## Douglas Long

**From:** Kaysen, Michelle <kaysen.michelle@epa.gov>
**Sent:** Thursday, February 6, 2020 1:53 PM
**To:** Michael Takacs
**Cc:** Brian Lindman; Phil Tannian; Douglas Long
**Subject:** RE: Revised CSM US Ecology Sheffield, Illinois

All,
Thank you for submitting the revised CSM and addressing EPA's comments. The CSM for the purpose of moving forward is approved. Since a CSM is a living document, I often don't refer to an agreed upon version as "final". The LTS plan can be developed around this CSM as proposed.

Thanks
Michelle

US EPA R5
Environmental Scientist
Land, Chemicals and Redevelopment Division
Remediation Branch
Corrective Action Section 2
(312) 886-4253 office

**From:** Michael Takacs <sendfile@usecology.com>
**Sent:** Monday, January 27, 2020 3:10 PM
**To:** Kaysen, Michelle <kaysen.michelle@epa.gov>
**Subject:** Revised CSM US Ecology Sheffield, Illinois

Michelle - attached for you to download is the cover letter and the revised CSM for the US Ecology facility in Sheffield, Illinois. I am sending a paper copy minus the 800+ page Appendix B.

## Files attached to this message

| Filename | Size | Checksum (SHA256) |
|---|---|---|
| CSM Report.pdf | 56.7 MB | 0fa025183c21cd2df839792932d5985253024df6f3b57d6354c3a6bdccd1488e |
| Cover letter for CSM.docx | 1.15 MB | 7682976fe5e860e2cbabb61b292c4e5b9879616f81359bdff866c70d06897b76 |

Please click on the following link to download the attachments:
https://sendfile.usecology.com/message/5Ph1jCOLgkVF9G1Z6fZMND
This email or download link can be forwarded to anyone.

The attachments are available until: **Wednesday, 26 February.**

Message ID: 5Ph1jCOLgkVF9G1Z6fZMND

US ecology

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January 24, 2020
(sent via email and UPS without Appendix B)

Ms. Michelle Kaysen
U.S. Environmental Protection Agency
Region 5
77 West Jackson Boulevard
Chicago, IL 60604-3590

Re: Revised Conceptual Site Model
US Ecology Former Hazardous Waste Disposal Facility
Sheffield, IL

Dear Ms. Kaysen:

US Ecology and their consultant, Geoengineers, have completed a revision of the Conceptual Site Model (CSM) for the closed facility in Sheffield, Illinois. The revisions were made based on our understanding of conclusions reached during our conference call on September 3, 2019.
We are hopeful that this version of the CSM will satisfy EPA's concerns and can be approved. We are working on a long-term stewardship plan (LSP) based on the CSM and EPA's comments regarding the monitoring and maintenance portion of the CSM. Upon approval of the CSM, US Ecology will submit the LSP to EPA for review and comment.

The following is a brief description of the changes made to the current revision of the CSM based on our notes from the September 3rd conference call.

***Item 1*** *– EPA questioned whether paleochannel is a preferential pathway for contaminant transport from the area of the upland guard wells to the lake and requested a demonstration to prove that this is the case or add an additional sampling location in Trout Lake to characterize area of groundwater discharge.*

US Ecology has amended the CSM to include a second surface water monitoring location directly east of the upland guard wells. The location is shown on Figure 22 in the CSM.

***Item 2*** *– EPA requested additional risk characterization of the groundwater-surface water interface where potentially contaminated groundwater enters Trout Lake.*

US Ecology has identified two shallow groundwater wells utilized in the radiologic monitoring program that are located on the shoreline of Trout Lake. They appear to be

screened appropriately for to evaluate conditions at the GSI. The wells are nos. 211 and 571 and are shown on Figure 22 of the CSM. The analytical results will be compared to the EPA Region IV screening levels for surface water.

EPA also requested that sampling of the monitoring wells be conducted semi-annually until the GSI/sediment impact has been characterized, but that USE may petition to change to annual monitoring if conditions warrant.

***Item 3*** *– EPA requested that a statistical approach will be used to characterize long-term trends and rates of attenuation.*

US Ecology will add a statistical component to the time-concentration plots that will evaluate the statistical significance of any trends as part of the long-term monitoring program. The statistical approach will follow EPA guidance and will be detailed in the LSP.

***Item 4*** *- EPA requested that sufficient constituents are needed to support a monitored natural attenuation (MNA) evaluation.*

The current and proposed monitoring plan includes parameters such as iron, magnesium, manganese, sulfate and chloride that may be useful in evaluating plume attenuation. However, chlorinated ethenes have been the most consistent indicators of landfill impact and these compounds, including tetrachloroethene and all breakdown products will continue to be monitored and will likely be the best indicators of attenuation.

***Item 5*** *– EPA requested that additional wells be monitored as part of the 5-year review sampling program to evaluate the source control measured implemented under corrective action.*

US Ecology has identified six wells that will be added to the program for this purpose. Two shallow wells (G142 and G192) will be sampled to evaluate the long-term effectiveness of the Trench 18 slurry wall. Four wells (G148, G149, G155 and G156), which are north and northeast of the Old Chem Site, will also be sampled as part of the 5-year review process. All six of these wells will be monitored annually for static water level elevations to help define groundwater flow patterns. The CSM has been modified to add these wells (see Table 2).

***Item 6*** *– EPA requested more details regarding what will trigger contingency actions and what contingency actions may apply to the various triggers.*

US Ecology has provided more detail in this section of the CSM and will provide additional details in the LSP.

***Item 7*** *– EPA requested that US Ecology analyze the landfill leachate for a class of emerging contaminants known as PFAS.*

# Conceptual Site Model

Sheffield Former Hazardous Waste Facility
Sheffield, Illinois

*for*
**U.S. Ecology**

December 5, 2019

GeoEngineers

3501 West Elder Street, Suite 300
Boise, Idaho 83705
208.433.8098

# Conceptual Site Model

## Sheffield Former Hazardous Waste Facility
## Sheffield, Illinois

**File No. 19730-002-00**

**December 5, 2019**

Prepared for:

US Ecology
PO Box 206
Sheffield, Illinois 61316

Attention: Doug Long

Prepared by:

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APP:NAM:DGW:mce

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## 1.0 INTRODUCTION

The US Ecology Sheffield facility (Figure 1) is a 46-acre permitted hazardous waste facility that operated from 1968 to 1983. The facility includes two hazardous waste landfills referred to as the Old Chem Site and New Chem Site (Figure 2). A 20-acre low-level radioactive waste (LLRW) facility (closed) owned and monitored by the State of Illinois is adjacent to the facility and within the property owned by US Ecology.

During operations, the US Ecology facility accepted industrial, laboratory and agricultural hazardous wastes. Approximately 165,000 cubic yards of waste were reportedly disposed of at the two landfills (93 percent at the New Chem Site). The Old Chem Site consists of six disposal trenches covering about 6 acres. The New Chem Site consists of 19 clay-lined burial cells covering approximately 40 acres.

The facility was subject to a Corrective Action Order as administered by the US Environmental Protection Agency (USEPA) under the Resource Conservation and Recovery Act (RCRA) in 1985 that required investigation of potential site releases that could adversely affect human or environmental health through exposure to hazardous contaminants (primarily volatile organic compounds [VOCs]), evaluation of alternatives to address exposure pathways and ultimately, implementation of corrective actions that would protect people and the environment.

Corrective actions were subsequently implemented and included containment of waste remaining on-site, and groundwater extraction and treatment to address a contaminated groundwater plume in the shallow aquifer beneath the facility. A portion of the landfill was isolated by constructing subsurface barrier walls, followed by capping the landfill surface in 1994. After the initial source control, additional groundwater remediation systems were installed in several phases including more groundwater extraction and treatment and in situ treatment by an air-sparging/soil vapor-extraction (AS/SVE) system. Various modifications have been made to remediation systems over the years to optimize performance. An injection system was added around some of the AS/SVE wells in 2006 to further degrade VOC compounds present in groundwater. In 2009, an AS/SVE system was installed to address ongoing exceedances in seeps along the north side of the landfill.

More than 20 years of groundwater monitoring data have been collected since the initial remedial systems were installed. Concentrations of the primary contaminants of concern (VOCs) have declined over time, demonstrating that natural attenuation is occurring, which led to the on-site wastewater treatment plant to be decommissioned in 2013. Other treatment systems are no longer in operation because corrective action goals have been met; however, US Ecology has maintained the AS/SVE treatment system associated with one seep (S309; see Figure 2) for future contingencies, should groundwater VOC concentrations show evidence of rebounding.

Investigations of site-specific geological conditions have shown that the shallow, contaminated aquifer is sufficiently isolated from the deeper water-bearing zone that provides regional drinking water. Site hydrogeology is well known, with most of the shallow groundwater discharging to a local surface water feature (Trout Lake) formed by a historical coal mining pit. Surface water monitoring results have also shown that the contaminated groundwater plume does not appear to be impacting Trout Lake, which serves as the point of compliance for the groundwater remedy.

The USEPA has requested that US Ecology prepare a Conceptual Site Model (CSM) for the Sheffield facility[1]. A CSM is essentially a tool to assist in making decisions about a site. The USEPA desires a comprehensive, but easily understood CSM that clearly supports their management decisions regarding post-closure care under the current RCRA program. The USEPA is concerned that there is not a single compilation or depiction of what is known about the site. A further concern is that while facility information is extensive, the record is fractured by both the age of the site and regulatory changes over time.

This CSM provides a history of the facility, including corrective actions implemented at the facility and identifies the following:

- The extent of contamination at the facility currently,
- The contaminants of concern (COCs),
- How people, animals and plants might be exposed to these contaminants, and
- How remedial actions have modified the presence, migration and exposure pathways.

The information presented in this CSM sets the stage for negotiations of an Agreed Order on Consent (AOC) that will govern the post-closure care at the facility. An approach to long-term stewardship is also provided as part of the CSM to further support negotiations regarding the AOC.

## 2.0 SITE CONDITIONS

The US Ecology Sheffield facility is in Bureau County approximately 20 miles west of Princeton, Illinois. The facility sits within a fenced 380-acre parcel owned by US Ecology. The Sheffield facility is in a rural area zoned primarily for agricultural use. The hazardous waste disposal area (Old and New Chem sites collectively) is zoned for conditional use for industrial waste disposal.

The facility sits on a rise that has been graded to limit runoff and erosion within the developed area. There is a slight north-south drainage divide that causes surface water runoff to both the east and west; however, most of the facility runoff drains to an unnamed tributary of King Creek to the northwest. Annual precipitation averages about 37 inches; however, it can vary widely (24 inches to 47 inches) and there is a long-term trend of increasing rainfall. Precipitation in the winter falls as snow.

Much of the area at and surrounding the facility has been filled with mine spoils prior to and during facility operations. The mine spoils were generated by strip mining of coal and consist of a mixture of redistributed glacial and bedrock materials. These mine spoils were used to fill low-lying areas and to backfill strip-mined areas. Coal mining spoils are up to 35 feet thick in the area immediately surrounding the facility according to soil boring logs. During site investigations, mine spoils were encountered north, west and southwest of the New Chem Site and north and northeast of the Old Chem Site as well as to the east of the facility.

[1] The state-owned LLRW facility is not included in this conceptual site model.

Trout Lake, a former strip-mining pit, is the closest surface water body to the facility; at its closest point, Trout Lake is approximately 200 feet east of the facility. US Ecology owns the Trout Lake property and the lake is fenced, locked and posted off-limits to fishing.

Geology and hydrogeology at the facility has been investigated and characterized by other consultants and US government agencies since 1966. In addition to the approximately 500 borings that have been drilled across the site, geophysical surveys, soil gas surveys, surface water and groundwater elevations, chemical sampling and field hydrologic testing have also been conducted. The following geology and hydrogeology discussions summarize past investigation results.

### 2.1. Geology

The facility is located on the northwestern margin of the Till Plains Section of the Central Lowlands physiographic province in Illinois. The Till Plains Section is composed of multiple Pleistocene epoch glacial ice sheet advances and retreats that scoured underlying bedrock and deposited till as terminal and ground moraines with subsequent outwash plains. Surficial geologic maps indicate Pleistocene aeolian silts and fine sand (Peoria Loess) overlay clay, silt and pebble till (Hulick, Toulon and Radnor Members of the Glasford Formation) derived from ground moraines; outwash sands cap the local area.

The loess and glacial deposits lie unconformably over shale and sandstone with thin coal seams and limestone beds of the Pennsylvanian-aged Shelburn-Patoka Formation (Anderson and Miao 2011; Kolata 2005). These rocks are situated along the northern margin of the Illinois basin structure. Additionally, lake bottom (lacustrine) deposits are discontinuous in the area, but where present, consist of silty clay, clayey silt and silt layers with sand and pebbles. Lacustrine deposits commonly directly overlie the Pennsylvanian bedrock. Loess deposits range up to 30 feet thick and the glacial till is up to 50 feet thick. Lacustrine deposits may be up to 30 feet thick. The Shelburn-Patoka Formation may range between 200 and 400 feet thick in the Sheffield area (Kolata 2005). Key marker beds (Danville No. 7 and Herrin No. 6 coal units) are present in the Shelburn-Patoka Formation beneath the site.

Though that portion of the site occupied by the landfill area is generally undisturbed, much of the adjacent area had been surface mined for coal (targeting the Danville No. 7 and Herrin No. 6 units) and backfilled with mine spoils in the 1940s and early 1950s. The approximately 23-acre Trout Lake originated as a surface mining pit. The mine spoils consist of up to 35 feet of intermixed glacial deposits and bedrock. Current site topography as a result of these activities is shown in Figure 1.

Review of boring logs indicates unconsolidated deposits underlying the site include loess, glacial till, glacial outwash sand and gravel, and lacustrine material. Fill material, derived from surface mining, as well as landfill capping material was also present. Unconsolidated deposit thickness ranged from 45 to 110 feet thick. Bedrock was encountered at an elevation ranging between 685 to 700 feet above mean sea level (MSL) and was generally sloping to the north. Figure 3 illustrates the geologic complexity of the facility in a cross section (15x exaggeration); Figure 4 shows the location of the cross section relative to the site features.

### 2.2. Hydrogeology

Prior to area surface mining in the late 1920s and early 1930s, surface water at the site originally drained to the northeast through an unnamed tributary to Lawson Creek, which currently drains to the north. Upon conclusion of surface mining activity, the tributary drainage was captured by the pit that became Trout

Lake. Additionally, ponds and lakes originating as surface mine pits currently receive groundwater discharge in the vicinity of the facility. Trout Lake is impounded by an earthen dam to the east that maintains the pool elevation at approximately 698.75 feet above MSL. The dam does not have a control gate and seasonal runoff can overtop the dam, with excess water discharging into a small ephemeral drainage and ultimately either infiltrating to groundwater or into Lawson Creek.

Groundwater lies within three hydrogeologic systems in the area: (1) a deep principal regional aquifer, (2) a Pennsylvanian bedrock aquifer and (3) an uppermost unconfined aquifer within unconsolidated glacial deposits. Groundwater flow beneath the facility is impacted by unconsolidated material heterogeneity, complex bedrock vertical joints and horizontal bedding planes, as well as irregular surface topography, and interference from engineered barriers and nearby surface water bodies.

The shallow unconfined glacial aquifer thickness ranges between 40 and 45 feet. Depth to groundwater ranges between 2 and 34 feet below ground surface (bgs) (720 to 750 feet above MSL). Groundwater flow is generally to the north-northeast and then east toward Trout Lake. However, subsurface barrier walls designed to isolate waste disposal trenches from groundwater flow-through were installed in the 1990s around the Old Chem Site and portions of the New Chem Site. The barrier walls are up to 64 feet deep, were installed from roughly ground surface to subsurface elevations between 710 and 735 feet above MSL and are anchored in the upper units of the Pennsylvanian bedrock. The barrier walls disrupt the north-northeasterly groundwater flow; diverting it to the east and northwest, creating a broad flattening of the groundwater gradient to the north of the landfill facility as shown in Figure 5, but does not affect local groundwater flow in the Pennsylvanian aquifer as shown in Figure 6. A generalized cross section showing relative strata thickness, idealized groundwater flow direction and barrier walls is provided in Figure 7.

Based on the 1989 SAIC Remedial Investigation (RI) report, groundwater saturation within the glacial deposits and mine spoils is generally continuous across lithologic boundaries, and the deposits and spoils act as a single hydrologic unit. The oldest glacial till (Hulick Member), lying unconformably on the Pennsylvanian bedrock, was reported with a hydraulic conductivity of $7.42 \times 10^{-5}$ centimeters per second (cm/sec). Hydraulic conductivity for the Toulon Sand Member ranged between $2.71 \times 10^{-2}$ and $5.52 \times 10^{-5}$ cm/sec. The youngest till (Radnor Member) was identified with a hydraulic conductivity of $8.8 \times 10^{-4}$ cm/sec. Mine spoils were reported with hydraulic conductivity ranging between $2.34 \times 10^{-2}$ and $1.61 \times 10^{-4}$ cm/sec.

A sequence of shale, coal and limestone composing the Pennsylvanian bedrock aquifer is approximately 250 to 300 feet thick beneath the site and acts as a relatively impermeable barrier for groundwater flow between the shallow glacial aquifer and the underlying regional aquifer (Foster et al. 1984). However, there may be some intermixing of groundwater within highly weathered bedrock and the shallow glacial aquifer near G-167 north of the New Chem Site (Figure 2). Groundwater flow in this bedrock aquifer occurs in complex joint and fracture systems. Hydraulic testing of the unit indicated an average hydraulic conductivity of $9.01 \times 10^{-6}$ cm/sec.

An east-west trending groundwater divide was identified beneath the LLRW site (Figure 8). Groundwater north of the divide generally flows toward the north and northeast; and is eventually channeled toward Trout Lake. However, barrier walls at the site divert north-flowing groundwater to the northwest in the northwestern portion of the site. Groundwater flow south of the divide is toward the southeast. Bedrock aquifer groundwater flow beneath the site is influenced by the presence of an erosional channel (paleochannel) within the Pennsylvanian shale bedrock that is filled with the Toulon Sand (Figure 8). The US Geological Survey and the Illinois State Water Survey report the Toulon Sand in this area provides a

preferential pathway for groundwater flow, providing lateral continuity within the paleochannel. The Toulon Sand acts as a conduit for shallow aquifer groundwater flow; initially to the northeast and then southeast, and ultimately discharging into Trout Lake. To the east at Trout Lake, the former surface mining activity removed the Toulon Sand, and further continuity to the east was terminated. Groundwater flowing within the Toulon Sand is co-mingled with groundwater from beneath the adjacent LLRW disposal unit. Therefore, contamination from the Old Chem Site, the New Chem Site and the LLRW unit contribute to contaminants detected in the Toulon Sand, with the highest concentrations located to the southeast of the Old Chem Site within the facility footprint.

## 3.0 SITE HISTORY

The facility has operated as an industrial landfill since 1967, with many changes in regulations, policies and guidelines over the course of its operational and closure history. A timeline of the operational and regulatory history of the facility is illustrated in Figure 9.

### 3.1. Operations

The Old Chem Site began operation in 1967 as an industrial waste landfill permitted by the State of Illinois and was closed in 1974. The Old Chem Site operated prior to the enactment of the RCRA laws; and therefore, was never permitted under the federal program.

The New Chem Site was permitted as an industrial waste landfill by the State of Illinois and began operating in 1974. The two-year experimental permit issued by Illinois Environmental Protection Agency (IEPA) was renewed in 1976, 1978 and 1980. A Part A application under RCRA was submitted in 1980 and in 1982, the IEPA issued a Part A permit for the facility. The facility ceased operation on January 24, 1983 and a RCRA Part B permit was not issued for this unit. Therefore, the New Chem Site is considered an Interim Status unit.

In 1976, as part of first renewal of the 2-year experimental permit for the New Chem Site, IEPA required the construction of in-ground barrier walls around the Old and New Chem Sites. Construction of the barrier walls began in 1978 and was completed in 1984.

Groundwater contamination by VOCs was first discovered in 1982. Disposal activities were terminated at the New Chem Site in 1983 and both disposal areas were covered, and the on-site evaporation pond was closed.

### 3.2. Site Investigations and Proposed Plan

US Ecology entered into an Administrative Order by Consent (Consent Order) under RCRA in 1985 that required investigation of potential facility releases, evaluation of alternatives to address exposure pathways and implementation of corrective actions. Site-specific investigations were initiated in 1985 and RI and Feasibility Study reports were completed and approved by USEPA in 1989 and 1990, respectively.

USEPA published a Proposed Plan for the facility in 1990 that identified the preferred alternatives for source control/isolation and groundwater remediation. The selected corrective measures were further detailed in EPA's Responses to Comments (RTC) document for the facility dated October 1990, which included the Scope of Work for the Corrective Measure Implementation (CMI) as an attachment. Source control/isolation

measures included capping of the Old and New Chem Sites and the installation of barrier walls around the Old Chem Site and along areas G-120 and Trench 18 EWC in the New Chem Site. Groundwater remediation to address a plume delineated in the shallow aquifer included the installation of a groundwater extraction system, treatment of contaminated groundwater, discharging of treated groundwater to surface water and implementation of a groundwater monitoring program.

The wastewater treatment plant (WWTP) began operating in 1990 for the collection and treatment of North Slope contaminated groundwater seeps and subsequent discharge under US Ecology's National Pollutant Discharge Elimination System (NPDES) permit.

## 3.3. Corrective Measures

In 1993, corrective measures selected by the USEPA were implemented. Corrective measure design elements included (1) source control/vertical barriers and capping (including installation of extraction wells within the barriers); (2) groundwater extraction and recovery; and (3) groundwater/seep above-ground treatment. Implementation of each remedy is discussed in the following sections.

### 3.3.1. Barrier Walls

Vertical barrier walls were installed in 1994 in three areas: (1) surrounding the Old Chem Site; (2) the G-120 Area; and (3) the Trench 18 EWC area to restrict groundwater flow through the waste trenches. These areas are identified on Figure 2. The barrier walls were installed to either contain or retard groundwater plume movement in these areas. The walls were constructed using a deep-soil mixing (DSM) with bentonite method to obtain a maximum permeability of $1x10^{-6}$ cm/sec and designed to extend below the base depth of the adjoining waste trenches and older barrier walls installed between 1978 and 1984. The top of each barrier wall generally followed surface topography; and the DSM walls were up to 64 feet deep, with the base keyed into the upper Pennsylvanian bedrock units (up to 3 feet). A geotextile/geonet drainage system, a freeze-thaw protective layer and a vegetated soil layer capped each barrier wall to provide surface infiltration protection.

### 3.3.2. Waste Trench Caps

Waste trenches in the Old Chem Site and two areas (G-120 area and the 18 EWC Trench) in the New Chem Site were capped in 1994 using a composite system that confined the waste layer with a bentonite clay layer[2] covered by a flexible membrane (high-density polyethylene [HDPE]) liner under a drainage system (HDPE geonet and non-woven geotextile), a 1.5-foot thick freeze-thaw layer and a 2-foot vegetated soil cover. The remainder of the New Chem Site was capped with a clay layer topped with a vegetated soil cover. Caps were graded to direct storm water runoff to the edges where gravel toe drains were installed to allow infiltration outside of the waste trench/barrier wall envelope. Erosion control was placed on slopes greater than 10 percent along cap margins. Periodic inspections by US Ecology staff are conducted to identify and mitigate damage caused by animals or erosion.

### 3.3.3. Groundwater Treatment

A USEPA-approved groundwater extraction and treatment system was installed in 1995. Extraction wells were installed in conjunction with new groundwater monitoring wells to remove contaminated groundwater

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[2] Permeability coefficient for bentonite clay layer = $1 \times 10^{-9}$ cm/sec

east and north of the Old Chem Site, as well as within the Old Chem Site barrier walls for treatment at the on-site WWTP. Upon effectively reducing chemical concentrations in groundwater by air stripping followed by carbon filtration of both the vapor and aqueous phases, USEPA approved discontinuing the WWTP operations in September 2012, and the equipment was removed in 2013 after it was demonstrated that no rebound in chemical concentrations had occurred.

#### 3.3.4. Leachate Collection

Leachate collection began in 1982 and consists of removing leachate generated within the waste trenches for disposal. Monitoring sumps, installed in 59 shallow leachate collection pits within the trenches, are checked annually[3] and pumped when at least 1 foot of leachate is measured within the standpipe. The leachate is pumped into a portable 100-gallon tank and transported to the leachate storage building, where it is transferred into 250-gallon totes. When full, the totes are sent to a facility licensed to dispose of the leachate. Leachate production dropped significantly following the first few years of collection and has averaged 2,100 gallons of leachate per year since 1985 (Figure 10).

#### 3.3.5. Seep Monitoring

US Ecology has been performing remedial activities along the North Slope to address the seep since 1986. Originally, seep water collected in a series of seven below-ground manholes and was directed to the wastewater treatment plant. Of the seven separate seep collection points (S304 to S310; Figure 2), only Seep S309 consistently reported tetrachloroethene (PCE) and trichloroethene (TCE) at concentrations exceeding practical quantitation limits (PQLs). With the completion and operation of the air sparging/soil vapor extraction (AS/SVE) unit in 2009, PCE and TCE concentrations decreased below PQLs in the individual Seep S309 and in Manhole No. 1, the collection point for North Slope seeps.

As previously noted, WWTP operations were discontinued and the WWTP equipment removed in 2013. However, before allowing WWTP shutdown, USEPA requested that US Ecology sample Seep S309 and Manhole No. 1 for four additional quarters to confirm that concentrations were consistently below PQLs. Subsequent monitoring showed that TCE and PCE were detected but at very low levels with no increase in concentrations[4]. US Ecology agreed to continue sampling Seep S309 semi-annually for VOCs and to leave the AS/SVE equipment intact at Seep S309.

As currently configured, seep water collects within the existing, enclosed manholes. Seep water infiltrates into groundwater within the manhole and does not discharge to the ground surface. Manholes are only accessible to US Ecology staff.

#### 3.3.6. Previous Groundwater Monitoring

As part of the corrective actions implemented at the site, long-term groundwater monitoring was conducted through 2009. The monitoring program was originally defined based on IEPA requirements but was further modified by USEPA. Originally, groundwater sampling took place quarterly and analyzed for a broad suite of analytes including semi-volatile and volatile organics, metals and other contaminants. Figures A-1 and A-2 in Appendix A provide the monitoring locations required by IEPA and later expanded by USEPA.

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[3] Sumps are inspected between spring thaw and fall freeze-up.

[4] Concentrations of TCE and PCE continue to be stable (no increase) since 2012.

The monitoring program was modified as part of the 2008 post-closure permit, which is discussed in more detail below.

## 3.4. Post-Closure Groundwater and Surface Water Monitoring

US Ecology applied for a post-closure permit with IEPA on October 24, 2008. IEPA and USEPA agreed that all future post-closure activities will be carried out under the 1985 Consent Order from USEPA (January 21, 2010 correspondence from USEPA); however, IEPA issued a post-closure permit to US Ecology on March 18, 2010. The permit requires ongoing environmental monitoring and post-closure care of the site for a minimum of 30 years from the closure certification date of September 30, 1996. The permit also requires the facility to follow the post-closure plan associated with the September 30, 1985 Consent Order between USEPA and US Ecology.

The post-closure groundwater and surface water monitoring program was approved by the USEPA on July 1, 2009 and has been conducted from 2009 to the present. The 2009 post-closure monitoring program superseded the monitoring program approved by IEPA and additional groundwater monitoring required by USEPA in accordance with US EPA RTC document for the facility dated October 1990. Monitoring locations, frequency, analytical program, points of compliance and compliance criteria are presented in the following sections.

### 3.4.1. Monitoring Locations

The post-closure monitoring program includes four classes of groundwater monitoring wells and a surface water monitoring location. The monitoring locations were identified and selected based on historical groundwater chemical concentrations, locations in relation to the contaminant plume, the screened water-bearing zone, and the intended function of each location in the monitoring program. The four groundwater monitoring well classes include: ambient, boundary, guard and plume wells.

- Ambient wells: the three ambient wells (G-145, G-186 and G-434) are hydrogeologically upgradient of the facility and monitor background groundwater quality.
- Boundary wells: the 10 boundary wells (G-105, G-142, G-154, G-157, G-160, G-162, G-191, G-192, G-193 and RIB-9) are in facility areas where chemical impacts have not been detected and are intended to signal if groundwater contaminants are migrating towards the property boundary.
- Guard wells: the three guard wells (591, 592 and 600) are near Trout Lake to provide an early warning of contaminant migration toward the lake.
- Plume wells: the eight plume wells (G-165, G-166, G-167, G-168, 547, 564, 575 and 594) are within the known Old Chem Site contaminant plume and allow for contaminant concentration trend monitoring.

Twenty-four groundwater monitoring wells, and a surface water collection point in Trout Lake (S501) are included in the post-closure sampling program. By agreement with USEPA, Seep S309 continues to be sampled. Locations of wells currently in the sampling program are shown on Figure 11 and well construction data are presented in Table 1.

### 3.4.2. Monitoring Frequency

The 2009 post-closure groundwater and surface water monitoring program requires that groundwater is sampled twice a year (spring and fall). Different analytes are associated with each groundwater monitoring event, as described in the next section. Seeps have also been sampled twice a year since 2016 (they were sampled more frequently in prior years).

### 3.4.3. Analytical Program

Chemical analytes in the groundwater and surface water monitoring program include the field parameters, inorganic indicator chemicals and COCs listed below.

- Field parameters: depth to water in each well, specific conductance and pH.
- Indicator inorganics: total and dissolved chloride, iron, manganese, sulfates and total dissolved solids.
- Contaminants of concern: benzene, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloropropane, methylene chloride, PCE, TCE, and vinyl chloride plus cis-1,2-dichloroethene, trans-1,2-dichloroethene, 1,4-dioxane, chloromethane, methacrylonitrile and vinyl acetate.

During the spring, the groundwater samples from all wells are analyzed for field parameters and indicator inorganics only, except for the plume wells, which are also analyzed for VOCs. The fall groundwater samples from all wells are analyzed for the field parameters, indicator inorganics and VOCs.

Surface water samples are analyzed for field parameters, indicator inorganics and VOCs during spring and fall monitoring. Seeps are sampled in spring and fall and analyzed for COCs.

### 3.4.4. Point of Compliance

USEPA agreed with selecting Trout Lake as the point of compliance for the facility in 1995 (USEPA 1995). The basis for EPA's decision was a deed restriction at the facility that precludes groundwater use in the area between the New and Old Chem Sites (aka, the landfill) and Trout Lake. USEPA did state that groundwater monitoring of the Old Chem Site groundwater plume upgradient of Trout Lake is necessary to provide a precursor of water quality at the point of compliance. The monitoring in the plume was to be used to indicate the rate of groundwater contaminant attenuation and estimate water quality at the point of compliance. S501 is the current point of compliance in Trout Lake and was selected during 1987 investigations to correlate with the axis of the paleochannel comprised of Toulon Sand, which provides a preferential pathway for groundwater flow from the site to Trout Lake. Compliance is based on chemical concentrations of COCs in surface water.

## 4.0 CONTAMINANTS OF CONCERN

The groundwater COCs at the US Ecology site were initially identified in USEPA's RTC document for the facility dated October 1990 (USEPA 1990). The 1990 groundwater COCs included the VOCs that make up total VOCs (benzene, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloropropane, methylene chloride, PCE, TCE, and vinyl chloride) and arsenic. Arsenic was not retained as a groundwater COC in US Ecology's 2008 RCRA Post-Closure Permit Application because arsenic only occasionally exceeded its Class IV groundwater quality standard (US Ecology 2008) in one well.

Three groundwater COCs (chloroform, PCE and TCE) along with total VOCs became the focus of evaluations over time due to the high frequency of detection, magnitude, association with source areas and effectiveness as surrogates for other VOCs. Between 1996 and 1998, USEPA directed their contractor, PRC Environmental Management, Inc. (PRC)/Tetra Tech EM Inc. (TTEMI) to conduct contaminant fate and transport modeling to calculate chloroform and PCE groundwater discharge concentrations protective of surface water quality in Trout Lake. This modeling was ultimately used to derive the guard well groundwater quality standards for chloroform, PCE, TCE[5] and total VOCs (TTEMI 1998) that are protective of surface water quality in Trout Lake, the point of compliance. These four groundwater contaminants or groups are considered the primary groundwater COCs at the facility and will be the focus of the temporal and spatial trends discussion in the following section.

## 5.0 SURFACE WATER AND GROUNDWATER QUALITY THRESHOLD AND COMPLIANCE CRITERIA

The post-closure monitoring program established surface water and groundwater quality threshold and compliance criteria for the monitoring locations discussed above. Threshold criteria were modeled concentrations that were used as an "early warning" of a potential water quality exceedance at the point of compliance. Compliance criteria were concentrations equivalent to two times the PQL that had to be met at the point of measurement in the lake. The modeled threshold and compliance criteria were based the groundwater classification at the facility, which has been established as Class IV – Other Groundwater[6]. Since that time, US EPA regions have developed risk-based screening concentrations for evaluation of soil and surface water at hazardous waste sites. US EPA Region 4 screening values (EPA 2018) have been included in this CSM to be consistent with recent guidance from the agency. These values were developed from the Great Lakes Initiative program and based on concentrations from the toxicological literature. The various screening values used to evaluate groundwater and surface water quality for the COCs and the wells in which they are applied for the post-closure monitoring program are provided in the following tables:

- Trout Lake surface water results were compared to two times the PQL and Region 4 risk-based screening levels to characterize water quality. The following table includes the screening values for those contaminants detected at least once in surface water:

| Contaminant of Concern | PQL-Based Screening Level | Region 4 Risk-Based Screening Level |
|---|---|---|
| 1,1,2-Trichlorotrifluoroethane | 10 µg/L | Not available |
| Acetone | 20 µg/L | 1,700 µg/L |
| cis-1,2-Dichloroethene | 10 µg/L | 620 µg/L |
| Methylene chloride (=dichloromethane) | 10 µg/L | 1,500 µg/L |
| Vinyl chloride | 10 µg/L | 930 µg/L |

Note: µg/L = micrograms per liter

[5] TCE was added, by verbal agreement with USEPA, after the development of site-specific groundwater screening criteria for the protection of surface water.

[6] Class IV groundwater is considered non-potable by the state of Illinois. This classification was assigned due to the historical contamination in the shallow unconsolidated aquifer from nearby historical coal surface mining activities

- Class IV – Other groundwater standards provided in 35 Ill. Adm. Code 620.440[7] are applied to the boundary wells and Seep 309 for those contaminants that were historically prevalent at elevated concentrations in plume wells.

| Contaminant of Concern | Class IV Standards |
|---|---|
| Benzene | 25 µg/L |
| Chloroform | 350 µg/L |
| 1,1-Dichloroethane | 7,000 µg/L |
| 1,2-Dichloroethane | 25 µg/L |
| 1,1-Dichloroethene | 35 µg/L |
| 1,2-Dichloropropane | 25 µg/L |
| cis-1,2-Dichloroethene | 200 µg/L |
| Methylene chloride (=dichloromethane) | 50 µg/L |
| PCE | 25 µg/L |
| TCE | 25 µg/L |
| Vinyl chloride | 10 µg/L |
| Total VOCs[1] | Not available |

Notes:

[1]Total VOCs are a sum of detected concentrations of benzene, chloroform, 1,1-dichloroethane, 1,2-dichloroethane, 1,1-dichloroethene, 1,2-dichloropropane, methylene chloride, PCE, TCE and vinyl chloride.

- Total chloride, total iron, total manganese, total sulfates and total dissolved solids concentrations measured in ambient wells define Class IV groundwater standards for the other site wells and Seep 309. Ambient concentrations have varied over time and by location. The maximum reported concentration in any of the ambient wells is provided in the table below:

| Indicator Chemical | Class IV Standards Based on Ambient Concentrations |
|---|---|
| Total chloride | 11 mg/L |
| Total iron | 20 mg/L |
| Total manganese | 4.8 mg/L |
| Total sulfate | 2,700 mg/L |
| Total dissolved solids | 3,100 mg/L |

Note:

mg/L = milligrams per liter

[7] Class IV: Other Groundwater standards require that 35 Ill. Adm. Code 620.420 chemical standards (Class II) are not exceeded. Total chloride, iron, manganese, sulfates and TDS concentrations default to existing concentrations under these rules.

- Modeled groundwater threshold concentrations established by USEPA in 1998 for the protection of surface water in Trout Lake are applied to the guard wells. These thresholds, as provided in the following table, were established using contaminant fate and transport modeling for the primary COCs.

| Contaminant of Concern in Guard Wells | Threshold |
|---|---|
| Chloroform | 1,570 µg/L |
| PCE | 547.5 µg/L |
| TCE | 547.5 µg/L |
| Total VOCs | 4,500 µg/L |

Note:
µg/L = micrograms per liter

- USEPA Region 4 risk-based screening levels for surface water are also compared to concentrations of historically prevalent VOCs in groundwater from the guard wells.

| Contaminant of Concern in Guard Wells | Screening Level |
|---|---|
| Benzene | 160 µg/L |
| Chloroform | 140 µg/L |
| 1,1-Dichloroethane | 410 µg/L |
| 1,2-Dichloroethane | 2,000 µg/L |
| 1,1-Dichloroethene | 970 µg/L |
| 1,2-Dichloropropane | 520 µg/L |
| cis-1,2-Dichloroethene | 620 µg/L |
| Methylene chloride | 1,500 µg/L |
| PCE | 53 µg/L |
| TCE | 200 µg/L |
| Vinyl chloride | 930 µg/L |

There are no groundwater quality standards or screening levels for the plume wells. Rather, groundwater monitoring data in these wells are used to evaluate and report contaminant trends (see Section 6 for analysis of trends).

## 6.0 STATUS AND TRENDS IN SELECTED CONTAMINANTS

Twenty years of monitoring data are available for wells that were incorporated into the post-closure monitoring program. Evaluation of the data shows significant changes in groundwater quality and distribution of COCs since implementation of corrective measures. Both concentrations and the area where groundwater is impacted have diminished over time.

Surface water in Trout Lake continues to meet both PQL-based compliance criteria and Region 4 risk-based screening levels. Concentrations of VOCs in seep S309 are low and have been stable since AS/SVE treatment ceased.

The status and trends are discussed further in the following sections for each type of monitoring well (ambient, boundary, guard and plume). This evaluation focuses primarily on PCE, TCE, and total VOCs as these chemicals are the most frequently detected COCs, co-occur with COCs less frequently detected and have established modeled threshold or risk-based compliance criteria. Detections of other VOCs that may be of concern are noted. The status of inorganic indicators is also described.

## 6.1. Groundwater Quality

Groundwater data used in these analyses are provided in Appendix B.1.

### 6.1.1. Ambient Well

No COCs have been detected in any of the groundwater collected from ambient wells, except for one low concentration (19 µg/L) of acetone in 2009 (was likely a laboratory contaminant, which is common) and one low concentration (21 µg/L) of TCE in 2001 in well G-186. Neither VOC exceeded its Class IV groundwater standard. Indicator inorganic concentrations (total chloride, total iron, total manganese, total sulfate and total dissolved solids) are variable with location and over time with no discernable trends.

### 6.1.2. Boundary Wells

Groundwater from boundary wells seldom has detected concentrations of COCs and no exceedances of Class IV groundwater standards for COCs. Methylene chloride was detected in two wells (G-154 and G-157) in 1999. Benzene was detected in groundwater from G-192 in 2004 and G-191 and G-193 in 2006. PCE has only been detected once (at the PQL) in one well (G-192) in 2004. Except for methylene chloride, concentrations are low (approaching PQLs); methylene chloride may have been a lab contaminant.

Indicator inorganic chemical concentrations in boundary wells seldom exceed the maximum concentration measured in ambient wells. Concentrations of total iron and total dissolved solids in boundary wells G-157, G-160 and G-162 (north of the facility and adjacent to previously mined areas) have been greater than ambient wells on a few occasions.

### 6.1.3. Guard Wells

COCs have been frequently been detected in guard wells at the facility, but usually at concentrations below the modeled thresholds protective of water quality in Trout Lake. Occasional exceedances of the modeled thresholds for chloroform, PCE and TCE have occurred in wells 591 and 600 with most of the exceedances occurring before 2003. PCE exceeded its modeled threshold in two later monitoring events (2013 and 2015) while TCE exceeded its modeled threshold in samples collected in the 2014 through 2016 monitoring events. No exceedances have occurred since 2016. A summary of exceedances of modeled threshold criteria is provided in the following table.

**GUARD WELLS WITH SAMPLES EXCEEDING MODELED THRESHOLDS OVER TIME**

| Year | Chloroform | PCE | TCE |
|---|---|---|---|
| 1999 | 591 | 591 | 591 |
| 2000 | 591 | 591 | 591 |
| 2001 | 591 | 591, 600 | |
| 2002 | | 600 | |
| 2003 | | | |
| 2004 | | | |
| 2005 | | | |
| 2006 | | | |
| 2007 | | | |
| 2008 | | | |
| 2009 | | | |
| 2010 | | | |
| 2011 | | | |
| 2012 | | | |
| 2013 | | 600 | |
| 2014 | | | 600 |
| 2015 | | 600 | 600 |
| 2016 | | | 600 |
| 2017 | | | |
| 2018 | | | |
| Modeled Threshold Level | 1,570 µg/L | 547.5 µg/L | 547.5 µg/L |

Note:

Blank cells indicate the contaminant did not exceed its threshold during that monitoring period.

When compared to Region 4 screening levels, guard wells had more exceedances of chloroform, TCE and PCE as well as benzene and methylene chloride. Locations and years exceeding criteria for the guard wells are summarized in the table below:

**GUARD WELLS WITH SAMPLES EXCEEDING REGION 4 SCREENING LEVELS OVER TIME**

| Year | Benzene | Chloroform | PCE | cis-1,2-Dichloroethene | TCE | Methylene Chloride | Vinyl Chloride |
|---|---|---|---|---|---|---|---|
| 1999 | 591 | 591 | 591, 600 | 591 | 591 | 591 | |
| 2000 | 591,600 | 591 | 591, 600 | 591 | 591 | 591 | |
| 2001 | 591 | 591 | 591, 592, 600 | 591 | | 591 | |
| 2002 | 591 | 591 | 591, 592, 600 | 591 | | | |

| Year | Benzene | Chloroform | PCE | cis-1,2-Dichloroethene | TCE | Methylene Chloride | Vinyl Chloride |
|---|---|---|---|---|---|---|---|
| 2003 | 591, 592 | 591, 592 | 600 | | | | |
| 2004 | 591 | | 600 | | | | 591 |
| 2005 | 591 | | 600 | | | | 591 |
| 2006 | 591 | | 600 | | | | |
| 2007 | 591 | | 600 | | | | |
| 2008 | 591 | | 600 | | | | |
| 2009 | 591 | | 600 | | | | |
| 2010 | 591 | | 592, 600 | | 591 | | |
| 2011 | 591 | | 600 | | 600 | | |
| 2012 | 591 | | 600 | | 600 | | |
| 2013 | | | 600 | | 600 | | |
| 2014 | | | 600 | | 600 | | |
| 2015 | | | 600 | | 600 | | |
| 2016 | | | 600 | | 600 | | |
| 2017 | 591 | | 600 | | 600 | | |
| 2018 | | | 600 | | 600 | | |
| Screening Level | 160 µg/L | 140 µg/L | 53 µg/L | 620 µg/L | 200 µg/L | 1,500 µg/L | 930 µg/L |

Notes:

Blank cells indicate the contaminant did not exceed its screening criterion during that monitoring period

As noted in the table above, benzene has been detected above its Region 4 screening level primarily in well 591 (there was one exceedance of the benzene screening level in well 592 in 2003 and one exceedance in well 600 in 2000). The magnitude of exceedance in well 591 has been consistent since 2000; concentrations average 460 µg/L and have ranged from 220 µg/L to 820 µg/L.

Chloroform exceedances primarily occurred in well 591 in monitoring events between 1999 and 2004, with concentrations declining by two orders of magnitude over time (e.g., from 16,000 µg/L in 2000 to 160 µg/L in 2003). It was also detected once above the Region 4 screening level in well 592 in 2003, but never exceeded the screening level in well 600.

PCE was detected above its Region 4 screening level (53 µg/L) in the three guard wells (prior to 2004 for well 591, in 2001, 2001 and 2010 in well 592 and all years for well 600). Concentrations in well 591 have varied over time (from non-detect up to 18,000 µg/L), while concentrations in wells 592 (non-detect to 86 µg/L) and 600 (55 µg/L to 830 µg/L) have been relatively steady.

TCE exceeded its Region 4 screening level (200 µg/L) in two of the three guard wells. Concentrations dropped below the screening level in well 591 in 2003 with two exceedances in 2009 and 2010. TCE has exceeded its screening level since 2000 at concentrations from 64 µg/L to 1,000 µg/L in well 600.

Concentrations of methylene chloride exceeded the Region 4 screening level in groundwater samples collected from well 591 prior to 2002. Concentrations of vinyl chloride were elevated above the Region 4 criterion in 2004 and 2005 samples from well 591. Chlorinated ethanes, ethenes and propane have not exceeded their respective Region 4 screening levels except for cis-1,2-dichloroethene in wells 591 and 600 prior to 2003.

Benzene, chloroform, TCE, PCE and vinyl chloride have never been detected at the point of compliance in Trout Lake (methylene chloride was detected once in 2002 and cis-1,2-dichloroethene was detected once in 2001, both at levels slightly above the PQL). The lack of detections in surface water in the area of likely groundwater discharge indicate that attenuation is occurring between the guard well locations and the lake protective of surface water quality.

Several indicator inorganic chemicals exceeded the maximum ambient concentration in guard wells. High concentrations of total iron and chloride have been noted in guard wells 591, 592 and 600.

#### 6.1.4. Temporal Trends in Plume Wells

Temporal trends were evaluated in plume wells to assess whether the plume is stable or attenuating. PCE, TCE, and total VOCs exhibit attenuating concentrations in plume wells as shown in Figures 12, 13 and 14 for wells G-168 (north of the G-120 barrier wall), 547 (north of the LLRW site) and 594 (east of the main facility). Although not required, guard well modeled threshold criteria were also compared to the plume well data to provide context for the difference in magnitude of concentrations measured in groundwater from these wells. Only TCE exceeded its modeled threshold in G-168 with those exceedances occurring prior to 2010. PCE exceeded the modeled threshold in well 594 prior to 2010. In well 547, both TCE and total VOCs have exceeded their respective thresholds though the last exceedance occurred in 2012.

Exceedances have also occurred in the guard well 600. Figure 15 shows that concentrations of all three chemicals have declined over time except in the Fall of 2015. All three chemicals increased during that monitoring period such that PCE and TCE exceeded their respective model-based thresholds. Concentrations have decreased since that time and continue to decline as of the Fall 2018 monitoring period. The cause of the increase is unknown as the well immediately upgradient did not exhibit a similar increase.

#### 6.1.5. Spatial Trends

Few wells have exhibited concentrations elevated above threshold or compliance criteria; exceedances have only occurred in guard and plume wells. COCs have not been detected in groundwater at ambient wells. Benzene, methylene chloride and PCE have been detected in several boundary wells at levels slightly above PQLs. Figures 16 through 19 show the concentrations and distribution of chloroform, PCE, TCE and total VOCs at the facility, based on 2017 and 2018 data.

### 6.2. Surface Water Quality

Surface water quality data from Trout Lake are included in Appendix B.2; data from Seep 309 are in Appendix B.3.

#### 6.2.1. Trout Lake

Four VOCs (1,1,2-trichlorotrifluoroethane, cis-1,2-dichloroethene, methylene chloride and vinyl chloride) were detected each in a single monitoring event at the Trout Lake point. Concentrations were less than two times their respective PQLs (the compliance criteria) and well below Region 4 screening levels. These single detections occurred prior to 2004. Acetone, a likely lab contaminant, was detected three times (2000, 2001 and 2002) but did not exceed its compliance criterion or its Region 4 screening level.

#### 6.2.2. Seep 309

Monitoring has continued since 2013 at this seep to document that VOCs are not detected following cessation of treatment. Although most VOCs have not been detected since then, three COCs have been detected in Seep 309: cis-1,2-dichloroethene, PCE and TCE. All three VOCs are typically detected during each monitoring event, but concentrations are low and similar from year to year. No exceedances of Class IV standards have occurred since 2015. Acetone has also been detected but at concentrations below the Class IV groundwater standard.

### 6.3. Sediment Quality

US EPA requested that sediment quality be included in the CSM to evaluate impacts to Trout Lake. One historical data set was available, as sediments have not been sampled as part of the long-term monitoring program. Surface sediment samples were collected during the 1989 remediation investigation at six locations in Trout Lake (Figure 20). Sampling location SED-5 was intended to serve as a background location as it was located north of the plume discharge zone. Samples SED-6 through SED-10 were located within the likely discharge zone of the historical plume. Sediment data are provided in Appendix B.4, as reported in the 1989 RI.

Metals were detected in surface sediment at both the background and likely plume discharge locations; and several organic compounds were detected in sediment within the plume discharge zone. Results were compared to USEPA Region 4 Sediment Screening Values for Hazardous Waste Sites (USEPA 2018), using both the conservative ecological screening value (ESV), based on concentrations reported to have a low probability of adverse effects, and the refined screening value (RSV), based on site-specific factors or other sources of information. The following contaminants were above their respective screening levels:

- Barium was measured at concentrations above its ESV but concentrations were below the RSV;
- Methylene chloride and acetone were detected in most samples, including the background sample, but were also present at the same magnitude in the blank samples, indicating their presence was likely an artifact of sampling handling or laboratory contamination;
- Bis(2-ethylhexyl) phthalate (BEHP) was detected in SED-7 and SED-8 at concentrations above its ESV (182 µg/kg), but well below its RSV (2,647 µg/kg); and
- TCE was detected at SED-9 below its PQL; it was also well below a value that would be protective of surface water quality (76.8 µg/kg)[8], assuming partitioning between sediment and water.

[8] Region 4 screening levels are expressed on an organic-normalized basis; however, no organic carbon data were available for Trout Lake sediment to allow comparison. To derive a similar screening level but expressed on a dry-weight basis, the chronic water quality value for BEHP was multiplied by it partitioning coefficients (Kow) to derive a sediment screening value protective of water quality.

## 7.0 RECEPTORS AND EXPOSURE PATHWAYS

Receptors at a site are people, plant, or animals that might be exposed to site contamination. Exposure can only occur if contamination is present in an environmental medium (soil, groundwater or surface water) located in an area, habitat or resource used by the receptor.

### 7.1. Current Receptors

Potential people that could be exposed to site contaminants at the facility both historically and under current conditions include visitors and site workers (US Ecology staff). Site security protocol requires a staff escort when visiting the facility grounds, so it is unlikely that other groups could be exposed. Restrictive covenants do not allow a change in site use, eliminating the potential for further development and removing future resident or construction worker receptors from consideration. Wildlife such as deer, songbirds and small mammals represent the main ecological receptors that may occur in terrestrial habitats at the facility. Benthic invertebrates (crayfish, worms and other things that live in sediments), fish and water-dependent wildlife, such as ducks, compose the likely receptors using aquatic habitats present at the facility.

### 7.2. Potential Exposure Routes

Exposure may occur if a receptor comes into direct contact with contaminated soil or groundwater (including seeps), incidentally consumes contaminated soil (e.g., from dirty hands or while grooming fur) or drinks contaminated water. Exposure may also occur if a receptor eats contaminated prey (e.g., fish, worms) or food (e.g., berries, seeds).

### 7.3. Contaminant Migration

Historically, contaminants leached from the New and Old Chem Sites either from precipitation infiltrating the waste or from shallow groundwater passing through unlined waste cells or trenches. A low permeability geologic layer beneath the shallow aquifer limited vertical migration of contamination; there is no evidence that the deep aquifer is contaminated. Groundwater and subsurface soil were ultimately impacted by migration of contaminants; however, there is no evidence that on-site surface water (Trout Lake or on-site creeks) were impacted by historical releases. The 1989 RI concluded that guard well 600 was the likely eastern extent of the plume and groundwater was likely migrating along the paleochannel.

### 7.4. Effect of Corrective Measures on Pathways and Potential for Exposure

Both the Old and New Chem Site cells and trenches have been capped with low permeability materials to limit infiltration into the waste and release of contaminants to groundwater.

Vertical barriers walls around the landfill are keyed into underlying less permeable geologic strata to prevent lateral migration of contaminated groundwater from the landfill. For a number of years, impacted groundwater outside of these barriers was extracted and treated until cleanup levels were achieved.

Leachate is regularly collected from sumps in the trenches around the waste cells and disposed at a permitted facility. Seeps along the north side of the New Chem landfill have been treated such that concentrations are low (below compliance criteria) and remain stable. Manholes are contained within seep infiltration structures and have restricted access (see photo at right). No seeps discharge directly to ground surface. These corrective measures and associated infrastructure have reduced contaminant migration and likelihood of exposure.

The current landfill surface is planted with grass to control both erosion and colonization by plants with deeper roots. The cap is also regularly mowed to observe invasive plant growth or evidence of burrowing animals. The cap also prevents people and ecological receptors from directly contacting contaminated soil.

Institutional controls and restrictive covenants are also in place that restrict access to the site (the entire facility property is fenced) and control future use of any groundwater from the facility.

### 7.5. Summary

Corrective measures implemented at the facility have substantially altered the pathways by which contaminants may migrate from the landfill waste or receptors might be exposed such that little or no exposure occurs today. Figure 21 illustrates the exposure pathways, pathway status (e.g., complete, incomplete, not applicable) and receptors under current conditions. No complete exposure pathways remain at the site.

## 8.0 PROPOSED LONG-TERM STEWARDSHIP PROGRAM

The proposed long-term stewardship program (LSP) consists of long-term monitoring, operation and maintenance of the corrective measures, reporting, institutional controls, contingency plans and financial assurances. This section provides a summary of the elements of the program; the details will be provided in the LSP plan provided under separate cover.

### 8.1. Proposed Long-term Monitoring

The proposed long-term monitoring is based on the current program, with modifications discussed in the following sections. The proposed monitoring program will support:

- Assessment of surface water quality at the points of compliance (Trout Lake);
- Evaluation of plume stability and attenuation;
- Determination of groundwater quality at guard wells;
- Confirmation of physical integrity of the remedy;
- Certification of institutional controls; and
- Contingency action planning.

The monitoring program will include collecting and evaluating groundwater and surface water quality samples, water level measurements and groundwater contouring, leachate collection and disposal, cap inspection and maintenance, invasive vegetation control, and site maintenance including fence repair and surface water runoff.

#### 8.1.1. Groundwater and Surface Water Chemical Monitoring

The long-term monitoring program will use a subset of the post-closure monitoring program well array, in addition to some wells monitored by other programs. No wells that are currently monitored will be decommissioned; however, the types of data that are collected and the frequency of collection will be modified. The proposed groundwater and surface water monitoring approach and rationale is provided in Table 2. The sampling locations are described below.

- Twelve wells from the post-closure program will be retained for the proposed LSP monitoring program along with two shoreline wells (part of the radiologic monitoring program) to monitor groundwater-surface water interactions downgradient of the guard wells. Each well will be sampled semi-annually (spring and fall); frequency may be reduced if contaminant concentrations continue to decline or remain stable.

| Boundary Well | Guard Well | Groundwater-Surface Water Interaction Well | Plume Well |
|---|---|---|---|
| G-160 | 591 | 211 | G-165 |
| G-162 | 592 | 571 | G-166 |
| | 600 | | G-168 |
| | | | 547 |
| | | | 564 |
| | | | 575 |
| | | | 594 |

- Six additional wells will be monitored as part of the five-year review cycle to assess the long-term effectiveness of source control:

| Upgradient of Trench 18 | Downgradient of Old Chem Site |
|---|---|
| G-142 | G-148 |
| G-192 | G-149 |
| | G-155 |
| | G-156 |

- All wells in the proposed monitoring program will have water levels measured during each sampling event.
- To assess whether Trout Lake gains/intercepts groundwater or loses water into the surrounding sediments, eight previously established radiologic monitoring wells along the shoreline (shown on Figure 22) were surveyed and added to the current monitoring well network for static water level measurements in the spring and fall. Preliminary water levels measured on June 26, 2019 indicate

that upland groundwater is discharging to the lake (i.e., the lake level is lower than the well elevations). This single observation will be confirmed by additional measurements over time.

- The Trout Lake point of compliance will continue to be sampled. An additional sampling location (S-502) along the shoreline southeast of S-501 will be added to the program to confirm continued compliance (Figure 22). This surface water sampling location will be directly east of the guard well locations.
- All groundwater and surface water samples will be analyzed for COCs and indicator chemicals, as in the current monitoring program. In addition, physical parameters such as turbidity will be measured to help in the interpretation of the monitoring data.
- COC concentrations will be reported on a both a total (i.e., results for a whole sample) and dissolved basis. Compliance with cleanup levels or thresholds will be based on dissolved concentrations to address the mobile/bioavailable fraction of each chemical. Total concentrations will be used in trends analyses. The evaluation approach is described in the next section.

US Ecology recognizes that there may be emerging contaminants of concern present at the site. As the methods and technologies to detect and monitor new contaminants are developed and approved for regulatory use, additional contaminants may be measured at the point of compliance. However, given the containment of historical sources, attenuation of the groundwater plume, and no VOC detections at the point of compliance in the lake since 2003 (and never any exceedances), it is unlikely that any emerging contaminants of concern would impact the lake, should they be present in the plume.

#### 8.1.2. Evaluation Approach

Groundwater and surface water monitoring data will be evaluated in different ways, depending on the purpose of the sampling location described below. Contaminant trends will be evaluated using statistical techniques to determine the presence and significance of any change in contaminant concentrations over time. Details of the statistical analytical approach will be provided in the LSP.

- Trout Lake Point of Compliance—Analytical results will be screened for COCs that are reported above their respective PQLs. Those dissolved COCs that are detected will be directly compared to Region 4 risk-based screening levels, as shown in this in-text table.

| Contaminant of Concern | Criterion |
|---|---|
| Benzene | 160 µg/L |
| Chloroform | 140 µg/L |
| 1,1-Dichloroethane | 410 µg/L |
| 1,2-Dichloroethane | 2,000 µg/L |
| 1,1-Dichloroethene | 130 µg/L |
| 1,2-Dichloropropane | 520 µg/L |
| Methylene chloride (=dichloromethane) | 1,500 µg/L |
| PCE | 53 µg/L |
| TCE | 220 µg/L |
| Vinyl chloride | 930 µg/L |

- Guard Wells—Analytical results will be screened for COCs that are reported above their respective PQLs. PCE and TCE will be used as a surrogate for all other COCs and will be compared on a dissolved basis to the Region 4 risk-based screening levels for surface water. Concentrations reported for whole samples (i.e., not dissolved concentrations) will be graphed using monitoring data compiled since 1999 to evaluate any trends in guard well contaminants.
- Plume Wells– Concentrations reported from whole sample analyses will continue to be graphed using monitoring data compiled since 1999 to evaluate trends in ongoing attenuation in these wells.

#### 8.1.3. Groundwater Flow

Groundwater levels will be measured in all wells from the proposed monitoring program. Data will be used to contour groundwater flow direction and gradients to document that no major changes in groundwater flow patterns have occurred over time.

### 8.2. Operations and Maintenance

Operations and maintenance activities will continue along similar lines as performed currently. Operations and maintenance activities will include physical inspections and repairs, grounds maintenance and vegetation management, leachate management and disposal and reporting.

#### 8.2.1. Physical Inspections

Physical inspections will be conducted quarterly and will include:

- Inspecting the physical integrity and condition of the boundary fence, drainage ditches, groundwater monitoring wells, leachate sumps and the site cover and slopes. The inspection will identify any deficiencies in the final cover, including sinkholes, erosion, evidence of burrowing animals, and areas needing revegetation or vegetation controls. The inspection will also confirm that the boundary fence is intact and groundwater wells and leachate sumps are undamaged, accessible and there is no evidence of tampering.
- Recording the results of each inspection in a maintenance log that documents the date, the personnel involved and a description of the findings, including any items in need of repairs.
- Repairing any physical deficiencies that may adversely affect the integrity of the remedy as soon as practicable.
- Documenting all related activities in an annual report.

#### 8.2.2. Grounds Maintenance and Vegetation Management

Grounds maintenance and vegetation management will include:

- Mowing both New and Old Chem Sites in the spring and fall.
- Clearing monitoring well monuments and sumps using a weed trimmer at the same frequency as mowing.
- Removing invasive growth of large vegetation (including trees, etc.) that may impact the physical integrity of the caps and drainage ditches or affect the ability to inspect or monitor locations at the facility.

### 8.2.3. Leachate Management

There are 59 leachate monitoring sumps at the facility. Leachate levels and pumping rates have decreased significantly since 1983 when the site stopped receiving waste materials for disposal. Many locations no longer yield pumpable quantities of leachate.

Leachate sump risers consist of polyvinyl chloride (PVC) or steel pipe and are clearly visible in the field, as they rise above the landfill cover. Each sump is equipped with a cap and security seal to provide evidence of tampering. For field identification, a long-lasting, non-rusting, metal plate stamped with the sump number has been permanently affixed to the riser pipe. Due to the small volumes of leachate generated at the site, the leachate sumps are monitored from July through October to check for the presence of liquids. The specifics for the leachate system inspection and leachate removal are provided below.

- When pumping sumps, transferring leachate, or packaging leachate for shipment, all personnel will be informed of and will follow safety and operational procedures as described below:
    - Personnel will wear chemical resistant Tyvek® suits and gloves, safety glasses with side shields or chemical splash goggles, boots with chemical resistant rubber pull-over boots, FM two-way radios, and respirators with organic vapor, acid gas dust, fume mist combination cartridges.
    - Absorbent material will be included in the field equipment in case a leak or a spill occurs.
    - All contaminated rags, Tyvek clothing and gloves will be placed in an open-head Department of Transportation (DOT)-approved drum and stored in the Leachate Accumulation Building with a polychlorinated biphenyl (PCB) caution and hazardous waste labels affixed. Open-head drums are closed except when adding solid waste. Before the drum has reached its 90-day accumulation period, the drum is shipped to an approved disposal facility.
- At the time of inspection, the date, depth of liquid, depth to bottom of the sump (both measured from top of casing) and the initials of the inspector will be entered on the sump log.
- If the depth of liquid (depth to bottom minus depth to liquid) is 1 foot or greater, leachate will be pumped from the sump until all liquid is removed. The total amount of liquid removed will be recorded on the sump log.
- Sumps that are essentially dry (less than 1 foot of leachate on the liner) in July will be sealed and not accessed until the following year.
- Any sumps that have 1 foot or greater of leachate will be pumped and monitored regularly until there is less than 1 foot for 2 consecutive months. At that time, these sumps will be sealed and monitored again the following year.

When required to pump sumps, these operational procedures are followed:

- 12-volt electric sump pumps will be used for all sumps.
- Each sump will be pumped into a mobile transfer tank.
- PCB caution and hazardous waste labels will be placed on the transfer tank.
- When the transfer tank is full or when the sump pumping operations are completed that day, the liquids will be transported to the Leachate Accumulation Building for transfer and packaging for off-site disposal.

When pumping leachate into the storage totes located inside the Leachate Accumulation Building, these operational procedures will be followed:

- A pump dedicated to the leachate accumulation building will be used for pumping leachate from the portable collection tank to the totes.
- The level in the totes will be checked prior to filling to control any overtopping of the totes.
- Absorbent material will be placed under the hose to catch any liquid that may leak or drip while pumping.
- The amount of leachate pumped in the totes during each filling will be recorded. The 90-day accumulation period begins when leachate is first pumped into the totes.
- Persons in the work area wear assigned protective equipment.
- All materials and equipment are stored inside the Leachate Accumulation Building.

### 8.3. Reporting

At the end of each year, an annual report will be prepared and submitted to USEPA Region 5. The report will include a summary of the inspections and any repairs, the leachate volume removed from the site and the results of groundwater monitoring conducted at the site.

### 8.4. Institutional Controls and Deed Restrictions

Current institutional controls at the facility include restricted access for the site as well as the entire property. All visitors are escorted while on the site. The entire property is fenced and gated with limited ingress/egress point. Land use is restricted, and no groundwater can be withdrawn from beneath the facility nor can any other resources be extracted from the site. Deed restrictions for the facility were filed with the county in 1981 and were updated to include the entire US Ecology property in approximately 1995.

US Ecology proposes to update the deed restriction using the following language:

> Specifically, because this property has been used to manage hazardous waste, post-closure use of the property on or in which hazardous wastes remain after partial or final closure must never be allowed to disturb the integrity of the final cover, liner(s) or any other components of the containment system, or the function of the facility's monitoring systems, unless the agency finds that the disturbance:
>
> (a) is necessary to the proposed use of the property, and will not increase the potential hazard to human health or the environment; or
>
> (b) is necessary to reduce a threat to human health or the environment; and
>
> (c) Written notice and a plan submitted to [***appropriate regulatory agency]*** with a schedule of implementation setting forth worker health and safety requirements, access limitations during the completion of any site work, and restoration of the property or other alternatives has been approved by the agency in writing prior to the commencement of any site work.

US Ecology will provide an annual certification that institutional controls and deed restrictions remain in place.

### 8.5. Contingency Plan

US Ecology will develop response actions for adverse events that are identified during long-term monitoring or operations and maintenance of the site. Response actions and triggers will be detailed in the LSP. Adverse events may include:

- Increasing chemical concentrations in plume or guard wells over time
- Deterioration or erosion of the final cover that may require regrading and/or reseeding
- Exceedances of water quality criteria at the points of compliance
- Breach or failure of a containment wall surrounding the disposal cells
- Release of leachate from the collection system

US Ecology anticipates that contingency planning will be a collaborative, adaptive process that incorporates new information over time.

### 8.6. Financial Assurance

US Ecology currently provides financial assurance in the form of a trust for post-closure monitoring, operations and maintenance costs for the Sheffield site. The mechanism for providing financial assurances during long-term care will be discussed with USEPA as part of the AOC negotiations.

## 9.0 REFERENCES


Anderson, R.C., and Xiaodong Miao. 2011. Surficial Geology of Henry County, Illinois; Illinois State Geological Survey, Illinois County Geologic Map ICGM Henry-SG, scale 1:62:500.

Foster, J.B., J.R. Erickson, and R.W. Healy. 1984. Hydrogeology of a Low-Level Radioactive-Waste Disposal Site near Sheffield, Illinois. US Geological Survey Water-Resources Investigations Report 83-4125.

Kolata, D.R. 2005. Bedrock Geology of Illinois, Illinois State Geological Survey. Illinois Map 14, scale 1:500,000.

PDC Technical Services, Inc. 2008. Application to Establish a Groundwater Management Zone. Prepared for US Ecology Inc., October 24, 2008.

Prairie Research Institute. 2018. Directory of Coal Mines in Illinois, Bureau County. Illinois State Geological Survey.

Prairie Research Institute. 2018. Coal Mines and Industrial Mineral Mines, Bureau County, Illinois State Geological Survey. County Coal Map Series.

Science Applications International Corporation (SAIC). 1989. "Revised Final Remedial Investigation Report for Sheffield Hazardous Waste Sites."

US Ecology, Inc. 2008. RCRA Post-Closure Permit Application. Hazardous Waste Management Facility, US Ecology, Inc. IEPA No. 0119050003; USEPA No. ILD 04-506-3450. October 2008.

US Environmental Protection Agency (USEPA). 1990. Response to comments for the US Ecology, Inc. Site, Sheffield, IL. October 1990.

US Environmental Protection Agency (USEPA). 1995. Letter from Walter S. Francis, Project Manager, RCRA Enforcement Branch to Richard Haggard, Project Manager, American Ecology Corporation regarding CMI Phase I Extraction Well Revised Design System Approval and CMI Phase II Delay Request Approval. June 26, 1995. USGS. 1995. Groundwater Atlas of the United States, Segment 10 (Illinois, Indiana, Kentucky, Ohio, Tennessee), Hydrologic Investigations Atlas 730-K.

US Environmental Protection Agency (USEPA). 2018. Region 4 Ecological Risk Assessment Supplemental Guidance. March 2018 Update. Scientific Support Section, Superfund Division. March 2018.

US Geological Survey (USGS). 1983. Neponset, Illinois 7.5-Minute Topographic Quadrangle, Provisional Edition.

Willman, H.B., and J.C. Frye. 1970. Pleistocene Stratigraphy of Illinois, Illinois State Geological Survey Bulletin 94.

TABLES

GeoEngineers

# Table 1

## Monitoring Well Construction Data

### US Ecology - Sheffield

### Sheffield, Illinois

| Number | Well Type | Water-Bearing Zone | Top of Well Elevation[1] | Bottom of Well Elevation[1] | Length of Screened Interval (Feet) | Top of Screen Elevation[1] | Bottom of Screen Elevation[1] | Screened Interval Lithology |
|---|---|---|---|---|---|---|---|---|
| G145 | Ambient Well | Bedrock | 778.51 | 722.9 | 10 | 732.9 | 722.9 | Shale, coal, shaley sandstone |
| G186 | Ambient Well | Bedrock | 761.91 | 729.21 | 10 | 739.21 | 729.21 | Highly weathered shale |
| G434 | Ambient Well | Unconsolidated Deposits | 784.08 | 724.05 | 14.5 | 738.55 | 724.05 | F-C sand, sand and silt loam, silty clay till |
| G105 | Boundary Well | Bedrock | 756.39 | 723.2 | 9.5 | 732.7 | 723.2 | Shale |
| G142 | Boundary Well | Unconsolidated Deposits | 759.13 | 731.5 | 10 | 741.5 | 731.5 | ? |
| G154 | Boundary Well | Unconsolidated Deposits | 741.96 | 690.9 | 10 | 700.9 | 690.9 | Sand |
| G157 | Boundary Well | Unconsolidated Deposits | 766.19 | 710.8 | 10 | 720.8 | 710.8 | Till, sand |
| G160 | Boundary Well | Unconsolidated Deposits | 734.15 | 693.6 | 10 | 703.6 | 693.6 | Mine spoils |
| G162 | Boundary Well | Unconsolidated Deposits | 719.54 | NP | NP | NP | NP | Mine spoils |
| G191 | Boundary Well | Bedrock | 764.53 | 670.24 | 11 | 681.24 | 670.24 | Coal |
| G192 | Boundary Well | Unconsolidated Deposits | 767.21 | 740.38 | 11 | 751.38 | 740.38 | Sandy silt, silt (Lacustrine) |
| G193 | Boundary Well | Bedrock | 768.31 | 679.19 | 10 | 689.19 | 679.19 | Shale, coal |
| RIB-9 | Boundary Well | Unconsolidated Deposits | 723.6 | 671.31 | 10.8 | 682.11 | 671.31 | ? |
| G591 | Guard Well | Unconsolidated Deposits | 738.46 | 702.1 | 12 | 714.1 | 702.1 | Glasford Fm, Toulon Mbr |
| G592 | Guard Well | Unconsolidated Deposits | 737.66 | 707 | 12 | 719 | 707 | Glasford Fm, Radnor Mbr |
| G600 | Guard Well | Unconsolidated Deposits | 734.43 | 704.4 | 10 | 714.4 | 704.4 | Glasford Fm, Toulon Mbr |
| G165 | Plume Well | Unconsolidated Deposits | 739.66 | 695.11 | 10.8 | 705.91 | 695.11 | Silty sand/sandy silt, clayey silt |
| G166 | Plume Well | Bedrock | 739.67 | 668.74 | 11 | 679.74 | 668.74 | Highly weathered siltstone |

| Number | Well Type | Water-Bearing Zone | Top of Well Elevation[1] | Bottom of Well Elevation[1] | Length of Screened Interval (Feet) | Top of Screen Elevation[1] | Bottom of Screen Elevation[1] | Screened Interval Lithology |
|---|---|---|---|---|---|---|---|---|
| G167 | Plume Well | Unconsolidated Deposit/Bedrock Transition[2] | 767.46 | 703.84 | 10.3 | 714.14 | 703.84 | Highly weathered siltstone |
| G168 | Plume Well | Unconsolidated Deposits | 766.26 | 716.11 | 10 | 726.11 | 716.11 | Clayey silt |
| G547 | Plume Well | Unconsolidated Deposits | 740.2 | 693 | 2 | 695 | 693 | Glasford Fm, Duncan Hills Mbr |
| G564 | Plume Well | Unconsolidated Deposits | 740.63 | 694.7 | 12 | 706.7 | 694.7 | Glasford Fm, Toulon & Hulick Till Mbr |
| G575 | Plume Well | Unconsolidated Deposits | 747.62 | 708.6 | 4 | 712.6 | 708.6 | Glasford Fm, Toulon Mbr |
| G594 | Plume Well | Unconsolidated Deposits | 740.21 | 704 | 12 | 716 | 704 | Glasford Fm, Toulon Mbr |

**Notes:**

[1]Elevation in feet above mean sea level.

[2]This well has been classified as being screened in both bedrock and glacial deposits in different documents. Boring logs indicate it is screened in highly weathered siltstone 2 feet below the glacial deposit noted in the adjacent well-G168. We are treating it as a transitional zone with some likely mixing with the overlying unconsolidated unit.

NP = Not provided

# Table 2

## Summary of Proposed Post-Closure Care Monitoring Program and Rationale

**US Ecology - Sheffield**

**Sheffield, Illinois**

| Number | Monitoring Point Type | Water-Bearing Zone | Screened Interval Lithology | Current Monitoring Interval | | Proposed Monitoring Interval | Current Analytes | Proposed Analytes/Measurements | Rationale |
|---|---|---|---|---|---|---|---|---|---|
| | | | | VOCs | Metals and Indicators | | | | |
| G145 | Ambient Well | Bedrock | Shale, coal, shaley sandstone | Annually–fall | Semiannually-spring and fall | None | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Water levels only | Background/upgradient well; VOCs have not been detected |
| G186 | Ambient Well | Bedrock | Highly weathered shale | Annually–fall | Semiannually-spring and fall | None | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Water levels only | Background/upgradient well; VOCs have not been detected except acetone in a 2009 sample and TCE in 2001, both at low concentrations |
| G434 | Ambient Well | Unconsolidated Deposits | F-C sand, sand and silt loam, silty clay till | Annually–fall | Semiannually-spring and fall | None | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Water levels only | Background well upgradient of Trench 18EW; VOCs have not been detected |
| G105 | Boundary Well | Bedrock | Shale | Annually–fall | Semiannually-spring and fall | None | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Water levels only | VOCs have not been detected; no exceedances of Class IV Groundwater Quality Standards. |
| G142 | Boundary Well | Unconsolidated Deposits | Not available | Annually–fall | Semiannually-spring and fall | Chemical analysis every 5 years, in perpetuity to assess barrier wall integrity. Water level measurements twice a year. | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Assess integrity of Trench 18W slurry wall |
| G154 | Boundary Well | Unconsolidated Deposits | Sand | Annually–fall | Semiannually-spring and fall | None | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Water levels only | In area where groundwater flow is minimal due to barrier walls; no VOCs detected; no exceedances of Class IV Groundwater Quality Standards). |
| G157 | Boundary Well | Unconsolidated Deposits | Till, sand | Annually–fall | Semiannually-spring and fall | None | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Water levels only | In area where groundwater flow is minimal due to barrier walls; no VOCs detected; no exceedances of Class IV Groundwater Quality Standards). |
| G160 | Boundary Well | Unconsolidated Deposits | Mine spoils | Annually–fall | Semiannually-spring and fall | Twice a year, with reductions in frequency if chemical trends stable or declining | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs4, selected metals[2], inorganic indicators3 and water levels | Downgradient of historical source area |
| G162 | Boundary Well | Unconsolidated Deposits | Mine spoils | Annually–fall | Semiannually-spring and fall | Twice a year, with reductions in frequency if chemical trends stable or declining | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Downgradient well |
| G191 | Boundary Well | Bedrock | Coal | Annually–fall | Semiannually-spring and fall | None | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Water levels only | Upgradient of Trench 18EW. Several VOCs detected at low levels; no detects since 2005 (no exceedances of Class IV Groundwater Quality Standards). |
| G192 | Boundary Well | Unconsolidated Deposits | Sandy silt, silt (Lacustrine) | Annually–fall | Semiannually-spring and fall | Chemical analysis every 5 years, in perpetuity to assess barrier wall integrity. Water level measurements twice a year. | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Assess integrity of Trench 18W slurry wall |
| G193 | Boundary Well | Bedrock | Shale, coal | Annually–fall | Semiannually-spring and fall | None | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Water levels only | Upgradient of Trench 18EW. Benzene detected only once (2006) and was slightly above detection limit. |
| RIB-9 | Boundary Well | Unconsolidated Deposits | Not available | Annually–fall | Semiannually-spring and fall | None | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Water levels only | VOCs have not been detected |
| G591 | Guard Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr | Annually–fall | Semiannually-spring and fall | Twice a year, with reductions in frequency if chemical trends stable or declining | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Downgradient of historical plume; use to evaluate attenuation/concentrations trends based on Region IV surface water standards. |
| G592 | Guard Well | Unconsolidated Deposits | Glasford Fm, Radnor Mbr | Annually–fall | Semiannually-spring and fall | Twice a year, with reductions in frequency if chemical trends stable or declining | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Downgradient of historical plume; use to evaluate attenuation/concentrations trends based on Region IV surface water standards. |
| G600 | Guard Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr | Annually–fall | Semiannually-spring and fall | Twice a year, with reductions in frequency if chemical trends stable or declining | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Downgradient of historical plume; use to evaluate attenuation/concentrations trends based on Region IV surface water standards. |

| Number | Monitoring Point Type | Water-Bearing Zone | Screened Interval Lithology | Current Monitoring Interval | | Proposed Monitoring Interval | Current Analytes | Proposed Analytes/Measurements | Rationale |
|---|---|---|---|---|---|---|---|---|---|
| | | | | VOCs | Metals and Indicators | | | | |
| G148 | Plume Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr | None | None | Chemical analysis every 5 years, in perpetuity to assess barrier wall integrity. Water level measurements twice a year. | None | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Assess integrity of Old Chem Site barrier walls. Within historical plume. |
| G149 | Plume Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr.; Glacial Till | None | None | Chemical analysis every 5 years, in perpetuity to assess barrier wall integrity. Water level measurements twice a year. | None | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Assess integrity of Old Chem Site barrier walls. Within historical plume. |
| G155 | Plume Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr. | None | None | Chemical analysis every 5 years, in perpetuity to assess barrier wall integrity. Water level measurements twice a year. | None | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Assess integrity of Old Chem Site barrier walls. Within historical plume. |
| G156 | Plume Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr. | None | None | Chemical analysis every 5 years, in perpetuity to assess barrier wall integrity. Water level measurements twice a year. | None | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Assess integrity of Old Chem Site barrier walls. Within historical plume. |
| G165 | Plume Well | Unconsolidated Deposits | Silty sand/sandy silt, clayey silt | Semiannually-spring and fall | Semiannually-spring and fall | Twice a year, with reductions in frequency if chemical trends stable or declining | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Within historical plume |
| G166 | Plume Well | Bedrock | Highly weathered siltstone | Semiannually-spring and fall | Semiannually-spring and fall | None | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Only two VOCs have been detected (chloroform and methylene chloride) in one sampling event. Concentrations near detection limits |
| G167 | Plume Well | Unconsolidated Deposit/Bedrock Transition[5] | Highly weathered siltstone | Semiannually-spring and fall | Semiannually-spring and fall | Twice a year, with reductions in frequency if chemical trends stable or declining | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Water levels only | A number of VOCs have been detected, similar to adjacent well G168. Proposing G166 to monitor groundwater in bedrock since this well appears to be in a transition zone |
| G168 | Plume Well | Unconsolidated Deposits | Clayey silt | Semiannually-spring and fall | Semiannually-spring and fall | Twice a year, with reductions in frequency if chemical trends stable or declining | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Within historical plume |
| G547 | Plume Well | Unconsolidated Deposits | Glasford Fm, Duncan Hills Mbr | Semiannually-spring and fall | Semiannually-spring and fall | Twice a year, with reductions in frequency if chemical trends stable or declining | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Within historical plume |
| G564 | Plume Well | Unconsolidated Deposits | Glasford Fm, Toulon & Hulick Till Mbr | Semiannually-spring and fall | Semiannually-spring and fall | Twice a year, with reductions in frequency if chemical trends stable or declining | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Within historical plume |
| G575 | Plume Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr | Semiannually-spring and fall | Semiannually-spring and fall | Twice a year, with reductions in frequency if chemical trends stable or declining | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Within historical plume |
| G594 | Plume Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr | Semiannually-spring and fall | Semiannually-spring and fall | Twice a year, with reductions in frequency if chemical trends stable or declining | Selected VOCs[1], selected metals[2], inorganic indicators[3] and water levels | Reduced VOCs[4], selected metals[2], inorganic indicators[3] and water levels | Within historical plume |

| Number | Monitoring Point Type | Water-Bearing Zone | Screened Interval Lithology | Current Monitoring Interval | | Proposed Monitoring Interval | Current Analytes | Proposed Analytes/Measurements | Rationale |
|---|---|---|---|---|---|---|---|---|---|
| | | | | VOCs | Metals and Indicators | | | | |
| 211 | Shoreline Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr | None | None | Twice a year, with reductions in frequency if chemical trends stable or declining | None | Reduced VOCs4, selected metals2, inorganic indicators3 and water levels | Shoreline well downgradient of historical plume. Use to screen groundwater-surface water interactions |
| 212 | Shoreline Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr | None | None | Twice to confirm gain/losses to Trout Lake | | Water levels only | Answer outstanding question from EPA hydrogeologist |
| 571 | Shoreline Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr | None | None | Twice a year, with reductions in frequency if chemical trends stable or declining | | Reduced VOCs4, selected metals2, inorganic indicators3 and water levels | Shoreline well downgradient of historical plume. Use to screen groundwater-surface water interactions |
| 572 | Shoreline Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr | None | None | Twice to confirm gain/losses to Trout Lake | | Water levels only | Answer outstanding question from EPA hydrogeologist |
| 573 | Shoreline Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr | None | None | Twice to confirm gain/losses to Trout Lake | | Water levels only | Answer outstanding question from EPA hydrogeologist |
| 574 | Shoreline Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr | None | None | Twice to confirm gain/losses to Trout Lake | | Water levels only | Answer outstanding question from EPA hydrogeologist |
| RIB-6 | Shoreline Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr | None | None | Twice to confirm gain/losses to Trout Lake | | Water levels only | Answer outstanding question from EPA hydrogeologist |
| RIB-11 | Shoreline Well | Unconsolidated Deposits | Glasford Fm, Toulon Mbr | None | None | Twice to confirm gain/losses to Trout Lake | | Water levels only | Answer outstanding question from EPA hydrogeologist |
| S309 | Seep | Surface Water | Not applicable | Semiannually-spring and fall | Semiannually-spring and fall | None | Selected VOCs[1], selected metals[2] and inorganic indicators[3] | None | Concentrations are low and stable with no exceedances of Class IV Standards in recent years |
| S501 | Point of Compliance | Surface Water | Not applicable | Semiannually-spring and fall | Semiannually-spring and fall | Twice a year, with reductions in frequency if chemical trends stable or declining | Selected VOCs[1], selected metals[2] and inorganic indicators[3] | Reduced VOCs[4], selected metals[2], inorganic indicators[3] | Point of compliance. Compared to EPA Region IV screening levels for surface water. |
| S502 | Point of Compliance | Surface Water | Not applicable | None | None | Twice a year, with reductions in frequency if chemical trends stable or declining | None | Reduced VOCs[4], selected metals[2], inorganic indicators[3] | Point of compliance east of guard wells. Compared to EPA Region IV screening levels for surface water. |

Notes:

[1]Selected VOCs include 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethane, 1,2-dichloropropane, 1,4-dioxane, benzene, chloroform, chloromethane, cis-1,2-dichloroethene, methacrylonitrile, methylene chloride, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene, vinyl acetate and vinyl chloride.

[2]Selected metals include iron, magnesium and manganese, reported on both a dissolved and total basis.

[3]Selected conventional indicators include total and dissolved solids, chloride and sulfate.

[4]Reduced VOCs include 1,1-dichloroethane, 1,2-dichloroethane, 1,2-dichloropropane, benzene, chloroform, cis-1,2-dichloroethene, methylene chloride, tetrachloroethene, trans-1,2-dichloroethene, trichloroethene and vinyl chloride (omits 1,1-dichloroethene, 1,4-dioxane, chloromethane, methacrylonitrile and vinyl acetate which have not been detected in the last 5 years).

[5]This well has been classified as being screened in both bedrock and glacial deposits in different documents. Boring logs indicate it is screened in highly weathered siltstone 2 feet below the glacial deposit noted in the adjacent well, G168. We are treating it as a transitional zone with some likely mixing with the overlying unconsolidated unit.