.6eV PID Lamp.

Start Up Instrument

Press **Mode** button

Observe displays:

On!……..

Multi RAE Version X.XX

Model Number SN XXXX

Date Time Temp

Checking Sensor Ids….

VOC Installed

CO Installed

H_2S Installed

OXY Installed

LEL Installed

H_2S VOC CO LEL OXY

Alarm Limits=

XX XX.X XX XX High XX.X

XX XX.X XX XX Low XX.X

XX XX.X XX STEL

```
XX XX.X XX
 TWA
```

```
Battery = X.XV
Shut off at 4.2V
```

```
User Mode=
```

```
Alarm Mode=
```

```
Datalog Time Left
```

```
Datalog Mode
```

```
Datalog Period
```

```
Unit ready in…..
10 Seconds
```

The pump will start, the seconds will count down to zero, and the instrument will be ready for use

Calibration Check and Adjustment

Allow instrument to warm up for 15 minutes.

Depress the **[N/-]** key first, then while depressing the **[N/-]**, depress the **[Mode]** key; depress both keys for 5 seconds.

Display will read:

```
Calibrate
Monitor?
```

Press the **[Y/+]** key

Display will read:

```
Fresh Air
Calibration?
```

If “Zero Air” is necessary, attach the calibration adapter over the inlet port of the Multi RAE Monitor and connect the other end of the tube to the gas regulator (HAZCO loaner regulator LREG.5, RAE Systems P/N 008-3011 or suitable .5 LPM regulator) on the Zero Air bottle (HAZCO P/N SGZA, RAE P/N 600-0024). If no Zero Air is available, perform the Fresh Air Calibration in an area free of any detectable vapor.

Press the **[Y/+]** key

Display will read:

```
Zero….
In progress…
```

```
CO Zeroed!
Reading = X
```

```
VOC Zeroed!
Reading = X
```

```
LEL Zeroed!
Reading = X
```

```
OXY Zeroed!
Reading = X
```

```
Zero Cal done!
```

```
H2S Zeroed!
Reading = X
```

In each of the above screens, “X” is equal to the reading of the sensor before it was zeroed.

Display will then read:

```
Multiple Sensor
Calibration?
```

Press the **[Y/+]** key

The display shows all of the pre-selected sensors and the “OK?” question:

```
CO H2S
LEL OK? OXY
```

Apply calibration gas – use either HAZCO Services Part Number R-SGRAE4 or Rae Systems Part Number 008-3002 – using a .5 LPM regulator and direct tubing.

Press the **[Y/+]** key. Display will read:

```
Apply Mixed gas
```

```
Calibration
In progress …
```

The display will count down showing the number of remaining seconds:

```
CO cal’ed
Reading=50
```

```
H2S cal’ed
Reading=25
```

```
LEL cal’ed
Reading=50
```

```
OXY cal’ed
Reading=20.9
```

```
Calibration done
Turn off gas!
```

Display will read:

```
Single Sensor
Calibration?
```

Press the **[Y/+]**.

Display will read:

```
CO VOC H2S
LEL pick? OXY
```

Attach 100 ppm Isobutylene (HAZCO P/N r-SGISO or Rae P/N 600-0002) using a 1.0 LPM regulator (HAZCO P/N LR10HS or Rae P/N 008-3021). Open regulator.

Press the **[Mode]** key once, the V of VOC will be highlighted.

Press the **[Y/+]**. The display will read:

```
Apply VOC Gas
```

```
Calibration
In progress…
```

The display will count down showing the number of remaining seconds, then display:

```
VOC cal'd
Reading=100
```

```
Calibration done
Turn off gas!
```

```
Single Sensor
Calibration?
```

Press **[Mode]** key twice to return to main screen.

CALIBRATION IS COMPLETE!

Operation

Because the Multi RAE has many functions in terms of operation, it is recommended the operational procedures as outlined in the instruction manual from pages 9 to 14 are followed.

Site Maintenance

After each use, the meter should be recharged and the outside of the instruments should be wiped clean with a soft cloth.

Scheduled Maintenance

Function	Frequency
Check alarm and settings	Monthly/before each use
Clean screens and gaskets around sensors	Monthly
Replace sensors	Biannually or when calibration is unsuccessful

IV. Quality Assurance Records

Quality assurance records will be maintained for each air monitoring event. The following information shall be recorded in the field logbook following FOP *Note-taking and Field Logbook*.

Identification - Site name, date, location, CTO number, activity monitored, (such as surface water sampling and soil sampling), serial number, time, resulting concentration, comments, and identity of air monitoring personnel.

Field observations - Appearance of sampled media (if definable).

Additional remarks (e.g., Multi RAE had wide range fluctuations during air monitoring activities).

V. References

Multi RAE Plus Multiple Gas Monitor User Manual, RAE Systems, Revision B1, November 2003.

FIELD OPERATING PROCEDURE

Note-taking and Field Logbook

I. Purpose and Scope

The purpose of this Field Operating Procedure (FOP) is to define protocols for recording field and sampling information in a field logbook. Data generated from the use of this FOP may be used to support the following activities: site characterization, risk assessment, and evaluation of remedial alternatives.

II. Equipment and Materials

- Field logbook
- Indelible black ink pen
- Write-in-the-rain pen (for extreme weather conditions—cold/rain)

III. Procedures and Guidelines

All information pertinent to a field or sampling effort will be recorded in a bound field logbook that will be initiated at the start of the first onsite activity. The field logbook will consist of a bound notebook with consecutively numbered pages that cannot be removed. The outside front cover of the logbook will contain the project (site) name and the specific activity (for instance, supplemental remedial investigation). The inside front cover will include the following:

- Site name and U.S. Environmental Protection Agency work assignment number
- Project number
- Site manager's name and mailing address
- Sequential logbook number
- Start date and end date of logbook
- Each page will be consecutively numbered, dated, and initialed. All entries will be made in indelible black ink, and all corrections will consist of line-out deletions that are initialed and dated. If only part of a page is used, the remainder of the page should have an "X" drawn across it. At a minimum, entries in the logbook will include the following:
- Time of arrival and departure of site personnel, site visitors, and equipment
- Instrument calibration information, including make, model, and serial number of the equipment calibrated
- Description of significant activities for the day
- Documentation of photographs taken during field activities (e.g., date, time, and description of photograph)
- Field observations (e.g., sample description, weather, unusual site conditions or observations, sources of potential contamination)
- Detailed description of the sampling location, including a sketch when necessary
- Details of the sample site (e.g., coordinates [*x*, *y*], water elevation [*z*], casing diameter and depth, integrity of the casing)

- Sampling methodology and matrix, including distinction between grab and composite samples
- Names of field team members and subcontractors
- Start or completion time of sample collection activities
- Field measurements (e.g., water depths, sediment probe depths)
- Type of sample (e.g., sediment, groundwater, NAPL, surface water, soil, debris)
- Number, depth, and volume of sample collected
- Field sample number
- Requested analytical determinations
- Sample preservation
- Quality control samples associated with the sample
- Sample shipment information including chain-of-custody form number and laboratory, carrier, date, and time
- Health and safety issues (including level of personal protective equipment)
- Signature and date by personnel responsible for observations

Sampling situations vary widely. No general rules can specify the extent of information that must be entered in a logbook. However, records should contain sufficient information so that someone can reconstruct the sampling activity without relying on the collector's memory. The field team leader will keep a master list of all field logbooks assigned to the sampling crew.

IV. Attachments

None.

V. Key Checks and Items

None.

Packing and Shipping of Environmental Samples

I. Purpose and Scope

The purpose of this field operating procedure (FOP) is to identify protocols for the packing and shipping of samples to the laboratory for analysis. This FOP is applicable for all samples collected and prepared for analysis at an offsite laboratory.

II. Equipment and Materials

- Waterproof hard plastic coolers
- Plastic resealable bags
- Plastic garbage bags
- Absorbent packing material (not vermiculite)
- Inert cushioning material (not vermiculite)
- Ice
- U.S. Environmental Protection Agency (EPA) Region 5 sample tags
- Scribe software
- Laptop and printer
- Adhesive labels 2 x 4 inches (generated by Scribe software)
- Chain-of-custody forms (generated by Scribe software)
- Airbills and shipping pouches (e.g., FedEx)
- Clear tape
- Strapping tape
- Mailing labels

III. Procedures and Guidelines

Prepare Bottles or Bags for Shipment

1. Arrange sample containers in groups by sample number.
2. Check that sample container lids are tight.
3. Secure sample labels to each container.
4. Arrange containers in front of assigned coolers.
5. Enclose each sample in a clear, resealable plastic bag, making sure that sample labels are visible.

Prepare Coolers for Shipment

1. Tape drains shut, inside and out.
2. Affix “This Side UP” labels on all four sides and “Fragile” labels on at least two sides of each cooler.
3. Place mailing label with laboratory address on top of each cooler.
4. Place inert cushioning material (e.g., bubble wrap, preformed poly-foam liner) in the bottom of the cooler. Do not use vermiculite.

5. Place appropriate chain-of-custody records with corresponding custody seals on top of each cooler.
6. Double bag and seal loose ice in resealable, plastic bags to prevent melting ice from leaking and soaking the packing material. Place the ice outside the garbage bags containing the samples. Place sufficient ice in the cooler to maintain the internal temperature at 4±2°C during transport.
7. Put an absorbent pad in the bottom of the cooler and fill the cooler with enough packing material to prevent breakage of the sample bottles and to absorb the entire volume of the liquid being shipped (offsite sample shipment only).
8. Record the EPA Region 5 custody seals on the chain-of-custody forms. Sign each chain-of-custody form (or obtain signature) and indicate the time and date the cooler was custody sealed.
9. Seal the laboratory copies of the chain-of-custody forms in a large, resealable plastic bag and tape to the inside lid of the cooler. Retain the Region 5 copies of the chain-of-custody forms for return to EPA. Each cooler must contain a chain-of-custody form (or forms) that corresponds to the contents of the cooler.
10. Close lid and latch.
11. Peel custody seals carefully from backing and place intact over lid openings (right front and left back). Cover seals with clear protective tape.
12. Tape cooler shut on both ends, making several complete revolutions with strapping tape. **Do not** cover custody seals.
13. Relinquish to carrier (e.g., FedEx). Place airbill receipt inside the mailing envelope and send to sample documentation coordinator, along with the other documentation.

IV. Attachments

None.

V. Key Checks and Items

None.

FIELD OPERATING PROCEDURE

Sample Handling and Chain-of-Custody Procedure

I. Purpose and Scope

The purpose of this field operating procedure (FOP) is to provide a definition of "custody" and describe protocols for documenting the transfer of custody from one party to the next (e.g., from the site to the laboratory). A documented custody trail is established using sample labels and a U.S. Environmental Protection Agency (EPA) chain-of-custody form that uniquely identifies each sample container and which person has possession of it from the sample's origin to its final destination. The chain-of-custody form also describes the sampling point, date, time, and analysis parameters.

Sample personnel should be aware that a sample is considered to be in a person's custody if the sample meets the following conditions:

- It is in a person's actual possession
- It is in view after being in a person's possession
- It is locked up so that no one can tamper with it after having been in physical custody

When samples leave the custody of the sampler, the cooler must be custody-sealed and possession must be documented.

Data generated from the use of this FOP may be used to support the following activities: site characterization, risk assessment, and evaluation of remedial alternatives.

II. Equipment and Materials

- Computer with Scribe software loaded
- Laser printer with paper (8.5-by-11-inch) and ink cartridge (black)
- Scribe generated tag label (2-by-4-inch adhesive labels)
- Indelible black ink pen

III. Procedures and Guidelines

Chain-of-Custody Forms

The chain-of-custody form must contain the following information:

- Case Number/Client Number: If a Contract Laboratory Program (CLP) laboratory is used, enter the case number provided by EPA's Regional Sample Control Center (RSCC). If the CLP is not used, enter the SAS number provided by CH2M's sample and analytical coordinator.
- EPA Region: Enter Region 5.
- Site Name/State: Velsicol Chemical Corporation Superfund Site/Michigan.
- Project Leader: Enter the CH2M Site Manager.
- Action: Remedial design investigation.
- Sampling Co.: CH2M.

- Sample No.: This is the unique number that will be used for sample tracking. For CLP, this number is taken from a block of numbers assigned by the EPA RSCC. For non-CLP, the CH2M sample and analytical coordinator will assign this number.
- Matrix: Describe the sample media (e.g., Sediment, soil, groundwater, NAPL).
- Sampler Name: The name of the sampler or sample team leader.
- Concentration: Low (L), Low/Medium (M) or High (H).
- Sample type: “Grab” or “Composite”.
- Analysis: This indicates the analyses required for each sample.
- Preservative: Document what preservative has been added to the sample (e.g., “HCl,” “Ice Only,” “None”).
- Station Location: This is the CH2M Station Location Identifier.
- Sample Collect Date/Time: Use military time.
- QC Type: This is for field quality control (QC)/quality assurance (QA) only and includes field duplicate, field blanks, equipment blanks, and trip blanks.
- Date shipped: The date that samples are relinquished to the shipping carrier.
- Carrier Name: (e.g., FedEx).
- Airbill: Airbill number used for shipping.
- Shipped to: This is the laboratory name and full address, including the laboratory contact. If the contact is not known, use “Sample Custodian”.
- Chain-of-Custody Record fields: The sampler’s signature must appear in the “Sampler Signature” and the “Relinquished By” fields. The date and time (military time) must also be included. If additional personnel were involved in sampling, their signatures should appear in the “Additional Sampler Signature(s)” field.
- Although the samples are relinquished to the shipping carrier, the shipping carrier does not have access to the samples as long as the shipping cooler is custody sealed. Consequently, the shipping carrier does not sign the chain-of-custody form.
- Sample(s) to be used for laboratory QC: This identifies which samples are to be used for matrix spike/matrix spike duplicate analyses.
- Indicate if shipment for case is complete: Use “Y” or “N”.
- Chain-of-Custody Seal Number: Record the custody seal numbers that appear on the Region 5 custody seals that can be found on the shipping container. There is usually a minimum of two per shipping container.

Sample Labels

Each sample container will be identified with a sample label. Each label will contain the following information:

- Case/SAS number
- The unique sample ID for sample tracking
- Date of sampling
- Time the sample was collected (in military time)
- All parameters for which the sample will be analyzed
- Preservative used (if any)

IV. Attachments

None.

V. Key Checks and Items

- All sample containers must be properly labeled.
- Each cooler must have a chain-of-custody form and the samples in the cooler (as identified by the sample tags) must match what is on the chain-of-custody form.
- Each chain-of-custody form must be properly relinquished (signature, date, time).
- The custody seal numbers must be written on each chain-of-custody form.
- The shipping cooler must be custody sealed in at least two places.